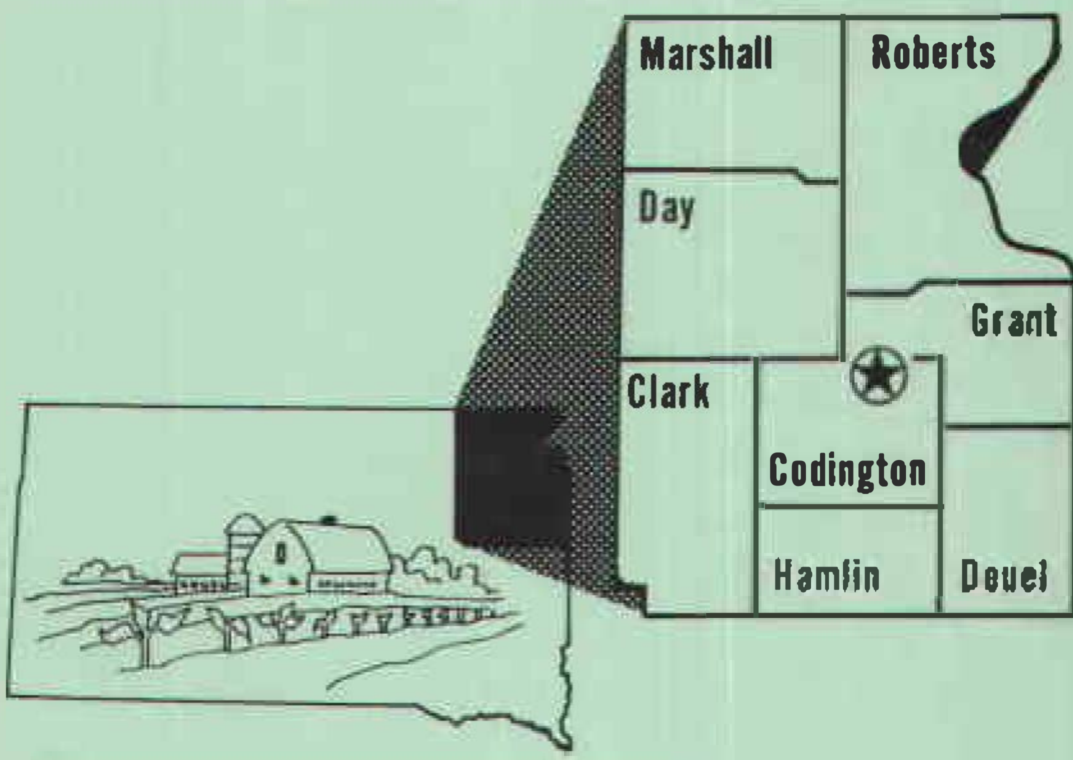
Plant Science Pamphlet No. 5

ANNUAL PROGRESS REPORT

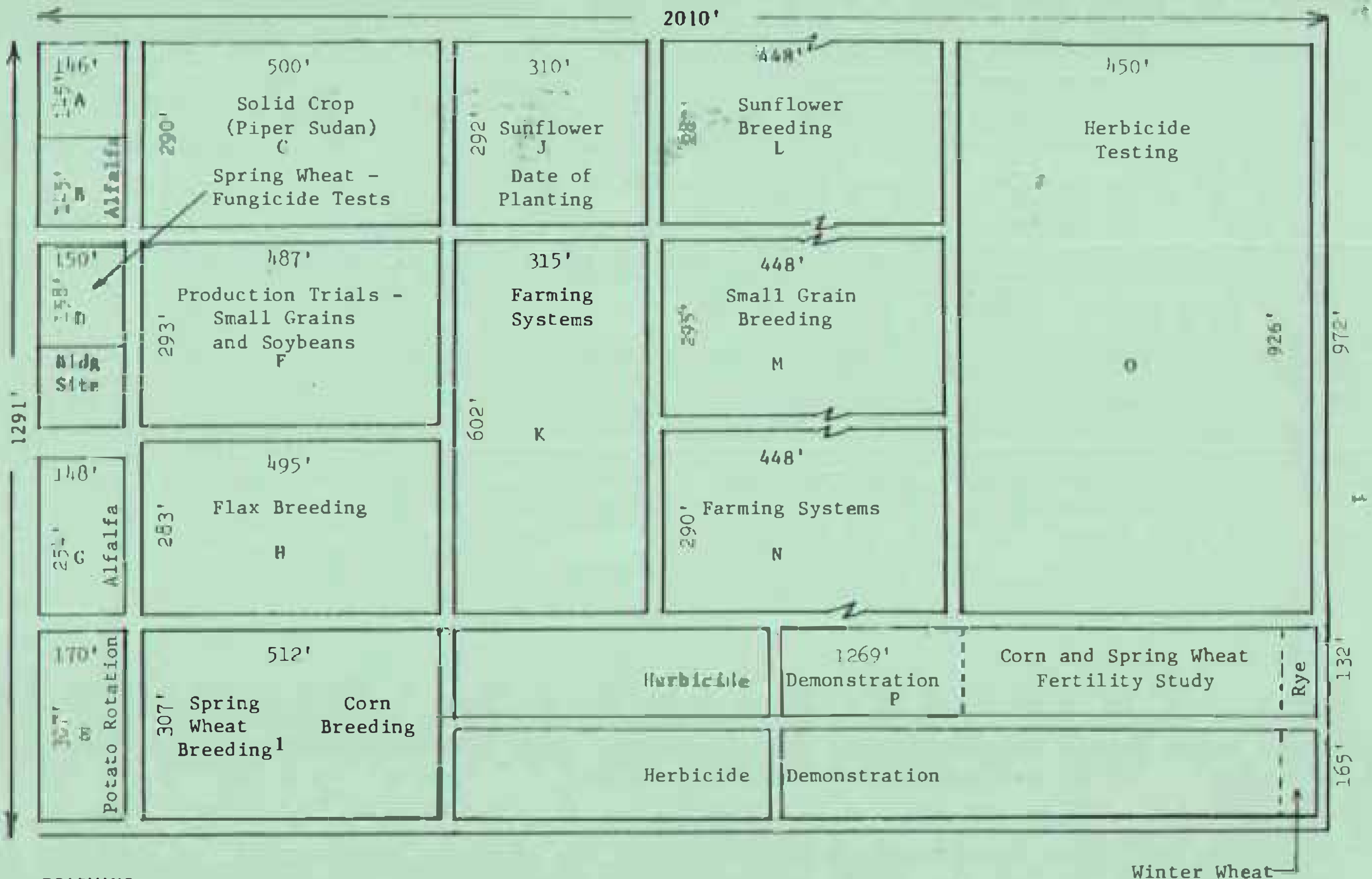
January 1988

1987
ANNUAL PROGRESS REPORT
Northeast Research Station
Watertown, South Dakota



PLANT SCIENCE DEPARTMENT
South Dakota State University
Brookings, South Dakota 57007

Northeast Research Station (Watertown)
Year 1987



Plot	ACREAGE
A	0.49
B	0.49
C	3.32
D	0.54
E	1.20
F	3.27
G	0.86
H	3.22
I	3.61
J	2.08
K	4.35
L	2.95
M	3.03
N	2.98
O	9.57
P	8.65

ROADWAYS
25 feet wide
Acreage in farm 59.6
Experimental Acreage 50.5

TABLE OF CONTENTS

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Watertown, South Dakota

Precipitation for the growing season was only .81 inches below normal; however, the distribution of rainfall was far from normal. April, May and June were generally warm and dry, and precipitation was about 5 inches below normal. Precipitation in July, August and September was nearly 5 inches above normal (Table 1). These conditions, combined with a comparatively long growing season, resulted in excellent row crop yields with corn yields among the highest recorded at the station. The small grain crop was generally good. Small grain, row, and forage crops all benefitted from the soil moisture reserves resulting from the wet 1986 season, and it was likely these reserves prevented a poor small grain crop. Conversely, subsoil moisture levels were very low this fall, and normal precipitation will be needed next spring to avoid moisture stress.

The dry spring slowed the development of most diseases, and, in contrast to 1986, there were no serious fungal or bacterial diseases in the small grain crops. The early spring apparently allowed earlier than normal northward movement of aphids carrying Barley Yellow Dwarf Virus, and there were significant infection levels of BYDV in barley, oats and spring wheat. There were no significant disease or insect problems in the forage or row crops. The lack of spring precipitation interfered with the performance of some herbicides, and grassy weeds were a problem in some studies. Weather conditions were ideal for mechanical weed control, and rotary hoeing followed by field cultivation provided very good weed control.

The summer field tour was well attended. Tour topics included: small grain variety performance, small grain diseases, herbicide demonstrations, spring wheat and corn fertility studies, alfalfa varieties, farming systems studies, oat herbicides, and sunflower insects. A meal sponsored by area Crop Improvement Associations was skillfully prepared by area County Agents. We wish to thank Ray Bundy and Richard Thaye for furnishing wagons for use at the tour. We also thank Morris Gunderson for supplying water for use at the farm, and Orrin Korth for his harvesting assistance and equipment loans. The 1988 tour will be held on July 12.

NOTE: Much of the information contained in this report is based on ongoing studies and results should therefore be considered tentative. This report does not contain detailed tabular information concerning small grain, flax and soybean performance. This information is available in Extension Circulars EC 774 and EC 775, and is available at County Extension offices. A complete set of the results of the herbicide demonstrations is available in the 1988 Herbicide Report (EC678).

AGRICULTURAL ADVISORY GROUP, 1987

Northeast Research Station, Watertown, SD
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Mike Johnson	Day County	87-89
Edwin Krause	Deuel County	83-87
Randy Frederick	Hamlin County	84-87
Lyle Kriesel	Grant County	84-87
Harlan Haugen	Codington County	86-89
Orrin Korth	Codington County	Permanent
Maurice Borton	SDSU, Head, Plant Science Department	
Loyal Evjen	Ag. Technician	
Steve Werner	Summer Field Assistant	
James Smolik	SDSU, Station Manager	

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Dale Wiitala	Deuel County
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Nate Thompson	Grant County
Gail Dobbs	District Supervisor

Table 1. Growing season precipitation

Month	Amount (in.)	Normal	Departure	Greatest Amount	Date
April	0.55	2.10	-1.55	0.42	20
May	2.03	2.97	-0.94	1.05	29
June	1.20	3.75	-2.55	0.76	10
July	4.16	2.67	+1.49	2.16	4
August	5.64	2.78	+2.86	3.60	8
September	2.44	1.85	+0.59	0.98	17
October	0.45	1.16	-0.71	0.30	16
Total:	16.47	17.28	-0.81		

Temperatures: Last frost - 24° F, April 22
First frost - 22° F, October 2
Frost free period: 162 days

SPRING WHEAT BREEDING

F. A. Cholick and K. M. Sellers

The experiments were planted on April 22, 1987 and harvested on August 3, 1987. All breeding plots were fertilized for a yield goal of 55 bu/A and planted at a rate of 80 lbs/A adjusted for kernel size. Before discussing the results, it should be noted that the time from planting to heading was approximately 9 days less than normal. This accelerated plant development was due to the above normal temperatures. The advanced yield trial averaged 43.1 bu/A which was 5 bu/A less than the past several growing seasons indicating that the early season heat stress reduced yield, but that the crop also recovered. In 1987, 40 experimental lines and 9 check (named) varieties were evaluated in the advanced yield trial which was grown at 9 locations. Among the experiments 10 lines have been tested 3 or more years, 5 lines were in their second year and 25 lines were in their first year of statewide evaluation. At the Northeast Farm location and averaged over the past three growing seasons, the highest yielding check varieties were Butte-86, Shield and Stoa which yielded 52.2, 51.2 and 50.4 bu/A, respectively. It should be noted that Shield shattered an estimated 15% in 1987 at this site. Within the group with three or more years of evaluation, 5 lines yielded 50 bu/A or more. The line SD 2956, a semi-dwarf, medium-early maturing and medium-low protein, produced 51.8 bu/A. This line is presently being increased for potential release in 1988. In 1987, 5 new lines out of the 25 evaluated were in the top yield group which yielded equal to or greater than Butte-86 which was the highest yielding check in 1987. Protein content in 1987 averaged 15.2 and ranged from 12.8 to 17.4, both the average and range are somewhat greater than previous years.

BLEND YIELD TRIAL, 1987

A replicated yield trial was conducted at Brookings, Watertown, Redfield, Brentford and Selby to evaluate the effect of blending varieties on grain yield and protein content. Four varieties Butte-86, Guard, Marshall and Stoa were grown as pure varieties and all possible two way blends. Therefore the blends were Butte-86-Guard, Butte-86-Marshall, Butte-86-Stoa, Guard-Marshall, Guard-Stoa and Marshall-Stoa. The grain yields and protein contents are summarized in Table 2.

The grain yields that are underlined are the treatments in the top LSD group. Protein was determined on a composite of the three replications, therefore the LSD cannot be determined. These results should be considered as preliminary because the study has been conducted for only one year, however; similar composite experiments have been conducted in other locations and in general the results agree. There appears to be little or no advantage to blending varieties in that the best blends grain yields were not superior to the best pure variety. This is best illustrated by comparing the yields when averaged over locations. Butte-86 and Stoa were the top yielding pure varieties and the blend of these two varieties was the only blend in the top yielding group. There may be an advantage in blending for protein content because the pure varieties Butte-86 and Stoa had proteins of 15.0% and 14.7%, respectively, while their blend had 15.2% protein content. This effect occurred in four of the six blends, however; as stated previously these results should be considered preliminary and this experiment will be conducted again in the 1988 growing season.

Table 2. Yield and protein results from blend study in 1987.

Variety	LOCATIONS											
	Brookings		Redfield		Watertown		Brentford		Selby		Average	
	yld Bu/A	pro %	yld Bu/A	pro %	yld Bu/A	pro %	yld Bu/A	pro %	yld Bu/A	pro %	yld Bu/A	pro %
Butte-86	58	13.7	42	15.7	51	15.1	46	14.2	48	16.2	49	15.0
Marshall	55	13.7	34	15.1	42	13.9	47	13.3	39	16.2	43	14.4
Guard	52	13.7	33	15.1	42	13.8	44	14.0	43	15.9	43	14.5
Stoa	60	13.9	40	14.9	52	14.3	52	15.3	51	15.0	51	14.7
B/G	55	13.6	38	16.1	54	15.3	45	14.4	47	15.1	47	14.9
B/M	57	13.9	37	16.4	47	13.8	47	15.9	44	16.6	46	15.3
B/S	57	14.1	39	16.3	53	15.5	47	15.0	49	15.0	49	15.2
G/M	47	13.3	31	15.4	43	13.7	44	14.6	40	16.4	41	14.7
G/S	53	13.5	37	15.6	46	14.1	48	14.4	48	15.5	46	14.6
M/S	56	13.8	40	15.6	49	15.3	48	13.9	48	15.7	46	14.9
LSD .05 yield	5.8		5.0		7.9		7.4		3.7		2.1	

VARIETY BY NITROGEN STUDY

F. A. Cholick, R. H. Gelderman and K. M. Sellers

Grain yield and grain protein content are both highly influenced by the availability of nitrogen. The range in yield potential among experimental lines and wheat varieties is about 15 bu/A and the range in protein content is approximately 3%. This study was conducted to determine if 16 varieties or experimental lines varying in yield potential and protein content responded differently to applied nitrogen. A soil test was taken in the fall of 1986 and indicated that there was 62 lbs of nitrogen in the top four feet of soil. The treatments were zero and 100 lbs of nitrogen applied as urea post emergence. There was not a significant yield or protein response from the additional nitrogen, therefore it was not possible to evaluate if varieties would respond differently. The varieties yielded differently with Butte-86, SD 3005, Stoa and SD 2956 representing the top yielding group. The long-term check variety Chris was the highest protein content (17.1%). This experiment will be repeated if a site with a lower nitrogen soil test is located.

POTATO FUNGICIDE SEEDPIECE TREATMENTS

Dale Gallenberg and Loyal Evjen

The main objective was to test the effect of two common potato fungicide seedpiece treatments on stand count and yield of two potato cultivars. The treatments used were captan/streptomycin (fir bark dust) and mancozeb (slurry) as well as check; the two cultivars were Kennebec and Red LaSoda. Seed was cut and treated one day prior to planting on May 14, 1987. Stand counts were taken six weeks after planting. Plots were observed throughout the season for disease development. Harvest was on September 17, 1987 when total tuber weights were taken.

Disease pressure was low during the season. Some Rhizoctonia and soft rot were noted at harvest. No significant differences were found in either cultivar for stand count or yield. Average % stand counts for the check, captan/streptomycin and mancozeb treatments were 75.0, 82.5, and 84.0, respectively, for Kennebec and 82.5, 80.0 and 85.5, respectively, for Red LaSoda. Yields (converted to cwt/A) were 203.3, 230.5 and 234.1, respectively, for Kennebec, and 257.7, 254.1 and 252.3, respectively, for Red LaSoda.

CROP PERFORMANCE TRIALS - (CPT)

Small grains, Soybeans and Corn

J. J. Bonnemann

The Crop Performance Testing Program conducted trials with five small grains and two maturity groups of soybeans at the Northeast Farm during the 1987 cropping season. Crops seeded were spring wheat and durum, oats, rye, barley, Group 0 and Group I soybeans. The proprietary soybean entries are the choice of the entering companies and are included on a fee basis.

Yields were generally good for the small grains (Tables 3 and 4) and good for the soybeans (Table 5). A hard freeze several weeks earlier than recorded would have resulted in poor soybean quality and lower yields. Corn performance trials from the Deuel County test plots are also included (Tables 6 and 7). The results of the small grains and soybeans and more agronomic details are reported in EC 774 (rev.), 1988 Variety Recommendations (1987 Crop Performance Results) for Small Grains and Flax, and EC 775 (rev.) 1988 Soybean Recommendations (1987 Crop Performance Results). These reports are available at County Extension Offices or from the Bulletin Room, SDSU, Brookings, SD 57007.

Table 3. 1987 Northeast Farm spring wheat and oat trials, CPT, South Dakota.

Entry	B/A	T.W.	Entry	B/A	T.W.
SPRING WHEAT			OATS		
Standard Height					
Alex	42.0	59.7	Benson	111.7	32.6
Butte	47.1	61.0	Burnett	107.2	32.6
Butte 86	58.8	62.1	Don	138.5	34.4
Chris (ck)	41.8	59.5	Hazel	118.2	33.3
Stoa	58.5	61.2	Hytest	115.8	38.0
Shield	46.7	59.6	Kelly	84.1	35.4
			Lancer	101.7	30.9
Semi-dwarfs			Lyon	87.8	29.1
			Moore	98.2	32.2
Angus	47.6	62.0	Nodaway 70	79.3	33.8
Apex 83	40.7	59.0	Ogle	143.8	32.9
Celtic	53.6	60.4	Otee	109.7	35.0
Challenger	43.8	60.3	Porter	123.1	32.6
Guard	50.5	60.6	Preston	104.0	34.5
Len	47.0	59.2	Proat	112.8	34.5
Leo 747	55.0	59.9	Sandy	93.7	33.2
Marshall	56.3	60.0	Starter	107.4	37.2
Norak	47.1	60.3	Steele	96.1	32.4
Nordic	59.7	61.4	Webster	108.8	32.9
Norseman	56.9	59.0	Wright	116.3	36.7
Success	51.2	59.4			
Telemark	50.5	59.3	Means	111.7	33.8
Wheaton	54.6	58.9	LSD (.05)	12.9	
2369	57.1	61.6	CV = %	8.2	
2385	40.2	60.1			
Mean	50.7	60.4			
LSD (.05)	7.1				
CV = %	8.7				

Table 4. 1987 Northeast Farm barley, durum and rye trials, CPT, South Dakota.

Entry	B/A	T.W.	Entry	B/A	T.W.
	BARLEY			**DURUM**	
Azure	70.9	47.2	Crosby	58.1	63.4
Bowman	72.9	50.4	Edmore	54.8	62.1
B1601	58.6	45.1	Fjord	59.5	62.9
Gallatin	72.6	48.3	Laker	48.5	59.3
Glenn	57.5	46.4	Monroe	59.0	61.8
Hazen	68.6	46.1	Rugby	63.0	62.3
Lewis	64.5	49.5	Stockholm	65.0	61.5
Morex	57.2	45.9	Vic	51.9	61.8
Primus II	52.0	47.1	Ward	54.5	61.6
Robust	67.0	48.4			
			Mean	57.1	61.8
Mean	64.9	47.4	LSD (.05)	7.7	
LSD (.05)	7.4		CV = %	9.4	
CV = %	6.8				
	RYE				
Musketeer	36.6	53.4			
Rymin	35.7	53.4			
Chulipan	38.0	53.9			
Prima	34.4	51.8			
Frederick	32.6	51.7			
Cougar	36.6	51.2			
Puma	33.0	53.7			
Mean	36.3	52.9			
LSD (.05)	NS				
CV = %	13.7				

Table 5. Soybean Trials, Northeast Experiment Farm, 1987. CPT.

1987 Group 0 Soybean Performance Trial, Watertown, SD

		Variety Means		
Variety Name	Mat Group	B/A Yield	Plant Height	Mature MO/DA
Weber 84 CK	I	51.4	44.0	9/25
Weber	I	47.7	35.0	9/24
Garst 8011	0	47.7	37.0	9/21
Pioneer 9091	0	47.5	32.0	9/20
Pride 8095	0	45.5	46.0	9/21
Glenwood	0	45.4	38.0	9/17
Swift	0	44.6	43.0	9/19
Mustang M-1000	0	44.0	39.0	9/21
Dawson	0	43.6	36.0	9/19
Nor-King S 09-90	0	43.3	36.0	9/20
Lincoln LS7008	0	42.0	39.0	9/20
Nor-King S 06-57	0	41.3	36.0	9/18
Terra Exp 085	0	40.8	38.0	9/21
Dassel	0	40.4	33.0	9/19
Interstate IS545	0	40.2	33.0	9/18
Hofler Carnet	0	39.6	38.0	9/21
Simpson	0	39.1	33.0	9/19
Ozzie	0	38.5	33.0	9/14
Arrowhead 8450	0	37.8	35.0	9/22
Evans CK	0	36.2	37.0	9/15
Mc Call CK	00	29.6	33.0	9/4
Mean		42.2	36.2	9/19
LSD (.05)		4.85		
CV		7.1		

.....continued

Table 5. (Continued)

1987 Group I Soybean Performance Trial, Watertown, SD

Variety Name	Mat Group	Variety Means B/A Yield	Plant Height	Mature MO/DA
Lincoln EXLS7122	I	45.1	42.5	9/25
Stine 1820	I	42.7	36.0	9/22
Dekalb CX 117	I	41.4	33.5	9/18
Garst 8101	I	40.4	42.0	9/24
Corsoy 79 CK	II	40.0	41.5	9/26
Agripro AP1776	I	39.7	40.0	9/22
Mustang M-1150	I	39.6	38.0	9/23
Prairie Brand PB142	I	38.5	41.5	9/24
Hardin	I	38.3	39.5	9/21
Seedtec 620B (BL)	I	37.9	40.0	9/21
Arrowhead 8550	I	37.8	38.5	9/22
Holfer Sapphire	I	37.4	36.0	9/22
Sands SOI 142	I	37.4	40.5	9/21
Mustang M-1180A (BL)	I	37.3	39.0	9/23
Hodgson 78	I	37.1	39.5	9/19
Interstate IS622	I	36.9	40.0	9/23
Sexauer 80-61830	I	36.6	42.0	9/25
Seedtec 630	I	36.5	38.5	9/23
Sibley	I	36.4	38.5	9/19
Arrowhead 8600	I	36.3	40.5	9/22
Weber 84 CK	I	36.2	42.5	9/23
Prairie Brand PB171	I	36.0	39.5	9/21
Interstate IS715	I	35.8	34.0	9/21
Pride B117	I	35.7	41.5	9/20
Weber	I	35.5	36.5	9/22
Hy-Vigor Rocker 9-BL	I	35.5	41.5	9/22
Hofler Jade	I	35.5	37.5	9/22
Mustang MO-1120A	I	35.3	38.0	9/20
Sands SOI 166	I	35.2	37.0	9/22
Lakota	I	35.1	39.0	9/22
SRF 31387	I	34.9	39.0	9/23
BSR 101	I	34.3	43.0	9/25
Terra Runner III	I	33.8	36.0	9/22
Hy-Vigor Ex Row 99	I	33.1	41.5	9/22
Agripro AP120	I	31.7	34.5	9/17
Evans CK	0	31.5	33.5	9/13
Mean		36.9	38.9	9/22
LSD (.05)		4.9		
CV		9.5		

Seeded May 19

Table 6. 1987 Corn Performance Trial, Area D1 (early), Deuel Co., SD.

Brand and Variety	Type and Cross		Yield B/A	Pct. Stalk Lodged	Percent Moisture	Perf. Score Rating
Golden Valley 282	M	2X	159.1	0.0	13.8	1
Betagold Ingrid	E	2X	153.8	0.0	14.5	2
Terning Encore	M	2X	152.6	0.0	16.8	4
Golden Valley 354	M	2X	152.5	0.0	14.2	3
Asgrow/O'Gold RX498	E	2X	148.7	0.8	16.6	5
Cargill 859	M	2X	148.6	1.4	17.2	6
Lynks LX 3970	E	2X	146.1	1.5	14.9	7
King K416	M	2X	144.2	0.0	14.4	8
Dahlgren DC-440	E	2X	138.9	2.1	14.2	9
Cargill 3537	M	2X	137.2	0.8	16.5	12
Cargill 3479	E	2X	136.4	0.8	15.5	11
Asgrow/O'Gold RX480	E	2X	136.1	1.4	16.1	13
Golden Valley 247	E	2X	134.7	0.0	14.0	10
Horizon 4090	E	2X	133.9	0.8	15.3	14
Pride Ex99	E	2X	133.8	1.5	16.1	17
Terning Premier	E	2X	132.6	0.0	15.0	15
SeedTec KX-3400	E	2X	131.6	0.0	14.1	16
King K2204	E	2X	130.4	0.0	13.9	18
Pioneer 3790	E	2X	129.0	0.9	15.9	21
DeKalb DK415	E	2X	128.6	0.0	15.0	19
Stauffer S4474	M	2X	127.8	0.0	18.2	24
Interstate 453	E	2X	127.5	0.0	14.6	20
Pioneer 3737	E	2X	127.3	0.0	15.4	22
Top Farm SX1096	E	2X	125.5	0.8	14.6	23
King K4422	M	2X	125.5	0.0	17.0	25
Lynks LX 4101	E	2X	123.5	0.0	16.8	26
Lynks LX 4024	E	2X	119.7	1.6	15.1	27
Terning Salute	M	2X	119.6	0.0	17.0	30
Asgrow/O'Gold X4506	E	2X	118.3	0.0	15.2	29
Interstate 463	E	2X	118.2	0.0	14.9	28
Horizon 6089	E	2X	117.2	1.6	15.8	31
SADAES Check 10	E	2X	116.3	3.0	16.3	33
Top Farm SX1195	E	2X	115.1	0.8	14.3	32
Supercrost 1989	E	2X	115.0	2.8	16.0	36
Custom CFS 1511	E	2X	113.5	2.2	14.5	35
Top Farm SX1193	E	2X	113.5	1.6	14.4	34
SDAES Check 4	E	2X	103.8	0.9	18.8	38
Betagold Gretel	E	2X	102.1	0.0	13.9	37
Cargill 3987	M	2X	97.4	1.6	16.8	39
Terning Armor	E	2X	93.1	24.4	15.3	42
Custom CFS 91017	E	M2X	92.8	1.5	14.8	40
Terning Sprint	E	2X	90.0	1.7	14.2	41
SDAES Check 11	E	2X	79.6	3.9	14.8	43
Means			125.4	1.4	15.4	
LSD (.05)			34.5	CV-%	19.9	

Table 7. 1987 Corn Performance Trial, Area D1 (late), Deuel Co., SD

Brand and Variety	Type and	Cross	Yield B/A	Pct. Stalk Lodged	Percent Moisture	Perf. Score Rating
Stauffer S5340	L	2X	151.8	0.0	19.7	1
SDAES Check 9	L	2X	146.8	0.0	20.8	6
Cargill 130411	L	2X	145.5	1.5	18.0	2
DeKalb DK464	E	2X	143.0	0.0	16.5	3
Golden Valley 2500	M	2X	141.8	0.0	16.1	4
King K416	M	2X	141.7	1.4	15.5	5
King K4422	M	2X	140.5	0.0	16.5	7
Pride X1027	M	2X	140.2	0.0	16.5	9
Top Farm SX1102	M	2X	140.1	0.0	16.4	8
Horizon 6101	M	2X	138.5	0.7	18.2	12
Supercrost Ex 87105	L	2X	138.1	0.8	17.1	10
Pioneer 3732	M	2X	137.8	1.5	17.3	11
Pride 4422	M	2X	135.0	0.0	16.8	13
Pride 5547	M	2X	132.9	0.9	21.0	15
DeKalb DK524	M	2X	132.8	2.4	18.1	14
Pioneer 3704	M	2X	126.1	0.8	17.9	16
Interstate 543	M	2X	123.5	2.4	17.5	17
SeedTec KX5400	M	2X	120.5	0.8	16.1	18
Horizon 6103	M	2X	119.4	1.7	19.6	19
Interstate 345	M	M2X	115.8	2.8	16.5	20
Golden Valley 374	M	3X	113.3	0.0	16.1	21
Top Farm SX1099	M	2X	109.8	1.5	15.7	22
Interstate 523	M	2X	99.3	2.7	15.5	23
Mean			131.9	0.9	17.4	
LSD (.05)			NS			
CV - 18.4%						

CONTROL OF FOLIAGE DISEASES ON SPRING WHEAT USING FUNGICIDES IN 1987

G. Buchenau, S. Rizvi and L. Evjen

Fungicide trials were conducted at the Northeast Farm in 1987 to obtain basic disease data to be used in a wheat disease model currently under development, and to further test the efficacy of standard fungicides mancozeb and propiconazole against foliage diseases of spring wheat, especially leaf rust and tan spot.

The plots were located in two areas with different cropping histories. Area 'A' was in spring wheat in 1986, and area 'B' was previously cropped to chickpeas. Although area 'A' had spring wheat in 1986, the 1986 stand was poor and the crop plowed under early, consequently, not much residue was present by 1987. Treatments were slightly different between the two areas. Since the spring wheat area should have contained more leaf spot inoculum, it was chosen to receive additional 'prediction' treatments. Plots were planted to Butte spring wheat on 16 April, 1987 with a conventional small grain drill. Later, 4 by 20 foot plots separated by 5 foot alleys were cut into the solid planting with a mower. Experiments were designed separately for the 'A' and 'B' areas, each had four replications arranged in a randomized complete block design.

Growing degree days (GDD) were used to predict the occurrence of various growth stages of wheat. GDD were calculated from Brookings automatic weather station data by cumulative summation of: (daily mean temperature -32^{o} F). GDD calculations began at planting and continued until the experiments were terminated.

Disease development was relatively late due to dry conditions early in the season. Due to this and to the lack of uniformity in the plots, it was decided that yield would not be very meaningful. Consequently, ca. 50 heads were collected at random from each plot on 23 July (3388 growing degree days) for determination of 1000 seed weight. This was the only yield component that was measured.

On 26 May, notes taken from the plots indicated no leaf rust or tan spot present. This was 40 days after planting (1100 GDD at Brookings), 8.5 leaves were present (4.5 on main tiller), no nodes present, but close. At this time, the boot stage was estimated to occur on 4 June. The first spray was applied on 4 June, 1405 growing degree days had elapsed at Brookings. Actual stage was Romig 9. No leaf rust was present at this time. Tan spot was rated as follows:

	Flag	2nd Leaf	3rd Leaf	4th Leaf
Area A:	0.2%	1.8%	4.2%	dead
Area B:	0	0.8	5.6	10.0

Leaves placed in a moist chamber were not very diagnostic. Occasional conidiophores of *Pyrenophora tritici-repentis* were noted, no Septoria developed.

Fungicides were applied with a CO_2 pressurized plot sprayer calibrated to deliver 30 gpa at 30 psi. Applications were made according to schedules noted in the tables below. Originally the 'predictive' schedules were to be based on weather data from Watertown or Redfield. Since the automated station was not available at Watertown and the sensors at Redfield were not accurate, Brookings weather data was used as a basis for spray scheduling. This was following the first 'favorable' period (FP) that occurred after 1400 growing degree days. This FP occurred on 11 June and the 'predictive treatments A-5 and B-4 were applied on 12 June. It was convenient to apply the second spray of mancozeb on the same date, 12 June, 90% headed, 8 days after the first application, 1755 GDD since planting.

Disease ratings were taken in the field on 23 June (2231 GDD, full berry) and on 6 July (2685 GDD, dough stage. Due to the very light disease incidence on 23 June, data were recorded as prevalence (% leaves with disease) and also as severity when prevalence was 100%. The data were then converted to consistent units, i.e., pustules per leaf for leaf rust and lesions per leaf for tan spot. This was done as follows: for both diseases, 100% prevalence = 1 pustule (or lesion) per leaf, hence 75% prevalence = .75 pustules/leaf and so on. 'Trace' prevalence was considered to be .01 pustules or lesions/leaf and trace severity was considered to be 1 lesion or pustule per leaf. For leaf rust, severity values of 100% = 1000 pustules/leaf, hence 10X (severity rating) = pustules/leaf. With tan spot, 100% severity was considered to be 100 lesions/leaf, thus severity rating = lesions/leaf. One hundred lesions is probably more than are really needed to cause 100% leaf necrosis. However, the data of Larez suggest that 500 infections may be required to cause 100% coverage of normal large flag leaves (leaf area of 22 cm^2/lesion size of .04 cm^2).

Results

The leaf rust and tan spot data were analyzed both as untransformed data and also after transformation (Ln (x+.001)). Bartlett's test indicated that the log transformation usually improved the status of variances, which in most cases were extremely unequal (Table 8). The disease data therefore, are presented as untransformed means in Tables 9 and 10 and the comparisons are based on the transformed analyses. FLSD's from the untransformed analyses are also included.

A. Leaf Rust

On 23 June, 19 days after the first fungicide application and 11 days after the 2nd application date, all treatments controlled leaf rust on flag leaves but it was apparent that the single early application of Tilt was either loosing its effectiveness, or was not as effective initially as were the other treatments. On the other hand, the single late Tilt application was not effective on 2nd leaves (Table 9).

By 6 July, it was clear that the single early Tilt was no longer effective. The two applications of mancozeb were more effective than any of the Tilt applications at this time.

Table 8. Effect of the log transformation on Bartlett's test for homogeniety of variance.

Variable	Untransformed Sig. level	Untransformed Range[a]	Transformed (Ln(x+.001)) Sig. level	Transformed (Ln(x+.001)) Range
'A' Plots				
23 Jun LR Flag	** (0 var)	10X	** (0 var)	2X
23 Jun TS Flag	** (0 var)	10X	NS	2X
23 Jun LR 2nd	**	400X	NS	6X
23 Jun TS 2nd	**	300X	NS	2X
6 Jun LR	**	40X	NS	5X
6 Jul TS	NS	4X	NS	2X
'B' Plots				
23 Jun LR Flag	** (0 var)	50X	** (0 var)	2X
23 Jun TS Flag	**	50X	NS	2X
23 Jun LR 2nd	*	5X	NS	3-4X
23 Jun TS 2nd	NS	3X	**	6X
6 Jun LR	**	15X	NS	3X
6 Jul TS	** (0 var)	4X	** (0 var)	2X

[a] Range of treatment standard deviations. Where zero variance existed for one or more treatments, the range is for the remaining treatments.

Table 9. Effect of fungicide sprays on leaf rust on Butte spring wheat at Watertown in 1987.

Treatment	23 June Flag	23 June 2nd	6 July Flag Leaf
Area A	pustules/leaf		%
1. Untreated	3.225a	113.0a	37.5a
2. Mancozeb, 4 June, 12 June	.007bc	0.3c	0.3c
3. Tilt, 4 June	.230b	0.5bc	24.1a
4. Tilt, 4 June, 12 June	.000c	0.1c	9.6ab
5. Tilt, 12 June	.002bc	63.0ab	5.7b
FLSD.05	(3.2)	(98)	17.3
Transformed F-ratio	**	**	**
Area B			
1. Untreated	13.188a	163.0a	36.32a
2. Mancozeb, 4 June, 12 June	.005b	38.0a	0.6c
3. Tilt, 4 June	.505a	40.0a	24.1ab
4. Tilt, 12 June	.000b	90.0a	5.6b
FLSD.05	(19.7)	(124)	18.8
Transformed F-ratio	**	NS	**

Means within the same column and area with the same letter do not differ significantly at p <.05 based on the analysis of transformed data. FLSD's are based on untransformed analyses, those in parentheses had nonsignificant F-tests.

B. Tan spot

On 23 June there appeared to be a difference between the wheat area and the chickpea area. In the wheat area, all treatments controlled tan spot about equally well on both flag and second leaves. In the chickpea area, only 2 applications of mancozeb reduced disease significantly below that of the untreated checks (Table 10).

The early single application of Tilt had lost its effectiveness by 6 July. The single late application of Tilt was equal to 2 sprays of mancozeb.

C. Kernel weight

None of the treatments significantly affected weight per seed.

Table 10. Effect of fungicide sprays on tan spot and yield of Butte spring wheat at Watertown in 1987.

Treatment	Tan Spot on 23 June Flag	Tan Spot on 23 June 2nd	Tan Spot on 6 July Flag leaf	Seed wt
	lesions/leaf		%	mg
Area A				
1. Untreated	0.73 a	10.0 a	31a	30.52a
2. Mancozeb, 4 June, 12 June	0.007bc	0.02b	7b	31.18a
3. Tilt, 4 June	0.033b	0.07b	23a	30.55a
4. Tilt, 4 June, 12 June	0.002c	0.03b	7b	31.27a
5. Tilt, 12 June	0.006bc	0.08b	9b	31.82a
FLSD.05	0.33	4.0	13	(1.95)
Transformed F-ratio	**	**	**	
Area B				
1. Untreated	0.69a	10.5a	27a	32.36a
2. Mancozeb, 4 June, 12 June	0.01b	2.6d	8b	31.69a
3. Tilt, 4 June	0.51ab	9.0a	23a	32.20a
4. Tilt, 12 June	0.38ab	11.3a	10b	31.02a
FLSD.05	(.49)	(8.2)	14	(2.81)
Transformed F-ratio	NS	NS	*	

23 June - Full berry, 6 July - dough
Treatments within a column and area with the same letter do not differ significantly at $P < .05$ (analyses of transformed data, except for kernel weight). The FLSD is from the untransformed analysis.

CORN BREEDING AND RESEARCH

Z. Wicks, III and G. Scholten

The Northeast Research Station is one of our locations for conducting advanced yield trials on our experimental corn lines. We had two experiments on the research farm.

White Corn Research:

Objective: To develop white corn hybrids adapted to South Dakota conditions in hopes of it being an alternate crop.

Methods: 27 early maturing white corn hybrids were evaluated in 1987. Planting was done on May 7 and the plots were machine harvested on October 14. Armstrong SX96 (90 day white corn hybrid) and SX95 (95 day white corn hybrid) were used as checks. Final plant population was 18,500 plants/acre.

Results: Table 11 gives the results of the most promising white corn hybrids when looking at yield and quality results. Stalk lodging was a slight problem, with our developed white corn hybrids standing much better than the check hybrids.

Table 11.

	1987		1986 & 1987 Avg	
Hybrid	bu/A	moist	bu/A	moist
SD50 x SD63	86.0	20.9	106.7	22.9
SD51 x SD63	98.0	21.1	102.3	21.0
SD55 x SD65	66.0	21.2	98.6	26.5
SD65 x SD69	65.0	22.3	93.6	22.8
SD54 x SD63	85.0	21.9	94.8	21.4
SD63 x SD65	85.9	22.5	96.9	23.7
SD56 x SD63	84.0	21.1	90.3	21.6
SD57 x SD63	74.0	20.9	84.8	23.0
Armstrong SX96	70.5	23.1		
Armstrong SX95	81.0	23.1		

Double Cross Hybrid Research:

Objective: To look at the possibility of growing a mixture of double-cross hybrid seed instead of single-cross hybrid seed in the state's lower producing areas.

Methods: 18 single-cross hybrids were used in making 3 separate double-cross hybrid populations (using a combination of 6 single-cross hybrids). The entries entered consisted of 18 single-cross hybrids, the first selfed generation from those single-cross hybrids, and the three double-cross hybrid populations.

Results: As was expected with Watertown being in a higher production area, the three double-cross populations were lower in yield compared to the average of the 18 single-cross hybrids used to make up those three populations. The results are in Table 12.

Table 12. Yield of hybrid, double-crossed and selfed corn populations.

		bu/A	bu diff. from hybrids	% diff. from hybrids
Pop. 1	6 Hybrids:	159.73		
	Double-cross pop.:	121.39	-38.34	-24.00
	Selfs:	103.38		
Pop. 2	6 Hybrids:	162.97		
	Double-cross pop.:	146.85	-16.12	-9.89
	Selfs:	108.52		
Pop. 3	6 Hybrids:	157.19		
	Double-cross pop.:	136.06	-21.13	-13.4
	Selfs:	107.67		

These results are about the same as in our other high production areas. Interestingly, we found that in our lower producing test sites we obtained a 2.42 bu/A yield advantage in the double-cross population vs the average yield of the single-cross hybrids.

THE USE OF SOIL TESTS TO PREDICT FERTILIZER NITROGEN NEEDS OF CORN

R. Gelderman and L. Evjen

Introduction:

Approximately 50% of the total fertilizer nitrogen applied in South Dakota is used on corn. The need for efficient and profitable nitrogen recommendations for corn is apparent. The best guide available for recommending fertilizer is a soil test. Soil tests need to be correlated to field response data such as reported here.

The objective of this study is to determine the relationship of the nitrate-nitrogen soil test to yield response of corn to nitrogen fertilizer.

Methods:

The study was located in the southeastern corner of the Watertown Station on a Brookings soil. These soils are deep, silty clay loam loess over glacial till. Results of soil tests from samples taken in the spring of 1987 are shown in Table 13.

Table 13. Spring soil test results of nitrogen corn study, Watertown Station.

NO_3-N					
0-24"	0-48"	O.M.	P	K	pH
lb/A		%	lb/A		
95	165	3.8	44	330	6.1

The soil tests for nitrate-nitrogen indicated a considerable quantity of nitrogen in the 2 to 4 foot depth (70 lb/A). Usually only 20-30 pounds are found at this depth. Phosphorus is considered adequate. One hundred pounds of 0-0-60 was broadcast and worked in to eliminate any potassium deficiencies.

The previous crop was sunflowers. The area was chiseled and disked before planting Pioneer 3790 on May 8, 1987 at a population of approximately 18,000 plants per acre. The fertilizer rate treatments were spread on the soil surface as ammonium nitrate several days after planting. The rates used were 0, 30, 60, 90, 120 and 150 lb of actual nitrogen per acre. Each treatment was replicated four times. The plots were hand harvested October 1.

Results and Discussion:

The average yields and grain moisture for the experiment are shown in Table 14. The grain yields indicated a slight trend higher for higher nitrogen rates until the 90 lb N rate was reached. The 150 lb/a rate appeared to lower yield slightly. No trend is indicated for grain moisture or stover yields. Rate of nitrogen did not affect these two measurements.

Table 14. Average corn grain, stover yields and grain moisture for the nitrogen rate experiment, 1987.

Rate of N	Grain Yield	Grain Moisture	Stover Yield
lb/a	bu/a (15%)	%	lb/a (dry wt.)
0	145	24.5	6410
30	148	22.8	6190
60	152	24.3	5837
90	157	23.7	6651
120	158	24.3	6585
150	151	24.0	5971
Sign. of F	0.17	0.50	0.09

The results indicate the SDSU fertilizer recommendation for 155 bu/A would be very close to the amount of nitrogen needed as suggested by these results. The SDSU recommendations are (155 x 1.45) - 20 = 205 lb of fertilizer and nitrate-N required. From this is subtracted the 95 lb of NO_3 in the 0-2'. and 80% of the amount of nitrate over 30 lb in the 2-4 foot level. This would be: 70 - 30 = 40 x .80 = 32. Thus, 205 - 95 - 32 = 78 lb N/A recommended. This value is very close to the approximately 90 lb of N that the data suggest is needed.

The level of nitrate at 2-4 feet is usually not this high under farmer fields. However, where deep nitrate-nitrogen is suspected this value can be useful in determining fertilizer N requirement for corn.

1987 SUNFLOWER BREEDING

C. L. Lay and K. A. Grady

Table 15. Seed yield of sunflower hybrids in the 1987 South Dakota Hybrid Trial grown at the Northeast Research Station, Watertown, SD.

Hybrid Identification	Seed Yield (lbs/A)
Pioneer P6440	2444
Jacques Zenith	1994
Jac Columbia II	1905
Cargill SF 100	2701
" SF 102	2201
" SF 103	2372
" C 207	2247
" C 208	2823
" E 409687	2537
Conti Hysun 33	1968
" Hysun 354	2575
SeedTec ST 316	2103
" ST 317	2267
" ST 330	1877
Interst IS 7111	1788
" E 65101	2184
" E 41281	1780
" E 61121	2206
Cenex CX 6101	1656
" CX 8101	1695
" CX 7101	1887
Dahlgren DO 855	2122
" DO 705	2217
Sunbred 285	2414
" 277	2207
" 281	1675
Sigco 465A	1904
" 475	2526
Agripro 2057	2802
" 5600	1722
" 2050	1427
" 3900	2069
Dekalb G 100	1908
" G 101	2061
SDSU SDH86029	1918
" SDH86026	2210
" SDH86004	1948
" SDH86018	1973
" SDH86006	2039
" SDH86009	1643
" SDH86010	1768
" SDH86025	1892
" SDH86032	1638
" SDH86013	2168

Table 15. (Continued.)

Hybrid Identification	Seed Yield (lbs/A)
" SDH86014	1776
" SDH86027	1742
" SDH86015	2100
" SDH86016	1622
" SDH86017	1898
" SDH86021	2150
" SDH86022	2249
" SDH86023	1883
" SDH86030	2100
" SDH86031	2039
Hybrid 894	1928
Interst IS 3001	1792
Test average	2035
LSD (.05)	447

1987 FLAX BREEDING

K. A. Grady and C. L. Lay

A yield trial of advanced experimental flax lines and named flax varieties was grown at the Northeast Research Station and three other locations in South Dakota in 1987. The main objectives of this trial are to provide data on performance of released flax varieties to farmer/growers as well as identify possible new varieties.

In 1987, seven advanced experimental lines from the SDSU flax breeding program were tested against fourteen named varieties (checks) and seven experimental lines from North Dakota and Canada. The test was seeded at the Northeast Research Station on April 23, 1987 and harvested on July 31, 1987. Due to dry conditions at seeding, there was differential emergence, with some plants emerging 1-2 weeks later than others in the same plot. Flowering data must therefore be considered approximate.

The highest-yielding check at the Northeast Station was Dufferin, with an average yield of 32 bu/A (Table 16). The highest-yielding experimental lines were CI 3243 (32 bu/A), CI 3101 (31 bu/A), CI 3252 (30 bu/A), and CI 3096 (29 bu/A). The mean yield across all varieties was 27 bu/A.

Table 16. Yield, days to flower, plant height, and % oil of flax varieties grown at the Northeast Research Station, Watertown, SD in 1987.

Variety	Origin-Year	Pedigree	Seed Yield (bu/A)	Days to Flower	Plant Height (cm)	% Oil
Linott	CAN-1966	CI 2522	25.9	54	53	38.5
Culbert	MN-1975	CI 2776	25.1	56	50	38.8
Culbert 79	SD-1979	CI 2838	25.3	54	49	39.0
Wishek	ND-1979	CI 2822	26.4	55	48	38.7
Clark	SD-1983	CI 2925	24.7	55	48	38.8
Flor	ND-1981	CI 2896	29.6	59	51	38.2
NorLin	CAN-1983	CI 2935	24.5	58	49	38.4
Linton	ND-1985	CI 2934	26.0	57	50	38.8
NorMan	CAN-1984	CI 3065	29.4	60	57	39.7
Rahab	SD-1985	CI 2943	26.9	59	54	39.9
Dufferin	CAN-1975	CI 2814	32.4	60	58	38.6
McGregor	CAN-1982	CI 2921	28.1	63	58	37.6
Vimy	CAN-1986	CI 3108	26.1	55	53	39.7
Verne	MN-1987	CI 2938	25.7	56	56	39.2
CI 3096	ND-exp.	CI2847/Culb79	29.2	58	50	39.1
CI 3131	SD-exp.	BFP/Culb	25.7	54	51	39.6
CI 3243	SD-exp.	N707//CI2777/N419	32.3	56	54	39.7
CI 3101	ND-exp.	Z2236/Culb79	30.7	56	55	39.7
CI 3136	ND-exp.	Z1067/Culb79	27.5	55	51	38.9
CI 3137	ND-exp.	Culb/Bsn//Culb/Bsn	27.3	57	52	39.0
CI 3248	ND-exp.	Z704/Duff	27.4	58	51	40.0
CI 3252	CAN-exp.	Duff/McGreg	29.9	60	56	38.8
CI 3253	CAN-exp.	STS	25.8	58	55	38.0
CI 3266	SD-exp.	Culb79//Lnt/SD1374	23.9	56	50	39.2
CI 3267	SD-exp.	M409/N415//M905	28.4	55	53	39.6
CI 3268	SD-exp.	" "	24.9	56	52	39.8
CI 3269	SD-exp.	" "	28.0	54	50	39.7
SDT 8613	SD-exp.	CI2854/Culb79// CI2892	24.4	58	55	39.1
		Mean	27.2	57	52	39.1
		LSD (.05)	ns	2	5	

ALFALFA VARIETY YIELD TEST

Kevin D. Kephart, Ed Twidwell and Robin Bortnem

Two alfalfa variety yield experiments were conducted at the NE Station during 1987. The experimental objective was to determine the yield performance of various alfalfa cultivars and experimental lines when grown in NE South Dakota.

The first of these experiments was established in late May of 1985 and consisted of 45 varieties. Average total dry matter yield obtained from four harvests was 6.14 tons per acre (Table 17) which was about one ton per acre less than in 1986. This yield differences is likely a result of reduced precipitation experienced during the early 1987 growing season. Interestingly, the second harvest in 1987 produced a greater average dry matter yield than did the first harvest (Table 17). The second harvest occurred well after the onset of the years mid-summer precipitation; therefore, the yield differences between the first two harvests were likely related to soil moisture availability. Prolonged drought stress occurring before flowering stages often restricts stem elongation in alfalfa. Although moisture stress reduced yield, the nutritive quality of the herbage was likely to be very high because of an increased leaf-to-stem ratio.

The second experiment consisted of 31 varieties and was planted on 25 April 1987. A single harvest was obtained on 22 July which produced an average dry matter yield of 1.81 tons per acre with a range of about one-half of a ton per acre (Table 18); however, there were no significant differences among varieties. Dry matter yields such as these from the single harvest in the seedling year are good. As demonstrated in this experiment, high yield in the seeding year is one advantage of seeding alfalfa with a pre-emergence herbicide (Eptam) instead of using a companion crop.

Results of these studies are useful in selection of alfalfa varieties for forage production. Measurements of forage yield taken over several harvests or years of production are usually more useful than are averages from a single harvest. Also, yield data from the seeding year is of limited use because differences associated with winterhardiness will not be expressed.

Examination of the 3-year yields for the first experiment (Table 17) reveal that, among the tested varieties, no single variety stands out as being superior. Improved disease and pest resistance are major advantages of using modern alfalfa varieties. The major factors to consider when selecting an alfalfa variety include multiple disease and pest resistance, moderate winterhardiness, high yield potential, and cost per unit of pure live seed.

Table 17. 1985 Alfalfa Variety Trial, Northeast Research Station, Watertown, SD, 1987

Variety	1986 4-Cut Total	1987 Forage Yield (Tons DM/A) Cut 1 5/29	Cut 2 7/22	Cut 3 8/20	Cut 4 10/21	4-Cut Total	3-Year Avg.	% Rel. Perf.
Surpass	7.62	1.86	3.39	1.21	1.24	7.70	5.66	108
5432	7.93	1.75	2.30	1.28	1.15	6.48	5.64	108
MN 5617	7.59	1.72	2.53	1.43	1.25	6.93	5.61	107
Maxim	7.92	1.59	2.44	1.19	1.19	6.41	5.58	107
Magnum +	7.58	1.55	2.42	1.38	1.29	6.64	5.56	106
Spectrum	7.90	1.33	2.37	1.20	1.28	6.18	5.53	106
Horizon	7.65	1.52	2.48	1.20	1.17	6.37	5.51	106
DK-135	7.49	1.28	2.32	1.22	1.13	5.95	5.45	104
Sparta	7.60	1.41	2.32	1.23	1.15	6.11	5.44	104
Vernema	7.31	1.54	2.50	1.36	1.14	6.54	5.44	104
Futura	7.54	1.44	2.34	1.12	0.97	5.87	5.44	104
532	7.23	1.66	2.38	1.43	1.34	6.81	5.43	104
Iroquois	7.36	1.61	2.47	1.26	1.12	6.46	5.42	104
526	7.49	1.57	2.24	1.24	1.24	6.29	5.38	103
MN 6216	7.65	1.54	2.48	1.34	1.07	6.43	5.38	103
Cimarron	7.85	1.17	2.28	1.17	1.10	5.72	5.37	103
Arrow	7.50	1.66	2.38	1.18	1.02	6.24	5.35	102
Peak	7.42	1.45	2.44	1.21	1.20	6.30	5.35	102
Magnum	7.20	1.40	2.33	1.23	1.16	6.12	5.32	102
Max 85	7.12	1.48	2.58	1.26	1.18	6.50	5.31	102
Elevation	7.24	1.41	2.35	1.22	1.24	6.22	5.30	102
Kingstar	7.50	1.46	2.47	1.21	1.24	6.38	5.30	102
120	7.37	1.26	2.26	1.23	1.16	5.91	5.28	101
Oneida VR	7.07	1.46	2.52	1.27	1.36	6.61	5.27	101
Thunder	7.28	1.60	2.24	1.16	0.96	5.96	5.24	100
Oneida	7.00	1.57	2.41	1.28	1.14	6.40	5.20	100
Dawson	7.24	1.38	2.34	1.15	1.09	5.96	5.19	99
Mohawk	7.14	1.46	2.51	1.34	1.14	6.45	5.19	99
NY 8412	7.09	1.52	2.40	1.19	1.29	6.40	5.18	99
Saranac AR	7.36	1.39	2.12	1.13	1.07	5.71	5.14	98
XAF31	7.22	1.43	2.28	1.14	1.07	5.92	5.13	98
H-156	7.20	1.37	2.21	1.20	1.06	5.84	5.13	98
Vernal	6.34	1.34	2.44	1.14	1.05	5.97	5.09	98
Endure	6.70	1.54	2.22	1.18	1.15	6.09	5.08	97
H-154	7.38	0.91	2.08	1.10	0.93	5.02	5.05	97
Epic	6.95	1.34	2.50	1.20	1.13	6.17	5.05	97
Agate	6.86	1.40	2.34	1.19	0.96	5.89	5.00	96
NY 8413	6.67	1.43	2.36	1.21	1.29	6.29	4.98	95
MN 6209	6.62	1.53	2.21	1.16	1.13	6.03	4.94	95

Table 17. Continued

Variety	1986 4-Cut Total	1987 Forage Yield (Tons DM/A) Cut 1 5/29	Cut 2 7/22	Cut 3 8/20	Cut 4 10/21	4-Cut Total	3-Year Avg.	% Rel. Perf.
Blazer	6.76	1.48	2.10	1.16	0.95	5.69	4.88	93
8016 PCa3	6.73	1.46	2.10	1.15	0.94	5.65	4.85	93
Megaton	6.54	1.54	2.26	1.16	0.72	5.68	4.84	93
Baker	6.08	1.46	2.19	1.09	1.09	5.83	4.70	90
Saranac	6.46	1.41	2.14	1.11	0.96	5.62	4.68	90
Big 10	6.10	1.15	2.16	1.06	1.00	5.37	4.56	87
Average	7.21	1.46	2.34	1.21	1.12	6.14	5.23	
LSD (0.05)	0.81	0.22	0.27	0.16	0.23	0.59	0.78	

Seeded: 5/20/85 at 12 lbs PLS/A, Ridomil 1 lb ai/A, Eptam 3lb ai/A.
Fertilized: None needed according to SDSU soil testing results. Soil pH: 6.2
% Relative Performance based on the 3-year average.

Table 18. 1987 Alfalfa Variety Trial, Northeast Research Station.

Variety	Forage Yield Tons DM/A Cut 1 7/22	% Relative Performance	Variety	Forage Yield Tons DM/A Cut 1 7/22	% Relative Performance
W-L 225	2.11	116	Commandor	1.80	99
SX 271	2.05	113	Cim 2000C	1.78	98
NAPB 31	2.03	112	MTO N82	1.78	98
120	2.00	110	Saranac AR	1.78	98
Cimarron	1.95	108	532	1.77	98
Dart	1.93	107	Big 10	1.74	96
MTO S82	1.90	105	636	1.72	95
Fortress	1.87	103	5432	1.72	95
Magnum III	1.86	103	Eagle	1.72	95
Iroquois	1.84	102	XPH 2001	1.68	93
Vernal	1.83	101	Mohawk	1.68	93
Blazer	1.82	100	526	1.66	92
Dynasty	1.82	100	SX 424	1.65	91
Endure	1.81	100	Arrow	1.65	91
DK-135	1.81	100	Saranac	1.60	88
NAPE 32	1.80	99			
Average	1.81				
LSD (0.05)	NS				

Seeded: 4/25/87 at 12 lbs PLS/A, Eptam 3 lb ai/A, Ridomil 1 lb ai/A.
Fertilized: 5/4/87 at 50 lbs P_2O_5/A.
% Relative Performance based on the average yield.

WEED CONTROL DEMONSTRATIONS

Leon J. Wrage, P. O. Johnson and W. E. Arnold

Demonstration plots provide side-by-side comparisons of herbicides under similar conditions. The plots are evaluated visually for weed control and crop tolerance. Data collected are summarized over several years to provide a more accurate measurement of expected performance. Rates used are those best suited for the weed and soil type. These plots are used for tours and form the basis for educational material.

The demonstration program at the farm was continued at the expanded level so all major crops in the area are included. The station provides the only site for evaluating herbicide performance in sunflower, edible bean, potato, flax and alfalfa establishment.

Weed control in 1987 reflected seasonal conditions typical for the Northeast area. Rainfall after planting was very limited and precipitation remained low through mid-season. As a result, many treatments performed at levels 10-20% below previous years. The value of cultivation as an integral part of the weed control system was apparent. Weed competition which developed in early season caused much greater crop loss due to moisture stress.

The crops included in the 1987 plots are listed below:

1) CORN HERBICIDE DEMONSTRATION. 42 treatments. Two-year averages.
2) SOYBEAN HERBICIDE DEMONSTRATION. 36 treatments. Three-year averages.
3) POTATO HERBICIDE DEMONSTRATION. 16 treatments. Three-year averages. Yield harvested.
4) FLAX HERBICIDE SCREENING. 20 treatments.
5) ALFALFA ESTABLISHMENT. 16 treatments. Three-year averages.
6) EDIBLE BEAN DEMONSTRATION. 12 treatments. Three-year averages.
7) SUNFLOWER HERBICIDE DEMONSTRATION. 14 treatments. Three-year averages.

Results for tests in corn and soybeans are presented in the following tables. Data from 1987 and multi-year averages are included.

Table 19. 1987 Corn Herbicide Demonstration

Treatment	lb/A act.	Percent Weed Control 1987[a] Gr	Bdlf	2-Yr Avg. Gr	Bdlf
PREPLANT INCORPORATED					
Check	-----	00	00	00	00
Eradicane	4	81	47	82	65
Eradicane	2	67	28	--	--
Eradicane+atrazine+Bladex	4+.5+1.5	93	73	92	84
Sutan+	4	79	78	82	66
Sutan+ +atrazine	4+1	86	94	92	96
Sutan+ +Bladex	4+2	88	95	92	93
Sutan+ +atrazine+Bladex	4+.5+1.5	90	85	93	88
SHALLOW PREPLANT INCORPORATED					
Atrazine	2.5	75	80	84	90
Bladex	3	66	43	--	--
Lasso	3	61	37	74	64
Dual	2.5	59	47	74	60
PREEMERGENCE					
Atrazine	2.5	72	93	84	96
Bladex	3	61	32	76	63
Lasso	3	69	73	78	81
Lasso	2	47	42	--	--
Dual	2.5	70	32	82	62
Dual	1.6	42	23	--	--
Prowl	1.5	70	46	75	65
Ramrod	6	79	37	76	60
+Harness	2.5	88	89	90	92
Lasso+atrazine	2+1	81	88	88	92
Lasso+Bladex	2+2	76	77	80	84
Dual+atrazine	2+1	80	93	88	96
Dual+Bladex	2+2	76	80	87	87
Atrazine+Bladex	.75+2.25	69	81	78	90
Ramrod+Bladex	4+2	75	47	83	66
Lasso+Bladex+atrazine	2+1.5+.5	73	88	85	93
+Banvel+Bladex+atrazine	.5+2.5+.75	74	91	--	--
+Prowl/atrazine (Prozine)	2.1	65	81	--	--

..................continued

Table 19. (Continued).

Treatment	lb/A act.	Percent Weed Control 1987* Gr	Bdlf	2-Yr Avg. Gr	Bdlf
EARLY POSTEMERGENCE					
Prowl+atrazine	1.5+1	60	87	75	98
Prowl+Bladex	1.5+1.5	71	62	81	77
Atrazine+crop oil	1.5+1 qt.	48	91	69	94
Bladex+X-77	2+.5%	37	37	62	60
Tandem+Bladex+atrazine+X-77	.5+1+.5+.5%	69	79	80	86
PREEMERGENCE & EARLY POSTEMERGENCE					
Ramrod&Banvel	4&.5	71	84	78	85
PREEMERGENCE & POSTEMERGENCE					
Ramrod&Banvel	4&.25	74	94	80	92
Ramrod&2,4-D amine	4&.5	72	80	77	81
Ramrod&Buctril	4&.38	74	91	74	88
Ramrod&Buctril+atrazine	4&.25+.5	87	95	81	94
Ramrod&Banvel+atrazine	4&.25+.5	92	95	84	94
Cultivated check**	-----	95	95	--	--

Evaluated: 7/13/87
PPI&PRE: 5/5/87
Planting Date: 5/5/87
EPOS: 5/26/87
POST: 6/12/87
Rainfall: 1st week 0.00 inches
2nd week 0.18 inches
** Cultivation: Rotary hoe 2X, field cultivate 2X.

* Average 3 ratings/plot

Gr=Yellow foxtail - heavy
Bdlf=Redroot pigweed; lambsquarter; wild mustard

+ Experimental

Table 20. 1987 Soybean Herbicide Demonstration

Treatment	lb/A act.	Percent Weed Control 1987* Gr	Bdlf	3-Yr Avg. Gr	Bdlf
PREPLANT INCORPORATED					
Check	-----	00	00	00	00
Vernam	2.5	61	36	--	--
Treflan	.75	68	75	79	73
Sonalan	1	78	81	87	81
Prowl	1.25	65	69	80	73
Treflan+Sencor/Lexone	.75+.38	79	86	85	90
Command	1	78	20	--	--
Treflan/Command (Commence)	1.31	75	59	--	--
Treflan+Command	.75+.75	83	54	--	--
Command+Sencor/Lexone	.75+.25	85	55	--	--
Commence+Sencor/Lexone	1.31+.3	74	75	--	--
+Prowl+Scepter	1.25+.125 (.6 pt)	88	98	--	--
+Prowl+Pursuit	1+.078 (5 oz)	91	96	--	--
SHALLOW PREPLANT INCORPORATED					
Lasso	3	80	71	73	66
Dual	2.5	84	45	74	53
+Lasso+Pursuit	2+.078 (5 oz)	88	95	--	--
+Lasso+Scepter	2+.125 (.6 pt)	83	92	--	--
PREPLANT INCORPORATED & PREEMERGENCE					
Treflan+Sencor/Lexone& Sencor/Lexone	.75+.25&.38	95	98	--	--
Treflan&Sencor/Lexone	.75&.5	90	91	94	95
PREEMERGENCE					
Amiben	3	81	85	75	73
Lasso	3	70	72	80	67
Dual	2.5	62	56	74	56
Lasso+Sencor/Lexone	2+.5	73	92	85	90
Dual+Sencor/Lexone	2+.5	70	82	83	88
Lasso+Amiben	2+2	85	84	87	86
Lasso+Lorox	2+1	72	65	83	78
+Cinch+Sencor/Lexone	1.3+.43	78	48	--	--
+Cinch+Scepter	1.3+.125 (.6 pt)	75	73	--	--

...............continued

Table 20. (Continued)

Treatment	lb/A act.	Percent Weed Control 1987* Gr	Bdlf	3-Yr Avg. Gr	Bdlf
PREEMERGENCE & POSTEMERGENCE					
Cultivated check**	-----	86	87	--	--
Lasso&Basagran+crop oil	2&1+1 qt.	76	94	76	91
Lasso&Blazer/Tackle+X-77	2&.5+.5%	82	93	81	94
Lasso&Cobra+X-77	2&.2+.25%	87	96	--	--
Lasso&Classic+X-77	2&.012+.25%	83	93	--	--
POSTEMERGENCE					
Fusilade+crop oil	.187+1 qt.	91	00	--	--
+Whip+crop oil	.15+1 qt.	80	00	--	--
Poast+Blazer/Tackle+ Basagran+crop oil	.3+.25+.5+1 qt.	77	53	81	79
LSD (.05)				15.1	18.1

Evaluated: 7/13/87
PPI&PRE: 5/18/87
POST: 6/12/87
Planting Date: 5/18/87
Rainfall: 1st week .70 inches
2nd week .39 inches

* Average 3 ratings/plot

Gr=Yellow foxtail - heavy
Bdlf=Redroot pigweed; lambsquarters; wild mustard

\+ Experimental

**Cultivation: Rotary hoe 2X, field cultivate 2X.

SUNFLOWER INSECT STUDIES

G. Hein, M. Gray, L. Evjen
J. Smolik, D. Walgenbach, and J. Gednalske

I. Banded Sunflower Moth Population Monitoring

Objectives:

1. To determine if populations of banded sunflower moth were present in Codington County.

2. To determine the seasonal occurrence of the banded sunflower moth at the Northeast Research Station.

Materials and Methods:

Delta-type sticky traps, baited with banded sunflower moth sex pheromone, were placed out at two locations on the Northeast Research Station, in 1986 and 1987. The traps were monitored twice per week, beginning about June 20 and continuing through the season. Traps were replaced with fresh traps periodically through the season.

Results:

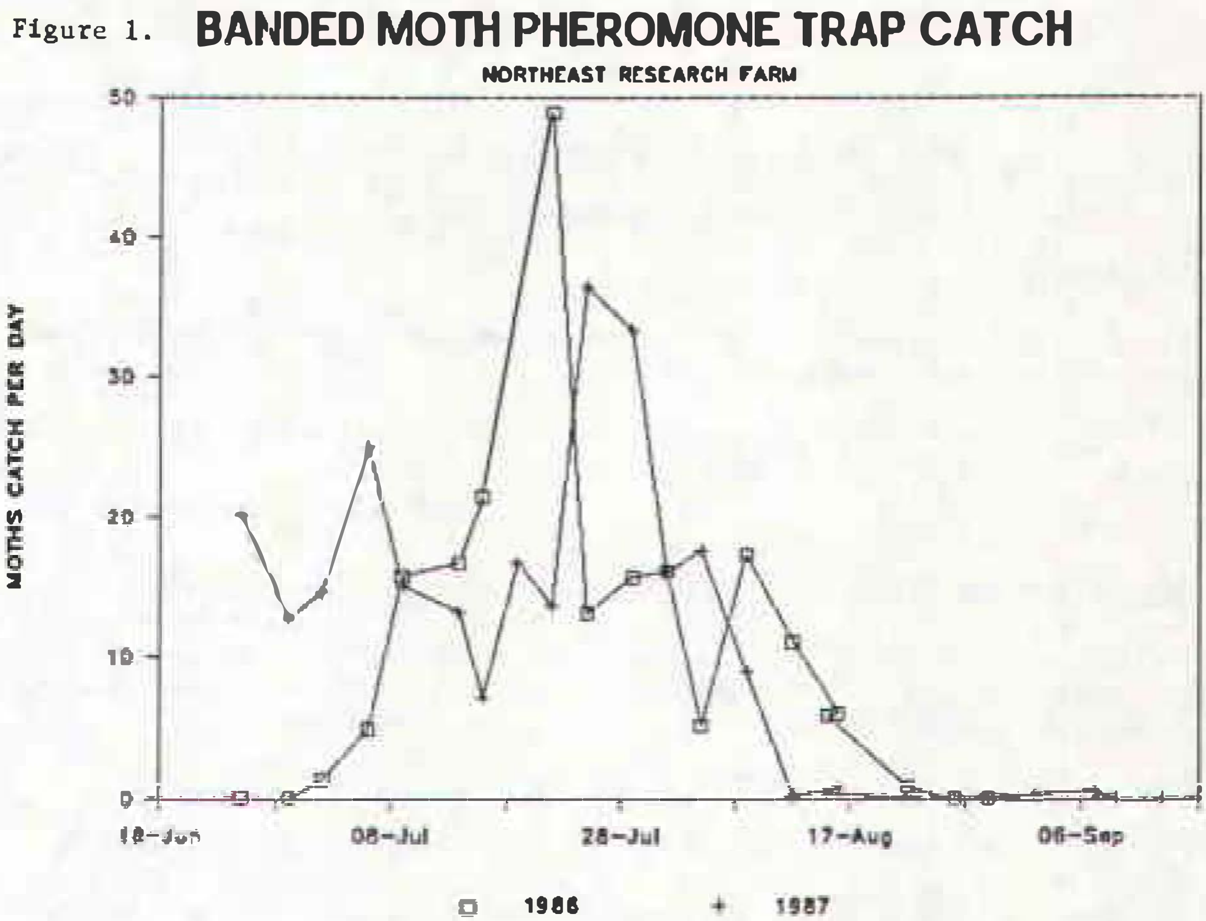
1986: The first capture of moths was observed on July 3, and moth catches gradually rose to a peak of 49 moths per trap per day (Figure 1). Moth captures dropped off sharply and gradually declined to zero in late August.

1987: Moths were captured in the pheromone traps during the first sampling period following placement on June 22. The earlier appearance of the moths is likely the result of unusually warm spring and early summer temperatures. Moth catches remained moderately high and peaked on July 27 after which catches declined rapidly to very low levels by mid August (Figure 1).

Sex pheromone traps attract only male moths. Therefore, the sharp decline in moth captures after the peak does not necessarily mean that moth populations were declining. It is likely that the drop in catch is the result of competition with females emitting their own pheromone and males seeking to mate. If this is occurring, maximum oviposition should be occurring about this time.

This study demonstrates the presence of relatively high populations of banded sunflower moth at the Northeast Research Station. High populations of banded sunflower moth were present during the last half of July and mating and subsequent oviposition appears most likely during this time.

Figure 1.



II. Sunflower Date of Planting

Objective 1:

Determine the influence of planting date on sunflower infestations by the banded sunflower moth and the head moth.

Materials and Methods:

1986: Two varieties, Sigco 432 (early maturing) and Sigco 455 (late maturing) were planted on four planting dates from May 21 to June 16. These eight treatments were used in a randomized complete block design with four replications. Plots were eight rows wide and 40 feet long.

1987: Two varieties (Sigco 432 and 455) were planted on five planting dates from April 24 to June 15. The ten treatments were replicated six times in a randomized complete block design. The plots were eight rows by 50 feet in size.

In both years, when the sunflowers were beginning to bloom in each plot, five heads per plot were bagged using Delnet pollination bags. At this time oviposition by the female moths should have been complete. The bagging prevented developing larvae from leaving the heads. When larval development was nearly complete (about 3 weeks later) the heads were removed and brought back to the lab and inspected for larvae.

Results:

1986: The plots in this study were subjected to a great deal of insect pressure. The early planted plots (May 21 and 29) were heavily infested with banded moth (Table 21). There was a significant reduction in banded moth damage with the later planting dates. The only plots where head moth were found were in the earliest flowering plots (Sigco 432, May 21).

1987: As in 1986, the late May and early June planting dates were subjected to the heaviest insect damage. Insect pressure subsided significantly for the earliest and latest planting dates.

Planting date had an important influence on banded sunflower moth infestations. Differences occurring between the two varieties planted on the same date, indicate that banded moth damage was related to the period of the season when the sunflowers were in the bud-to-flowering stages. Banded moth females will oviposit on sunflowers that are in the late bud stage. The newly hatched larvae feed on pollen and young florets, and later they will begin to destroy the developing seeds. The highest damage occurred when the plots were flowering during late July and early August. This period was just after the first large peak in pheromone trap catch (Figure 1). The earlier and the later flowering plots were not exposed to maximun oviposition pressure, and resulting damage was not as high. Planting date also appeared to have an important influence on head moth infestations. Those plots that were flowering during mid-to-late July were the most severely infested with head moth.

It is unlikely that damage by these two species can be completely avoided through the selection of maturity and planting date. But, the risk of infestation by these two species can be significantly reduced by choosing a variety and planting date to avoid the bud to early flowering stages in the last half of July and early August.

Table 21. Banded moth and head moth infestations in sunflower date of planting studies, 1986 and 1987.

Variety	Planting Date	Initial Flowering Date	Larvae/Head[a] Banded Moth	Larvae/Head[a] Head Moth
1986				
Sigco 432	May 21	July 25	212.2 a	7.4
	May 29	July 30	190.4 a	0.8
	June 5	Aug. 6	96.1 b	0.0
	June 16	Aug. 13	29.0 c	0.0
Sigco 455	May 21	Aug. 1	187.6 a	0.8
	May 29	Aug. 4	99.2 b	0.0
	June 5	Aug. 11	37.1 c	0.0
	June 16	Aug. 18	17.2 c	0.0
1987				
Sigco 432	April 24	July 7	2.9 f	0.9 e
	May 7	July 13	11.8 cde	5.0 cde
	May 20	July 21	16.4 bc	9.6 abc
	June 3	July 29	21.5 b	14.8 a
	June 15	Aug. 10	14.2 cd	0.1 e
Sigco 455	April 24	July 10	8.4 def	6.8 bcd
	May 7	July 17	13.2 cd	11.8 ab
	May 20	July 27	35.8 a	2.7 de
	June 3	Aug. 4	32.4 a	0.6 e
	June 15	Aug. 17	5.4 ef	0.1 e

[a]Means sharing the same letter do not differ significantly (DMRT).

Objective 2:

Determine the influence of planting date on sunflower seed weevil infestations.

Materials and Methods:

Sunflower date of planting plots were established in 1982 - 1987. In 1982 and 1983 two and four varieties, respectively, were planted about May 1, May 15, and June 1. Plots were four rows by 100 feet in size and replicated six times in a randomized complete block design. Plots in 1984 were planted on eight planting dates beginning on April 25. These plots were not replicated and therefore were not analyzed. Plots in 1985 were planted on eight planting dates beginning on May 1. These plots were replicated eight times. The plots established in 1986 and 1987 were described previously. Head samples were collected and hand harvested to obtain an estimate of seed weevil damage. The damage data from 1987 is still being collected.

Results:

Seed weevil infestation data are shown in Table 22. Significant differences between planting dates occurred in 1982 and 1983. Only slight seed weevil damage was detected for the May 1 plantings, and moderate damage occurred for the May 15 planting dates. The highest damage occurred in the June 1 plantings. The 1984-85 data show the same trends seen in 1982-83. Early and late planting dates showed the least amount of damage, and the middle to late May and the early June planting dates had the greatest amount of damage. The 1986 data show no significant differences indicating a relatively constant seed weevil damage risk for late May and June plantings. In most years differences existed between varieties. In several instances for the early May planting dates, the shorter season varieties, planted on the same date as the longer season varieties, showed less damage than the longer season varieties. This indicates the influence of planting date is determined by the period that the sunflowers are in bloom.

It appears that seed weevil damage potential is the greatest for the combination of planting dates and varieties that result in the sunflowers being in bloom after mid July. Flowers blooming after this time seem to have a relatively constant risk of seed weevil oviposition and damage. Sunflowers planted after mid June do have a reduced damage potential for seed weevils, but they also have an increased damage potential for frost. Growers desiring to reduce the risk of seed weevil damage, may have some success by planting short season sunflowers in early or mid May or regular maturity sunflowers in April and early May. The earlier the sunflowers are planted, the lower the risk of seed weevil damage. While seed weevil damage will not be eliminated by this practice, the potential for damage certainly should be reduced.

Table 22. Seed weevil infestations in the sunflower date of planting studies, 1982-1986.

	% Infested Seed[a]					
Variety	Sigco 432	Sigco 455	Sigco 894	Sokota 2057	Interstate 7101	PAG 102
Planting Date						
1982						
May 1	3 d		8 d	6 e	7 de	
May 15	20 c		21 bc	10 cde	12 cd	
June 1	29 b		39 a	28 b	27 b	
1983						
May 1	7 de		13 cd			
May 15	10 cde		15 c			
June 1	35 a		30 ab			
1984						
April 25	11					10
May 3	6					14
May 9	15					13
May 16	31					24
May 23	26					30
May 30	31					16
June 14	12					3
June 21	2					3
1985						
May 1	7	14				
May 8	11	17				
May 22	17	17				
May 28	16	15				
June 5	14	12				
June 11	15	19				
June 20	5	9				
June 25	6	7				
1986						
May 21	15	17				
May 29	22	16				
June 5	17	12				
June 16	22	23				

[a]Means sharing the same letter do not differ significantly (DMRT).

BARLEY AND RYE TESTING

D. L. Reeves

The Mississippi Valley Barley Nursery has been grown here the last four years. This is a regional test which is grown in several states and Canada. It consists primarily of experimental lines which will be considered for release as varieties. Most of the entries in this test were developed in either Minnesota or North Dakota. There were 20 entries in the test this year.

The rye yield test is grown at this station and three other locations in South Dakota. Ten entries were planted in the fall of 1986. Results of this test are in the following table.

Table 23. Rye yield test results.

Variety	Yield (bu/A)	TW (lb/bu)	Protein (%)
Chulipan	38	53.9	9.2
Cougar	37	51.2	14.4
Frederick	33	51.7	11.4
Musketeer	37	53.4	7.5
Prima	34	51.8	11.4
Puma	33	53.7	12.9
Rymin	36	53.4	9.6
SD x 73-19*	41	52.9	14.6
SD x 83-3*	38	53.6	13.6
SD x 84-2*	38	53.4	13.3
Mean	36	52.9	

*Experimental lines from SDSU. Two are semi-dwarfs.

These were grown on summer fallow but received no additional fertilizer. All had good winter survival.

OATS RESEARCH

D. L. Reeves

Lon Hall, the project's technician, in cooperation with the extension weed specialists, conducted a herbicide experiment with five varieties of oats and 16 different treatments. The treatments used five herbicides: 2,4-D amine, MCPA amine, MCPA ester, Bromoxynil, and Banvel. They were either applied alone or as a tank mix at different rates and at the 3-4 or 6-7 leaf stages. Selected data is presented in Table 24. All values reported are significantly lower than the untreated oats.

Table 24. Effect of herbicide treatments on oat yields, test weights, and lodging.

Herbicide	Rate	Leaf Stage	Yield	Test Wt.	Lodging Index
	(lb ai/A)		(bu/A)	(lbs/bu)	(0-9*)
untreated	--	--	85.9	31.7	0.06
2,4-D amine	0.5	3-4	72.4	30.6	2.04
2,4-D amine	0.75	3-4	67.4	29.9	2.42
2,4-D amine	1.0	3-4	71.9	30.2	3.14
Bromoxynil + MCPA ester	0.38 0.38	6-7	70.6	--	--
Banvel + MCPA amine	0.08 0.25	3-4	78.3	30.6	--
Banvel + MCPA amine	0.16 0.25	3-4	73.5	29.5	--
Banvel + MCPA amine	0.12 0.25	6-7	73.1	28.3	--

* 0 is no lodging.

Our results indicate farmers need to be certain their oats are sprayed at the proper rate and stage. The 2,4-D amine doesn't always cause lodging, but if lodging is present there will be much more when it is used.

Oat Breeding

We rely very heavily on this station for information on the potential grain quality of oats. Therefore, all of our selections are tested very early at this location. There were eight different tests which contained selections being tested with the possibility of being released as a variety. This year we had over 290 different entries tested here.

One regional test, the Uniform Midseason Oat Performance Nursery, is annually grown here. This test contains entries approaching release as a variety. This year there were 36 entries with three from South Dakota.

Some of our more promising advanced lines are included in the statewide Standard Variety Oat Trials conducted by J. J. Bonnemann. This year we had six experimental lines in that test. These are not reported in the published reports, but they do assist considerably in the evaluation of new selections.

FARMING SYSTEMS STUDIES, 1987

Principal Investigators:

Jim Smolik (Project Leader), Paul Fixen, Jim Gerwing, Bob Hall, Bob Kohl, Russel McKinney and Leon Wrage; Ag. Technician: Loyal Evjen

Cooperators:

George Buchenau, Fred Cholick, Tom Dobbs, Paul Evenson, Brad Farber, Kevin Kephart, Diane Rickerl and Don Taylor.

Objectives:

A. Measure yields and economic returns.

B. Determine influence of farming system on soils ability to supply plants with mineral nutrients.

C. Compare rates of soil erosion.

D. Measure beneficial and harmful arthropod populations and measure insect damage.

E. Compare populations of plant feeding, predaceous and microbial feeding nematodes.

F. Determine populations of fungi and bacteria, and measure mycorrhizal associations and soil fungistatic properties.

G. Determine effect of farming systems on earthworm populations.

H. Determine weed species present and densities.

I. Measure effect of farming systems on soil water contents.

The farming systems studies were established in 1985. With the exception of continuous no-till winter wheat the systems consist of three or four year rotations. We envision these as comparatively long-term studies (6 - 8 years) since the effects of rotations are best measured after completion of several cycles. The plots are relatively large scale (3000 sq. ft. in Study I and 2000 sq. ft. in Study II) in an attempt to minimize border effects. The systems and rotation schedules in Study I are: ALTERNATE (no synthetic fertilizer or pesticide and no moldboard plow), Oats/alfalfa - alfalfa - soybean - corn; CONVENTIONAL, corn - soybean - spring wheat; RIDGE-TILL, corn - soybean - spring wheat. The systems in Study II are: ALTERNATE, oats/clover - clover - soybean - spring wheat; CONVENTIONAL, soybean - spring wheat - barley; MINIMUM-TILL, soybean - spring wheat - barley; CONTINUOUS NO-TILL winter wheat.

Cultural Practices

Fertilizer and pesticide inputs in the conventional, ridge-till, min-till and winter wheat systems are based on current Plant Science Department recommendations. The cultural practice information for the various systems is listed in Tables 25-28. Alternate corn in Study I and alternate soybeans in both studies were rotary hoed twice, two and three weeks after planting. The alternate spring wheat in Study II was rotary hoed two weeks after planting.

Table 25. Cultural practice information - farming systems studies.

Study I	Planting date	Fertilizer N-P-K (lb/A)	Manure	Herbicide (Actual/A)	Hand weeding (hr/A)
Corn					
Alternate	May 12	--		--	--
Conventional	May 6	37-0-0		Lasso II, 7 lb. band	--
Ridge-till	May 6	37-0-0		Lasso II, 7 lb. band Banvel 1/2 pt.	--
Soybean					
Alternate	May 15	--			--
Conventional	May 14	--		Treflan 1 1/2 pt.	1.64
Ridge-till	May 13	--		Lasso II, 7 lb. band, Blazer 1 1/2pt.	1.39
Spring Wheat					
Conventional	April 15	77-0-0		Hoelon 2 pt. + Buctril 1 pt.	--
"Ridge"-till	April 15	77-0-0		Hoelon 2 pt. + Buctril 1 pt.	--
Oats/Alfalfa	April 16	--	2.51 T/A dry matter (equivalent to 104.9 - 28.1 - 176.7 lb/A N-P-K) Applied 2 Oct.	--	--
Alfalfa		--			--

NOTE: Seeding rates (lbs/A); Oats 48, Alfalfa 9.5, Spring Wheat 70; Corn 19,400 seeds/A, Soybean 150,000 seeds/A.

Table 26. Cultural practice information - farming systems studies.

Study I	Tillage: Pre-Plant	Tillage: Post-Plant
Corn		
Alternate	Field cultivate + harrow, disc 1X	Rotary hoe 2X and Cultivate 2X, fall disc
Conventional	Field cultivate + harrow	Cultivate 2X, fall disc
Ridge-till	--	Cultivate 2X, ridge at last cultivation
Soybean		
Alternate	Disc and field cultivate	Rotary hoe 2X and Cultivate 2X
Conventional	Disc 2X	Cultivate 2X
Ridge-till	--	Cultivate 2X
Spring Wheat		
Conventional	Field cultivate and harrow	Fall plow
"Ridge"-till	--	Fall chisel
Oats/Alfalfa	Field cultivate + harrow, disc 1X	--
Alfalfa	--	Subsurface sweep and chisel in Sept.

Note: The "ridge"-till spring wheat was seeded with a hoe-drill. All row crops in these studies are planted in 36" rows. Field packer was used after seeding Oats/Alfalfa.

In contrast to previous years ridges were not built after harvest of "ridge"-till spring wheat, and these plots were chisel plowed instead. We hope to improve weed control in ridge-till corn by building ridges at the second cultivation.

Table 27. Cultural practice information - farming systems studies.

Study II	Planting date	Fertilizer N-P-K (lb/A)	Herbicide (Actual/A)	Hand weeding (hr/A)
Spring Wheat				
Alternate	April 16	--	--	--
Conventional	April 15	108-0-0	Hoelon 2 pt + 1 pt. Buctril	--
Minimum-till	April 15	108-0-0	Hoelon 2 pt + 1 pt. Buctril	--
Soybean				
Alternate	May 15	--	--	2.47
Conventional	May 14	--	Treflan 1 1/2 pt	1.45
Minimum-till	May 14	--	Lasso 3 qt. Blazer 1 1/2pt	1.31
Barley				
Conventional	April 15	37-0-0	Bronate, 1 1/2 pt.	--
Minimum-till	April 29	77-0-0	Bronate, 1 1/2 pt.	--
Oats/Clover	April 16	--	--	--
Sweet Clover		--	--	--
No-Till Winter Wheat	Sept 1	108-0-0	Fall 1 pt Roundup + 1/2 pt 2,4-D	--

NOTE: Seeding rates (lbs/A); Oats 40, Sweet Clover 4.5, Red Clover 4.5, Spring Wheat 70, Barley 58, Soybean 150,000 seeds/A.

A 50:50 mix of sweet clover and red clover was used in 1987 in the alternate system. The clover weevil has been a problem on sweet clover in previous years, and we feel it has reduced stand vigor, which results in poorer weed competition in this treatment. Red clover is not attacked by this insect, and a mixture of the two clovers may result in a better stand.

Table 28. Cultural practice information - farming systems studies.

Study II	Tillage Pre-Plant	Tillage Post-Plant
Spring Wheat		
Alternate	Disc and field cultivate	Rotary hoe 1X, fall chisel
Conventional	Field cultivate 2X	Fall plow
Minimum-till	--	Fall chisel
Soybean		
Alternate	Disc and field cultivate	Rotary hoe 2X, Cultivate 2X
Conventional	Disc 2X	Cultivate 2X
Minimum-till	--	Cultivate 2X
Barley		
Conventional	Field cultivate 2X	Fall plow
Minimum-till	Field cultivate	Fall chisel
Oats/Clover	Disc and field cultivate	--
Sweet Clover	--	Fall chisel
No-Till Winter Wheat	--	--

NOTE: The min-till spring wheat and barley were seeded with a hoe-drill. The min-till soybeans were seeded with a ridge-till planter. A field packer was used after seeding Oats/Clover.

Small Grain Yields

1987 spring wheat yields were substantially lower in both Study I and II (Table 29) than those measured in 1986, apparently in response to the dry spring. In Study I yield of conventional spring wheat was significantly higher than "ridge"-till, however, there were no significant yield differences between systems in Study II (Table 29). Protein levels were significantly higher in conventional and minimum-till spring wheat compared to alternate, very likely due to the nitrogen applications. Continuous no-till winter wheat yields were nearly 20 bushels lower in 1987 compared to the previous year (Table 29). Downy brome has become an increasingly severe problem in this system, and unless appropriate herbicide treatments are available it probably will be discontinued in 1988.

Barley yields were also lower than in 1986 and minimum-till barley was significantly less than conventional (Table 29). The lower yield in minimum-till resulted from several factors. The preceding spring wheat crop left substantial amounts of residue, and coupled with ample early spring soil moisture interfered with the operation of the hoe drill. A field cultivator was subsequently used to incorporate some of the residue. The planting difficulties resulted in a two week delay in planting (April 29). This date is not late for barley in a normal year, however, the early, warm 1987 spring apparently resulted in an earlier than normal northward movement of the aphid vectors of barley yellow dwarf virus (BYDV). Both the conventional and min-till barley had significant amounts of BYDV, although infection levels were much higher in the min-till, which appeared to account for much of the yield difference between the two systems. Oat yields in Study I were similar to the previous year and were about 12 bu higher in Study Il (Table 29). Soil nutrients, particularly nitrogen, are quite low at this stage in the alternate rotation, and it is probable N was yield-limiting.

Table 29. Small grain yields, farming systems studies.

	Spring wheat var. Guard		
Study I	Yield (Bu/A)[a]	Test wt.	Protein %
Conventional	43.6*	57.8	14.9
"Ridge"-till	39.8	58.6	14.0
	Oats var. Moore		
	Yield (Bu/A)	Test wt.	Protein %
Oats/Alfalfa	59.9	37.6	13.9

-----continued-----

Table 29. (continued)

Study II — Spring wheat var. Guard

	Yield (Bu/A)	Test wt.	Protein %
Conventional	44.7	57.5	15.0
Alternate	44.2	58.5	13.6
Minimum-till	48.8	58.4	15.1
FLSD .05 =	n.s.	n.s.	0.6

Winter Wheat var. Siouxland

	Yield (Bu/A)	Test wt.	Protein %
Continuous, no-till winter wheat	33.8	55.9	13.4

Barley var. Robust

	Yield (Bu/A)	Test wt.	Protein %
Conventional	80.8*	43.7	12.9
Minimum-till	46.5	40.0	13.5

Oats var. Moore

	Yield (Bu/A)	Test wt.	Protein %
Oats/Clover	72.4	36.7	15.2

[a] Avg. of four replications. * Indicates significant increase at .05 level.

Row Crop Yields

Conventional and ridge-till corn yields were significantly higher than alternate (Table 30). A different hybrid (3953) was used in the alternate system. At both the NE Station and several other areas in eastern SD this hybrid was infected with significant amounts of common smut. This disease is not usually considered a serious problem, however, in this study approximately 37% of the plants were infected which resulted in a 11% yield loss. Hybrid 3953 is an early maturing hybrid, and was used in the alternate system because corn is planted later in this system following an additional shallow cultivation for weed control. Also, we felt that soil nutrient levels, particularly nitrogen, might be limiting in the establishment stages of the alternate rotation and perhaps better suited to a shorter season hybrid.

However, it appears N levels were adequate in the system in 1987 and in 1988 the same hybrid will be planted on the same date in all systems. The very good year for row crop development was reflected in the conventional and ridge-till corn yields which were 2-10 bu/A higher than in 1986.

Soybean yields in the alternate and conventional systems were significantly higher than ridge-till in Study I (Table 30). Early season weed pressure was greater in the ridge-till system which apparently reduced yield. There were no significant differences in soybean yields in Study II. Soybean yields over both studies were 2-5 bu/A higher in most instances than those measured in 1986.

Table 30. Row crop yields - farming systems studies.

Study I	Corn - Pioneer Hybrid 3906
	Yield (Bu/A) No. 2
Conventional	124.4[a]
Ridge-till	121.4
Alternate (Pioneer Hybrid 3953)[b]	86.9
FLSD .05 =	12.3
	Soybeans - Simpson
	Yield (Bu/A) 13% Moisture
Conventional	31.0
Ridge-till	28.5
Alternate	31.6
FLSD .05 =	2.5
	Soybeans - Simpson
Study II	
Conventional	32.8
Minimum-till	31.6
Alternate	33.2
FLSD .05 =	n.s.

[a] Avg of four replications.
[b] Hybrid 3953 was heavily infected with common smut in this study (approx. 37% of plants smutted), which resulted in a yield loss of 11% in 3953.

Forage Yields

Alfalfa yields were good (Table 31), but were substantially less than the previous higher precipitation year. However, sweet clover yields were higher than in 1986, apparently due to the vigorous stand established in the preceding high moisture year. Sweet clover forage is not removed after mowing since the purpose of this crop is to improve soil nutrient levels and tilth. Both of the forage crops also aid in control of weeds and soil erosion.

Table 31. Forage crop yields - farming systems studies.

Study I	1st Cutting (June 4)	2nd Cutting (July 6)	3rd Cutting (Aug 10)	Total (T/A) Dry Matter
Alfalfa - Vernal	1.90	1.20	1.35	4.45
Study II				
Sweet Clover[b]	2.40			2.40

[a] Avg of four replications.
[b] Forage not removed.

Tissue analysis (% N-P-K):		
Alfalfa	1st cutting,	3.40-0.24-2.60
	2nd cutting,	3.79-0.21-1.56
	3rd cutting,	3.41-0.23-2.22
Sweet Clover		2.79-0.21-2.15

The incidence of a potential root rotting fungus (Fusarium) on soybean roots was lower than in 1986. However, incidence was significantly higher in the conventional system compared to alternate and ridge-till in Study I (Table 32). This fungus is often associated with corn residue which may account for generally higher infection levels in Study I compared to Study II. Also, trifluralin (Treflan) has been reported to increase infection levels in soybean which, combined with corn residues, may have resulted in higher incidence in the conventional system.

Table 32. Incidence of Fusarium on roots of soybean-farming systems studies.

Study I	Primary Root	Secondaries	Study II	Primary Root	Secondaries
Alternate	4.8[a]	15	Alternate	0	1.3
Conventional	2.5	29	Conventional	0	0.5
Ridge-Till	4.0	12	Min-Till	0	2.3
$FLSD_{.05}$ =	n.s.	16		n.s.	n.s.

[a] Percent of roots with lesions - Average of 4 reps. Data collected by Colette Beaupre, Plant Science Department.

Weed Populations

Numbers of grassy weeds were much higher in ridge-till corn compared to alternate and conventional (Table 33). Although similar at-planting herbicide treatments were used in both the conventional and ridge-till systems, the higher levels of surface residue in the ridge-till system coupled with the dry spring apparently reduced herbicide effectiveness. Grassy weed numbers were higher in conventional and ridge-till soybeans compared to alternate (Table 33). This also occurred in 1986 and provides evidence of the effectiveness of the alternate rotation, when combined with cultivation, in control of weeds without use of herbicides. As noted in Table 25 there was no hand-weeding in the alternate soybeans in Study I in 1987. There was little difference in numbers of annual broadleaves between the systems in either corn or soybeans. In Study II grassy weed numbers in soybeans were lowest in the conventional system (Table 34). In spring wheat grassy weed numbers were lowest in both conventional and minimum-till compared to alternate.

When weed numbers are averaged over all crops within a system the lowest number of grassy weeds occurred in the alternate system in Study I (Table 33), while numbers of annual broadleaves were highest. In Study II the lowest numbers of both grasses and broadleaves occurred in the conventional system (Table 34). In interpreting the weed count data it should be noted that weed counts were obtained just after small grain harvest and shortly before post-harvest tillage. Perennial grasses and broadleaves have not been a problem in either study to date.

Table 33. Weed populations - farming systems studies.

Study I	Alternate	Conventional	Ridge-till
Corn			
Annual grasses	11[a]	6	46
Annual broadleaves	5	6	3
Soybeans			
Annual grasses	6	18	14
Annual broadleaves	2	2	1
	Alternate	Conventional	Ridge-Till
Spring Wheat			
Annual grasses	--	8	13
Annual broadleaves	--	4	1
Oats/Alfalfa			
Annual grasses	10		
Annual broadleaves	4		

-----continued-----

Table 33. (continued)

Alfalfa			
Annual grasses	8		
Annual broadleaves	10		
System Average			
Annual grasses	9	11	24
Annual broadleaves	5	4	2

[a] Number/3 sq ft - avg. of four replications - green and yellow foxtail dominant grasses. Dandelion, pigweed and smartweed were most common broadleaves. Sampled July 30.

Table 34. Weed populations - farming systems studies.

Study II	Alternate	Conventional	Minimum-till
Soybean			
Annual grasses	7[a]	2	7
Annual broadleaves	3	3	4
Spring Wheat			
Annual grasses	8	4	4
Annual broadleaves	6	8	9
Barley			
Annual grasses	--	3	14
Annual broadleaves	--	2	4
Oats Clover			
Annual grasses	18		
Annual broadleaves	3		
Sweet Clover			
Annual grasses	20		
Annual broadleaves	28		
Continuous No-Till Winter Wheat			
Annual grasses			2
Annual broadleaves			23
System Average (excluding winter wheat)			
Annual grasses	13	3	8
Annual broadleaves	10	4	6

[a] Numbers/3 sq ft - avg of four replications, green and yellow foxtail dominant grasses. Oxalis, dandelion, pigweed and smartweed were most common broadleaves. Sampled July 30.

Soil Test Results

Phosphorus (P) soil test results show that P levels are dropping at an unusually high rate of 16-19% each year in both farming system studies (Tables 35 and 36). This is occurring across all systems and an equilibrium level has not yet been reached. These soils have now moved into P deficient regions and indicate the need to add phosphorus in conventional, ridge-till, and minimum till systems.

Phosphorus levels in Study II in the fall of 1985 were higher following soybeans in all systems (Table 36). This same effect occurred in the ridge-till system in Study I (Table 35). Corn and soybean plots in the conventional and alternative systems in Study I showed higher levels of soil P than those following spring wheat or oats and alfalfa in 1985.

Samples taken in the fall of 1987 show elevated P levels following soybeans in the alternate system of Study II. Conventional and ridge-till plots have all had soybeans on them (gone through rotation once) which may have balanced out initial differences. Soil test P levels in the alfalfa plots of Study I are elevated due to manure addition after oats in 1986.

Organic matter (O.M.) levels in Study I were not different between spring and fall 1985 in any system (Table 35). There were also no differences in the alternate system in 1987. However, the ridge-till corn and soybean plots had significantly higher O.M. levels than those following spring wheat in the fall of 1987. Conventional tilled soybeans were also higher in O.M. than spring wheat plots in both the spring and fall of 1987. No significant differences in O.M. levels were found in Study II (Table 36).

Table 35. Soil test phosphorus and organic matter in Study I, 1985-1987.

		Phosphorus				Organic Matter			
		1985		1987		1985		1987	
System	Crop	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
		ppm				%			
ALT.	oats/alfalfa	30	21#	14	16	3.9	3.7	3.4	4.0
	alfalfa	30	21	21	20	3.9	3.7	3.5	3.8
	soybeans	30	24	16	15	3.9	3.7	3.3	3.9
	corn	30	29	18	16	3.9	3.9	3.5	3.8
	Avg.	30	24	17	17	3.9	3.8	3.4	3.9
CORN	corn	30	30	19	21	3.9	3.7	3.4	3.8
	soybeans	30	30	18	19	3.9	3.6	3.7	3.9
	wheat	30	23	19	22	3.9	3.7	3.4	3.6
	Avg.	30	28	19	21	3.9	3.7	3.5	3.8

-----continued-----

Table 35. (continued)

R.T.	corn	30	19	23	17	3.9	3.5	3.8	4.2
	soybeans	30	30	18	15	3.9	3.9	3.9	4.0
	wheat	30	21	14	12	3.9	3.7	3.6	3.5
	Avg.	30	23	18	15	3.9	3.7	3.8	3.9
	FLSD .10	--	7	5	5	--	NS	0.3	0.3
	CV %	--	25	23	23	--	6	7	6

\# Manure P_2O_5 applied, oats/alfalfa: 1985 24 lbs/A
(after sampling) 1986 30 lbs/A
1987 64 lbs/A

Soil sampling dates: 4/1/85, 9/17/85, 4/15/87, 9/21/87.

Table 36. Soil test phosphorus and organic matter in Study II, 1985-1987.

		Phosphorus				Organic Matter			
		1985		1987		1985		1987	
System	Crop	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
		ppm				%			
CONV.	soybean	34	26	18	14	4.0	4.0	4.0	3.9
	sp. wheat	34	22	21	15	4.0	4.0	3.9	3.9
	barley	34	20	17	12	4.0	3.9	3.8	3.6
	Avg.	34	23	19	14	4.0	4.0	3.9	3.8
MIN.	soybean	34	26	17	13	4.0	4.0	3.9	4.3
	sp. wheat	34	22	19	14	4.0	3.9	4.3	4.0
	barley	34	23	17	12	4.0	3.9	3.8	4.1
	Avg.	34	24	18	13	4.0	3.9	4.0	4.1
ALT.	oats/s. clover	34	21#	22	14	4.0	4.0	3.9	4.0
	s. clover	34	21	20	14	4.0	3.8	4.0	4.1
	soybean	34	27	27	20	4.0	4.0	4.0	4.1
	sp. wheat	34	27	19	12	4.0	3.8	4.0	3.8
	Avg.	34	23	22	15	4.0	3.9	4.0	4.0
CONT.	w. wheat	34	26	21	17	4.0	4.0	4.0	4.0
	FLSD .10	--	3	--	4	--	NS	--	NS
	CV %	--	12	--	20	--	5	--	9

\# Manure P_2O_5 applied to 1985 oats/sw clover after sampling = 24 lbs/A

Soil sampling dates: 4/1/85, 9/18/85, 5/4/87, 10/1/87.

Soil nitrate values and applied nitrogen rates for Study I are found in Table 37. These data indicate that the highest soil NO_3 levels in the fall of 1987 occurred following spring wheat in the conventional system. This is not unusual since there is a longer period of time after wheat harvest for mineralization of N to occur than after other crops. There is, however, about 30 pounds difference between the conventional and "ridge-till" wheat in Study I. In Study II (Table 38), all crops in the conventional system were nearly 30 pounds higher in soil nitrate than the respective crops in the minimum till system. Decreased nitrate levels under reduced tillage compared to plowed systems has been observed in several other studies in South Dakota and elsewhere. Generally, soil nitrate levels have been higher in the fall following wheat than either barley or soybeans. This occurred in both fall 1985 and fall 1987 samplings. Nitrate levels in Study II for the fall 1987 were much higher than expected considering the N applied and yield levels attained by the crops. The reader is reminded that these systems are not yet fully established and caution should be exercised in applying the data.

Table 37. Soil and applied N in Study I, 1985-1987.

		Soil NO_3-				Applied N					
		1985		1987		Fertilizer			Manure		
System	Crop	Spring#	Fall	Spring	Fall	85	86	87	85	86	87
		-------lbs/A 2'---------				---------lbs/A----------					
ALT.	Oats/alfalfa	18	13	76	9	0	0	0	44	33	105
	Alfalfa	18	14	60	38	0	0	0	0	0	0
	Soybeans	18	18	111	23	0	0	0	0	0	0
	Corn	18	15	77	21	0	0	0	0	0	0
CONV.	Corn	18	33	95	14	110	110	37	0	0	0
	Soybeans	18	21	84	24	0	0	0	0	0	0
	Wheat	18	18	86	56	110	90	77	0	0	0
R.T.	Corn	18	22*	90	13	110	110	37	0	0	0
	Soybeans	18	21	94	19	0	0	0	0	0	0
	Wheat	18	17	72	21	110	90	77	0	0	0
	FLSD .10	--	6	NS	8						
	CV %		25	32	28						

0-6" only.
* Plot 40 excluded
Soil Sampling dates: 4/1/85, 9/17/85, 4/15/87, 9/21/87.

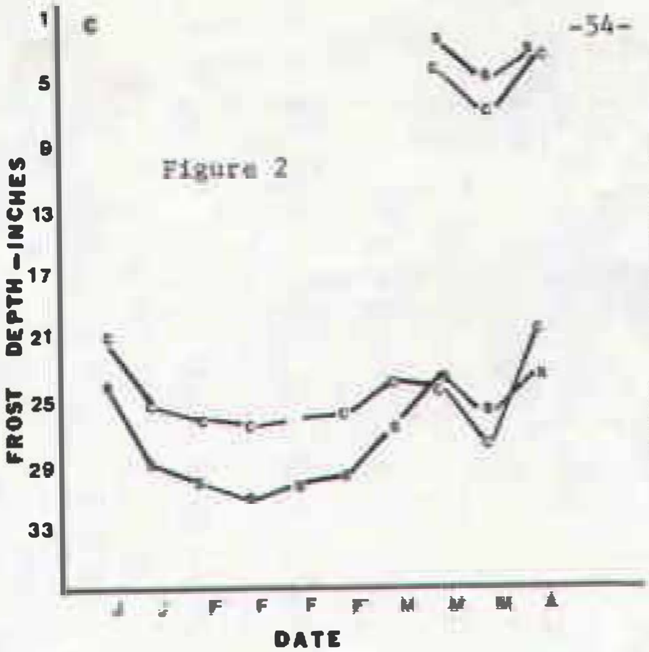
Table 38. Soil and applied N in Study II, 1985-1987.

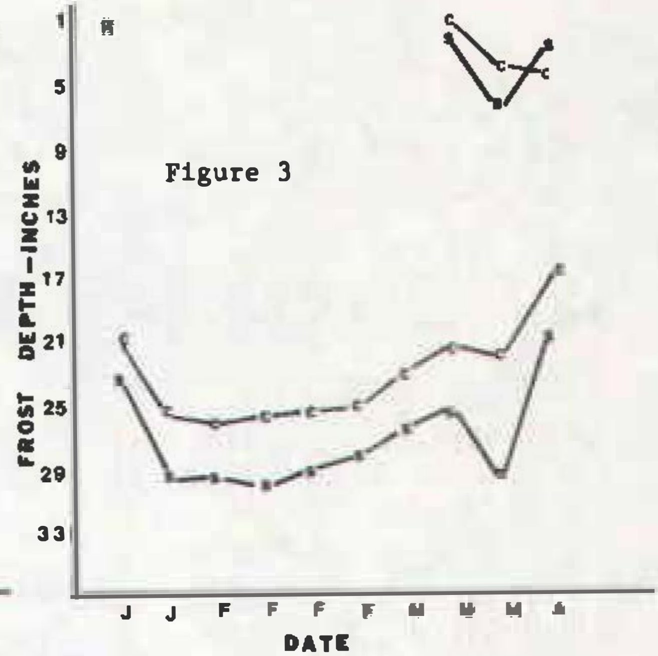
		Soil NO_3-N				Applied N					
		1985		1987		Fertilizer			Manure		
System	Crop	Spring#	Fall	Spring	Fall	85	86	87	85	86	87
		-------lbs/A 2'---------				----------lbs/A----------					
CONV.	Soybean	31	17	72	73	0	0	0	0	0	0
	Sp. wheat	31	55	51	138	110	90	108	0	0	0
	Barley	31	30	73	107	110	70	37	0	0	0
MIN.	Soybean	31	17	42	48	0	0	0	0	0	0
	Sp. wheat	31	44	47	102	110	90	108	0	0	0
	Barley	31	33	44	76	110	70	77	0	0	0
ALT.	Oats/s. clov.	31	18	47	52	0	0	0	44	0	0
	S. clover	31	19	25	99	0	0	0	0	0	0
	Soybean	31	18	100	61	0	0	0	0	0	0
	Sp. wheat	31	21	64	53	0	0	0	0	0	0
CONT.	W. wheat	31	63	46	81	110	90	108	0	0	0
	FLSD .10	--	19	--	29						
	CV %	--	53	--	29						

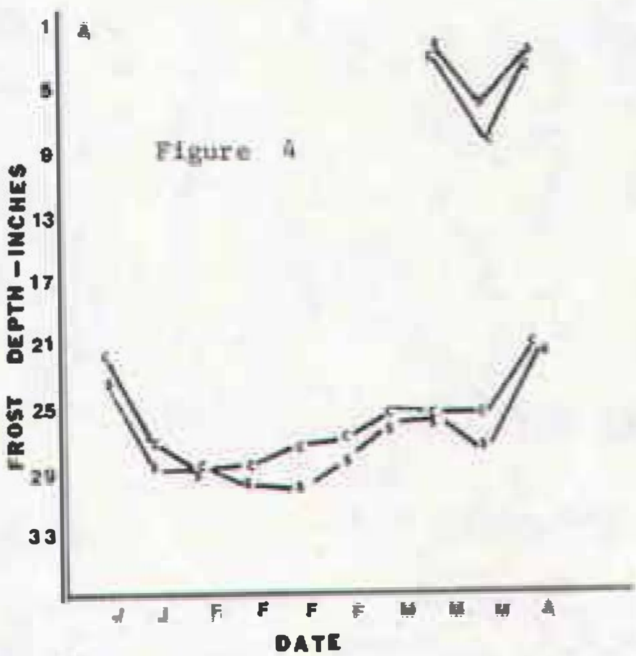
\# 0-6" only.
Soil Sampling dates: 4/1/85, 9/18/85, 5/4/87, 10/1/87.

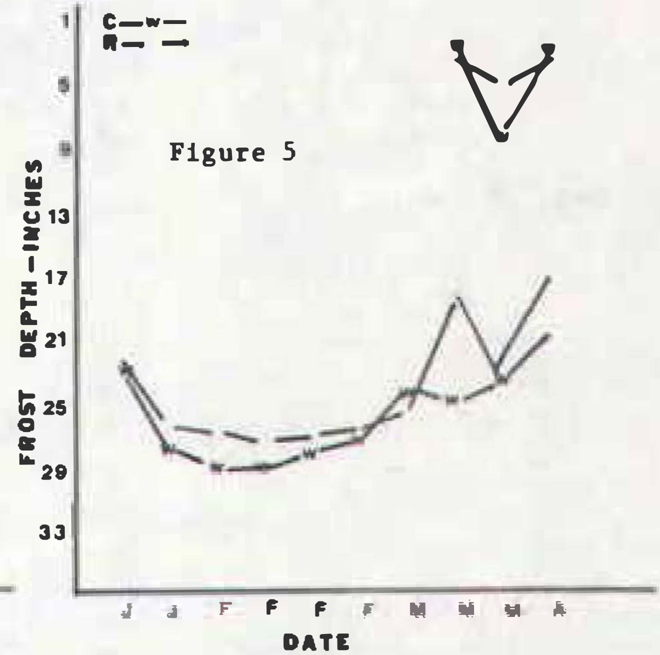
Soil Temperature, Moisture and Bulk Density

Soil frost depth during the 1986 - 87 winter, with no snow cover, was deepest in mid-February, and began to thaw in mid-March (Figures 2-6). In the conventional and ridge-till systems frost was deeper in soybeans soils compared to corn (Figures 2 and 3). In the alternate system there was little difference between row crops, but oat/alfalfa soils froze less deeply than other treatments (Figures 4 and 6). Frost depth in alfalfa was very similar to spring wheat, which was between the row-crop depths.









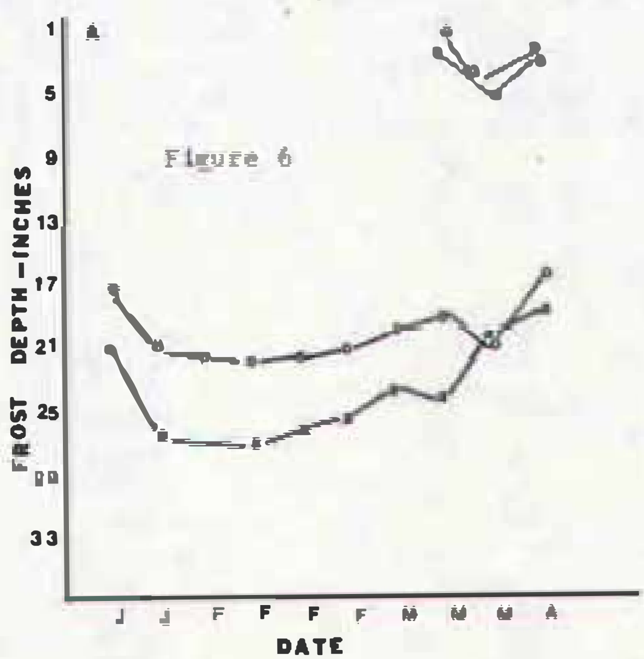


Fig. 2. Frost depth in conventional corn and soybean.

Fig. 3. Frost depth in ridge-till corn and soybean.

Fig. 4. Frost depth in alternate corn and soybean.

Fig. 5. Frost depth in conventional &"ridge"-till spring wheat.

Fig. 6. Frost depth in oats/ alfalfa and alfalfa.

At the time of spring wheat planting, soil physical properties were influenced by crop residue and tillage (Table 39). In the alternate system, oat/alfalfa residue kept soils cool, damp and dense. Soybean residue was lighter than corn residue and allowed soils, which had frozen deeply, to warm and dry rapidly in both the alternate and conventional system. The ridges formed in corn and wheat stubble were dryer than those in soybean and there was a difference between the ridge and furrow measurements.

Table 39. Effect of previous crop on various soil properties in Study I[a].

	Soil properties								
	Temperature			Moisture			Bulk density		
System:	Alt	Conv	Ridge	Alt	Conv	Ridge	Alt	Conv	Ridge
Previous Crop	^{o}F			%			g/cc		
Corn	62.6[b]	59.0	61.2/59.0[c]	24.4[d]	25.2	17.4	1.65[d]	1.48	1.33
Soybean	62.6	61.7	67.1/59.0	13.6	20.4	23.2	1.39	1.60	1.36
Wheat	--	68.9	62.9/54.5	--	20.6	16.9	--	1.04	1.21
Oat/Alfalfa	50.9	--	--	30.3	--	--	1.46	--	--
Alfalfa	59.9	--	--	24.9	--	--	1.07	--	--

[a] Sampled April 16, 1987.
[b] Avg of four replications, temperature at 6".
[c] Ridge/Furrow temperatures.
[d] 0 - 6" depth.

By mid-July, differences in soil physical properties reflected the seasons crop rather than the previous crop residue (Table 40). Soil temperatures in the soybean plots were cooler and drier than corn. Spring wheat soils were generally drier and warmer than row-crop soils. Little difference was seen among mid-season bulk densities.

Table 40. Effect of cropping system on various soil properties in Study I[a].

Soil Properties:	Temperature			Moisture			Bulk density		
System:	Alt	Conv	Ridge	Alt	Conv	Ridge	Alt	Conv	Ridge
Crop	^{o}F			%			g/cc		
Corn	75.5[b]	76.0	78.0	22.6[c]	24.6	23.0	1.30[c]	1.30	1.28
Soybean	73.0	72.8	73.5	21.1	23.6	21.5	1.21	1.36	1.36
Wheat	--	77.2	77.5	--	20.4	19.5	--	1.21	1.31
Oat/Alfalfa	76.5	--	--	20.9	--	--	1.33	--	--
Alfalfa	73.2	--	--	22.7	--	--	1.38	--	--

[a] Sampled July 6, 1987.
[b] Avg of four replications, temperature at 6".
[c] 0 - 6" depth.

Fall residue was measured after tillage treatments. There were three levels of residue (Table 41). Alfalfa and conventional spring wheat, which had been more heavily tilled, averaged 28.5%. Spring wheat (ridge) and oats/alfalfa (alternate) averaged 95% residue cover. All other treatments averaged 67.7%, ranging from 61 to 78%.

Table 41. Fall residue in farming systems in Study I.

Crop	System Alternate	Conventional	Ridge-till
Corn	61[a]	66	66
Soybeans	66	78	69
Spring Wheat	--	26	91
Oats/Alfalfa	99	--	--
Alfalfa	31	--	--

[a] Percent of residue cover after fall tillage. Measured November 20, 1987. Average of four replications.

Fall soil moisture was higher in the 0 - 6" increment in the alternate row-crops than the conventional or ridge-till row crops (Table 42) soil moisture decreased with depth with the exception of alfalfa which had been undercut and spring wheat which had been plowed. In general, soil moisture levels are very low in the 24 - 48" depth, and indicate the need for adequate spring precipitation.

Table 42. Fall soil moisture to a depth of four feet in Study 1.

Crop	Depth inches	Alternate	System Conventional %[a]	Ridge-till
Corn	0 - 6	16.5	13.6	16.0
	6 - 24	14.3	11.1	14.2
	24 - 48	10.6	9.1	8.5
Soybeans	0 - 6	17.0	15.8	16.6
	6 - 24	14.6	15.6	16.2
	24 - 48	10.5	10.7	12.1
Spring Wheat	0 - 6	--	15.4	11.9
	6 - 24	--	13.8	13.6
	24 - 48	--	19.2	10.0
Oats/Alfalfa	0 - 6	13.3	--	--
	6 - 24	13.7	--	--
	24 - 48	8.9	--	--
Alfalfa	0 - 6	12.2	--	--
	6 - 24	18.0	--	--
	24 - 48	9.8	--	--

[a] Percent soil moisture (gravimetric) on October 13, average of four replications.

In Study II the highest percent soil moisture in early August in the upper foot of soil occurred in continuous no-till winter wheat (Table 43). Soil moisture was also comparatively high in the 12 - 24" depth under mowed sweet clover. In spring wheat percent soil moisture in the 0 - 12" depth was highest in alternate followed by conventional and min-till.

Table 43. Soil moisture in farming systems Study II.

Crop	Depth (inches)	Alternate	System Conventional	Min-till
Spring Wheat	0 - 12	15.6[a]	13.5	11.3
	12 - 24	11.2	10.6	9.8
	24 - 36	10.0	8.0	7.2
	36 - 48	13.0	12.2	9.6
	48 - 60	15.7	14.3	13.7
Barley	0 - 12	--	16.7	15.7
	12 - 24	--	13.5	12.4
	24 - 36	--	8.8	10.3
	36 - 48	--	11.8	14.3
	48 - 60	--	14.8	14.7
Soybean	0 - 12	9.9	11.2	12.2
	12 - 24	7.8	10.8	11.9
	24 - 36	9.9	10.8	10.4
	36 - 48	11.9	9.8	12.0
	48 - 60	12.4	12.3	10.9

Depth (inches)	Oats/Clover	Sweet Cover	Continuous Winter Wheat
0 - 12	13.9	14.9	18.2
12 - 24	11.0	19.4	16.5
24 - 36	9.5	12.9	13.7
36 - 48	13.3	16.3	13.7
48 - 60	13.3	14.2	12.5

[a] Percent soil moisture (gravimetric), sampled August 5. Average of four replications, except soybean (non-replicated).

Nematodes and Earthworms

The highest population of dagger nematodes occurred in September on soybeans in the reduced tillage systems in both studies (Tables 44 and 45). Populations in ridge-till soybeans were quite high, and it is likely these populations reduced soybean yield in this system. Averaged over all crops in a system dagger nematode numbers were highest in the alternate systems in both studies. The lowest populations of dagger nematodes occurred in the conventional systems in both studies, possibly as a result of use of the moldboard plow. Lance nematode numbers were comparatively low in both studies. As has been noted in previous years populations of earthworms (Oligochaeta) generally declined over the growing season in both studies. At this point in the project it does not appear that any of the systems has a consistent effect on earthworm populations.

Table 44. Nematode and earthworm populations - farming systems studies.

Study I	Sampling date	Dagger	Lance	Earthworm
Corn				
Alternate	May	36[a]	3	21
	September	354	13	6
Conventional	May	6	7	67
	September	8	27	2
Ridge-till	May	2	16	13
	September	97	12	3
Soybean				
Alternate	May	32	3	15
	September	119	4	15
Conventional	May	3	16	6
	September	27	5	12
Ridge-till	May	16	53	11
	September	781	22	11
Spring Wheat				
Conventional	May	1	2	37
	July	2	0	19
"Ridge"-till	May	4	2	50
	July	91	0	19
Oats/Alfalfa	May	6	3	54
	July	183	67	18
Alfalfa	May	77	47	6
	September	168	57	5

[a] Number/500 cc soil - Average of four replications.

Table 45. Nematode and earthworm populations, farming systems studies.

Study II	Sampling date	Dagger	Lance	Earthworm
Spring Wheat				
Alternate	May	78[a]	4	34
	July	93	3	27
Conventional	May	24	11	26
	July	32	13	40
Minimum-till	May	38	5	27
	July	57	11	19
Soybean				
Alternate	May	31	23	50
	September	185	1	2
Conventional	May	51	58	36
	September	76	79	9
Minimum-till	May	9	7	44
	September	243	14	12
Barley				
Conventional	May	5	2	46
	July	32	29	13
Minimum-till	May	73	1	40
	July	54	8	12
Oats/Clover	May	12	36	33
	July	98	157	12
Sweet Clover	May	85	14	15
	September	118	17	19
No-Till Winter Wheat	May	17	4	18
	July	58	36	22

[a] Number/500 cc soil - Average of four replications.

Populations of total plant feeding nematodes were generally highest in soybeans in all systems in Study I (Table 46). Populations were also quite high in oats overseeded to alfalfa. Pin nematodes were the dominant plant feeder in both of the above crops. In Study II plant feeding populations were generally lower with the exception of populations in September in minimum-till soybeans. It is probable that certain of the nematodes associated with soybeans in these studies are influencing yield, however, evaluation of these effects will require detailed greenhouse experiments. Populations of both predaceous and microbial feeding nematodes were generally high in all crops in both studies (Tables 46 and 47). Neither of these groups responded in a consistent manner to either tillage or seasonal effects.

Table 46. Plant feeding, predaceous and microbial feeding nematode populations, farming systems studies.

Study I	Sampling date	Plant Feeding	Predaceous	Microbial Feeding
Corn				
Alternate	May	218[a]	255	530
	September	608	393	998
Conventional	May	341	368	1242
	September	411	185	410
Ridge-till	May	69	296	725
	September	366	339	884
Soybean				
Alternate	May	456	621	1549
	September	1448	750	935
Conventional	May	528	354	575
	September	2685	493	823
Ridge-till	May	741	347	509
	September	1223	485	720
Spring Wheat				
Conventional	May	189	401	916
	July	191	284	872
"Ridge"-till	May	135	204	534
	July	923	436	1009
Oats/Alfalfa	May	594	697	1705
	July	2013	755	1437
Alfalfa	May	1443	472	738
	September	64	101	514

[a] Number/100 cc soil - Average of four replications.

Table 47. Plant feeding, predaceous and microbial feeding nematode populations, farming systems studies.

Study II	Sampling date	Plant Feeding	Predaceous	Microbial Feeding
Spring Wheat				
Alternate	May	627[a]	671	1264
	July	340	830	1122
Conventional	May	230	298	826
	July	99	239	609
Minimum-till	May	89	171	534
	July	76	197	605
Soybean				
Alternate	May	311	347	717
	September	792	493	751
Conventional	May	335	710	1043
	September	581	280	463
Minimum-till	May	144	380	793
	September	1687	501	687
Barley				
Conventional	May	224	404	898
	July	76	373	789
Minimum-till	May	448	364	1013
	July	94	189	576
Oats/Clover	May	351	718	1638
	July	673	583	1010
Sweet Clover	May	635	460	1021
	September	319	529	1355
Continuous No-Till Winter Wheat	May	148	396	913
	July	246	380	775

[a] Number/100 cc soil - Average of four replications.

Soil Microorganisms and Fungistasis

Tillage systems can affect crop yields through their influence on various soil microorganisms which either cause root disease, or which inhibit the growth of root disease agents thereby controlling these diseases 'biologically'. To establish a microbiological profile of the various tillage systems, the populations of selected genera of soil fungi were determined, and in addition, the soil samples were tested for their ability to suppress two diseases, common root rot of wheat, and root rot (seedling blight phase) of alfalfa.

All treatments were assayed in May, plots with small grain were sampled in late July and the remaining plots in September. In the May samples, few significant differences were obtained in populations of fungi belonging to Pythium or Fusarium species. Fluorescent Pseudomonas bacteria were higher under corn in the alternative system (Study I) than in other crops-tillage combinations. Table 48 is a sample of some of the data obtained from the microbial assays and Table 49 typifies the suppressiveness analysis. In the latter, specific crop-tillage treatments occasionally suppressed one or the other disease, but neither crop nor tillage system was consistently suppressive. Variation was high in these tests and we do not believe that the systems have stabilized.

Table 48. Effect of tillage on selected microbial populations in the AFS plots at Watertown in 1987.

Study	Tillage	1987 Crop	24 July Samples Pythium	Fusarium	FP*	28 Sept Samples Pythium	Fusarium
				CFU per gram of soil			
I	Alt	Soybean	--	--	--	308[a]	773[a]
	Alt	Corn	--	--	--	583[a]	1068[a]
	Alt	Oat/Alf	154	420	1420	--	--
	Alt	Alfalfa	--	--	--	338[a]	749[a]
	Conv	S. Wheat	130	500	1630	--	--
	Conv	Corn	--	--	--	585[a]	933[a]
	Conv	Soybean	--	--	--	548[a]	760[a]
	Ridge	S. Wheat	105	420	1310	--	--
	Ridge	Corn	--	--	--	518[a]	935[a]
	Ridge	Soybean	--	--	--	623[a]	943[a]
		$FLSD_{.05}$	33	NS	NS	(301)	(332)

-----continued-----

Table 48. (continued)

				CFU per gram of soil			
II	Conv	Barley	117	500	1810	--	--
	Conv	Soybean	--	--	--	265[b]	778[a]
	Conv	S. Wheat	127	460	500	--	--
	Min-til	Barley	134	400	3440	--	--
	Min-til	Soybean	--	--	--	378[ab]	603[a]
	Min-til	S. Wheat	122	360	1750	--	--
	Alt	Soybean	--	--	--	370[ab]	649[a]
	Alt	S. Wheat	180	500	4750	--	--
	Alt	Oat/Clo	134	460	560S.	--	--
	Alt	W. Wheat	136	330	2060	510[a]	805[a]
	Cont	W. Wheat	136	330	2060	--	--
		$FLSD_{.05}$	NS	NS	NS	(209)	(388)

* Multiply FP by 1000 to get original numbers.
[a] Selective media were not delimiting fluorescent pseudomonas on this run.

Table 49. Suppressiveness assays of soil samples taken in July, 1987.

			C. sativus assay		P. ultimum
Tillage	86 Crop	87 Crop	% emergence	% healthy	% stand
		Study I			
Alternate	Corn	Oat/Alfalfa	10a	31a	31a
Conventional	Soybean	Spring Wheat	11a	33a	32a
Ridge-till	Soybean	Spring Wheat	14a	5a	31a
		$LSD_{.10}$	9	32	23
		Study II			
Conventional	Sp. Wheat	Barley	19 c	54 b	45a
Conventional	Soybean	Spring Wheat	28abc	31ab	25ab
Minimum-Till	Sp. Wheat	Barley	38a	28ab	28ab
Minimum-Till	Soybean	Spring Wheat	34ab	23a	16 b
Alternate	Soybean	Spring Wheat	23 bc	30ab	30ab
Alternate	Sp. Wheat	Oat/S. Clover	24 bc	38ab	43a
Continuous	W. Wheat	W. Wheat	21 c	36ab	25ab
		$FLSD_{.05}$	12		
		$LSD_{.10}$	10	26	21

Highest numbers indicate most suppressiveness.

Arthropod Populations

In general, insects were not a problem in any of the farming system crops in 1987. Predaceous and plant feeding insect populations were highest in the alfalfa plots versus the other crops early in the season (Table 50). This trend continued throughout the growing season. Within the alfalfa a large increase in the number of ladybird beetles was noticed over the previous years. This trend follows that seen in other fields in the eastern part of South Dakota. Insect populations between system treatments showed very few differences within crops. This could be due to the timing in the system study (we have just completed one rotation), the size of the plots, and the general low pest population seen in the major crops in 1987.

Table 50. Arthropod populations in alfalfa, winter wheat, soybeans, and oats - farming systems studies.

	Plant Feeding				Predaceous			
Sampling Date:	5/87	6/87	7/87	8/87	5/87	6/87	7/87	8/87
Crop								
Alfalfa	41[a]	36	51	42	37	42	27	32
Winter Wheat	18[a]	12	NS	NS	5	3	NS	NS
Soybeans	NS	14[b]	19	12	NS	2	6	5
Oats	7[a]	NS	NS	NS	1	NS	NS	NS

[a] Number/100 sweeps, avg. of 4 reps. NS = Not sampled.
[b] Number/3 row ft., avg. of 5 spots per plot, avg. of 4 reps.

The predominant insects found in the alfalfa plots were alfalfa weevils and aphids as plant feeders and ladybird beetles and nabids as predators. Leafhoppers and aphids made up the plant feeding insects in the wheat and oat crops with ladybird beetles and nabids being the predominant predators. Grasshoppers were the predominant pest in the soybeans throughout the growing season, though little if any economic damage occurred, and carabids and nabids were the predominant predators.

Some differences were seen in the corn plots with the European corn borer. Corn borer populations were lower in the alternate system versus the other farming systems (Table 51).

Table 51. European corn borer populations.

	Alternate	Conventional	Ridge-till
No. of infested plants:	3[a]	8	8

[a] average number of plants infested per 10 plants examined. Sampling consisted of 10 plants examined in each of three areas/plot, a positive plant had one or more live corn borers in the plant or ear. The two edge rows were not sampled to alleviate some of the edge effect. Sampled 10/87.

ECONOMICS OF ALTERNATIVE FARMING SYSTEMS

Tom Dobbs and Mark Leddy

The Economics Department conducted research on the economics of alternative farming systems during 1987 under a companion research project (H-076). This work emphasized development of machinery cost estimates, crop enterprise cost and return budgets for the various rotation and tillage systems, and whole-farm analyses of the profitability of various systems.

Only three years of production data for the farming systems at the Northeast Research Station are available at this time. Due to transition effects and climatic variations, it is too soon to draw any firm conclusions from this set of crop trials. Production practices and yields will need to be monitored for several years.

Nevertheless, initial enterprise budgets have been estimated for the farming systems under examination. These budgets are based on a combination of experience to date, reviews of literature and historical data, and scientific judgement about what the "normalized" practices and yields for these systems might be over time. Detailed budgets and associated assumptions are contained in SDSU Economics Research Report 87-5, by Thomas Dobbs, Lyle Weiss, and Mark Leddy.

An overview of initial results of the economic analyses is shown in Tables 52 and 53. (Results for Continuous No Till winter wheat are not shown here because of major questions about the longer term viability of that system.) Yield assumptions are shown in Table 52. The following per-acre costs and returns are shown in Table 53: (1) direct costs other than labor; (2) gross income; (3) net income over all costs except land, labor, and management; (4) net income over all costs except land and management; and (5) net income over all costs except management. The last column of Table 53 shows whole farm net income over all costs except management for a hypothetical farm with 540 tillable acres in the Watertown, S.D. area. Costs and returns were based upon estimated 1987 input and product prices and participation in the 1987 Federal farm program for food and feed grains.

The results show the Alternative systems to have significantly lower "direct costs other than labor" than the other systems. All systems cover full costs (including land) when 1987 farm program provisions are in effect. The various net income figures for the Alternative system are \$5 to \$15/acre lower than those for the other systems in Farming Systems Study I and are nearly the same as those for the other systems in Study II. These results indicate that the Alternative systems provide definite opportunities to lower cash operating costs. In at least some situations, there may be little or no sacrifice of net income by adopting Alternative systems.

Table 52. "Normalized" Yield Summary.

STUDY I	Yield (bu. or ton)/Acre				
	Corn	Soybeans	S. Wheat	Oats	Alfalfa
Alternative	75	28		70	3.6
Conventional	82	30	42		
Ridge Till	84	31	42		

STUDY II	Yield (bu.)/Acre				
	Barley	Soybeans	S. Wheat	Oats	S. Clover
Alternative		27.5	40	70	Not harvested
Conventional	70	30	42		
Minimum Till	65	30	42		

Table 2. Results of Farming Systems Analyses Based upon "Normalized" Budgets.

	Dollars/Acre					
			---------Net Income Over---------			
	Direct Costs Other Than Labor	Gross Income	All Costs Except Land, Labor & Mgmt.	All Costs Except Land & Mgmt.	All Costs Except Mgmt.	Whole Farm, Net Income Over All Costs Except Management[2]
Study I[1]						
Alternative (oats/alf-alfalfa-soybeans-corn)	42	121	49	36	10	5,385
Conventional (corn-soybeans-s. wheat)	63	143	54	45	19	10,372
Ridge Till (corn-soybeans-s. wheat)	65	145	58	51	25	13,273
Study II						
Alternative (oats/clover-clover-soybeans-s. wheat)	30	96	41	31	5	2,767
Conventional (soybeans-s. wheat-barley)	57	124	40	30	4	2,126
Minimum Till (soybeans-s. wheat-barley)	61	122	38	30	4	2,234

1 Crops are shown in the order in which they occur in each rotation.
2 For farm with 540 tillable acres.

A M.S. thesis in Economics (by Mark Leddy) has recently been completed which explores the "sensitivity" of these preliminary results to several variables. Variables examined included: (1) fertilizer prices; (2) herbicide prices; (3) crop yields; (4) farm program target prices and other provisions; and (5) alfalfa hay prices. Detailed results are found in the thesis and will be reported elsewhere. Some of the findings are briefly reported here, however.

Alternative system yields would need to be about 8% higher than Conventional system yields in Farming Systems Study I--given 1987 farm program provisions--for the Alternative system to produce the same net return as the Conventional system. In Farming Systems Study II, on the other hand, the Alternative system would produce as much net return as the Conventional system even with yields 7-8% lower than the Conventional system. The fact that unharvested sweet clover acres in Study II's Alternative system qualify as farm program set-aside acres helps the profitability of that system significantly.

Elimination of the Federal farm program would reduce the profitability of all systems dramatically. All systems--including the Alternative systems--would still cover all costs other than for land and management if we assume market prices would be about 70% of the level of 1987 target prices for corn and small grains and 70% of the 1987 soybean market price. The relative effects on each farming system of selected farm program changes (such as changes in target price levels and set-aside requirements) vary with the type and magnitude of change.

Increases in the cost of petroleum based chemical inputs will enhance the relative profitability of Alternative farming systems. For example, approximately a 50% increase (above current levels) in the prices of fertilizer and herbicides would cause the net returns for Conventional and Ridge Till systems in Study I to fall to the level of net returns for the Alternative system (Figure 7).

Relative profitability of the various systems in Study I is also sensitive to assumed prices of alfalfa hay. Alfalfa hay is harvested 1 year in the 4-year Alternative system rotation in Study I. In the "baseline" analyses, alfalfa hay prices were set at $30/ton. However, when alfalfa prices are changed to $35/ton, the Alternative system becomes more profitable than the Conventional system; when alfalfa prices are increased to $40/ton, it also becomes more profitable than the Ridge Till system (see Figure 8; in this Figure, profit equals net cash farm income minus depreciation).

The effects of combining livestock operations with Alternative and other farming systems have also been examined in the economics research during 1987. Effects of cow-calf, wintering steer, and dairy operations on profitability, liquidity, forage utilization, labor requirements, and manure availability have been examined. Results of those analyses will also be reported elsewhere.

At this stage of the economics research on Alternative farming systems, it appears that such systems do offer sufficiently positive prospects to warrant not only continued, but broadened and more detailed, investigation.

Figure 7.

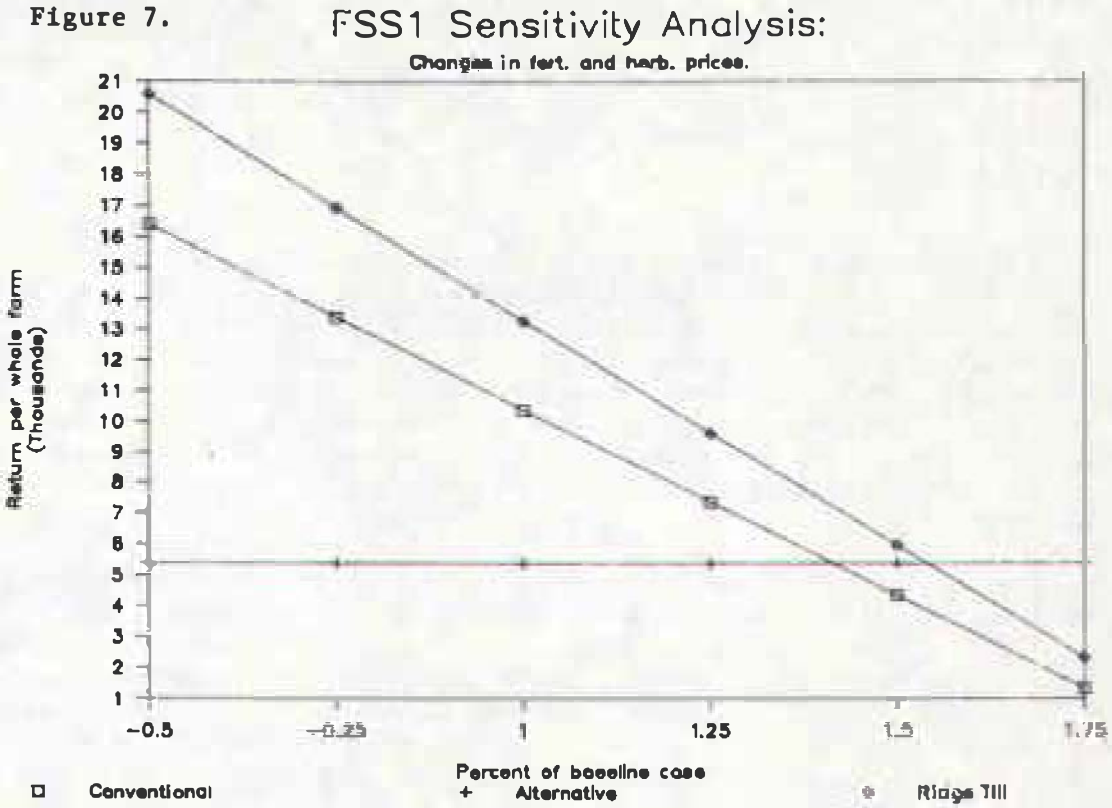


Figure 8.