1987 Research and Cropping Results

Fourth Annual Progress Report

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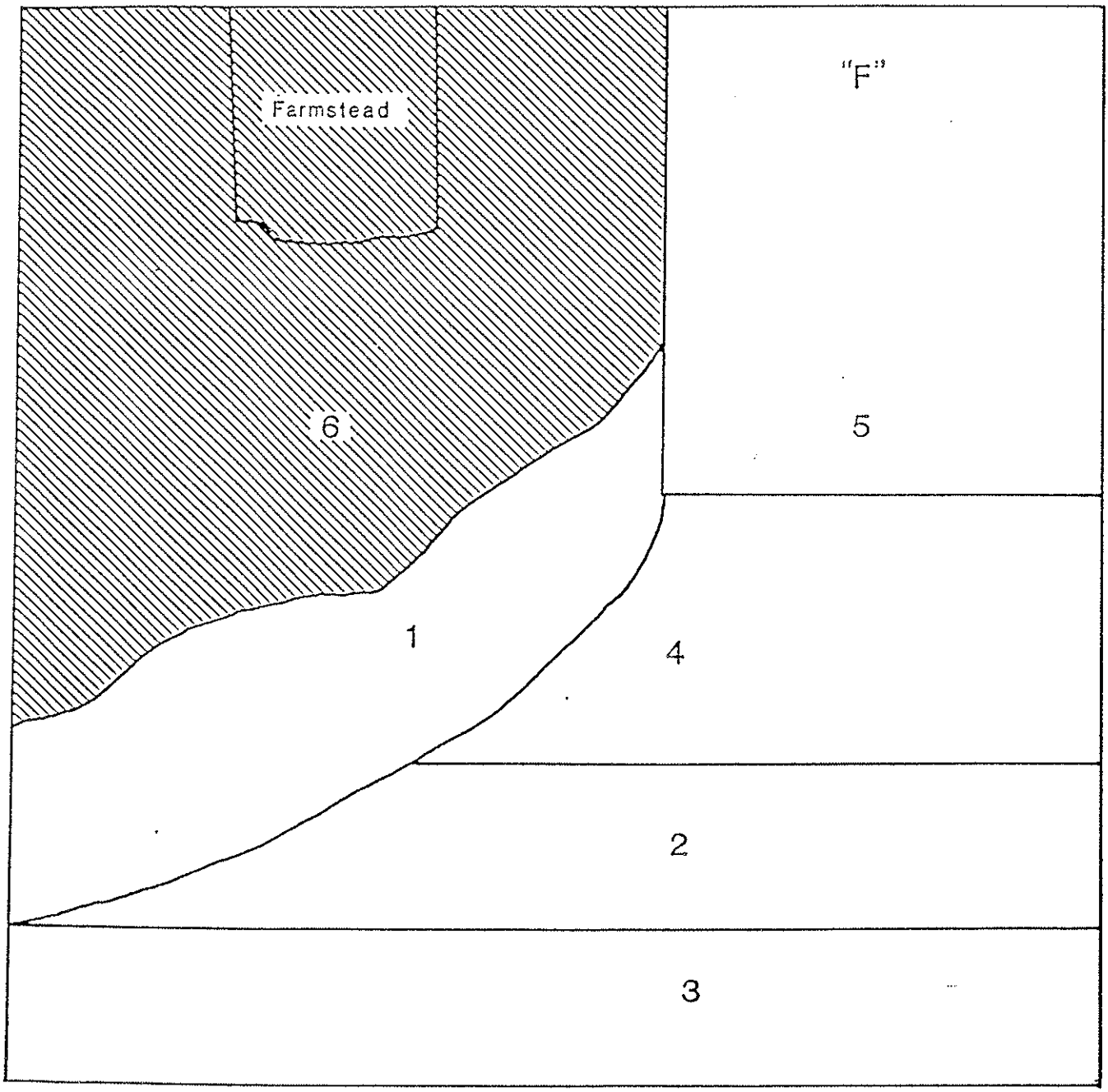
Contents Relate to Cooperative Agreement between
USDA-ARS and Area IV Soil Conservation Districts
represented by the Area IV SCD Research Advisory Committee

NW$\frac{1}{4}$ Sec 17



F. NW-1/4 Sec. 17 - Research Activities

F1. Conservation Bench Area - This area was dropped from the acreage being leased by the Area IV SCD beginning in 1987. Total acreage leased for USDA-ARS and AREA IV SCD Research Farm is now 382 acres.

F2. Field divided into 6 blocks of about 3 areas each with 2 blocks seeded to Waldron spring wheat, 2 blocks seeded to Butte 86 spring wheat and 2 blocks seeded to Bowman barley in 1986. Seeded 3 winter wheat varieties (Wanalta, Roughrider and Norstar) No-till into each standing spring grain stubble source from Waldron and Butte 86 spring wheat and Bowman barley September 26, 1986. This field was topdressed with 50 or 100 lb N/ac, April 28, 1987.

Grain yield of Winalta, Roughrider and Norstar winter wheat varieties as influenced by no-till seeding into standing stubble of spring barley (Bowman) and spring wheat (Butte-86 and Waldron) with 50 or 100 lbs of N/ac topdressed.

Stubble Source	N-Fert. added	Winter Wheat Variety			
		Winalta	Roughrider	Norstar	Avg.
	lb N/ac	- - - - - - - - - - bu/ac - - - - - - - - - -			
Bowman Barley	50	29.7	35.0	31.3	32.0
	100	34.0	37.2	32.1	34.4
	Avg.	31.9	36.1	31.7	33.2
Waldron Sp. Wheat	50	39.2	40.1	33.0	37.4
	100	39.2	37.3	39.4	38.6
	Avg.	39.2	38.7	36.2	38.0
Butte-86 Sp. Wheat	50	38.1	39.0	34.5	37.2
	100	34.8	41.3	33.1	36.4
	Avg.	36.5	40.2	33.8	36.8
Avg. (Varieties)		35.8	38.3	33.9	

Disease observations for No-Till Winter Wheat Grown in Different Types of Stubble in a No-Till Cropping System. (Joe Krupinsky)

In order to determine the effect of stubble on leaf spot diseases on wheat, wheat plants grown in barley and wheat stubble were monitored for leaf spot diseases during the 1987 growing season. Leaf damage was determined by rating individual wheat leaves for amount of necrotic leaf tissue. Fungi causing the leaf spot diseases were identified by microscopic examination of incubated diseased leaves. Three varieties of winter wheat (Roughrider, Norstar, and Winalta) were planted in barley (Bowman) and wheat stubble (Butte 86 and Waldron). Varieties differed in the amount of leaf spot damage. Norstar (23%) had less leaf spot diseases than Roughrider (30%) or Winolta (33%). Wheat grown on wheat stubble had a higher level of leaf damage (30% on Waldron stubble and 33% on Butte 86 stubble) than wheat grown on barley stubble (24% on Bowman stubble). In general it appears that the level of leaf spot diseases can be influenced by the type of stubble present. The studies will be continued in 1988.

F3. Winter wheat (varieties) were in this field in 1986. This field was undercut April 24, 1987 and TR-10 Treflan granules were applied in front of the undercutter at a rate of 1.0 lb ai/ac. The field was undercut again June 1, 1987 and sunflower (Sokota 4000) was seeded June 3, 1987 with the IH-800 cycle seeder and 40 lbs N/A side-banded. The field was harvested October 13, 1987 and seed yields averaged 1800 lb/ac.

F4. This field, previously in sunflower in 1986, was divided into 6 blocks of about 4 acres each and seeded 2-blocks each to Waldron spring wheat, Butte-86 spring wheat and Bowman spring barley. The field received a broadcast application of 30 lb N/a April 28, 1987. The field was undercut May 5, 1987 and all three spring grains (Waldron, Butte-86, and Bowman) were seeded later the same day (May 5, 1987) with 70 lbs/a of 18-46-0 with the seed. The Bowman barley yielded about 50 bu/ac and the Waldron and Butte-86 spring wheat blocks yielded about 30 bu/ac. Winter wheat varieties Winalta, Roughrider, and Norstar were no-till seeded (September 14-15, 1987) into each spring cereal stubble source (Bowman Barley and Waldron and Butte 86 Spring Wheat) in six blocks to provide Dr. Krupinsky the opportunity to study disease cycles in a cropping sequence where disease susceptible and disease-resistant varieties are grown in rotation in a no-till cropping system.

F5. ARS Land Lease

a. Spring Barley and Spring Wheat Variety Cooperative Study (Dr. Armand Bauer)

Variety	Plant Population	Heads	Height	Test Weight	Kernel Weight	Grain Yield	Kernels/ Spike [2/]
	no/m^2	no/m^2	inches	lbs/bu	mg	bu/ac	no.
1987 Barley Varieties							
Azure	142	377	31.0	49.2	34.9	74.2	30.3
Bowman [1/]	139	605	30.7	51.6	43.9	76.9	15.6
Hector [1/]	161	562	29.5	48.7	34.1	68.7	19.3
Morex	177	378	32.3	47.8	31.5	69.6	31.4
Robust	157	347	29.5	49.7	33.2	64.3	30.0
LSD	24	41	1.6	0.4	0.9	4.3	-
1987 Wheat Varieties							
Alex	162	516	33.1	59.5	29.1	36.6	16.4
Challenger	142	364	23.6	59.6	31.8	45.1	26.2
Cutless	166	509	28.7	59.2	28.4	36.2	16.8
Leif	130	372	29.9	60.1	33.0	48.3	26.4
Len	150	414	28.7	58.8	32.0	38.6	19.6
ND 618	157	477	29.9	59.6	27.8	43.1	21.8
Nordic	146	392	28.3	60.4	34.7	51.9	25.6
Wheaton	90	328	26.4	57.5	31.8	49.5	31.9
LSD	28	38	2.4	0.4	0.6	4.6	-

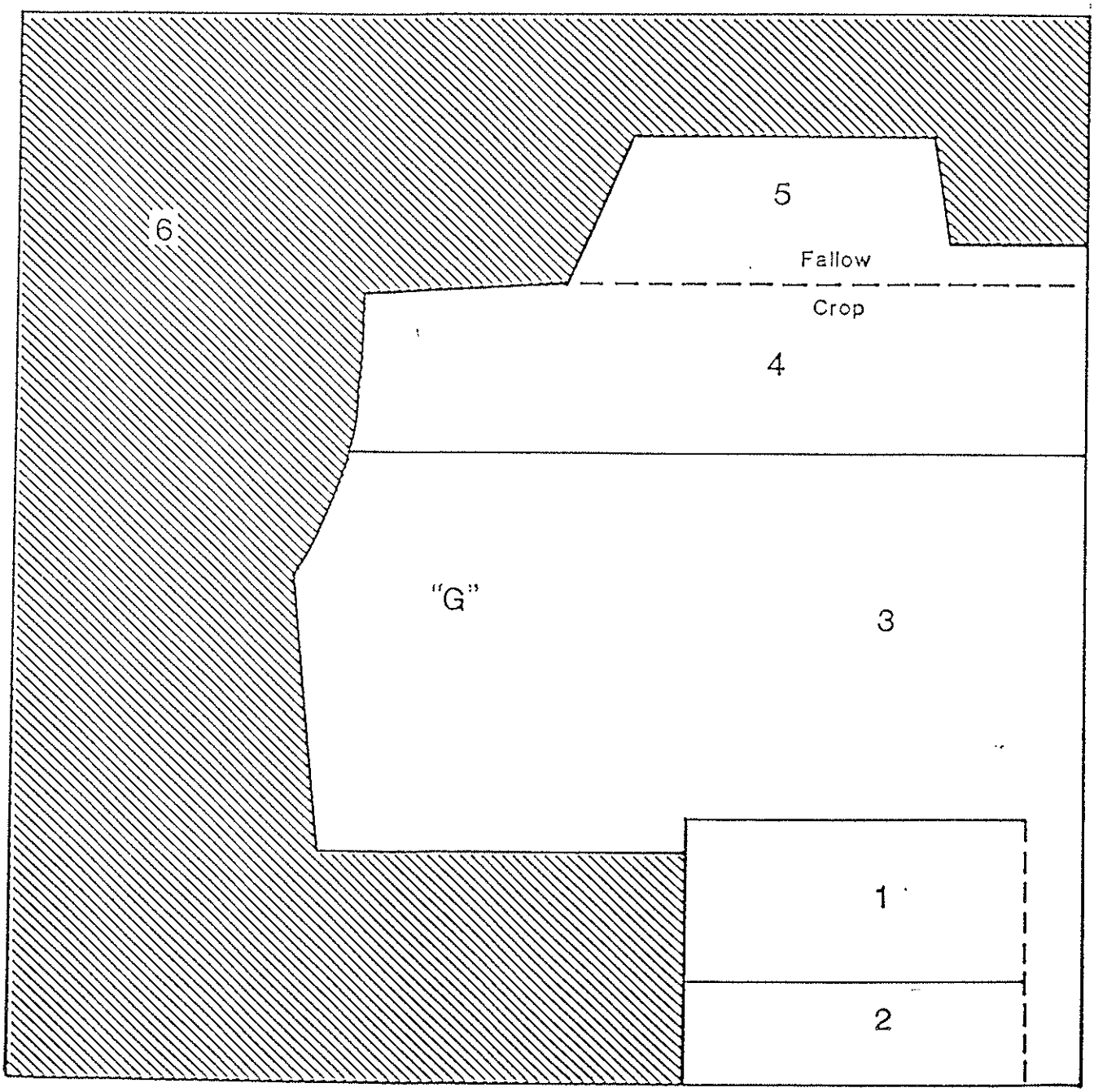
1/ Two-row barley; other are six-row
2/ Calculated from grain yield, kernel weight, and head population.

b. Wheat stubble heights, continuous cropping and summerfallow comparison of water storage and grain yields, average 1977-1987.

Treatment	Soil Water [1/] Overwinter Gain	Soil Water [1/] At Planting	Grain Yield [2/]
	inches to four feet		bu/ac
Short (2 inches)	2.55	3.68	27.9
Medium (8 inches)	3.00	4.00	29.5
Tall (14 inches)	3.96	4.89	29.4
Cont. Crop	3.03	4.18	27.5
Summerfallow	1.46	6.06	30.5

1/ Average of 10 years.
2/ Average of 9 years. Hailed out in 1980.

SW$\frac{1}{4}$ Sec 8



G. SW-1/4 Sec. 8 - Research Activities

G1. Populus Progeny Test - Dr. Richard Cunningham - Res. Geneticist
Dr. Joe Krupinsky - Plant Pathologist

During the period 1983 to 1985, 176 hybrid poplar and cottonwood clones were planted in this area to compare their survival, growth rate, cold hardiness and pest resistance. Similar field tests were established at several other sites throughout North Dakota. The following table compares the performance of these clones when averaged over all the sites. A clone, average for each trait, would score 300. Note that of all the clones currently produced by the nursery, only Robust is in the top ten. Imperial also performed well. Walker survived and grew well, but is susceptible to leaf diseases. Northwest, Siouxland and Brooks #2 all performed below average. Several NE hybrids and Walker progeny were the top performers.

PERFORMANCE OF POPLAR CLONES IN FIELD TESTS[1]

CLONE	NAME	SCORE[2]	SURV	HT	CD	FORM	CW	TERM	CANK	RUST
14384	Lydick	232.7	101.5	102.6	125.7	87.3	115.1	136.1	132.7	100.5
14066	Northwest	255.1	101.5	102.4	80.2	90.6	111.8	73.1	62.6	172.2
14057	Dacotah	279.3	102.3	124.3	80.2	91.3	129.3	78.9	86.6	124.1
14182	Brooks #2	279.5	103.4	102.1	69.7	96.2	104.6	50.9	68.9	167.5
14065	Siouxland	296.1	103.3	108.5	117.9	106.0	101.4	187.1	105.3	45.9
14036	Towner	307.9	101.5	113.9	111.0	107.6	104.1	160.0	94.8	67.0
14335	Platte	314.4	102.3	120.4	110.3	91.2	122.9	131.6	60.6	94.9
14306	Plains cottonwood	319.6	101.6	109.4	89.6	94.5	114.4	70.3	56.9	134.0
14178	Walker	342.6	102.7	114.5	70.3	127.9	88.3	56.6	90.2	137.7
14484	Smooth-bark cottonwood	360.0	103.2	47.8	79.2	127.2	39.6	65.8	60.6	131.4
14385	Ashford	363.8	101.0	120.9	98.7	108.2	111.1	99.4	98.6	55.8
14064	Norway	377.4	103.3	115.3	101.8	109.0	104.8	118.6	82.7	45.9
14046	Eurameriсana	391.3	103.3	86.1	113.1	106.0	80.7	56.3	82.7	97.6
14042	Russian poplar '	393.0	103.3	92.2	117.9	103.2	88.7	58.5	90.2	86.1
14353	NE-308 Hybrid	393.1	102.2	114.6	107.2	117.8	96.4	127.6	102.4	22.3
14386	Imperial	393.9	101.4	121.8	104.0	120.3	100.5	130.8	87.9	34.4
14299	Cathayana	394.3	103.3	83.8	82.4	113.0	73.4	51.6	71.4	91.8
14058	Robusta	397.5	104.7	122.9	105.4	113.0	107.3	124.3	94.0	23.0
14161	Italian Black poplar	398.1	94.0	101.6	134.8	108.0	93.6	112.2	98.7	25.8
14272	Morden Hybrid	401.7	103.3	131.3	93.7	126.1	103.4	65.1	75.2	109.0
14393	OP progeny of 'Walker'	402.1	103.2	114.6	46.2	166.8	63.6	65.8	60.6	138.7
14167	Serotina de Selys	415.5	104.0	110.6	130.5	123.1	87.9	120.4	52.6	91.8
14271	Morden Hybrid	419.5	102.7	113.7	103.4	127.2	87.9	72.7	75.2	91.8
14354	NE-380 Hybrid	447.4	101.6	106.6	125.4	140.7	76.6	114.2	113.8	22.3
14395	OP progeny of Walker	449.5	103.2	128.3	65.8	162.3	73.8	78.9	60.6	116.8
14280	Z#1 Hybrid	456.6	100.8	116.0	122.6	132.0	89.2	53.0	72.1	100.5
14415	NE-222 Hybrid	482.4	103.2	145.8	132.0	117.7	116.8	65.8	60.6	73.0

[1] Values are the percentage each clone's mean is of the overall plantation mean at each test site.

[2] Score = 300 + Survival + Height + Crown Density + Crown Form - Crown Width - # Terminals - Stem canker rating - Leaf rust & Leaf spot rating.

G2. Grass Breeding - Dr. Reed Barker

Crested Wheatgrass/Western Wheatgrass Populations

Crested wheatgrass and western wheatgrass spaced-plant nurseries were continued in 1987. Both species were first planted on Area IV land in 1984. The crested wheatgrass is an advanced population of elite breeding stock. About 400 plants were visually selected for high forage yield and freedom from diseases. These plants were intermated in the field in 1987 and the seed harvested for establishment of the third cycle of selection. The nursery was then destroyed. The western wheatgrass is an important population derived from western wheatgrass plants collected in 1977 from counties in western North Dakota and South Dakota. Abut 400 plants were selected and intermated in 1986. Progeny from these selections were established in 1987 for the third selection cycle during the next 3-years. The new nursery has over 1800 plants. Data on in vitro organic matter digestibility (IVOMD) of the 1986 selected plants were completed in 1987. (See following table.) Among 372 individuals, IVOMD ranged from 52 to 72% indicating adequate variability for selecting for this important forage characteristic. However, usable genetic variability may not be as great because within family differences were large. Maximum minus minimum family means ranged from 1.1 to 13.6%. Data collection and selection in both nurseries will continue in 1988.

Family means for in vitro organic mater digestibility (IVOMD) with families larger than 2.

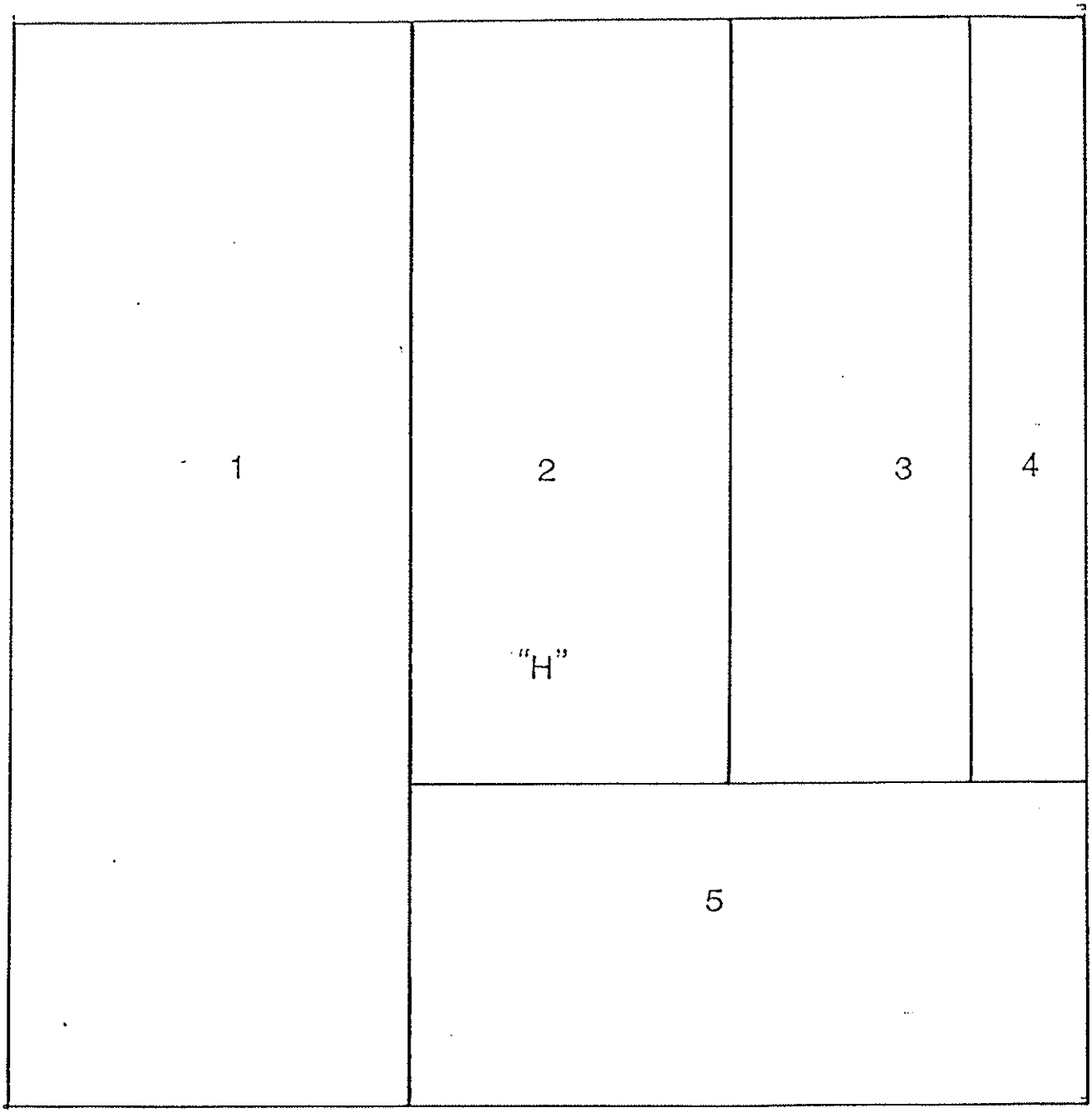
Family	Family size	Average	Minimum	Maximum	Range
301	3	61.8	61.2	62.3	1.1
240	3	62.3	61.4	63.5	2.1
333	3	58.9	57.2	59.9	2.7
92	3	61.2	59.9	62.7	2.8
34	3	59.4	58.1	60.9	2.8
223	3	61.7	60.6	63.6	3.0
208	3	62.3	60.3	63.5	3.2
368	3	57.4	55.1	58.6	3.5
68	4	61.3	59.7	63.5	3.8
95	3	62.1	60.3	64.2	3.9
280	3	63.0	60.0	65.0	5.0
94	4	63.4	60.4	66.4	6.0
218	3	61.9	59.8	65.8	6.0
56	3	58.8	56.7	62.8	6.1
13	3	60.9	58.4	64.6	6.2
118	4	63.5	60.5	66.9	6.4
306	3	62.6	59.2	65.7	6.3
186	3	60.3	56.9	63.7	6.8
19	3	61.7	57.9	64.8	7.0
69	3	64.2	59.6	66.8	7.2
336	3	59.0	56.0	63.8	7.3
70	3	64.0	58.9	66.8	7.9
110	3	62.4	58.1	66.2	8.1
272	3	58.8	54.9	63.2	8.3
130	3	62.0	57.2	65.5	8.3
304	3	63.4	58.8	68.2	9.4
225	3	60.8	54.6	64.3	9.7
331	3	58.8	53.7	65.7	12.0
318	4	64.0	55.8	68.1	12.3
84	3	64.6	58.3	70.8	12.5
322	5	62.8	55.6	68.7	13.1
209	3	63.6	56.3	69.9	13.6

G3. This field was in sunflower in 1986 which received severe straight-line wind damage (peak wind velocity estimated at 100 mph) causing stalk breakage and a yield loss of 500-700 lbs/ac. Therefore volunteer sunflower would be expected to be a weed problem in the 1987 barley crop. This field received 40 lb N/A broadcast April 28, 1987 and the field was undercut May 5, 1987. Bowman barley was seeded May 7, 1987 using a cultivator-double disk-press drill in a tandem operation with 70 lb/ac of 18-46-0 with the seed. The field was sprayed with Bromoxynil + 2,4D each at 5 oz ai/ac May 28, 1987 and again on June 8, 1987. These two sprayings provided excellent weed control (volunteer sunflower being the main weed problem) and the yield of Bowman barley averaged about 60 bu/ac.

G4. Spring wheat-summerfallow cropping (15.3 acres spring wheat and 13.5 acres summerfallow). Registered seed of spring wheat variety Butte-86 was seeded with a conventional till plant system April 28, 1987 with 70 lbs of 18-46-0 with the seed. This field yielded about 35 bu/ac and we saved about 100 bushel to insure good quality seed for our own use in the Research Farm studies in 1988.

The summer fallow field was fallowed using the minimum tillage concept. This field was undercut May 5, 1987; undercut again June 15, 1987, and sprayed with Landmaster (40 oz ai/ac) July 24, 1987.

NE$\frac{1}{4}$ Sec 18



H. NE 1/4 Section 18 - Research Activities

H1. Cropping Sequences - Conservation Tillage Systems Research Project (65 acre study)

1a. Spring wheat-fallow (1987 Spring wheat plots)

Spring Wheat Crop Plots - Schedule of Operations for Each Tillage System.

Date	Conventional Till No Residue	Conventional Till >30% Cover	Minimum-Till 30 to 60% Cover	No-Till <60% Cover
4-21	--	--Applied 30,60,90 lb N/a Broadcast as 34-0-0----------		
4-22	Burned Stubble	----	----	----
4-24	Applied 30.60,90N	----	----	----
4-28	Disk	Disk	----	----
4-29	----	----	Roundup+2,4D	Roundup+2,4D
4-30	Planted Butte 86 and Stoa		----	----
5-1	----	----	Planted Butte 86 and Stoa	
5-19	- - - - - - - - - Sprayed Hoelon + Bromoxynil - - - - - - - - - - - - - - -			
8-4	- - - - - - - - - Hand Harvest Samples Obtained - - - - - - - - - - - - - -			
8-7	- - - - - - - - - - - - - Combine Harvest - - - - - - - - - - - - - - - - - -			

1b.

Spring Wheat Grain Yield Data (1987)

Cultivar	Rate of Nitrogen	Conv-Till	Min-Till	No-Till	Avg. of N rates
	lb N/ac	- - - - - - - - bu/ac - - - - - -			
Butte-86	0	38.1	36.2	33.8	36.0
	20	40.6	35.4	36.4	37.5
	40	38.3	37.6	34.8	36.9
	Avg	39.0	36.4	35.0	36.8
Stoa	0	38.2	39.3	35.6	37.7
	20	37.9	35.9	34.5	36.1
	40	37.6	40.5	36.2	38.1
	Avg	37.9	38.6	35.4	37.3
	Avg (Tillage)	38.4	37.5	35.2	

1c. Spring wheat - Summerfallow - 1987 Fallow Plots

Schedule of Operations for Fallow-Tillage Systems

Date	Conventional Till No Residue	>30% Cover	Minimum-Till 30 to 60% Cover	No-Till <60% Cover
4-22	Burned Stubble	----	----	----
4-28	Disked	----	----	----
5-14	----	Undercut	Undercut	Roundup+2,4-D
5-19	Hoelon+Bromoxynil	----	----	----
6-16	----	Undercut	----	----
6-17	Landmaster	----	Landmaster	Landmaster
7-16	Undercut	Undercut	----	----
7-27	Landmaster	Landmaster	Landmaster	Landmaster

B. Spring wheat-winter wheat-sunflower cropping system

1a. Spring wheat plots - Schedule of operations for each tillage system.

Date	Conventional Till	Minimum Till	No Till
4-21	Applied 30,60,90 N Treatments using 34-0-0; Barber Spreader		
4-29	Disk	Roundup+2,4D	Round+2,4D
4-30	Seeded Butte 86 and Stoa with Haybuster 1000, 7-inch spacing		
5-29	Sprayed 2,4D and Bromoxynil 5 oz ai/ac each		
6-4	Sprayed Hoelon + Bromoxynil,16 oz + 5 oz ai/ac, respectively		
8-3	Harvest	Harvest	Harvest

1b. Spring wheat yield data (1987) for continuous cropping sequence

Cultivar	Rate of Nitrogen	Conv-Till	Min-Till	No-Till	Avg. of N rates
	lb N/ac	- - - - - - - - - bu/ac - - - - - - - - - - - - -			
Butte 86	30	18.8	22.5	27.5	22.9
	60	24.8	31.8	38.1	31.6
	90	22.6	26.1	36.7	28.5
	Avg	22.1	26.8	34.1	27.7
Stoa	30	17.2	22.6	24.1	21.4
	60	20.6	29.7	31.3	27.2
	90	22.9	28.5	33.2	28.2
	Avg	20.2	26.9	29.7	25.6
	Avg (Tillage)	21.2	26.9	31.9	

2a. Winter Wheat Plots - Schedule of Operations for each Tillage System

Date	Conventional Till	Minimum Till	No Till
Aug 31 '86	----	----	Roundup+2,4D
Sept 8	Undercut	Undercut	----
Sept 27	Disk	----	----
Sept 27-29	Seeded Roughrider and Norstar (Bettinson Drill, 7 in spacing)		
April 21 '87	Applied 30,60,90 N Treatments (34-0-0 w/Barber Spreader)		
May 14	Sprayed Bromoxynil and 2,4D, 4 oz ai/ac each		
Aug 7	Harvest	Harvest	Harvest

2b. Winter Wheat Yield Data (1987) for Continuous Cropping Sequence

Cultivar	Rate of Nitrogen	Conv-Till	Min-Till	No-Till	Avg. of N rates
	lb N/ac	- - - - - - - - - bu/ac - - - - - - - - - - - - -			
Roughrider	30	36.0	41.9	40.7	39.5
	60	42.7	42.1	42.4	42.4
	90	43.9	45.3	47.2	45.5
	Avg	40.9	43.1	43.4	42.5
Norstar	30	38.8	44.2	40.6	41.2
	60	42.1	44.0	44.9	43.7
	90	40.3	45.1	45.2	43.5
	Avg	40.4	44.4	43.6	42.8
	Avg (Tillage)	40.6	43.8	43.5	

3a. Sunflower Plots - Schedule of Operations for Each Tillage System

Date	Conventional Till	Minimum Till	No Till
Oct 16 '86	----	----	Surflan (1.25 lb ai/ac)
April 21 '87	Applied 30,60,90 N Treatments, 34-0-0 w/Barber Spreader		
April 23	Undercut + Treflan	Undercut + Treflan	----
May 14	----	Undercut	Roundup
May 18	Disk	----	----[1/]
May 19	Planted Sokota 2057 and Sokota 4000 w/IH800 unit planter		
Aug 5	Contract aerial sprayed for insect control		
Oct 14	C-Harvest	C-Harvest	C-Harvest

1/ Furadan applied in row (1 lb ai/ac)

3b. Sunflower Yield Data (1987) for Continuous Cropping System

Cultivar	Rate of Nitrogen	Conv-Till	Min-Till	No-Till	Avg. of N rates
	lb N/ac	- - - - - - - - bu/ac - - - - - - - - - - - - -			
Sokota 2057	30	1760	1920	1740	1810
	60	1960	1980	2130	1960
	90	2020	2000	2100	2040
	Avg	1910	1970	1990	1960
Sokota 4000	30	1700	1540	1680	1640
	60	1616	2140	1590	1780
	90	1760	1960	1440	1850
	Avg	1690	1880	1700	1760
	Avg (Tillage)	1800	1920	1850	

3c. Leaf Spot Diseases of Wheat in Two Crop Rotations - Dr. Joe Krupinsky

Several times during the 1987 growing season, varieties were monitored for leaf damage caused by leaf spot diseases by rating individual wheat leaves for amount of necrotic leaf tissue. The average of the flag leaf ratings is used in this report. Fungi causing the leaf spot diseases were identified by microscopic examination of incubated diseased leaves. Although tan spot caused by Pyrenophora tritici-repentis was the most common foliar disease present, Septoria nodorum blotch caused by Leptosphaeria nodorum was also present and considered an important part of the leaf-spot complex.

In the 1986-87 winter wheat crop, plants were rated 7 times for leaf spot diseases. In general the plants grown on the low nitrogen treatment (30% necrosis) had more flag leaf damage than the plants on the high nitrogen treatment (20% necrosis). The effect of nitrogen on leaf damage is consistent with information obtained from the 1986 crop. When considering the tillage system, more flag leaf damage was associated with the conventional tillage treatment (27% necrosis) than the zero-till treatment (22% necrosis). This is not consistent with research data obtained in 1986. Differences between years demonstrates that it is necessary to monitor diseases in these cropping rotations for several years before general conclusions can be made.

Spring wheat plants in the 1987 continuous cropping rotation were rated 4 times for leaf spot diseases. The results were similar to the winter wheat crop. More flag leaf damage due to diseases was associated with the low nitrogen treatment (38% necrosis) than the high nitrogen treatment (29% necrosis). The effect of nitrogen on leaf spot diseases is consistent with data obtained from the 1986 crop. Among the different tillage types, more leaf damage was associated with the conventional tillage treatment (36% necrosis) than with the zero-till treatment (26% necrosis). As with winter wheat this is not consistent with data obtained in 1986.

The amount of disease damage in the spring wheat crop in the spring wheat-fallow rotation was not affected by the nitrogen (0 and 40 lbs nitrogen/acre) or tillage treatments (zero-till and conventional). The lack of nitrogen and tillage effects on leaf spot diseases in the spring wheat-fallow rotation is consistent with 1986 data.

The management of variables involving cropping rotations, conservation tillage, soil fertility, and varieties is complex. The understanding of how all these management practices affect leaf spot diseases requires long-term research in order to better understand how all these management practices interact.

H. Winter Wheat Varieties and N-Fertilizer Responses

H1. Spring barley (Bowman) was grown in this field in 1986 with a yield level of 50 bu/ac. The remaining barley stubble was 8 to 10 inches tall. The field was sprayed with Landmaster (40 oz/ac) Sept. 5, 1986 to control volunteer barley and weeds. Six winter wheat varieties were seeded no-till with the Melroe-Bettenson drill (Rocky, Roughrider, and Norstar; seeded Sept. 30, 1986; and Norwin, Archer, and Agassiz, seeeded Oct. 6, 1986) with 70 lbs of 18-46-0 with the seed. Nitrogen fertilizer as ammonium nitrate (34-0-0) was topdressed at 0, 30, 50, 70, 90 and 120 lb N/ac April 27 1987 with the Barber spreader. Winter wheat varieties were sprayed May 16, 1987 with Bromoxynil and 2,4D (5 oz ai/ac each) for weed control.

Grain yield and test weight of varieties as influenced by N-fertilization are shown in the following tables.

a. Grain Yield

	Rate of N Applied (lb N/ac)						
Variety	0	30	50	70	90	120	Variety Avg
	- - - - - - - - - - Grain Yield (Bu/ac) - - - - - - - - - - - -						
Norwin	34.9	45.7	45.9	43.2	44.7	42.4	42.8
Archer	35.9	46.8	43.8	46.8	52.4	46.9	45.4
Rocky	32.5	43.9	53.2	47.0	47.8	52.4	46.1
Roughrider	25.6	37.7	38.5	45.2	42.7	43.3	38.8
Norstar	33.2	39.8	46.4	45.7	41.4	46.9	42.2
Agassiz	29.0	41.4	41.3	42.6	48.0	41.5	40.6
Avg (N-rate)	31.9	42.5	44.9	45.1	46.1	45.5	

b. Test Weight

	Rate of N Applied (lb N/ac)						
Variety	0	30	50	70	90	120	Variety Avg
	- - - - - - - - - -Test Weight lb/bu - - - - - - - - - - - -						
Norwin	62.2	61.1	61.4	60.6	60.6	60.2	61.0
Archer	59.5	59.0	58.9	58.6	58.2	57.9	58.7
Rocky	61.2	61.4	62.0	61.2	61.4	61.1	61.4
Roughrider	61.8	61.8	61.4	62.4	61.2	60.7	61.6
Norstar	62.6	62.6	62.8	62.3	61.7	61.6	62.3
Agassiz	63.1	63.2	62.4	61.8	62.2	61.3	62.3
Avg (N-rate)	61.7	61.5	61.5	61.2	60.9	60.5	

c. Disease Observation of Winter Wheat Varieties Grown on Zero-Till With Different Nitrogen Levels - Dr. Joe Krupinsky

Six varieties of winter wheat (Agassiz, Archer, Norstar, Norwin, Rocky, and Roughrider) were planted in barley stubble in the fall of 1986 in a north-south orientation. Different rates of nitrogen were applied in a east-west direction. Nitrogen levels included: 0 lbs/acre, 30 lbs/acre, 50 lbs/acre, 70 lbs/acre, 90 lbs/acre, and 120 lbs/acre. Flag leaves were rated 2 times for leaf spot diseases during the 1987 growing season. The level of leaf spot diseases for four varieties was twice as high on the 0 lbs/acre plots when compared to the plots on which nitrogen was applied. For example, the level of flag leaf necrosis for Roughrider was 39% on the 0 lbs/acre treatment compared to 19% on the 90 lbs/acre treatment. Similar results were found for Agassiz (32% at 0, 14% at 90), Archer (27% at 0, 19% at 90), and Rocky (41% at 0, 23% at 90). A similar pattern was obtained with the 70 and 120 lbs/acre treatments. In other words these four varieties expressed a higher level of resistance to leaf spot diseases when nitrogen was adequate then when nitrogen was lacking or insufficient. The other two varieties responded uniformly to all nitrogen treatments. For example, the disease levels for the 0 lbs/acre treatment and the 90 lbs/acre treatment was 10% and 11% necrosis, respectively, for Norstar and 28% and 27% necrosis, respectively, for Norwin. Thus varieties varied in their response to nitrogen. Norstar had a lower disease rating than Agassiz, Archer, Norwin, Rocky, and Roughrider when comparisons were made on the 0 lbs/acre treatments but when comparisons were made on the higher nitrogen treatments Norstar could not be differentiated from the other cultivars.

The management of variables involving soil fertility and varieties can have an impact on leaf spot diseases. A good understanding of how these management practices affect leaf spot diseases requires long-term research over a number of years because environmental conditions vary from year to year.

H3 and H4. Fields H3 and H4 were both cropped to sunflowers in 1987 because winter wheat was the previous crop in both instances (H3 - Winter Wheat Varieties and H4 - Block Field of Roughrider). This field area was tilled with the Haybuster undercutter with granular application of Treflan (TR-10) at 1.0 lb ai/a April 23, 1987. This field was undercut again May 19, 1987 at a shallow tillage depth (about 2-inches). Five varieties of sunflower were seeded June 2, 1987 with the IH 800 Cyclo-seeder, 4-row unit planter at a population of 22000 plants/acre in 36-inch row spacing with 50 lbs N/acre side-banded 3 inches beside the row. Sunflower varieties yields based on combine harvesting of field size blocks were as follows:

Sokota 2057	=	1881 lbs/ac
Sokota 4000	=	1788 lbs/ac
Sokota 5000	=	2085 lbs/ac
Dahlgren 728	=	1950 lbs/ac
Dahlgren 855	=	2328 lbs/ac

H5. Corn Research Activities (A. Bauer and S. Merrill)

a. Residue-Nitrogen Level Effects on Corn Performance

Table 1. Corn grain yield as affected by nitrogen (N) and residue management.

Residue 1/	Pounds N/acre to four feet			
	60	120	200	Avg.
	bu/ac 2/			
Disk	148	152	149	150
Undercut	148	146	141	145
No-till	144	154	142	147
Avg.	147 ab	151 a	144 b	

1/ Source was barley.
2/ Expressed as 15.5% water concentration. Plant population was 18585 plants per acre.

Table 2. Corn stover yield as affected by nitrogen (N) and residue management.

Residue 1/	Pounds N/acre to four feet			
	60	120	200	Avg.
	tons/ac 2/			
Disk	8.58 a	8.52 a	9.31 a	8.80
Undercut	8.46 a	8.82 a	8.25 ab	8.51
No-till	7.38 b	8.89 a	8.90 a	8.39
Avg.	8.14 b	8.74 a	8.82 a	

1/ Source was barley.
2/ Expressed as 70% water concentration. Plant population was 18585 plants per acre.

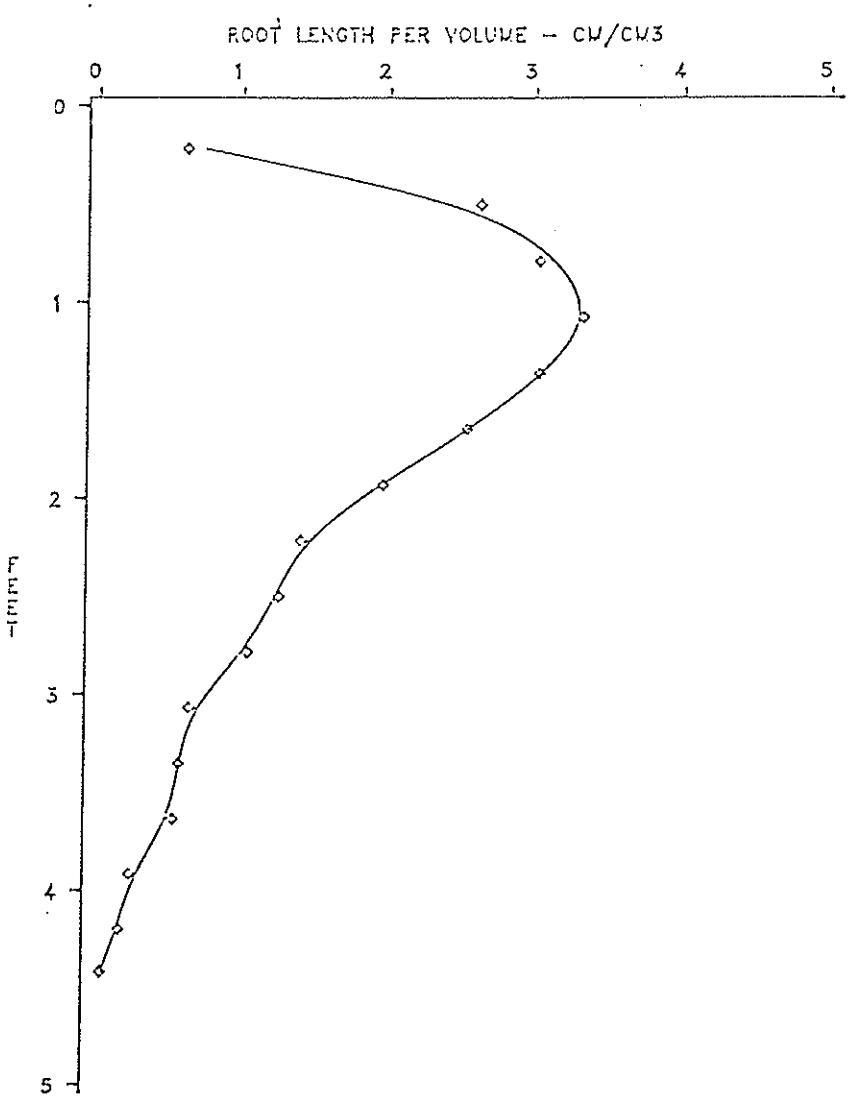
Table 3. Corn grain and stover yield as affected by irrigation and residue management. Nitrogen (N) level to four feet was 200 pounds per acre.

Irrigation	-Residue	Grain Yield 2/	Stover Yield 3/
Yes 1/	Disk (main)	151	9.92
Yes	Disk (reps)	133	7.89
No -	Disk	142	7.21
No -	Undercut	146	10.08
No -	No-till	133	7.16

1/ Applied 5.5 inches between Aug. 1 to Sept. 11.
2/ Expressed at 15.5% water concentration.
3/ Expressed at 70% water concentration.

The effects of irrigation and tillage on corn root growth and development were studied using a system of observation tubes placed at an angle into the soil. The tubes allowed measurements of the rate of root growth to be made to a depth of 4.5 feet. A small video camera lowered into the tubes allowed images of roots intercepted by the tubes to be viewed with a television monitor in the field. During the 1987 season, the depth of penetration and rate of growth of roots of no-till corn appeared to be equal to root penetration and growth observed in conventional and undercut tillage plots. Supplemental irrigation applied at flowering and at later stages did not noticeably affect root growth. Figure 1 shows the rooting depth 90 to 95 days after planting. (Corn was planted June 1, 1987).

Figure 1. Corn root length per volume of soil to 4.5 feet 90 to 95 days after planting.



Soil water content was measured each week from planting to harvest with a neutron probe. The change in soil water content from planting to harvest (Table 4) is an indirect measure of the depth of root penetration. It is assumed that the disappearance of water is due to the presence of roots.

Table 4. Difference in soil water content between planting and harvest at various depths to 5.5 feet in plots with varying residue and nitrogen levels.

Residue - Nitrogen lbs/ac [1/]	Soil depth, inches						
	0-6	6-12	12-18	18-30	30-42	42-54	54-66
	inches of water						
Disk 60	0.90	0.62	0.45	0.99	0.35	-0.11 [2/]	-0.11 [2/]
120	0.82	0.66	0.51	0.95	0.32	-0.06	-0.06
200	0.88	0.66	0.53	0.96	0.22	-0.04	-0.04
Undercut 60	0.74	0.54	0.46	0.84	0.27	-0.04	-0.04
120	0.77	0.53	0.45	0.70	0.07	0.00	0.00
200	0.88	0.55	0.43	0.66	0.12	-0.06	-0.06
No-till 60	0.86	0.61	0.48	0.83	0.23	-0.17	-0.17
120	0.83	0.52	0.42	0.72	0.18	-0.16	-0.16
200	0.76	0.46	0.42	0.82	0.25	-0.11	-0.11

1/ The sum of the amount present in the soil to four feet and the amount added in fertilizer.

2/ The minus sign means that more water was present at harvest than at planting.

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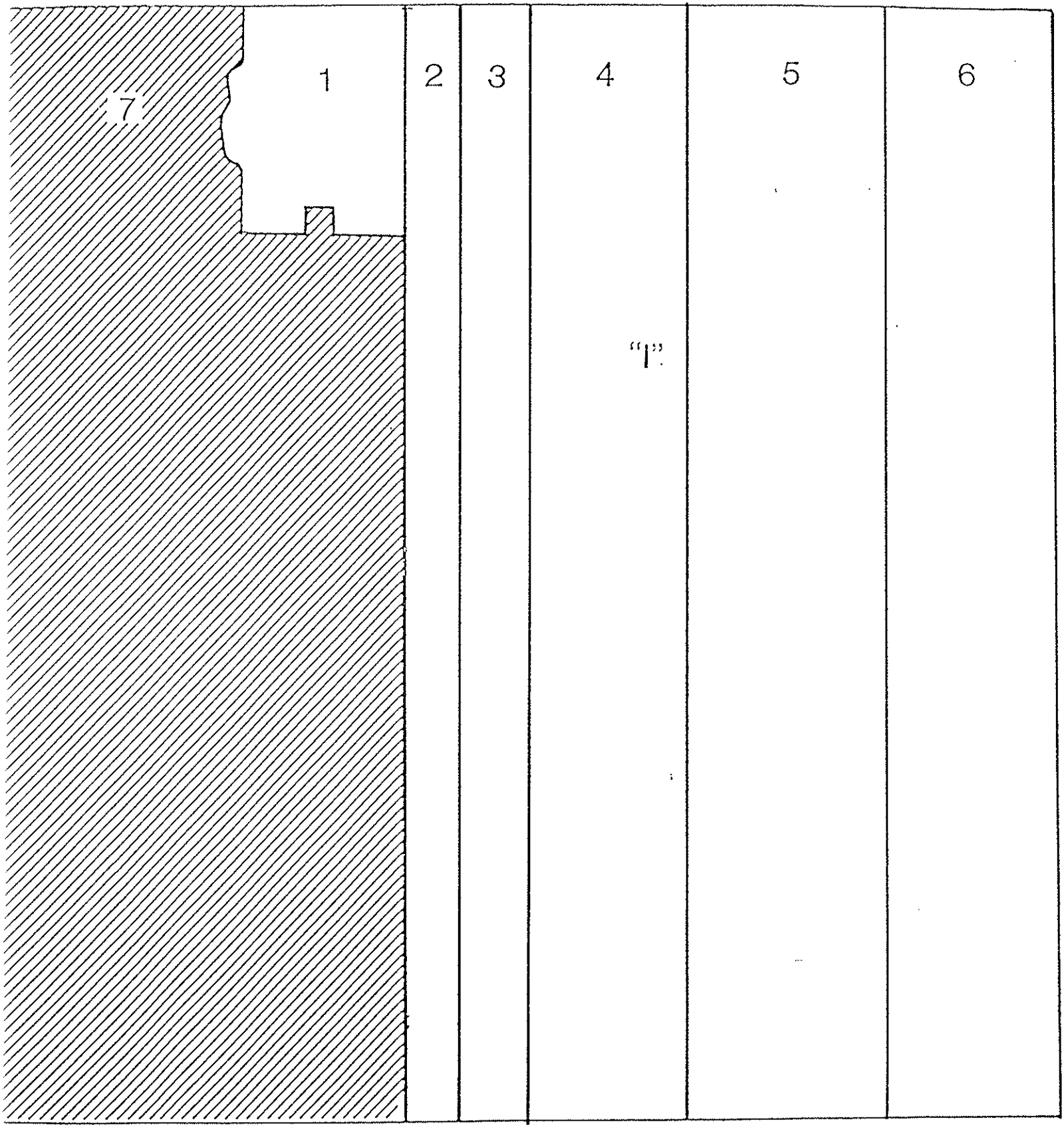

I. NE1/4 Sec 20 - Research Activities

Table 1. Effect of date of windrowing on agronomic characters of Butte 86 hard red spring wheat in 1987.

Date mo-day-yr	SWC[1] %	Grain yield bu/ac	Kernel[2] weight mg	Test weight lbs/bu	Grain[3] nitrogen %N
7-13-87	109	20.2	19.60	53.6	3.40
7-15-87	88	22.6	22.03	56.3	3.38
7-17-87	91	26.3	24.32	58.3	3.36
7-22-87	68	29.9	28.32	59.6	3.28
7-24-87	48	32.7	29.64	60.8	3.35
7-26-87	38	30.9	29.84	61.0	3.46
7-29-87	24	31.0	29.64	61.8	3.39
7-31-87	10	29.8	30.00	59.1	3.48
8-05-87[4]	9	29.6	29.59	59.6	3.31
LSD[5]	9	1.6	0.77	0.5	NS

1/ Spike (head) water concentration at windrowing.
2/ Mg (milligrams); 28,350 mg = one ounce.
3/ The %N times 5.7 times 0.88 equals % protein at 12% water concentration.
4/ Straight combined.
5/ Numbers in the column above must differ by the amount indicated to be significantly different at the 95% probability level. The NS indicates the odds of less than 95 out of 100 that differences between the numbers are due to treatment (swathing date) rather than chance.

A publication providing a picture guide to determine when windrowing can proceed without adverse effect on grain yield or quality factors is in advanced planning stages. The publication is expected to be an Extension Bulletin.

IA. Soil Erosion-Soil Productivity Study

This, 1987, was the fourth and last year of the research to assess the effect of topsoil loss by erosion on soil productivity, as measured by wheat yields. The available nitrogen (nitrate) and water levels were maintained uniformly among three sites, each with different soil organic matter content in the upper foot. Wheaton spring wheat was planted April 28, 1987 at about one million viable seeds per acre.

Statistical analysis of the 1987 data is not complete. However, there is nothing to indicate that the outcome differed from that of previous years. In the 1987 report we showed that the contribution of each ton of organic matter to productivity, over the range of about 23 to 48 tons per acre in the upper foot of soil, is equivalent to about 15 to 19 pounds of wheat yield per acre.

IB. Timing of Nitrogen Application to Wheat by Plant Development Stage

This study was initiated in 1987 to measure the effect of split applications of nitrogen to spring wheat on yield and quality factors. The rationale for the study is that: (1) the yield potential of wheat can be altered during the growing season when larger than average or expected rainfall is received, and (2) there is concern--more so in the humid regions--of nitrate movement into the ground water. In the experiment we used all combinations of two nitrogen levels--80 and 140 pounds N per acre--and two water levels--dryland and supplemental irrigation. The nitrogen was applied so as to test the effect of applying part of it at the 3-leaf, flag leaf, and heading stages, as well as having all of it present at planting. A major part of this study is to measure the nitrogen concentration and content in leaves, stems, and heads (when present) each week from the 3-leaf to grain ripe stage. This will provide information about how fast nitrogen is taken into the plant when applied to the soil at different plant development stages. These analyses are not complete.

Another part of the study was to apply 30 pounds of N per acre from "NiSul" as a foliar treatment at about grain watery-ripe stage (shortly after flowering) to measure change, if any, in grain protein. The marketplace, at times, pays a premium for grain protein. Whether the premium will be offered is largely dependent on the protein concentration in hard red winter wheat. Hard red winter wheat is the miller's main source for bread flour. Information on the protein concentration in hard red winter wheat is available by the time a spring wheat grower needs to make a decision about increasing protein in his crop. This part of the research will determine whether a foliar application of nitrogen after flowering is a viable option for increasing grain protein.

IC. Fields 3 and 5 were summer fallow in 1987 using the minimum tillage concept. Fields 3 and 5 were undercut May 12, sprayed with Landmaster (Field 5, June 15 and Field 3, June 17), undercut July 17, sprayed with Landmaster (Field 3, July 3 and July 25 and Field 5, August 1) followed by spot spraying with 2,4D on August 19 on both fields.

ID. Field 1, 2, 4, and 6 were cropped to spring wheat in 1987 using a double-disk drill combination till-plant system with 60 lbs of 18-46-0 with the seed. Field I2 was seeded to Butte 86 and Fields 4 and 6 were seeded to Stoa, April 28, 1987. Field I has been no-till seeded to spring wheat each year since 1985. This field received 40 lbs N/ac on April 28 and seeded the same day. All fields were sprayed May 30 for broadleaf weed control using Bromoxynil and 2,4D, 5 oz ai/ac each. Combine yields averaged 35 bu/ac with 14% protein for the fields that had been summerfallowed (Fields 2, 4 and 6) and the continuous spring wheat (Field 1) yielded about 30 bu/ac with 13.5% protein.