1988 Research and Cropping Results

Fifth Annual Progress Report

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A. L. Black, LD/Soil Scientist
Armand Bauer, Soil Scientist
Joe Krupinsky, Plant Pathologist
Steve Merrill, Soil Scientist
Richard Cunningham, Geneticist (Trees)
John Berdahl, Geneticist (Grasses)

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

Acknowledgment

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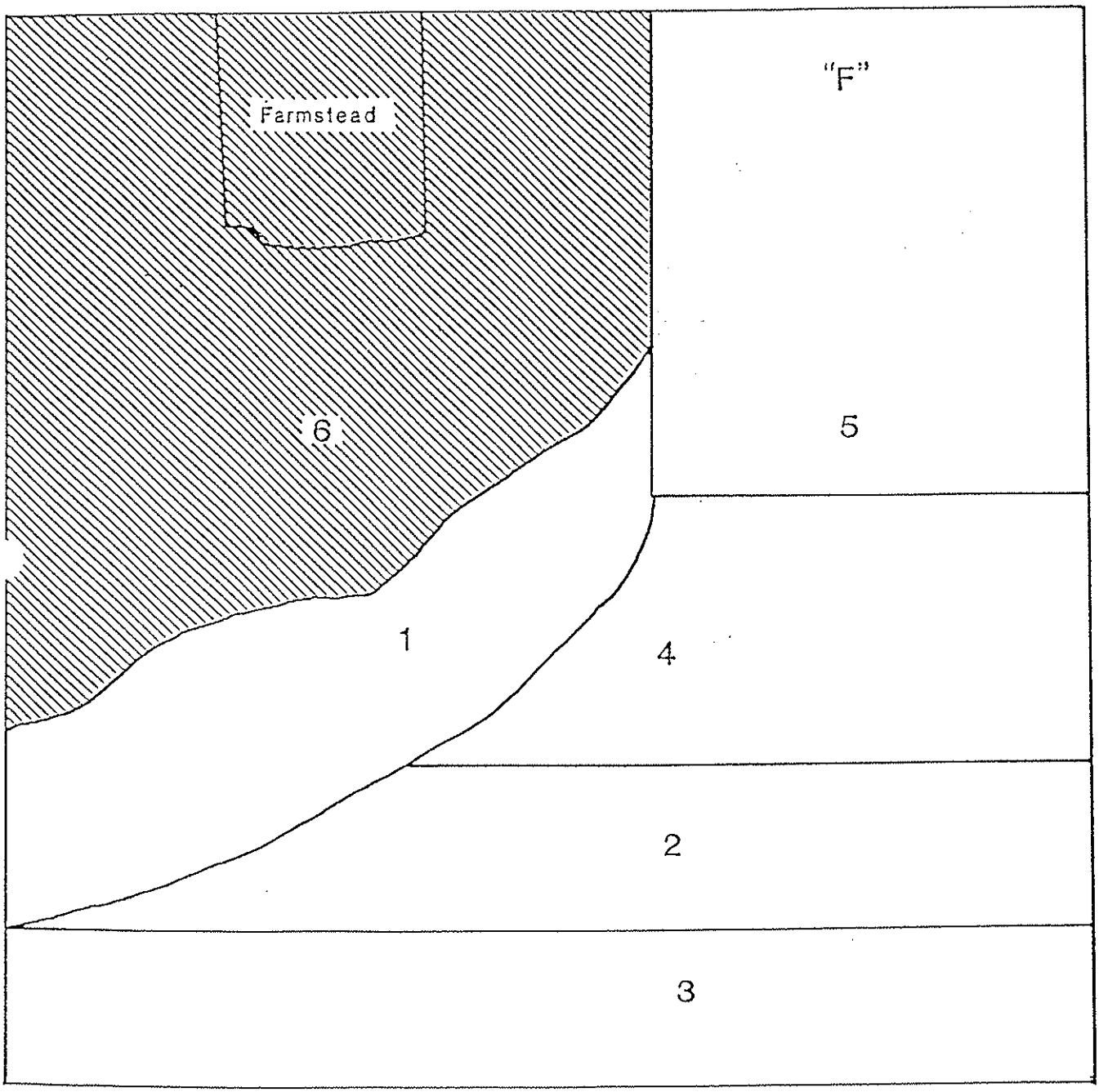
NW$\frac{1}{4}$ Sec 17



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

F1. Conservation Bench Area - This area was dropped from the total acreage leased by the Area IV SCD beginning in 1987. Total cropland now leased is 382 acres.

F2. The previous crop in 1987 on this field was winter wheat varieties seeded no-till into different spring wheat and barley stubble plots. After winter wheat harvest, this field was undercut because of excessive weed populations. On April 22, 1988, this field was undercut with simultaneous granular application of TR-10 (Treflan) at a rate of 1.0 lb ai/ac. The field was undercut again May 13, 1988 and three sunflower varieties were seeded May 20, 1988. Harvested on September 11, 1988, sunflower varieties Agripro 4200, Dahlgren 725, and Dahlgren 855 yielded 640, 690, and 510 lbs/acre, respectively. Stored soil water was low because of fall tillage which reduced quantity of snow trapped.

F3. The previous crop in 1987 was sunflower. The field was tilled with the undercutter April 25, 1988. Spring wheat 'Butte 86' was seeded May 9, 1988 with the Haybuster 1000 no-till drill with 30, 60, or 90 lbs N/acre banded between each pair of 7-inch rows. This field showed signs of residual Treflan damage as well as severe drought damage. Therefore, with near zero yield potential, the field was not harvestable and was sprayed July 21, 1988 with Landmaster. All crop and weed plants were effectively controlled and sufficient soil water was gained to establish a good stand of winter wheat seeded Sept. 26, 1988.

F4. This field was seeded to winter wheat, Sept. 14-15, 1987. Winter wheat varieties Winalta, Roughrider, and Norstar were no-till seeded into each spring cereal stubble source (Bowman barley and Butte 86 and Waldron 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 system. Because of the 1988 drought, this field yielded only 6.0 bu/ac and there was no opportunity to study leaf-spot diseases because the plant leaves were showing predominantly drought symptoms and little or no leaf-spot diseases.

F5. ARS Land Lease

Spring wheat and spring barley varieties were planted on April 25, 1988 on summerfallow, in 6-inch row spacing, about 1.5 inches deep with a press drill, at about 1,000,000 viable seeds per acre. The surface was free of residues after planting. Irrigation water was applied to the barley beginning in June.

Agronomic characters of the varieties (cultivars) are shown in Table 1. The pre-tillering plant population and number of heads at harvest are expressed in number per square meter (m^2). To convert to number per square yard, multiply by 0.836. The height is expressed in centimeters (cm). To convert to inches multiply by 0.39.

The amount of available soil water in foot-increments to 6 feet by dates and plant development stages, and the amount of rain (or irrigation on barley) between soil measurement dates is shown in Table 2 for barley and Table 3 for wheat. These data show the water depletion from the soil, which is an indirect indication of the presence of roots. Data of this kind has been collected from wheat since 1979, and was summarized and published as North Dakota Agricultural Experiment Station Bulletin 519, 1989.

We have planted wheat and barley on the same day--side by side--for several years. Barley is always ready for harvest about two weeks before wheat. The approximate 2-week difference comes about this way:

1. Barley emerges about <u>one</u> day earlier than wheat.

2. Nearly all cultivars of both crops produce 8 leaves on the main stem. But barley requires about 6 heat units (growing degree-days) less per leaf or morphological unit (flag leaf extension, boot-stage, etc.) than wheat. So through heading, barley "gains" about another 3 to 4 days on wheat.

3. Barley cultivars in the northern Great Plains begin to flower when the awns are about an inch out of the collar (boot). Flowering in barley is usually completed before heading. Wheat does not begin to flower until about 3 to 4 days after heading is complete. The time period for heading is about 4 to 5 days. It is during this period that barley "gains" on wheat, a "gain" of about 7 to 9 days.

4. The time period required for grain-filling is the same in the barley and wheat varieties that we have observed.

Table 1. Agronomic characteristics of spring wheat and spring barley cultivars grown at Mandan, ND, 1988.

Cultivar	Measurement								
	POP	HEA	HGT	TWT	THO	YIE	STR	HEP	KPH
	no/m^2	no/m^2	cm	lbs/bu	mg	bu/ac	lbs/ac	no	no
Azure	185	458	47	47.4	29.78	15.0	3304	2.5	15.9
Bowman	222	927	46	49.1	34.66	38.1	3482	4.2	9.1
Gallatin	197	769	53	48.3	28.89	27.5	3572	3.9	12.6
Morex	189	380	47	46.7	28.44	21.5	2720	2.0	22.5
Robust	200	426	44	46.4	28.35	18.2	3255	2.1	21.1
Arra 1/	173	500	41	41.4	27.85	13.8	3183	2.1	11.7
Datal 1/	197	695	47	40.2	21.60	14.8	3037	3.5	13.8
Otal 1/	87	367	51	42.4	23.19	13.3	2177	4.2	17.5
LSD 2/	26	29	3	3.1	3.22	6.9	312		2.6
Alex	158	327	58	57.9	24.26	16.1	2190	2.1	19.5
Amidon	180	275	55	57.9	24.25	19.0	2162	1.5	22.2
Challenger	185	247	41	56.5	22.49	14.3	1515	1.3	22.5
Cutlass	169	301	45	56.5	20.94	13.7	1757	1.8	17.9
Keif	151	266	49	56.9	23.41	16.5	1739	1.8	18.3
Len	171	283	46	57.8	23.15	12.3	1889	1.7	15.4
Nordic	144	252	45	58.7	27.27	17.5	1890	1.8	18.6
Wheaton	174	229	41	55.7	23.10	14.9	1466	1.3	20.5
LSD 2/	19	20	5	1.1	1.43	2.3	205		2.3

POP = Plant population pre 3-leaf stage.
HEA = Head population @ harvest.
HGT = Height at harvest.
TWT = Test weight.
THO = 1000 kernel weight.
YIE = Grain yield, combine.
STR = Straw yield, m^2.
HEP = Heads per plant.
KPH = Kernels per head.

1/ These are from Alaska.
2/ The difference between any two values in the column above must be at least this large to be significant at the 95% confidence level.

Table 2. Available soil water by foot-increments to six feet and rainfall/ irrigation applied between dates of soil water measurement on spring barley, Mandan, ND, 1988.

Planted 4/25/88
Emerge 5/06/88

Date	DS[1/]	Soil depth - feet						Rain
mo/day		0-1	1-2	2-3	3-4	4-5	5-6	inches
		- - - - - - inches available water - - - - - -						
								0.52[2/]
5/06	0.5	1.37	1.88	2.08	1.78	1.80	1.90	
								0.04
5/10	1.6	1.33	1.86	2.02	1.80	1.77	1.87	
								0.12
5/19	3.8	1.18	1.88	2.06	1.80	1.84	1.93	
								0.00
5/25	5.4	0.70	1.87	2.07	1.84	1.87	2.02	
								0.16
6/01	7.0	0.28	1.65	1.96	1.80	1.84	1.95	
								0.00
6/07	8.4	-0.11	1.00	1.78	1.78	1.87	1.95	
								2.01[3/]
6/15	9.8	0.59	0.48	1.29	1.70	1.84	1.99	
								2.55[4/]
6/21	11.9	0.11	0.42	0.97	1.44	1.74	1.91	
								1.61[4/]
6/28	13.5	0.94	0.40	0.74	1.34	1.80	1.99	
								2.05
7/05	14.0	1.31	0.86	0.66	1.28	1.72	1.96	
								0.00
7/12	14.6	0.17	0.68	0.65	1.16	1.74	1.94	
								0.00
7/20	15.0	-0.09	0.56	0.35	1.06	1.66	1.93	
	"Used"	1.46	1.32	1.73	0.72	0.14	-	9.06

1/ Development stage, Haun scale, average 5 barley varieties. Stages on 5/10 and 5/19 estimated from regression.
2/ Planting to 5/06.
3/ Rain was 0.40 inches; the remainder is from irrigation.
4/ All from irrigation.
5/ Received 0.08 inches rain on 7/20.

Total water = 14.43 inches
(5) Average yield = 24.1 bu/ac

Table 3. Available soil water by foot-increments to six feet and rainfall amounts between dates of soil water measurement on spring wheat, Mandan, ND, 1988.

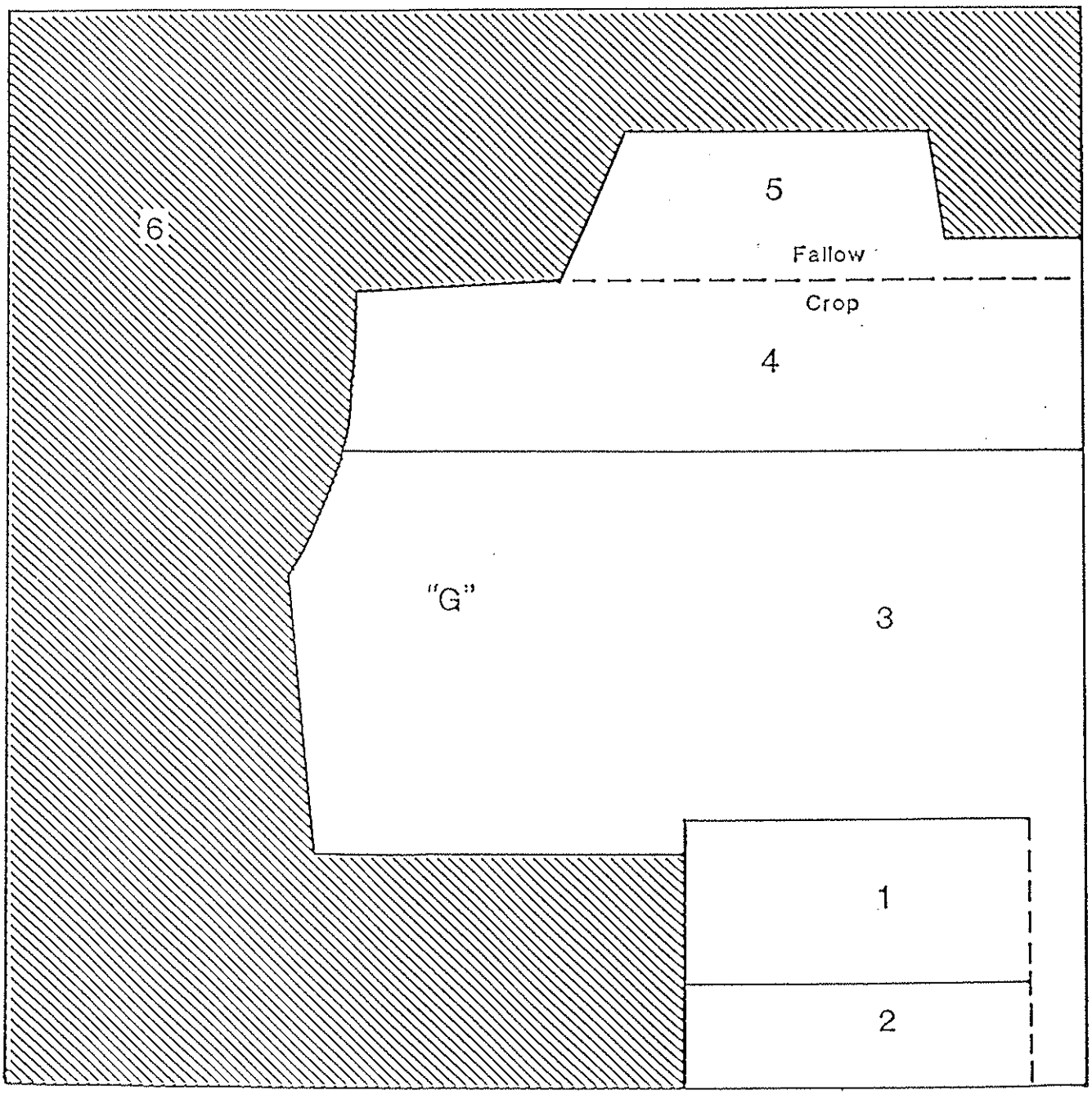
Planted 4/25/88
Emerge 5/07/88

Date	DS[1/]	Soil depth - feet 0-1	1-2	2-3	3-4	4-5	5-6	Rain
mo/day		inches available water						inches
								0.52[2/]
5/06		1.18	1.77	2.01	1.81	1.72	1.64	
								0.04
5/10		1.18	1.72	2.00	1.80	1.74	1.63	
								0.12
5/19		1.09	1.78	2.01	1.81	1.76	1.67	
								0.00
5/25		1.02	1.77	2.03	1.86	1.79	1.71	
								0.16
6/01		0.52	1.60	1.96	1.84	1.77	1.68	
								0.00
6/07		0.00	1.05	1.83	1.80	1.81	1.70	
								0.40
6/15		0.30	0.45	1.40	1.76	1.75	1.73	
								0.00
6/21		-0.07	0.32	0.93	1.54	1.68	1.62	
								0.00
6/28		-0.06	0.24	0.59	1.26	1.74	1.70	
								2.05
7/05		1.09	0.24	0.47	1.14	1.61	1.65	
								0.00
7/12		0.16	0.24	0.45	0.99	1.59	1.66	
								0.00[3/]
7/20		-0.10	0.21	0.43	0.85	1.49	1.62	
	"Used"	1.28	1.56	1.58	0.96	0.23	0.02	3.29

1/ Development stage.
2/ Planting to 5/06.
3/ 0.08 inches recorded on 7/20.

Total water = 8.92 inches
Average Yield = 15.5 bu/ac

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



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

G1. Populus Clonal Testing - Dr. Richard Cunningham - Res. Geneticist
Dr. Joe Krupinsky - Plant Pathologist

During the period 1983 to 1988, 240 hybrid poplar and cottonwood clones were planted in this area to compare their survival, growth rate, cold hardiness, and pest resistance. Similar field tests have been established on eight other sites in North Dakota. The following table compares the performance of several clones when averaged over all the sites. Three scores were calculated; Score1 is based on survival and height only; Score2 and Score3 include additional variables where data were available. A clone, average for each trait, should score 300. Many of the clones have not yet been scored for leaf and stem canker diseases because the plantations they are tested in have not yet been infested.

For the second year in a row, Hybrid Poplar NE-222 scored highest for Score1 and Score2. The hybrid poplar 'Serotina de Selys' was about average for Score1 but well above average for Score2. This reflects its resistance to leaf spots and stem cankers. Another hybrid poplar, #14271 had the highest Score3 value primarily as a result of its stem canker resistance. A white poplar selected in South Dakota, survived well, grew rapidly, and had excellent leaf disease resistance. Note that of all the clones currently distributed by Lincoln-Oakes Nurseries, none were in the top ten based on Score1.

G2. Grass Breeding - Dr. John Berdahl

Two western wheatgrass populations currently are being evaluated on land made available for a cooperative research project of USDA-ARS and the North Dakota Area IV Soil Conservation District. Each population consists of 2000 plants spaced on 6-foot centers. The populations constitute the cycle 2 and cycle 3 generations of a recurrent selection program. The cycle 2 population remained dormant during most of the 1988 growing season due to record high temperatures and drought. The cycle 3 population, established on fallow in 1987, had sufficient stored soil water to produce limited growth. Rhizomatous spread, density of forage cover, and plant vigor were scored on all plants in the cycle 3 population. Seed yields and forage quality data were not collected in 1988 due to drought. We may have an excellent opportunity to assess survival and recovery from drought in the spring of 1989. Other traits under study include spike emergence date, spike number, spike length, and fertility; seed maturity date, seed quality, and dormancy; rate of leaf senescence; and insect and disease problems. Parent-progeny relationships (heritability) for different traits will be determined using the cycle 2 and cycle 3 generations.

PERFORMANCE OF POPLAR CLONES IN FIELD TESTS

CLONE	NAME	SCORE1 [1]	SCORE2 [2]	SCORE3 [3]
14488	Black cottonwood	195.3	.	.
14124	'Nor'easter' NE-237	296.8	270.6	6.8
14178	'Walker'	301.1	323.6	429.0
14189	'Tower'	303.5	.	.
14066#	'Northwest'	305.4	265.9	377.7
14272*	Hybrid poplar #78101	305.4	377.5	456.0
14389*	OP progeny of 'Walker'	307.0	299.0	.
14064#	'Norway'	309.1	348.2	419.2
14167	Hybrid poplar 'Serotina de Selys'	309.2	459.4	.
14273*	Hybrid poplar #7899	309.4	292.0	373.1
14392	OP progeny of 'Walker'	310.4	227.4	304.1
14386#	'Imperial'	314.3	392.6	445.5
14271*	Hybrid poplar #78102	315.9	433.8	514.9
14390*	OP progeny of 'Walker'	317.0	279.9	.
14274*	Hybrid poplar #7873	319.1	381.8	479.6
14394*	OP progeny of 'Walker'	319.3	352.4	466.0
14439	'Ravirdeau'	320.9	.	.
14385	'Ashford'	326.9	390.1	450.6
14297#	'Robusta'	328.6	353.7	427.2
14065#	'Siouxland'	329.1	299.0	354.3
14369	Hybrid poplar NE-348	330.3	243.9	.
14312	Plains cottonwood - Burleigh County	334.3	258.9	.
14316	Plains cottonwood - Morton County	334.5	319.9	.
14425	Hybrid poplar NE-367	335.9	.	.
14168	Hybrid poplar 'Eucalyptus'	341.0	324.8	379.6
14397	White poplar Turner County, SD	352.4	393.5	.
14415	Hybrid poplar NE-222	366.3	532.2	.

1
SCORE1=100+SURV+HEIGHT
2
SCORE2=300+SURV+HEIGHT+DENSTY+FORM-CROWN-TERM-CANK-NECRO
3
SCORE3=300+SURV+HEIGHT+DENSTY+FORM+DORM-WIDTH-TERMNL-CANKS-NECRO-MORT
#
Currently propagated and distributed by Lincoln-Oakes Nurseries.
*
Conditionally released to Lincoln-Oakes Nurseries. Will be distributed on trial basis.

A cycle 2 population of crested wheatgrass on Area IV land was terminated in 1988 after seed of individual plant selections had been harvested in 1987. This land will be fallowed in 1989 in preparation for establishment of other grass breeding nurseries in 1990. The cycle 3 crested wheatgrass population derived from the nursery on Area IV land was space-planted in 1988 at a site on the USDA-ARS research station.

G3. Winter wheat varieties were no-till seeded into 6- to 8-inch standing barley stubble September 16, 1987 with HB-1000 no-till drill (7-inch spacing). Nitrogen rates of 0, 25, 40, 60, 90, and 120 lbs N/ac were applied April 21, 1988 across winter wheat varieties Roughrider, Agassiz, Norstar, Norwin, and Rocky in two replications on the east end of the field (Table 1). The western two-thirds of the field received a commercial broadcast application of 50 lbs N/A. The entire field was combined and the average yield was 13.0 bu/ac with 17.2% protein and 61 lb/bu test weight.

Grain yields of winter wheat varieties as affected by N-rates are shown in the following Table 1.

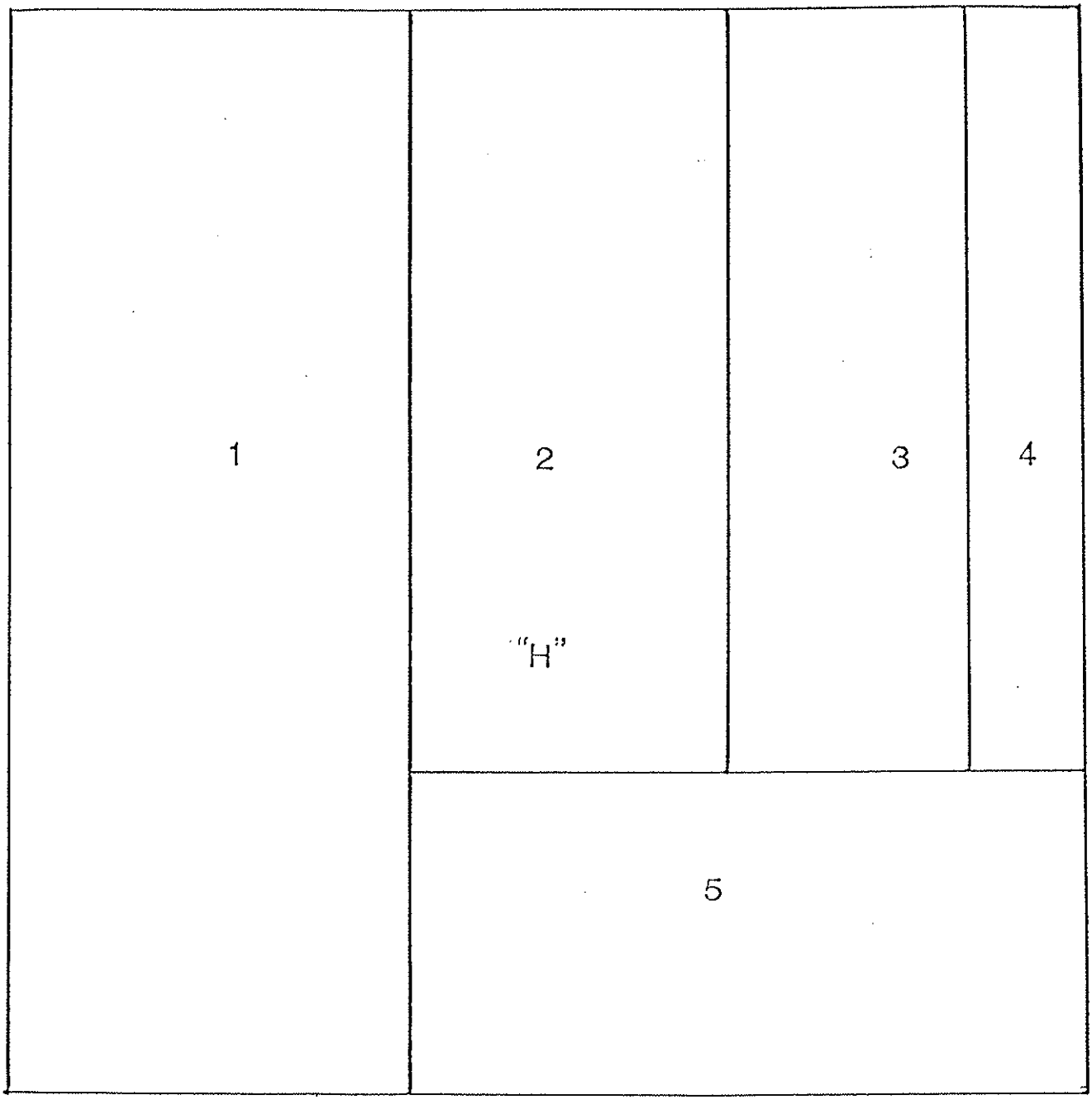
G4. This summerfallow field was seeded to spring wheat 'Stoa' April 29, 1988. This crop was sprayed with a mixture of Brominal, ME-4 (1/2 pt) and Hoelon (2 1/2 pts) on June 1, 1988 with good weed control resulting. Spring wheat crop was combine-harvested July 25, 1988 yielding about 10.0 bu/ac with 16.6% protein and 59 lb/bu test weight.

G5. This field was summerfallowed in 1988 using minimum tillage system involving only three operations; undercutter tillage May 25, 1988 followed by two spray applications of Landmaster on July 21 and Aug. 26, 1988.

Table 1. Grain yields of winter wheat varieties as affected by fertilizer nitrogen (N) rates, 1988.

Variety	Rate of N applied - lbs/ac						
	0	25	40	60	90	120	Avg
	Bu/ac						
Rocky	16.2	19.6	18.5	18.4	19.2	18.2	18.4
Norwin	15.4	11.8	12.2	15.2	16.0	12.3	13.8
Roughrider	13.8	15.8	18.6	16.2	15.0	18.4	16.3
Agassiz	12.8	11.4	14.6	11.0	9.8	12.0	11.9
Norstar	13.6	14.0	10.0	12.5	11.6	13.0	12.4
Avg. N-rates	14.3	14.5	14.7	14.7	14.3	14.7	

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



H. NE-1/4 Section 18 - Research Activities

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

(A1) Spring wheat-fallow (1988 spring wheat plots)

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

Date mo/day	Conventional-till No-residue to <30% Cover	Minimum-till 30 to 60% cover	No-till >60% cover
4/16	Applied 0,20,40 lb N/ac	Broadcast as 34-0-0 to all tillage systems	
4/30	---	Undercut	---
5/5	Disked	---	---
5/5	Seeded Butte 86 and Stoa Spring Wheat in all tillage systems		
6/1	Sprayed Hoelon and Brominal ME-4[1/]		
6/25-28	Hand harvest samples obtained		
7/29	Combine harvested all plots		
8/24	Sprayed all plots with Roundup[2/]		

[1/]Sprayed mixture of 1/2 pt. Brominal + 2 1/4 pts. Hoelon/acre.
[2/]Sprayed Landmaster (43 oz. formulation/ac) bulk material.

(A2) Grain yields of spring wheat in the spring wheat-fallow rotation as affected by tillage system, N-rates, and cultivar grown.

Spring Wheat Grain Yield Data (1988)

Cultivar	Rate of N	Conventional-till No Residue	Conventional-till <30% Cover	Minimum-till 30-60% Cover	No-till >60% Cover	Avg
	lbs N/ac	bu/ac				
Butte 86	0	6.2	7.8	7.5	8.1	7.4
	20	5.8	5.0	6.1	7.8	6.2
	40	5.3	6.3	5.5	7.7	6.2
	Avg.	5.8	6.4	6.4	7.9	6.6
Stoa	0	6.5	8.0	8.5	9.0	8.0
	20	6.1	7.2	8.1	7.5	7.2
	40	5.1	7.8	8.5	8.1	7.4
	Avg.	5.9	7.7	8.4	8.2	7.5
Avg. (Tillages)		5.8	7.0	7.4	8.0	

(A3) Spring wheat-summerfallow with the schedule of operations for fallow plot series in 1988 as follows:

Date	Coventional till		Minimum-till	No-till
mo/day	No Residue	<30% Cover	30 to 60% Cover	>60% Cover
4/27	Disk Plow	----	----	----
5/16	----	----	----	Roundup
5/23	Disked	Disked	Undercut	----
6/7	----	Undercut	Roundup	Roundup
7/11	Roundup	Roundup	Roundup	Roundup
8/9-11	Roundup	Roundup	----	----

H1-B, Spring wheat-winter wheat-sunflower cropping system

B1. Spring wheat crop plots-schedule of operations for each tillage system.

Date mo/day	Conventional-till	Minimum-till	No-till
4/16	Applied 30,60,90 lbs N/ac	Broadcast as 34-0-0 across tillages	
4/28	----	----	Roundup
4/30	----	Undercut	----
5/5	Disked	----	----
5/5	Seeded Butte 86 and Stoa with HB-1000 disk drill (7-inch spacing)		
6/1	Sprayed with Brominal ME4(1/2 pt) and Hoelon (2 1/4 pts)		
7/25-28	- - - - - - Hand Harvest samples were obtained - - - - - - - -		
7/29	- - - - - - - - - - Combine Harvest - - - - - - - - - - - - - -		
8/9	- - - - - - - - - - Sprayed with Roundup- - - - - - - - - - - -		

B1 Spring wheat grain yields in the spring wheat-winter wheat-sunflower rotation as influenced by tillage system, N-rates, and spring wheat cultivar grown.

Spring wheat grain yield data (1988) for continuous cropping

Cultivar	Rate of Nitrogen	Conv-till	Min-till	No-till	Avg.
	lbs N/ac	- - - - - - - - - bu/ac - - - - - - - -			
Butte 86	30	0.7	1.3	1.1	1.0
	60	1.2	0.8	1.5	1.2
	90	0.8	1.4	1.7	1.3
	Avg.	0.9	1.2	1.4	1.2
Stoa	30	1.2	1.2	1.1	1.2
	60	1.1	0.7	0.8	0.9
	90	0.9	1.1	1.2	1.1
	Avg.	1.1	1.0	1.0	1.1
Avg (Tillages)		1.0	1.1	1.2	

B2. Winter wheat plots - schedule of operations for each tillage system following spring wheat-continuous cropping.

Date mo/day	Conventional-till	Minimum-till	No-till
8/19 (87)	Roundup	Roundup	Roundup
9-2 (87)	Undercut	Undercut	---
9/15 (87)	Seeded Roughrider and Norstar winter wheat with HB-1000 no-till drill		
4/16 (88)	Applied 30,60, and 90 lb N/A broadcast as 34-0-0		
5/21	Sprayed Brominal ME-4 (5 oz ai/a) plus 2-4D (5 oz ai/ac)		
7/7	- - - - - - Hand Harvest Samples Obtained - - - - - - -		
7/15	- - - - - - Combine Harvested all Plots - - - - - - - -		
7/16	Roundup	Roundup	Roundup

B2. Winter wheat grain yields (1988) in the spring wheat-winter wheat-sunflower rotation as affected by tillage system, N-rates and cultivar grown.

Cultivar	Rate of Nitrogen	Conv-till	Min-till	No-till	Avg.
	lbs N/ac	- - - - - - - - - bu/ac - - - - - - -			
Roughrider	30	4.6	5.5	3.6	4.6
	60	5.0	5.5	3.8	4.8
	90	4.1	4.1	2.0	3.4
Avg.		4.6	5.0	3.1	4.3
Norstar	30	7.6	6.1	2.8	5.5
	60	3.7	5.0	2.7	3.8
	90	3.3	4.4	2.1	3.3
Avg.		4.9	5.2	2.5	4.2
Avg (Tillages)		4.7	5.1	2.8	

B3. Sunflower plots - schedule of operations for each tillage system following winter wheat-continuous cropping.

Date mo/day	Conventional-till	Minimum-till	No-till
9/9/87	----	----	Surflan (1.25 lb ai/ac)
4/16/88	Applied 30,60, or 90 lb N/ac broadcast as 34-0-0		
4/21	Undercut + Treflan	Undercut + Treflan	----
5/16	Disked	Undercut	Roundup
5/17	Seeded Agrapro 3900 and 2057 Cultivars with IH800 Cyclo-Seeder		
7/5	Received hail damage on Rep 3 (10 to 15% loss of heads)		
9/14	- - - - - - - Hand harvest samples obtained - - - - - - -		
10/11	- - - - - - - - - - Combine harvested - - - - - - - - - -		

B3. Sunflower seed yield data (1988) in the spring wheat-winter wheat-sunflower rotation as affected by tillage system, N-rates and cultivar grown.

Cultivar	Rate of Nitrogen	Conv-till	Min-till	No-till	Avg.
	lbs N/ac	- - - - - - - - - lb/ac - - - - - - - -			
AgP 2057	30	710	820	790	770
	60	840	940	900	890
	90	830	1040	1050	970
	Avg.	790	930	910	880
AgP 3900	30	680	730	650	890
	60	800	900	820	840
	90	940	990	900	940
	Avg.	810	870	790	820
Avg. (Tillages)		800	900	850	

C1. It was a bad year for plant diseases at the cooperative research farm. Under such dry conditions the plants were stunted. The leaves were yellowing from the lack of water and heat stress. This made it difficult to distinguish between heat stress or drought stress symptoms and disease symptoms. Although plants were not rated for foliar diseases, leaves were collected and processed in the lab to identify the disease organisms present. The fungi that cause tan spot and septoria leaf spot were present on over 50% of the samples processed indicating that the fungi that cause the foliar diseases were present in spite of the drought.

Although the fungal spore traps were working all summer, few spores were collected. This information can be compared to data collected during a more normal year. Environmental data were also collected from the plots. This information will document the heat stress and drought conditions and will be used for future comparisons.

D1. Study of Wheat Root Growth, Aboveground Development, and Water Use as Affected by Tillage/Residue Management. (S.D. Merrill, A. L. Black)

A system of root observation tubes and video technology was used in continuous cropping system spring wheat to observe root growth. Low subsoil water resulting from previous sunflowers extraction was coupled with severe late spring and early summer drought to limit root growth and penetration. Conventional disk tillage with lower residue resulted in significant root penetration to approximately 2 1/2 feet while zero-tillage plots showed penetration to 3 1/2 feet (Table 1). Severe drought resulted in abortion of almost all tillers, and water and thermal stresses allowed only a fraction of florets to develop grains. This degenerative process was significantly greater in conventional-till plots compared to no- or minimum-till (Table 2). Very low aboveground growth means low amounts of residue, raising the potential for disaster in 1989 (Table 3).

D2. Wind Erodibility Hazard of Wheat Summerfallow Ground Affected by Tillage/Residue System. - S. D. Merrill, A. L. Black

Soil surface properties, that according to current scientific theories will predict wind erosion hazard, were measured in the fallow-phase of the spring wheat-summerfallow cropping system during 1988. A low-residue treatment, in which burning or multiple tillage is used, has been added to the conventional, minimum, and no-till treatments of the Cropping Systems Experiment. The generally greater aggregate sizes measured for minimum and no-till surface soils is indicative of lesser wind erodibility hazard (Table 4).

Table 1. Distribution of root length with soil depth observed 41 to 53 days after seeding in 1988.

Depth below soil surface	Tillage System - Conventional	Minimum	No-till
feet	%		
0.00 - 0.36	0.06	0.58	1.51
0.36 - 0.64	12.53	11.36	8.95
0.64 - 0.92	17.91	11.93	16.32
0.92 - 1.21	15.38	7.58	16.71
1.21 - 1.49	17.85	16.01	15.12
1.49 - 1.78	15.51	16.44	15.75
1.78 - 2.20	11.54	11.66	7.26
2.20 - 2.35	7.02	5.28	7.44
2.35 - 2.63	1.50	12.83	3.79
2.63 - 2.91	0.65	4.95	3.60
2.91 - 3.20	0.00	1.32	2.43
3.20 - 3.48	0.00	0.00	0.79
3.48 - 3.77	0.00	0.00	0.26
3.77 - 4.05	0.00	0.00	0.00
4.05 - 4.34	0.00	0.00	0.00

Table 2.

Tillage system	Total aboveground material midseason(1)	Total aboveground material final(2)	Grain yield	Total residue available	Harvest index(3)
	-lbs/ac-				%
Conventional	285	282	29	253	10
Minimum	359	343	60	283	17
No-till	442	385	71	315	18

(1) On 6/23/88, 48 days after seeding.
(2) On 7/25/88, 80 days after seeding.
(3) Grain yield as percentage of total aboveground material.

Table 3.

Tillage system	Plant population	No. heads	Kernel weight	Kernels per head	Grain yield
	$no./m^2$	$no./m^2$	mg(1)		bu/ac
Conventional	228	84	19.8	1.9	0.48
Minimum	226	109	15.5	3.9	0.99
No-till	275	100	17.7	4.5	1.18

(1) milligrams

Table 4. Average aggregate size measured by rotary sieving of dried surface soil samples. (Data shown are the calculated geometric mean diameters in mm).

Date	Day of year	Burned or multiple tillage	Conventional undercutting or disk tillage	Minimum undercutting tillage	No tillage	Averages
26MAY88	147	3.84	2.14	3.98	7.42	4.46
08JUN88	160	1.93	3.98	3.69	21.39	7.75
29JUN88	181	5.08	1.54	3.20	17.69	6.88
06JUL88	188	3.47	3.02	3.87	6.55	4.25
28JUL88	210	3.99	7.46	18.24	24.72	13.60
05AUG88	218	11.86	2.54	4.24	5.91	6.14
25AUG66	238	2.06	2.33	2.72	4.04	2.79
20SEP88	264	3.92	2.53	5.34	3.54	3.83
18OCT88	292	2.57	4.18	4.53	5.02	4.08
Averages		4.35	3.36	5.63	10.91	6.09

H2. The previous crop in this field was winter wheat in 1987 followed by sunflowers in 1988. The field received no fall tillage and was first undercut April 21, 1988 with TR-10 Treflan granules applied simultaneously with a Gandy-granular applicator at a rate of 1.0 lb ai/ac. A second undercutter tillage was performed May 12 and four sunflower varieties were seeded May 18, 1988 with the IH 800 unit-row cyclo-seeder with 50 lbs N/ac banded 3 inches beside the row. The sunflower was sprayed with Scout (7.5 oz/ac) July 26, 1988 which effectively controlled insects. The four sunflower varieties were combine harvested October 19, 1988 and the yields are as follows: Agripro 3900 = 1020 lb/ac; Agripro 4200= 850 lb/ac.; Dahlgren 725 = 980 lb/ac and Dahlgren 855 = 830.

H3-4 The previous crop in 1987 was sunflower varieties so the field was cropped to spring barley 'Bowman' in 1988. The field was undercut April 26, 1988 and the barley was seeded with a disk-drill tandem operation May 9, 1988. The barley was swathed on August 10 but only a small portion of the field was combine harvestable on August 18, 1988. We only obtained 140 bu from this field which resulted in an average yield of 3.5 bu/ac. The field was sprayed with Landmaster (50 oz/ac) August 24, 1988 which effectively controlled all vegetative growth of the barley and weeds. This spray operation made it possible to conserve enough soil water in the upper foot of soil to obtain a successful stand of winter wheat seeded Sept. 23, 1988.

H5 Corn was planted on May 13, 1988 with an International Early Riser Cyclo Air Planter in 36-inch spacing. Final plant population was 14,250 plants per acre (35,880 per hectare). Because of persistent above-average air temperatures during much of the growing season coupled with below average seasonal rainfall, and some hail at tasseling stage, no ears were produced. The total dry matter yield harvested on August 15 is shown in Table 1.

Corn usually will remove water to depths greater than 30 inches. The relatively shallow rooting depth in 1988 is, at least in part, attributed to lack of development of brace roots.

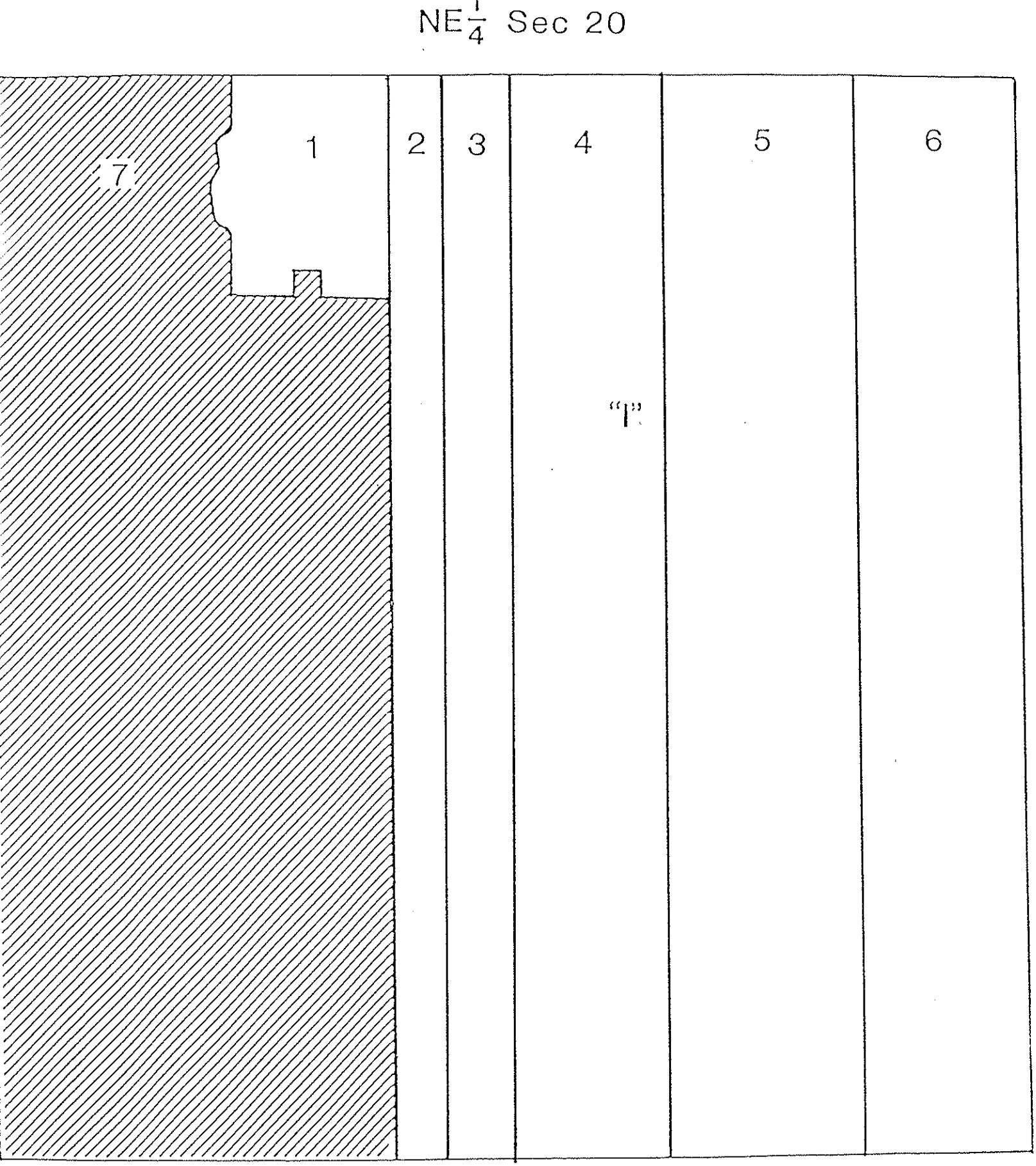
Table 1. Total dry matter and equivalent silage yields of corn as affected by soil surface residues and nitrogen (N) levels.

Residues	N level lbs/ac		Dry matter lbs/ac	Silage (70% H20) tons/ac
<30%	60		1603	2.67
(disk)	120		1969	3.28
	200		1920	3.20
		Avg.	1830	3.05
30-60%	60		1832	3.05
(undercutter)	120		1551	2.59
	200		2134	3.56
		Avg.	1838	3.06
>60%	60		1620	2.70
(no-till)	120		1498	2.50
	200		1679	2.80
		Avg.	1600	2.67
	60	Avg.	1684	2.81
	120	Avg.	1673	2.79
	200	Avg.	1911	3.19

The soil water content change from May 13 to August 17 to 66-inch soil depth is shown in Table 2.

Table 2. Soil water content difference between harvest and planting under corn as affected by soil surface residues and nitrogen (N) levels.

Residues	N Level lbs/ac		0-6	6-12	12-18	18-30	30-42	42-54	54-66
					inches available water				
<30%	60		0.60	0.51	0.39	0.10	-	-	-
(disk)	120		0.56	0.54	0.44	0.43	-	-	-
	200		0.55	0.56	0.43	0.25	-	-	-
		Avg.	0.57	0.54	0.42	0.26	-	-	-
30-60%	60		0.70	0.63	0.53	0.47	0.01	-	-
(undercutter)	120		0.62	0.56	0.40	-	-	-	-
	200		0.63	0.54	0.44	0.21			
		Avg.	0.65	0.58	0.46	0.23	-	-	-
>60%	60		0.62	0.57	0.44	0.23	0.02	-	-
(no-till)	120		0.69	0.65	0.49	0.14	0.02	-	-
	200		0.61	0.54	0.43	0.02	-	-	-
		Avg.	0.64	0.59	0.45	0.13	0.01	-	-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I. NE 1/4 Sec 20 - Research Activities.

IA 1988 NAPP - In this, the second year of a planned 3-year study, Alex spring wheat was planted on April 27, in an area cropped to wheat in 1987, with a press drill preceded by a double-disk, in 6-inch spacing to a depth of about 1.5 inches. The treatments were: two water levels-dryland and supplemental water, and two nitrogen levels--80 and 140 pounds N (as NO_3) per acre, to a depth of four feet plus fertilizer nitrogen from ammonium nitrate (34-0-0). The nitrogen was applied as a split application between planting and specific plant development stages. (All N was present at planting in one treatment.)

Data of seedling (at 3-leaf stage) and head population, grain yield and kernel weight are provided in Table 1. Protein analysis is not complete.

Table 1. Effect of timing of application of nitrogen on agronomic characteristics of spring wheat with two levels of water (W_1 and W_2).

Nitrogen 1/ lbs N/ac					MEASUREMENT: Seedlings no/m2		Heads no/m2		Yield bu/ac		Kernel mg	
P	5	F	H	A	W1	W2	W1	W2	W1	W2	W1	W2
80					166	158	236	338	13.3	21.3	22.0	24.6
80		30*			164	153	236	429	12.7	20.8	22.2	22.1
80			30*		163	152	225	495	12.9	21.9	22.3	22.0
80				30*	149	158	224	416	13.4	22.9	23.4	23.5
40	40				162	152	228	399	13.6	20.1	23.2	23.1
40	40	30*			148	147	229	427	14.6	20.9	22.9	20.9
40	40		30*		155	156	239	462	15.2	21.2	23.4	22.0
40	40			30*	154	158	244	455	15.5	21.9	22.8	21.3
40	40*				156	155	214	429	12.8	20.4	23.6	22.8
40		40			161	163	215	438	12.7	20.1	23.2	22.2
40		40	30*		157	142	215	318	12.1	16.7	23.4	23.3
40		40		30*	154	153	198	310	11.2	15.1	22.6	24.5
140					158	150	222	382	11.7	16.8	21.3	20.8
140		30*			149	151	224	408	11.5	17.3	21.8	20.4
140			30*		150	161	216	454	11.3	16.2	21.6	18.1
140				30*	154	156	233	514	12.0	15.6	21.8	19.9
80	60				155	123	224	382	12.4	16.9	21.2	18.7
80	60	30*			139	138	195	405	12.2	13.2	21.1	18.6
80	60		30*		144	148	229	504	11.4	13.1	21.7	18.3
80	60			30*	142	138	231	457	10.7	15.2	23.0	20.1
80	60*				148	138	216	342	10.8	8.2	21.8	18.9
80		60			139	160	230	405	11.6	14.6	21.7	21.3
80		60	30*		146	159	219	404	10.8	16.2	21.5	20.9
80		60		30*	157	146	204	304	11.2	17.7	21.4	23.6

*Liquid (Ni-Sul)

1/ Present at planting (P) to four feet; amount applied at 5-leaf (5), flag leaf (F), heading (H), and flowering (A) stage.

The portion of the experiment which received supplemental water (W_2) was severely infected with foxtail. Samples were removed from these plots and the wheat and foxtail dry matter were measured separately. These data are shown in Table 2.

Table 2. Dry matter yield of wheat and foxtail where supplemental water (W_2) was applied.

Treatment				Dry Matter		Ratio
P	5	F	A	Wheat	Foxtail	Wheat/Foxtail
lbs N/ac				Tons/ac		
80				1.7	0.3	5.3
80			30	2.1	0.5	4.5
40	40		30	2.3	0.7	3.2
40		40	30	1.3	0.8	1.5
			Avg.	1.9	0.6	
140				1.8	1.1	1.6
140			30	2.5	1.1	2.1
80	60		30	2.0	1.5	1.3
80		60	30	1.3	1.2	1.0
			Avg.	1.9	1.2	

1/ P=Planting, 5=5 Leaf, F=Flag Leaf, A=Anthesis (flowering).
2/ Liquid.

IB Fields I3 and I5 were cropped to spring wheat in 1988 using a double-disk drill combination till-plant system with 60 lbs of 18-46-0 with the seed. A portion of field I3 was seeded to spring wheat variety 'Amidon' and the remainder to Butte 86 on April 27, 1988. The Amidon spring wheat yielded about 11 bu/ac despite some spray damage from roundup drift from adjacent fallow at heading. All of the spring wheat variety Amidon was saved for seed in 1989 as a replacement for Stoa. These fields were sprayed May 28, 1988 with Brominal (1/2 pt) and Hoelon (2 1/4 pts). The two fields were straight-combine harvested July 28, 1988 averaging 12 bu/ac, 16.5% protein and 58 lb/bu test weight.

IC Fields I1, I4, and I6 were summer fallowed in 1988. All three fields were undercut May 24, 1988. On June 17-18, 1988 various segments of these fields were sprayed using a surfacant and 17 lb of ammonium sulfate per 100 gallons of water in the tank as follows: I2 field, Landmaster BW (38 oz formulation/ac) to one-half of the area and Landmaster II (34 oz formulation/ac) on the other half; I4 field, Landmaster BW (38 oz formulation/a) on other half; I6 field, Landmaster II (40 oz formulation/a) on half of area and Landmaster II (46 formulation/a) on other half. Fields I2, I4 and I6 were sprayed again July 18-19, 1988 with Landmaster II (40 oz formulation/a). Fields I2, I4, and I6 were sprayed again August 25-26, 1988 with Landmaster II (40 oz formulation/a). These products all provided excellent weed control (ask your dealer which product and rate was most economical).