1990 Research and Cropping Results

Seventh Annual Progress Report

February 21, 1991

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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.

<u>NOTICE</u>

Acknowledgment

USDA-ARS and Area IV SCD recognize the contributions made to this research program by the following cooperators: Elanco Products Co.; Monsanto Agr. Products Co.; Dahlgren and Co.; AgriPro, Inc.; Sigco Research Inc.; Hoechst-Roussel Agri-Vet Co.; NDSU-Agricultural Experiment Station, and NDSU-Cooperative Extension Service.

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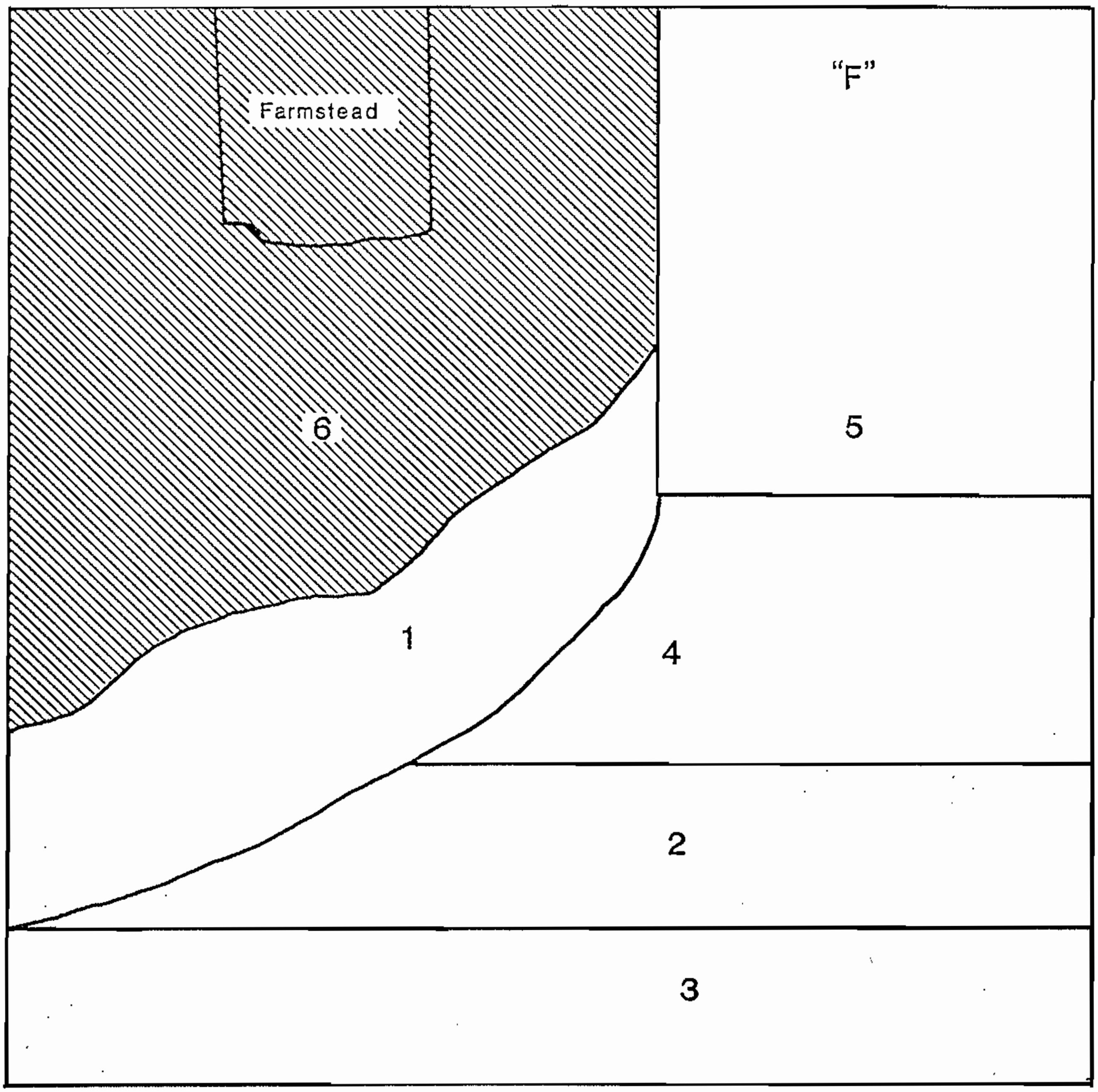

F. NW 1/4 Section 17 - Research Activities

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

F2. The previous crops in 1989 were spring wheat (Butte 86 and Waldron) and spring barley (Bowman) which provided 3 different stubble sources, in 2-replications, for no-till seeding of winter wheat. Winter wheat varieties Roughrider, Norstar and Winalta were seeded no-till Sept. 19, 1989 into each spring grain variety stubble. This study was initiated in 1986 to provide Dr. Krupinsky the opportunity to study disease cycles in a cropping sequence with disease-susceptible and disease-resistant winter wheat and spring grain cereal crops in a no-till system. Unfortunately, continuing drought conditions (no rainfall March to May 26) in 1990 were unfavorable for leaf spot disease development. Also, leaf damage from drought has been a major confounding factor in making disease observations the last 3-years. The winter wheat varieties yielded about 15 bu/ac, 58 lbs/bu with 16.0% protein. (Joe Krupinsky and Al Black)

F3. The previous crop was winter wheat. The winter wheat stubble was undercut April 18, 1990 as Treflan granules were simultaneously applied at a rate of 0.8 lb ai/ac with a front-mounted Gandy granular applicator. The field was undercut again May 21, 1990 for the second operation to incorporate the Treflan and control existing weeds. Three sunflower varieties (ST-330), ST-317 and D0838) were seeded May 24 with the 800 Cyclo-unit row planter at a seeding rate of 21000 seeds/ac and with 30 lbs N/ac banded beside the row. Since rainfall during April-May was not sufficient to wet the Treflan-treated soil zone (upper 2-inches), the Treflan granules did not dissolve soon enough to allow proper incorporation and activation to adequately control weeds. Therefore, Kochia and Russian thistle were not properly controlled. Sunflower seed yields were so poor (100 lbs/ac, or less) that custom combine costs ($12.00/ac) could not be recovered. Therefore, the field was tandem disked at a shallow soil depth to chop the weeds and sunflower and keep weeds from tumbling across other fields (including the neighbors) whenever the wind blew.

F4. The previous crop was sunflower in 1989. This field received a commercial broadcast application of 30 lbs N/ac April 21, 1990. Spring barley 'Bowman' was seeded May 3 at a rate of 75 lbs/ac with 35 lbs 18-46-0 applied with the seed. The barley was sprayed with a mixture of 2,4-D ester and Buctril (6 oz ai/ac each) on June 9 and the crop was harvested Aug. 1, 1990. The barley yielded 36 bu/ac and had a test weight of 44 lb/bu. Seed from this field was sold at a premium to Heartland Elevator along with Bowman barley harvested from Field G2 for $1.90/bu.

On August 23, 1990, we established a subsoiling experiment in this field using the Tye Paratiller operated at a 19-inch depth on 20-inch centers. Eight plots (50-by 100 ft) were established to provide 4 replicates of paratilled (subsoiled) and non-subsoiled plots. An old plow-pan (2- to 3-inches thick) was found at a depth of 9-inches. We no-till seeded these plots and the remainder of this field to winter wheat on Sept. 18, 1990 using the Haybuster no-till drill with 50 lbs/ac of 18-46-0 applied with the seed. Access tubes have been installed to measure soil water by the neutron meter technique. This is our first study on soil compaction as a possible factor affecting crop yields. (Black, Bauer and Merrill)

F5. ARS Land Lease - A major portion of this field area was planted to 4 varieties of sunflower (SIGCO-442, SIGCO-452, DO-838 and ST317) following application and the undercut-undercut system of incorporation of Treflan applied at a rate of 0.8 lb ai/ac. The varieties were seeded May 29, 1990 and 30 lb N/ac was side-banded beside the row at the time of seeding. This field had previously been cropped to spring wheat for 12 years as part of the stubble height management work relating to snow trapping and water conservation published by Bauer and Black. Therefore, this field had not had a deep rooted crop like sunflower grown on it in the past 12 years. Subsoil water in the 4- to 6-foot depth was the primary reason this sunflower field yielded 700 to 800 lbs/ac, while fields with sunflower in 1987 had no subsoil water because of the 1988, 1989, and 1990 drought years and produced less than 200 lbs/ac.

ARS Land Lease (variety trials) - Variety comparison trials with spring wheat have been conducted at this site since 1979. Barley varieties have been included since 1983. The varieties are planted on summerfallow with a press drill in tandem with an offset disk. Row spacing is six inches and planting depth about 1.5 inches. Planting rate of all varieties is one million viable seeds per acre based on kernel weight, germination percentage, and kernel water concentration.

Data of various measurements made are shown in Table 1. Note that all weights are expressed on an oven-dry-basis. Grain yields on a field-run basis would be about 12% higher than shown.

Barley varieties Bowman, Gallatin, and Hector are the two-row type and the others are six-rowed. Note the difference in the number of heads (HEA) and kernels per head (KPH) between these two barley types.

Available soil water by date and plant development stage in foot increments to six feet are shown in Table 2 and Table 3 for wheat and barley, respectively, and as well the rainfall quantity between soil water measurement dates. It appears that wheat used more water from the soil than barley, primarily because there apparently was more soil water associated with the

Table 1. Variety characteristic comparisons of spring wheat and spring barley, Mandan, 1990.

Variety	POP no/m²	HEA no/m²	WHE %	HES no	HGT in	TEW lbs/ac	YIE bu/ac	STR lbs/ac	YIM bu/ac	KPH no	TKW mg	NEG [4/] %
	Measurement [1/]											
Amidon	230	443	3.2	1.9	37	61.7	41.3	5086	49.2	30.3	25.51	2.91
Butte 86	210	465	1.4	2.2	34	62.5	45.1	4462	48.7	26.1	27.35	3.00
Cutless	234	479	3.1	2.0	34	62.3	40.9	4754	44.8	25.5	25.51	2.93
Grandin	217	422	2.0	1.9	34	61.9	46.9	4551	49.9	28.4	28.56	3.08
Gus	241	490	1.5	2.0	33	61.5	48.0	4463	53.2	28.8	25.82	3.22
Marshall	257	452	2.5	1.7	31	60.4	50.8	4591	55.1	35.3	23.81	3.03
Nordic	255	446	3.5	1.7	33	61.2	55.6	5193	59.5	31.1	29.98	2.66
Stoa	219	442	1.7	2.0	34	62.7	51.1	4694	50.0	28.0	28.73	3.14
Vance	193	389	2.9	2.0	30	58.0	40.9	4112	43.5	29.9	26.42	3.12
LSD	24	NS	1.2	NS	1.6	0.6	2.5	542	6.8	4.0	1.27	0.11

Variety	POP [2/] no/m²	HEA no/m²	HES no	HGT in	TEW lbs/bu	YIE bu/ac	STR lbs/ac	YIM bu/ac	TKW mg	KPH no	NEG [4/] %
Azure	215	372	1.8	33	47.3	44.5	3689	64.3	33.35	28.0	2.53
Bowman	235	579	2.5	29	50.3	41.4	3706	52.5	41.67	11.7	2.74
Gallatin	175	519	3.1	30	47.6	45.6	3500	56.1	32.39	18.0	2.65
Hector	190	605	3.3	34	48.2	42.2	3986	62.0	34.85	15.9	2.71
Robust	230	309	1.4	34	47.2	27.5 [3/]	3407	63.6	33.22	33.3	2.79
Morex	167	307	1.9	33	46.9	33.5 [3/]	3224	56.8	30.63	32.5	2.62
LSD	NS	71	0.7	2	0.7	4.2	382	8.2	0.50	2.6	NS

[1/] POP - Plant population, pre-three leaf stage. ($no/m^2 * 0.836 = no/yd^2$)
HEA - Total heads (includes those that were white).
WHE - White heads.
HES - HEA/POP.
HGT - Height at harvest.
TEW - Test weight.
YIE - Grain yield, combine sample.
STR - Straw yield, from square meter samples.
YIM - Grain yield, from square meter samples.
KPH - Kernels per head, calculated from HEA, YIM, and TKW from YIE.
TKW - 1000-kernel weight, combine sample.
NEG - Nitrogen concentration in grain, combine sample.
(All weights are expressed on an oven-dry basis.)

[2/] Variable because of non-uniform germination.

[3/] Two rows were inferior for reasons not determined.

[4/] Multiply %N in wheat by 5.016 and %N in barley by 5.5 to convert to % protein at 12% kernel water content.

Table 2 . Available soil water by foot increments to six feet and rainfall between dates of soil water measurements on Amidon spring wheat, 1990.

Planted	April 24
Emerge	May 8
Harvest (m^2)	July 27
Harvest (combine)	Aug 2

Date mo/day	DS 1/	Soil depth (feet) 0-1	1-2	2-3 inches water	3-4	4-5	5-6	Rain inches
								0.04
5/03	-	1.19	1.19	1.41	1.31	1.59	1.39	
								0.16
5/15	1.2	1.19	1.24	1.48	1.37	1.59	1.42	
								0.79
5/23	2.3	1.47	1.26	1.48	1.39	1.59	1.44	
								0.95
5/29	3.5	1.88	1.32	1.47	1.42	1.65	1.46	
								0.94
6/04	4.8	2.19	1.39	1.49	1.41	1.63	1.46	
								0.16
6/11	6.3	0.96	1.27	1.51	1.45	1.69	1.47	
								1.85
6/20	8.2	2.17	0.95	1.36	1.40	1.64	1.46	
								0.00
6/26	9.7	0.83	0.75	1.21	1.34	1.62	1.47	
								1.22
7/05	12.2	0.32	0.41	0.78	1.17	1.60	1.42	
								0.00
7/09	13.2	0.08	0.25	0.57	1.03	1.64	1.50	
								0.71
7/16	14.0	-0.04	0.12	0.36	0.72	1.55	1.47	
								0.04
7/23	15.1	-0.17	0.03	0.23	0.54	1.50	1.48	
								0.00
7/30	16.0	-0.26	0.02	0.19	0.42	1.48	1.50	
	"Used"	1.45	1.17	1.22	0.89	0.11	-0.11	6.86

1/ Development stage, expanded Haun scale, estimated from regression of growing degree days.

Rain = 6.86 inches
(5/03-7/30) Soil water use (4 ft) = 4.73
11.59 inches

Table 3. Available soil water by foot increments to six feet and rainfall between dates of soil water measurements on Azure barley 1990.

Planted	April 24
Emerge	May 7
Harvest (m^2)	July 20
Harvest (combine)	July 27

Date mo/day	DS 1/	Soil depth (feet) 0-1	1-2	2-3 inches water	3-4	4-5	5-6	Rain inches
								0.04
5/03	-	0.85	0.60	1.08	1.24	1.43	1.59	
								0.16
5/15	1.5	0.80	0.67	1.13	1.34	1.47	1.60	
								0.79
5/23	2.7	1.02	0.69	1.13	1.32	1.48	1.57	
								0.95
5/29	4.0	1.33	0.70	1.18	1.36	1.50	1.66	
								0.94
6/04	5.3	1.66	0.68	1.16	1.35	1.50	1.63	
								0.16
6/11	7.0	0.32	0.54	1.17	1.39	1.51	1.62	
								1.85
6/20	9.0	1.50	0.32	1.01	1.32	1.49	1.60	
								0.00
6/26	10.5	0.19	0.24	0.91	1.29	1.49	1.61	
								1.22
7/05	11.7	-0.06	0.12	0.64	1.14	1.45	1.60	
								0.00
7/09	12.5	-0.18	0.02	0.49	1.06	1.51	1.65	
								0.71
7/16	13.8	-0.24	-0.03	0.39	0.91	1.46	1.62	
								0.04
7/23	14.2	-0.29	-0.05	0.37	0.85	1.46	1.63	
								0.00
7/30	15.0	-0.32	-0.05	0.36	0.86	1.48	1.62	
	"Used"	1.17	0.65	0.72	0.38	-0.05	-0.03	6.86

1/ Development stage, expanded Haun scale, estimated from regression of growing degree days.

	Rain =	6.86 inches
(5/03-7/30)	Soil water use (4 ft) =	2.92
		9.78 inches

wheat plots--at least that is what was measured. Based on water removed from the soil at the 4-5 foot depth, it appears wheat roots went deeper than barley roots in 1990.

Water use and yield from these variety trials conducted over the years and data from eight trials conducted in 1979-1980-1981 were evaluated to estimate the grain yield response to an inch of water after the initial yield point (IYP) water requirements were met. The IYP is the quantity of water used in evapotranspiration (the sum of water lost from the soil by evaporation and transpiration from the crop) before grain is produced. The IYP is not constant from year to year, so we used 4.0 inches in our calculations. The information is shown in Table 4. (Bauer & Black)

An article will be published in North Dakota Farm Research, January-February 1991 which provides more discussion than is presented here.

Table 4. Spring wheat and barley agronomic characteristics, water use, and grain yield per inch of water used in evapotranspiration after the initial yield point (IYP) at North Dakota sites, 1979-1990.

Year	Site	Heads	Kernel weight	Kernel/head 3/	Yield 2/	Rain 9/	Soil 10/ water	Grain yield 11/ per inch water
		Agronomic characters						
		no/yd^2	mg	no	bu/ac	inches	inches	
				WHEAT				
1979	Winter	312	29.66	21.3	35.2	5.65	5.43	4.8
1979	Marquart 1/	298	35.88	31.6	59.6	6.86	4.47	8.0
1980	Winter	293	35.73	22.5	41.9	8.81	2.97	5.3
1980	Ystaas	489	32.14	16.9	42.7	10.15	2.84	4.6
1980	Marquart 1/	295	33.15	28.0	48.9	3.61	6.27	8.1
1981	Winter 1/	345	26.40	28.4	45.9	10.06	3.66	4.6
1981	Ystaas	395	30.02	18.5	38.6	7.83	3.23	5.3
1981	Marquart 1/	369	29.63	29.7	57.0	12.61	2.17	5.2
1979	Mandan	319	29.99	19.6	33.0	5.92	4.45	5.0
1981	Mandan	445	26.84	20.8	44.4	15.06 4/	1.32	3.5
1982	Mandan	461	29.51	20.9	51.4	8.52	5.49	5.0
1983	Mandan	455	29.68	28.4	39.5	9.68 5/	6.46	3.2
1984	Mandan	375	24.62	29.7	51.1	4.27	7.14 7/	6.8
1985	Mandan	360	30.34	29.2	53.1	9.17	7.78	4.0
1986	Mandan	367	31.36	25.8	47.5	12.00	4.64	3.7
1987	Mandan	353	34.81	23.1	48.9	10.58	3.28 7/	4.9
1988	Mandan	228	26.44	19.4	17.4	3.29	5.38	3.5
1989	Mandan	339	22.33	24.2	31.9	4.53	7.18	4.0
1990	Mandan	374	30.07	29.3	52.3	6.86	4.73	6.8
							Avg.	5.1
				BARLEY				
1983	Mandan	476	34.19	26.5	87.0	9.37 5/	5.33	8.0
1984	Mandan	389	35.39	21.8	66.0	4.27	7.14	8.8
1985	Mandan	401	35.84	23.9	84.2	9.17	7.78 8/	6.2
1986	Mandan	372	41.88	24.4	75.2	11.69	4.34 8/	6.2
1987	Mandan	380	33.15	25.3	79.2	9.48	3.28	8.9
1988	Mandan	495	33.62	8.9	27.0	9.06 6/	5.23	2.5
1989	Mandan	356	24.11	24.7	41.7	4.53	7.18	5.3
1990	Mandan	375	34.35	23.2	49.1	6.86	2.92	8.3
							Avg.	6.8

1/ Durum wheat. All other wheats are hard red spring.
2/ Expressed at 12% water concentration. Yields and kernel weight of each variety trial are an average of all varieties.
3/ Calculated from heads/yd^2, grain yield, and kernel weight.
4/ Includes 7.80 inches of irrigation.
5/ Includes 4.05 inches of irrigation.
6/ Includes 5.77 inches of irrigation.
7/ Access tubes were in barley.
8/ Access tubes were in wheat.
9/ Rainfall recorded at the site from planting to harvest.
10/ Difference in soil water content to 4 feet from planting to harvest.
11/ Bushels/acre/inch in excess of 4 inches water loss by evapotranspiration. The value is the quotient of the grain yield minus one bushel, divided by the sum of growing season rainfall plus soil water removed from planting to harvest, minus 4 inches. Calculation of the value is based on the assumption that 4 inches of water are lost by evapotranspiration to produce one bushel of grain.

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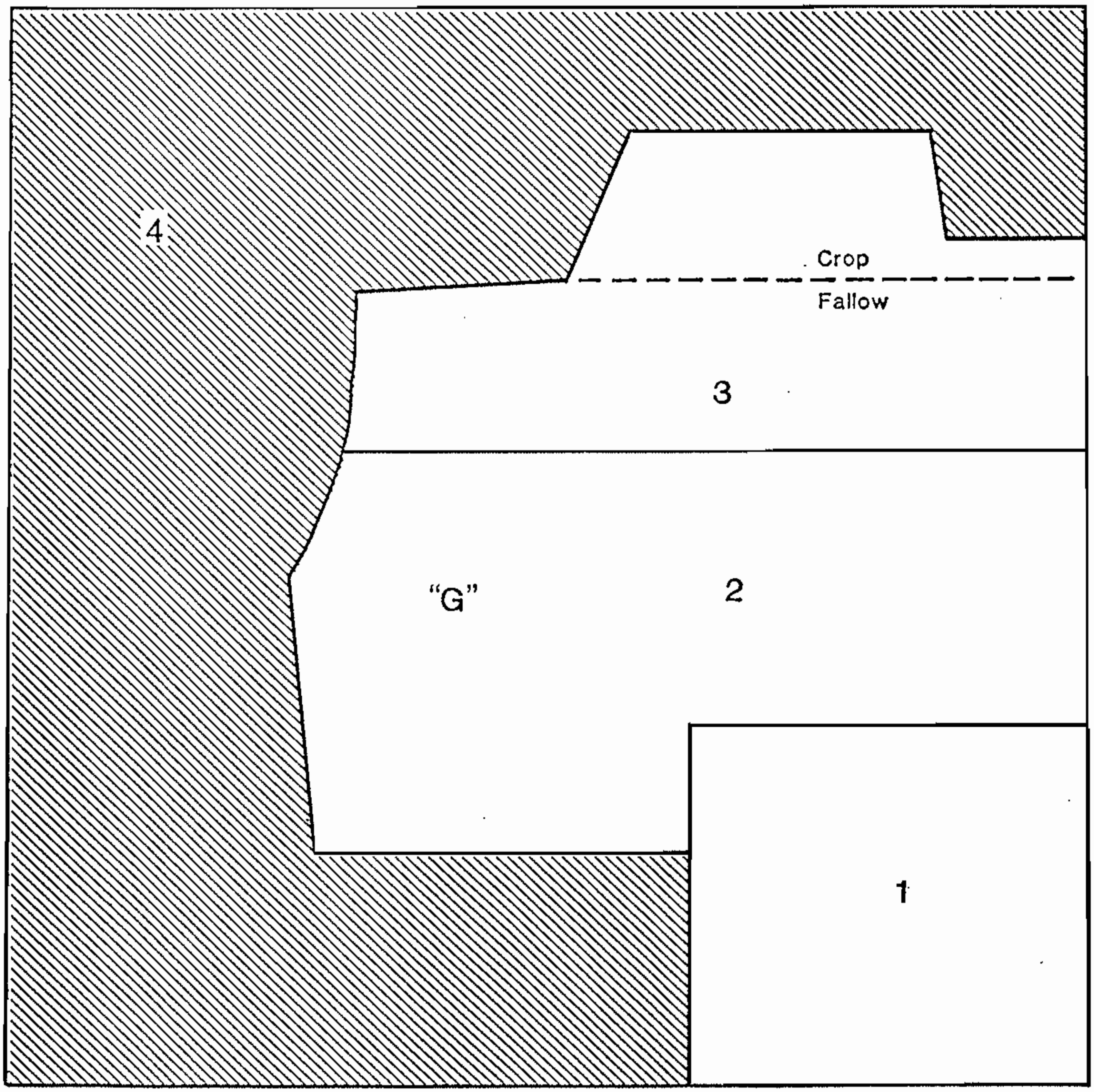

G. SW 1/3 Section 8 - Research Activities

G1. Rich Cunningham - Joe Krupinsky

A. During the period 1983 to 1988, 240 hybrid poplar and cottonwood clones were planted in this area to compare their survival, growth rate, cold and drought hardiness, and pest resistance. Similar field tests have been established on eight other sites in North Dakota and Minnesota. Survival of all clones is scored annually, while total height, crown width, crown density, crown form, crown die-back, and stem diameter are measured every five years at a minimum. Pest incidence is scored whenever significant. The combined effects of the drought suffered the past three years are very apparent in the data collected in 1990. The following table reports the performance of several clones when averaged over several sites. A performance score was calculated by combining each clone's survival, height growth, crown die-back and leaf beetle scores.

CLONE	NAME	SCORE	SURV	HT.	DIE-BACK	LEAF BEETLE
14358	Populus sp. NE-324	259.2	64.6	97.7	386.8	116.3
14189	'Tower'	640.3	94.9	96.2	81.0	69.8
14045	'Siouxland'	646.5	116.7	116.0	93.1	93.0
14041	'Norway'	647.1	114.8	111.0	85.7	93.0
14386	'Imperial'	656.1	118.9	128.6	98.4	93.0
14058	'Robusta'	672.0	113.5	116.9	42.2	116.3
14447	P. Xacuminata Smooth-barked Ctwd.	679.5	104.1	82.0	13.6	93.0
14057	'Dacotah'	701.3	106.3	106.0	18.0	93.0
14178	'Walker'	702.4	118.0	106.2	28.8	93.0
14154	Populus deltoides Wis. (193-4)	709.4	117.9	122.4	37.8	93.0
14165	Populus ? 'Melville'	717.0	134.0	119.1	19.7	116.3
14182	P. delt. x Xpetroskyana'Brooks #2'	720.9	137.2	84.5	7.7	93.0
14520	Populus sp. 'Assiniboine' PX71-130	728.8	103.5	121.0	2.7	93.0
14066	Populus Xjackii 'Northwest'	729.4	136.2	94.4	8.2	93.0
14273	P. deltoides X P. nigra 'Italica'	730.0	127.8	119.2	24.0	93.0
14162	Populus trichocarpa ND (1)	734.4	118.6	90.0	4.4	69.8
14390	Populus sp. OP progeny of 'Walker'	740.2	113.6	131.0	11.4	93.0
14311	P. deltoides Burleigh County	760.8	155.1	108.7	9.9	93.0

B. Cooperative Hackberry Provenance Test - A 26-acre site, immediately west and slightly north of the poplar test site, and not part of the Area IV Research Farm, has been leased from the Nelson estate. This area serves as the site for a Cooperative Hackberry Provenance Test. About 13.5 acres were planted to hackberry trees grown from seed collected at 180 different sites located throughout the Great Plains. The planting stock was grown by the NDASCD's Oakes Nursery, lifted in the fall of 1989, and distributed in the spring, 1990 to test-site cooperators at 16 locations, ranging from Manitoba to Oklahoma and Iowa to Colorado. The Mandan test planting includes all 180 seed sources for a total of 3900 trees. Survival at most sites has been good to excellent. Data will be collected at 5-year intervals for at least 20 years.

G2. USDA-ARS and NDSU Forage Grass Breeding Activities Performed in 1990. (Dr. Ian Ray & Dr. John Berdahl)

Research continues on two western wheatgrass breeding populations that are being evaluated on land made available by the North Dakota Area IV Soil Conservation District. Half-sib progenies of 282 selections from these breeding populations were established in replicated, solid-seeded rows and are being evaluated for stand establishment, forage yield, forage quality components, and seed yield. A study was initiated to determine the effects of nitrogen fertilizer and burning treatments on seed production of western wheatgrass. Other studies were initiated to obtain genetic information on western and crested wheatgrasses that will be used to develop more efficient breeding methods. (Dr. Ian Ray)

Release notices have been prepared for 'Reliant' intermediate wheatgrass and 'Mankota' Russian wildrye. These two grass cultivars were developed by USDA-ARS, Mandan and are being released jointly by USDA-ARS, USDA-SCS, and NDAES. Persistence and sustained productivity of Reliant under hay management have been excellent, and the cultivar is recommended in mixtures with alfalfa for hay in regions of the northern Great Plains where annual precipitation averages more than 14 inches. No grazing data on Reliant are available. Based on the sustained productivity of Reliant in standard performance tests, persistence under grazing is expected to be as good or better than other intermediate wheatgrass cultivars. Russian wildrye is drought resistant and persistent under heavy grazing, but extensive use of this grass has been limited by slow seedling establishment. Mankota has had significantly improved stand establishment capability and forage yields when compared with 'Vinall', the most commonly used cultivar of Russian wildrye in the northern Great Plains region of the United States. Foundation and certified generations of seed increase beyond breeders seed are authorized for Reliant and Mankota. Foundation seed of Reliant will be available by spring 1991, and foundation seed of Mankota is expected to be available by fall 1991 from the USDA-SCS Plant Materials Center, Bismarck, ND. (Dr. John Berdahl)

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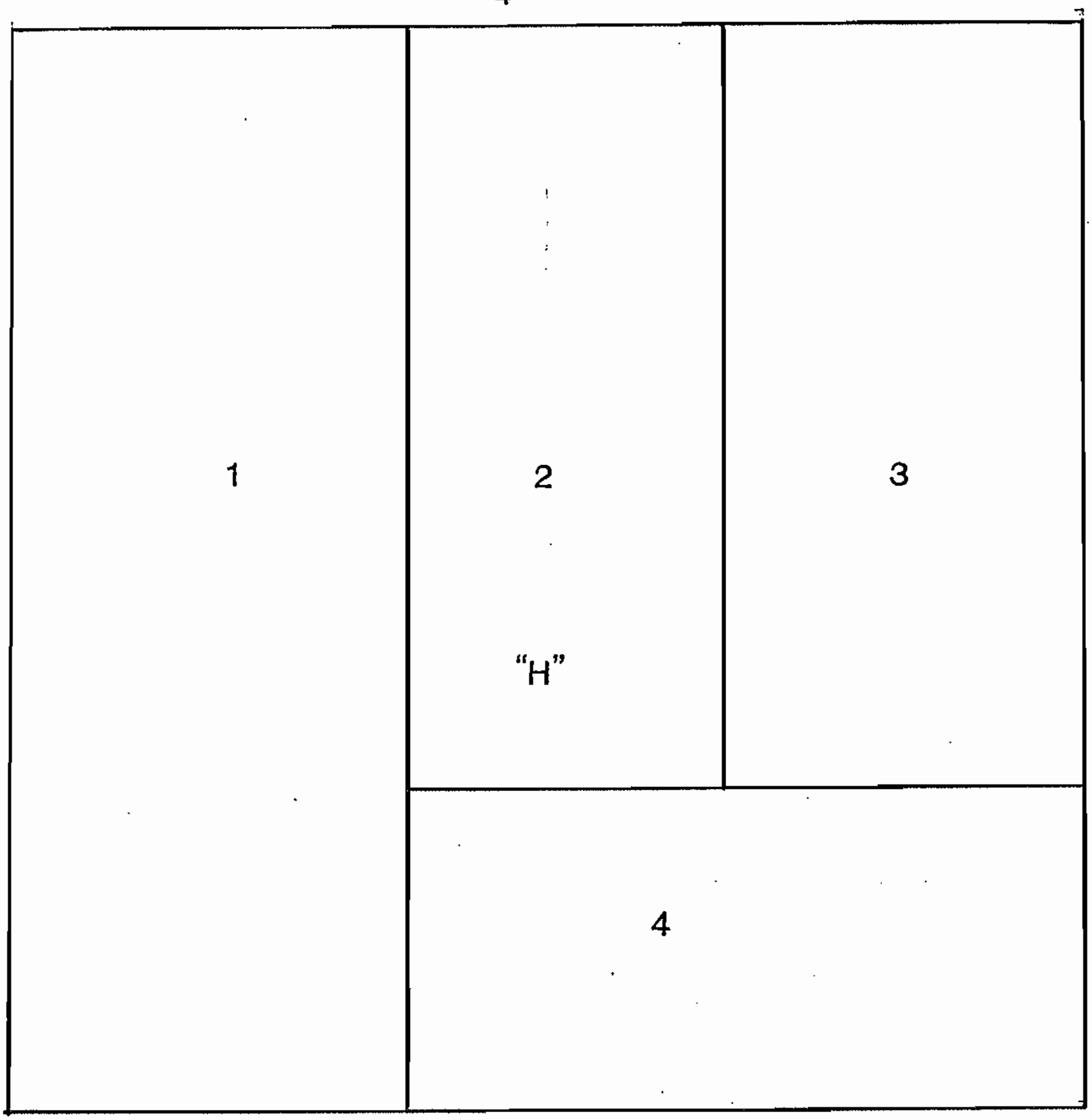


H. NE 1/4 Section 18 - Research Activities

H1-A. Cropping Systems - Conservation Tillage Research Project (65 Acre-Study)

(A1) Spring wheat-fallow (1990 spring wheat crop plots)

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

Date mo/day	Conventional-till No-residue to	Conventional-till <30% Cover	Minimum-till 30 to 60% cover	No-till >60% cover
5/3	Applied 0,20,40 lb N/ac, broadcast as 34-0-0 to all tillage systems			
5/3	Tandem disked	Tandem disked	Undercut	---
5/5	- - - Seeded Butte 86 and Stoa spring wheat in all tillage plots - - -			
6/9	- - - Sprayed all plots with Tiller (12 oz/ac) + Buctril (12 oz/ac)- -			
8/7	- - - - - - - - - - Hand harvest samples (all plots) - - - - - - - - - -			
8/10	- - - - - - - - - - - - - Combine harvested - - - - - - - - - - - - - - - - - -			

(A2) Grain yields of spring (1990) wheat in the spring wheat-fallow rotation as affected by tillage system, N-rates, and cultivar grown.

Spring Wheat Grain Yield Data (1990)

Cultivar	Rate of Nitrogen	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	36.8	33.5	36.0	34.3	35.1
	20	35.1	35.7	33.5	36.7	35.3
	40	33.6	36.2	38.3	38.6	36.7
	Avg.	35.2	35.1	35.9	36.5	35.7
Stoa	0	36.3	37.5	34.9	39.4	37.0
	20	34.3	34.3	39.6	35.7	36.0
	40	33.2	39.5	34.4	38.5	36.4
	Avg.	34.6	37.1	36.3	37.9	36.5
Avg. (Tillages)		34.9	36.1	36.1	37.2	36.1

(A3) Spring wheat-summerfallow with the schedule of operations performed for fallow series plots in 1990 as follows:

Date	Conventional-till		Minimum-till	No-till
mo/day	No Residue	<30% Cover	30 to 60% Cover	>60% Cover
5/17-19	Offset Disk	Tandem Disk	Undercut	Roundup+2,4D
6/18	----	----	Roundup+2,4D	Roundup+2,4D
7/9	Roundup+2,4D	Roundup+2,4D	" "	" "
7/19	" "	" "	" "	" "

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
5/3	- - - - Applied 30,60,90 lbs N/A, broadcast as 34-0-0 - - - -		
5/3	Tandem Disked	Undercut	----
5/5	Seeded Butte 86 and Stoa Spring Wheat (HB-1000 no-till drill)		
6/8	- - - Sprayed Tiller (12 oz/ac) + Buctril (12 oz/ac) - - - - -		
8/6	- - - - - - - - - - Took hand harvest samples - - - - - - - - - -		
8/10	- - - - - - - - - - - Combine harvested - - - - - - - - - - - - -		
8/31	- - - - - - sprayed Roundup + 2,4-D (all plots) - - - - - - - -		
9/17	Tandem Disked	Undercut	----
9/17	- Seeded Roughrider and Norstar winter wheat (HB-8000 drill) -		

B1. Spring wheat grain yields (1990) in the spring wheat-winter wheat-sunflower rotation as influenced by tillage system, N-rates, and cultivar grown.

Cultivar	Rate of Nitrogen	Conv-till	Min-till	No-till	Avg.
	lbs N/ac	- - - - - - - - - -	bu/ac - - - - - - - -		
Butte 86	30	13.2	13.3	14.8	13.8
	60	15.6	15.0	16.7	15.8
	90	15.5	14.5	15.9	15.3
Avg.		14.8	14.3	15.8	15.0
Stoa	30	12.1	12.9	14.2	13.1
	60	12.4	15.5	13.6	13.8
	90	12.1	13.6	15.5	13.7
Avg.		12.2	14.0	14.4	13.5
Avg. (Tillages)		13.5	14.2	15.1	14.3

B2. Winter wheat plots - schedule of operations for each tillage system following spring wheat in the 3-year rotation.

Date mo/day	Conventional-till	Minimum-till	No-till
8/23/89	- - - - -Sprayed Roundup plus 2,4-D (all plots) - - - - - -		
9/15/89	Tandem Disked	Undercut	---
9/18/89	- - - - Seeded Roughrider and Norstar with HB-8000 Drill - -		
5/3	- - - Applied 30,60,90 lbs N/ac, broadcast as 34-0-0 - - - -		
6/1	- - - Sprayed with Buctril (6 oz/ac) + 2,4D (6 oz/ac) - - -		
7/24	- - - - - - - - Took hand harvest samples - - - - - - - - - -		
8/10	- - - - - - - - - - - Combine harvested - - - - - - - - - - -		
9/7	- - Sprayed all plots Roundup (16 oz/ac) + 2,4D (8 oz/ac)- -		
10/24	----	----	Applied Surflan (1.5 lb ai/ac)

B2. Winter wheat grain yields (1990) in the spring wheat-winter wheat-sunflower rotation as influenced 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	18.2	20.3	18.6	19.0
	60	16.5	24.8	19.3	20.2
	90	21.0	25.9	19.1	22.0
Avg.		18.6	23.7	19.0	20.4
Norstar	30	17.3	18.5	17.4	17.7
	60	13.7	20.5	20.2	18.1
	90	18.1	21.3	18.2	19.2
Avg.		16.4	20.1	18.6	18.3
Avg (Tillages)		17.5	21.9	18.8	19.4

B3. Sunflower plots - schedule of operations for each tillage system following winter wheat in the 3-year rotation.

Date mo/day	Conventional-till	Minimum-till	No-till
8/24/89	- - - - - - - - - - - - - - -	Roundup - - - - - - - - - - - - - -	
10/12/89	----	----	Surflan 1.5 (ai/ac)
4/19	Undercut + Treflan	Undercut + Treflan	----
5/3	- - - Applied 30, 60, 90 lb N/ac broadcast as 34-0-0 - - - -		
5/19-20	Tandem disk	Undercut	Roundup + 2,4-D
5/21	- Seeded AgriPro 2057 & 4040 cultivars with IH-800 planter -		
7/30	- - - - Sprayed for Insect, Asana XL (.33 lb ai/ac) - - - - -		
10/1	- - - - - - - - - Took hand harvest samples - - - - - - - - - -		
10/15	- - - - - - - - - - - - Combine Harvest - - - - - - - - - - - - - - -		
10/19	Disked	Disked	Mowed

B3. Sunflower seed yield data (1990) in the spring wheat-winter wheat-sunflower rotation as affected by tillage systems, N-rates and cultivar grown.

Cultivar	Rate of Nitrogen	Conv-till*	Min-till*	No-till	Avg.
	lbs N/ac	- - - - - - - - -	- lb/ac -	- - - - - - -	
AgroPro 2057	30	130	30	420	190
	60	140	40	590	260
	90	50	60	450	190
	Avg.	110	40	490	210
AgroPro 4040	30	230	10	400	190
	60	160	10	480	220
	90	10	20	620	220
	Avg.	130	10	500	210
Avg. (Tillages)		120	30	500	210

*Conv-till and min-till both had high weed populations early in the growing season because Treflan, TR-10 granules were not activated by moisture in the treated zone until rainfall sufficient to wet the upper 2-inch soil depth came about the 1st of June. Russian thistle and ragweed were the principal weeds not controlled that accounted for the large yield reduction compared to no-till that received fall-applied Surflan where green foxtail grass became the primary weed not controlled.

D1 Root length density observations of spring wheat and winter wheat.

Research on root growth, water use, and aboveground development of wheat was carried out in 1990 on plots of the Cropping Systems Experiment (CSE). Special plots immediately adjacent to the CSE were established on non-fallowed spring wheat ground for the purpose of making an agronomically valid direct comparison of spring and winter wheats. These "comparison" plots were given over 5 inches of irrigation in Sept. 1989 immediately prior to winter wheat sowing in order to rectify subsoil drought. Altogether, the treatments allowed comparison of winter and spring wheats, conventional-till and no-till, two nitrogen rates, and continuous cropping versus wheat-fallow cropping systems. Results were: a) The total amount of root length growth of spring wheat was approximately the same as that of winter wheat under stored soil water conditions at least as favorable as provided by summer- fallow; higher grain yield of winter wheat was predominantly associated with higher harvest index values than those of spring wheat. b) Depth of spring wheat root penetration under continuous rotational cropping was significantly less than that under crop-fallow. Multi-year drought and water "mining" by the previous sunflower crop have rendered the subsoil rather dry in cropping years 1988 to 1990. c) Higher nitrogen fertilization did not appear to increase winter wheat root length growth, but boosted spring wheat root growth from 7% to 48% depending on treatment. Higher N-fertilization was associated with higher root length to shoot biomass ratios in spring wheat. d) The total root length growth of no-till spring wheat in the annual cropping sequence was more than double that of the comparable conventional-till crop. (Merrill)

Table 1. Total root length growth at midseason, final aboveground biomass yield, grain yield and auxiliary measurements for wheat in 1990. CONT is continuous rotational cropping with spring wheat following sunflowers, FALL is spring wheat-summerfallow, and COMP refers to spring wheat-winter wheat comparison plots given irrigation in Sept. 1989. HIGH-N refers to 100 or 90 lb N/A for COMP or CONT and FALL plots, respectively; LOW-N refers to 0 or 30 lb N/A for COMP or CONT and FALL plots.

Treatment	Total Root Length	Final Biomass Yield	Ratio: Rt. Len. to Bioms.	Grain Yield	Harvest Index [1/]
	cm/cm^2	lb/A	km/kg	lb/A	
Spring Wheat | CONT | HIGH-N Convent.-till	153	2259	60.5	522	0.23
Spring Wheat | CONT | HIGH-N No-till	325	3262	89.0	727	0.22
Spring Wheat | FALL | LOW-N Convent.-till	288	4898	52.5	1771	0.36
Spring Wheat | FALL | HIGH-N Convent.-till	396	5429	65.1	1346	0.22
Spring Wheat | FALL | LOW-N No-till	355	5913	53.6	1545	0.26
Spring Wheat | FALL | HIGH-N No-till	381	5893	57.7	1497	0.25
Spring Wheat | COMP | LOW-N No-till	341	5096	59.7	1678	0.33
Spring Wheat | COMP | HIGH-N No-till	506	5593	80.8	1929	0.34
Winter Wheat | COMP | LOW-N No-till	396	5399	65.5	2578	0.48
Winter Wheat | COMP | HIGH-N No-till	399	6787	52.5	2796	0.41

[1/] Ratio of grain yield and final biomass.

Table 2. Distribution of root length growth observed with micro-video camera and minirhizotron system approximately 50 to 54 days after sowing of spring wheat in 1990. All plots for which data are given were no-till and high-nitrogen; treatment terms used as explained in text of Table 1 above. Data are percentages of total roots found at each 0.28 ft. depth increment.

Soil Depth	Spring wheat Comparison Plots	Spring wheat Fallowed Plots	Spring wheat Continuous Plots	Winter wheat Comparison Plots
feet				
0.28	0.5	1.8	0.3	3.3
0.57	9.8	7.8	18.1	17.0
0.85	14.3	15.0	19.4	13.6
1.14	13.5	18.4	21.6	10.5
1.42	12.0	12.6	13.0	6.5
1.70	11.4	10.1	11.2	8.1
1.99	11.4	8.7	11.7	7.6
2.27	10.5	9.5	4.3	8.1
2.56	6.2	7.6	0.4	6.3
2.84	5.5	4.4	0	6.1
3.13	1.7	2.8	0	5.9
3.41	1.8	1.2	0	2.7
3.68	0.9	0	0	1.8
3.98	0.6	0	0	1.6
4.26	0.1	0	0	0.6
4.55	0.1	0	0	0.3

Effect of conservation tillage level on wind erodibility properties under spring wheat-summerfallow. (Merrill & Black)

The study of soil wind erodibility properties begun in April, 1988 has been carried out through 1990 and is expected to continue through 1991. Measurements are being conducted on the fallow phase of the spring wheat-summerfallow component of the 65-acre Cropping Systems Experiment. Aggregate size distribution, measured with a rotary sieve, and given as the geometric mean diameter (GMD) in Table 1, were lower than the values obtained in 1988, but higher than those measured in 1989. The multiyear drought of 1988, 1989, and spring 1990 is believed to be responsible for this pattern of results. Also, while the GMD values from no-till were higher than for other tillages in 1988, no-till GMD was somewhat lower than that of other tillages in both 1989 and 1990. Measurement of the percentage cover of soil surface components reveals that low-residue soil was in a dangerously wind-erosive condition in the spring of 1990 on land fallowed in 1989. Data in Table 2 indicates that drought had increased the percentage of erodible loose material and decreased plant material cover in the lower-residue tillages to dangerous levels. In such a situation, the dominant protective element is probably standing wheat residue, which ranges from largely non-existent in the low-residue treatment to adequate in no-till. Percentages of surface components data for 1990-fallowed plots in 1990, given in Table C, indicate that wind erodibility was significantly lower than in the spring of 1990. At least average precipitation after the middle of May is the cause of this.

Table 1. Average geometric mean diameters (GMD) in millimeters (mm) for tillage treatment plots in spring wheat-summerfallow system in 1990. Fallowing tillage occurred between 17-MAY-90 and 21-MAY-90.

Calendar Dates	Low-residue	Conventional-till	Minimal-till	No-till
15-MAY-90	1.24	2.41	1.67	1.65
21-MAY-90	1.85	1.13	1.91	1.45
22-JUN-90	4.87	2.36	2.10	1.89
26-JUL-90	5.19	3.72	2.31	1.49
21-AUG-90	4.25	4.27	2.77	1.43
12-SEP-90	1.78	2.34	1.50	1.44
03-OCT-90	2.27	2.30	2.26	1.90
01 NOV-90	2.19	1.62	1.19	1.52
MEAN, all dates	2.96	2.49	1.97	1.60

Table 2. Percentages of soil surface occupied by various surface entities late in 1989 and during 1990 in the spring wheat-summerfallow system under various types of conservation tillage for plots having primary fallowing tillage in May 1989. Crusted soil (predominantly), rocks and cracks (less frequent) make up the rest of soil surface entities for which data are not given here.

Calendar Dates	Surface Component	Low-residue	Conventional-till	Minimal-till	No-till
17-OCT-89	Loose material	2.5	0.8	2.5	0.8
	Clods	3.3	2.5	0.8	0.0
	Plant material	11.7			
03-MAR-90	Loose material	18.3	15.0	11.7	4.2
	Clods	2.5	0.8	0.8	0.0
	Plant material	8.3	20.8	24.2	33.3
03-MAY-90 05-MAY-90		disked seeded	disked seeded	undercut seeded	seeded
24-APR-90	Loose material	50.8	12.5	9.2	38.3
	Clods	1.7	1.8	0.8	0.8
	Plant material	8.3	25.0	23.3	25.8
09-MAY-90	Loose material	69.2	66.7	0	0
	Clods	21.3	17.5	8.3	2.5
	Plant material	1.7	9.2	14.2	25.0
08-JUN-90	Loose material	0.0	0.0	0.0	0.8
	Clods	0.0	0.0	0.0	2.5
	Plant material	5.8	9.6	14.6	23.3

Table 3. Percentages of soil surface occupied by various surface entities during 1990 in the spring wheat-summerfallow system under various types of conservation tillage for plots having primary fallowing tillage in May 1990.

Calendar Dates	Surface Component	Low-residue	Conventional-till	Minimal-till	No-till
17-MAY-90		offset disked			
19-MAY-90			disked		
20-MAY-90				undercut	
21-MAY-90		undercut	undercut		
24-MAY-90	Loose material	3.3	17.1	12.5	1.7
	Clods	8.8	8.8	12.9	0.0
	Plant material	11.7	32.1	38.8	65.0
25-JUN-90	Loose material	68.8	56.7	0.0	0.0
	Clods	22.1	23.3	0.0	0.4
	Plant material	5.8	17.1	46.3	62.5
02-AUG-90	Loose material	4.6	4.6	9.6	0.8
	Clods	2.1	0.0	0.4	0.4
	Plant material	13.3	18.3	38.3	64.2
24-AUG-90	Loose material	1.3	3.3	0.8	3.3
	Clods	2.5	0.4	1.3	2.5
	Plant material	20.8	27.1	40.8	63.3
21-SEP-90	Loose material	7.1	0.4	1.7	0.0
	Clods	0.0	0.0	0.0	0.0
	Plant material	17.1	34.2	43.3	53.3
10-OCT-90	Loose material	11.3	0.8	2.9	0.4
	Clods	0.4	0.0	0.4	0.0
	Plant material	15.8	17.5	38.8	50.4
06-NOV-90	Loose material	11.0	4.2	5.0	0.4
	Clods	1.0	0.0	0.4	0.0
	Plant material	13.0	20.4	47.1	67.5

H2. The previous crop in this field was spring barley in 1989. By straight-combining the barley we were able to leave a stubble height of about 8 to 10-inches and the stubble was sprayed with Roundup plus 2,4-D August 23, 1989 to control weeds and volunteer barley. Sufficient soil water was conserved to seed winter wheat varieties September 23, 1989. The resulting stand was about 70% by October 15, 1989 and there was about a 50% stand present in the spring after green-up in 1990. The decision was made to not reseed to spring wheat, and hence N-rates of 0, 30, 50, 70, 90, and 120 lbs N/ac were established May 4, 1990 across varieties (Roughrider, Agassiz, Norwin, Archer, Rocky, and Norstar) by broadcast application using 34-0-0 as a source of N. The wheat was sprayed with a mixture of Buctril plus 2,4-D June 1, 1990. Variety by N-rate samples were harvested July 26, 1990 and the results are shown in the following table.

Winter wheat yields seeded no-till after spring barley as affected by cultivar and rate of N applied. (Yield samples were taken from 4 rows, 6 feet in length where plant population was least affected by winterkill.)

Rate of N	Cultivar						
	Roughrider	Agassiz	Norwin	Archer	Rocky	Norstar	Avg.
lb/ac	bu/ac						
0	22.4	22.4	23.4	18.5	24.4	18.7	21.6
30	21.3	19.8	23.1	20.8	25.2	20.5	21.8
50	22.3	21.3	23.6	19.9	27.8	21.6	22.8
70	26.0	25.7	20.2	21.4	26.4	25.1	24.1
90	25.8	25.4	22.4	20.8	29.5	19.4	23.9
120	26.8	22.0	21.6	23.4	22.9	22.1	23.1
Avg	24.1	22.8	22.4	20.8	26.0	21.2	22.9

H3. The previous crop in this field in 1989 was winter wheat but the west-half was seeded to spring wheat because of winterkill. The entire field was used to evaluate Treflan, TR-10 and Sonolan, 10-G granules at different rates involving time of application (fall or spring) and methods of incorporation using the undercutter to develop a conservation tillage-production system for sunflower. The treatments were: Sonolan fall applied at 1.2 lb ai/ac, 1) without undercutting plus Roundup burndown just before seeding sunflowers, 2) with one undercutter incorporation at time of application plus Roundup burndown in spring before seeding sunflowers, 3) with one fall undercutter incorporation followed by a spring undercutter-tillage just before seeding sunflower; Treflan fall applied at 1.3 ai/ac, with spray and/or undercutter treatments numbered 4, 5, and 6 repeated as for Sonolan fall treatments 1, 2, and 3, respectively. In addition, we compared Treflan and Sonolan spring applied using the undercut-undercut system both at a rate of 0.8 and 1.0 lbs ai/ac. Because of the lack of significant fall-overwinter-early spring precipitation and the fact that the surface soil (0 to 2-inch depth) was dry until about May 26, 1990; none of the treatments provided the desired level of weed control. The spring undercut-undercut treatment using Sonolan 10-G at 1.0 lb ai/ac provided the best weed control (about 85-90%). The spring undercut-undercut treatments with Sonolan at 0.8 lb ai/ac or Treflan at 1.0 lb ai/ac were nearly equal in weed control effectiveness (about 80%). Treflan applied at a rate of 0.8 lb ai/ac using the spring undercut-undercut system provided about 70% weed control. None of the fall applications of Treflan or Sonolan provided enough weed control potential to warrant further investigation.

Five cultivars of sunflower (AP-4040, AP-4100, AP-2057, ST-452, and DO-707) were seeded with the IH-800 cyclo, unit-row planter May 22-23, 1990 with 50 lbs N/ac banded beside the row. Seed yields were not measured by variety or weed control treatment due to the large variability in weed control treatment due to the large variability in weed control effectiveness of the herbicide treatments used. The field averaged about 200 lbs/ac and the west half of the field with fall applied Sonolan or Treflan treatments did not warrant harvesting.

H4. (1) In 1988 and 1989, two large blocks of land were established in a spring wheat-fallow rotation to provide an opportunity to study two annual legumes, Tangi flat pea and Simu-Sl peas, as a cover crop (partial summerfalllow) for soil protection and to provide 30 to 50 lbs of fixed-N.

We established three cover crop treatments 1) no-cover crop, 2) Tangi flat peas and 3) Simu-Sl peas planted May 25, 1989 after applying 0.8 lb ai/ac of Treflan granules incorporated by the undercut (April)-undercut (May) tillage system. The pea cover crops were sprayed with Roundup to kill top growth and halt soil water use at first bloom (50 days), full bloom (80 days) or allowed to grow 120 days to maturity. During the relatively "dry" summerfallow period of 1989, the no-cover crop fallow had 4.3-inches of available water to 4 feet on Sept. 26, 1989 gaining only 0.1 inch since June 1, 1989. The Tangi flat pea used 0.3-, 1.4- and 1.7-inches of stored soil water after 50, 80, and 120 days of growth, respectively and the Simu-Sl peas used 0.9-, 1.6- and 1.5-inches of stored soil water. Precipitation (rain and snowfall) during the late-fall, overwinter, period was 60% below normal. Therefore, stored soil water deficits caused by the pea cover crop treatments were not restored compared to no cover crop fallow by spring wheat seeding time in 1990. Spring wheat yields in 1990 where Tangi flat peas had been grown during the 1989 fallow for 50, 80, and 120 days averaged 22.9, 15.0 and 12.1 bu/ac, respectively; for Simu-Sl peas, spring wheat yields were 18.7, 21.0 and 16.0 bu/ac, respectively. Spring wheat yields in 1990 on Treflan treated fallow and no Treflan fallow without peas averaged 23.5 and 30.4 bu/ac, respectively. The fact that 1989 Treflan treated fallow produced 23% (6.9 bu/ac) less spring wheat in 1990 than untreated fallow is of special interests to us and needs further study. (Black and Bauer)

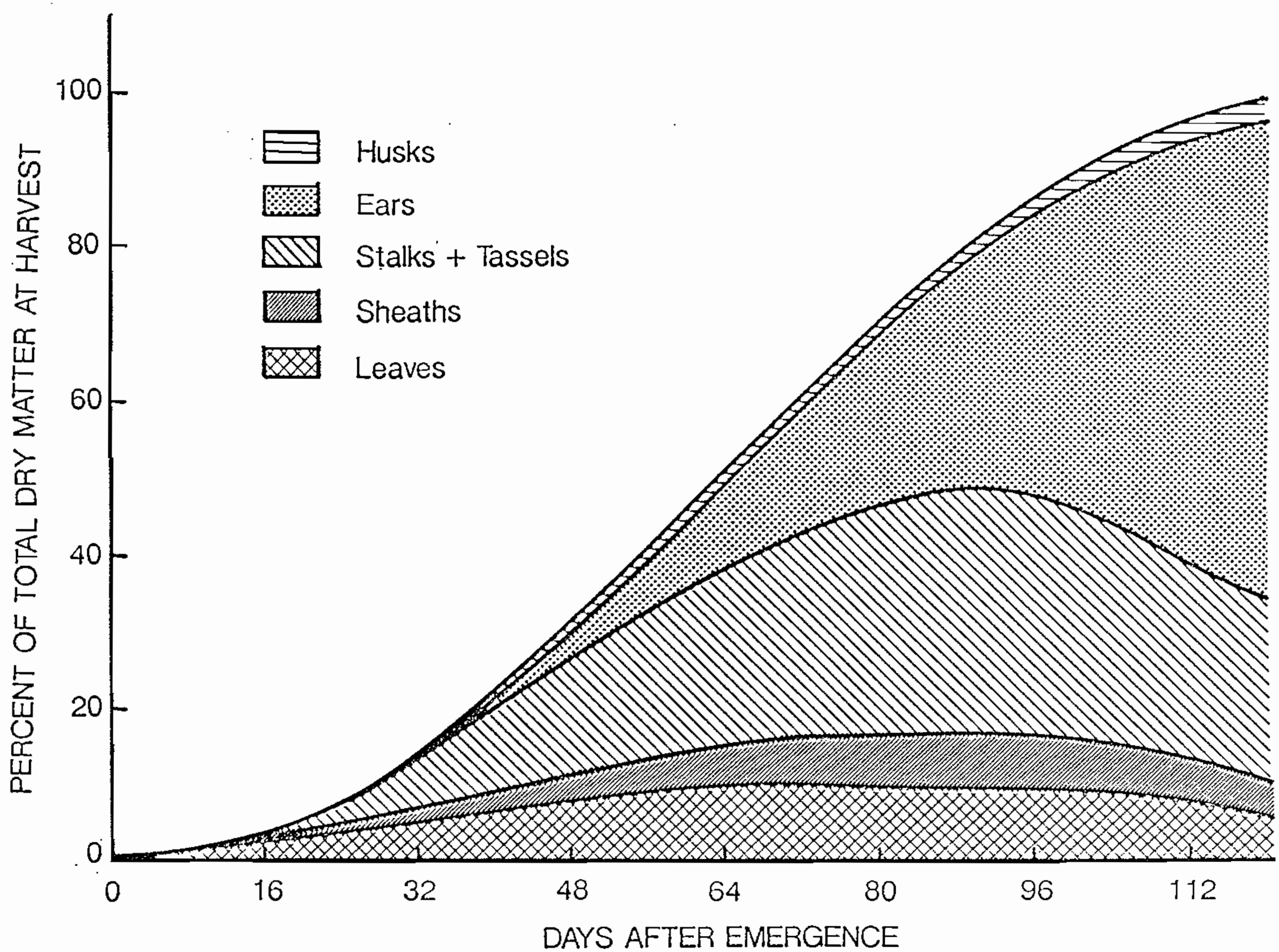
(2) Effect of Post-Planting Soil Surface Residue Levels on corn Performance. Pertinent data of the 1987-1988-1989 corn trial's have been reported in this report annually. Grain was produced only in 1987, but it was a yield level rarely obtained under dryland conditions in the semiarid (mid through western part) region of North Dakota--about 140 to 145 bushels per acre.

A manuscript has been prepared summarizing the three years of data, and plans are to publish it as a North Dakota Agricultural Experiment Station Research Report. Our purpose in conducting the corn trials was to develop a response to the oft-repeated question from those touring the research farm, and that was, "Can I substitute corn for the sunflowers in a rotation?" My response to the question is: "If you are after a cash grain crop, the odds are greater that sunflowers will produce grain of economic value more often than corn. If you are after the superior scavenger crop (removing water and nutrients that may have moved beyond the normal rooting depth of wheat or barley), the best choice is sunflowers because it appears to be a deeper-rooting crop than corn". Those who can utilize corn silage in their farming enterprise could consider corn because of its proven record as a reliable crop for this purpose.

Information from the 1987 trial was used to develop the information shown in Figure 2. This depicts that approximate percentage of the total weight at harvest that is found in various plant parts at any given time during the growing season. (Bauer)

(3) The first phase of research to evaluate the effects of air temperature on head size in spring barley has been completed. Heads begin to form spikelets at Haun stage 3.5 or 11 days after emergence for Bowman and at Haun stage 3.8 or 12 days after emergence for Azure. Final head size is determined at 21 and 23 days after emergence for Azure and Bowman, respectively. Total number of kernels formed per head decreased at the rate of 1.5 kernels for Azure and 0.6 kernels for Bowman per each degree increase in the average maximum daily air temperature above 64°F during the head development period. These data help explain why late seedings often results in reduced yields. (Al Frank)

Figure 2. Accumulative dry matter percentage in corn plant parts in relation to total dry matter at harvest as a function of days after emergence, 1987. (Average aerial dry matter yield at harvest was 13,240 pounds per acre).



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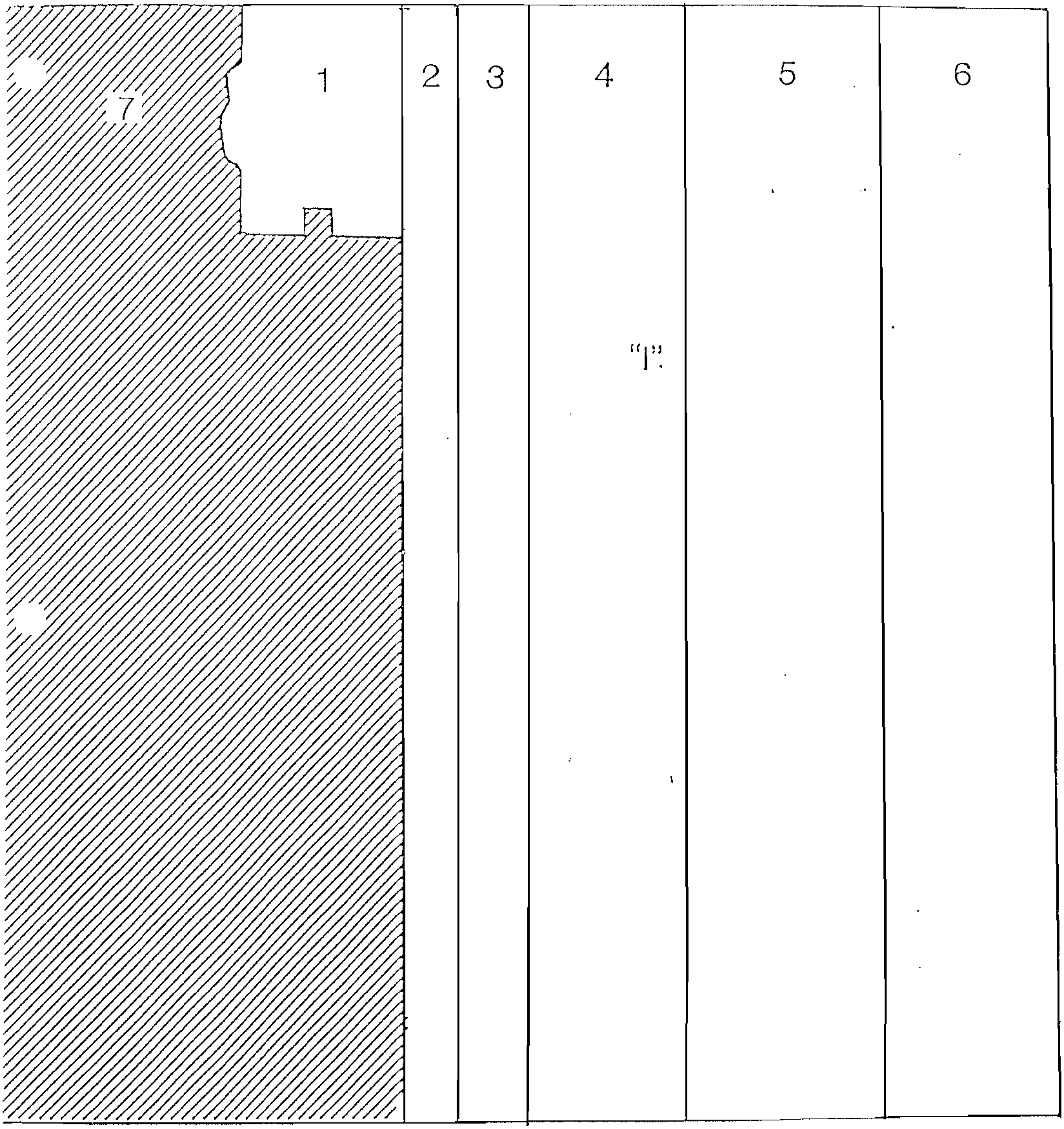

I. NE 1/4 Section 20 - Research Activities

I1. 1990 NAPP - This is the fourth year of this type of trial, but it was conducted differently in that the supplemental water was applied by a trickle irrigation system and all of the available nitrogen was present in the soil at planting.

Results shown in Table 1 are typical of nitrogen-water studies. Grain yields within a given water level increase as nitrogen level increases; and grain yields increase as water level increases. Note at water level 3 that grain yields at nitrogen level 3 decrease. This decrease is primarily due to the kernel weight in this treatment (22.88 milligrams) compared to other treatments. Apparently grain filling did not proceed as rapidly as in the other treatments.

Tissue nitrogen concentration and content data from this trial (not yet measured) and other of previous years will be combined to develop the capability to predict post-emergence fertilizer nitrogen needs of spring wheat. (Bauer & Black)

Table 1. Effect of water and available nitrogen level on characters of Amidon wheat, 1990.

Water level 1/	Nitrogen level 2/	Characters POP	HEA	YIE	TKW	TEW	KPH
	lbs N/ac^2	no/m^2	no/m^2	bu/ac	mg	lbs/bu	no
1	55	200	224	19.9	28.00	62.7	22.5
	110	182	288	32.8	28.14	63.0	30.5
	150	191	365	36.5	26.58	61.7	30.1
2	55	189	299	33.7	29.99	62.8	28.8
	110	181	311	39.9	29.57	62.8	30.1
	150	181	363	40.3	28.29	62.0	30.9
3	55	177	344	40.3	28.50	62.4	28.8
	110	203	424	42.3	26.45	61.8	27.8
	150	187	427	36.3	22.88	57.8	32.3
Water Avg.	1	191	292	29.7	27.57	62.5	27.7
	2	184	324	38.0	29.28	62.5	29.9
	3	189	398	39.6	25.94	61.0	29.6
Nitrogen Avg.	55	189	289	31.3	28.83	62.6	26.7
	110	189	341	38.3	28.05	62.5	29.5
	150	186	385	37.7	25.92	60.8	31.1
LSD	Water (W)	--	24	4.0	1.87	0.9	--
	Nitrogen (N)	--	20	2.4	0.94	0.5	1.8
	W*N	19	35	4.1	1.62	0.9	3.1

1/
Water levels 1, 2, and 3 represent increasing amounts of water.

2/
Refers to available nitrate-nitrogen to four feet at planting plus fertilizer nitrogen applied at planting.

3/
POP - seedling population before 3-leaf stage. Multiply no/m2 * 0.836 no/yd^2.
HEA - head population near harvest. The count does not include white heads.
YIE - grain yield
TKW - kernel weight
TEW - test weight
KPH - kernels per head
(All expressed on oven-dry basis)

I2. Fields I3 and I5 were no-till summerfallowed in 1989. Because of the relatively low level of straw produced in 1988 (about 1200 lb/ac), we elected to summerfallow without tillage to assure 30% cover at the end of the summerfallow period. Both fields were sprayed only 3 times during fallow using Roundup plus 2,4D or Roundup plus diacamba type mixtures with 2% ammonium sulfate and a surfactant.

Amidon spring wheat was seeded in the I3 and I5 fields May 8-9, 1990 at a calibrated seeding rate of 1-million viable seeds per acre. These fields were sprayed June 14, 1990 with Tiller (0.25 lb ai/ac) plus Buctril (0.25 lb ai/ac) one pt/ac each which provided 100% control of all weeds including green- and yellow-foxtail grasses. These two fields were straight combine harvested August 15-16, 1990. The fields had no weeds present. Spring wheat yields average 35.5 bu/ac; test weight; 58 lb/bu and protein content; 15.5 to 17.2%.

Field I1 has been continuously cropped to spring wheat with 40 lbs N/ac added each year since 1984. We have seeded one-half of the field no-till each year and the other one-half as disk-seed. This field was seeded to spring wheat (Butte 86) May 8, 1990 at a seeding rate of 1-million viable seeds per acre. The spring wheat was sprayed June 13, 1990 with a mixture of Tiller plus Buctril (0.25 lbs ai/ac, each). Combine harvesting occurred August 8, 1990 and the spring wheat yielded about 16 bu/ac in 1990. Dr. Joe Krupinsky, Plant Pathologist, has been making disease observations in this field since 1984. Even though the drought years of 1988, 1989, and 1990 have not been conducive to leaf spot diseases there has been no build-up of leaf spot diseases with continuous spring wheat compared to spring wheat in other rotations. Dr. Krupinsky has found evidence of the presence of common root rot (*Cochliobolus sativus* and *Fusarium*). Additional research, using treated and untreated spring wheat seed, will be required in 1991 to determine the potential severity of these root rot pathogens on plant development (tops and roots) and grain yields.

I3. Fields I2, I4, and I6 were no-till summerfallowed in 1990. All three fields were sprayed with Roundup plus 2,4-D on June 18, 1990. Fields I2 and I4 were sprayed with Glean June 25, 1990 to use up the last of our inventory and avoid a waste disposal problem. All three fields were sprayed with Landmaster BW (45 oz/ac) July 12-16, 1990 and Roundup plus 2,4-D on Sept. 10, 990. Therefore, these 1990-fallow fields received only 3 spray operations to control weeds and conserve crop residue. These fields had 2200 to 2700 lbs/ac of crop residue at harvest in 1989, 1700 to 2000 lbs at the beginning of fallow in 1990. We ended the summer fallow period with 1200 to 1500 lbs/ac surface residue (50 to 60% cover).