1993 Research and Cropping Results

Tenth Annual Progress Report

February 23, 1994

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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.

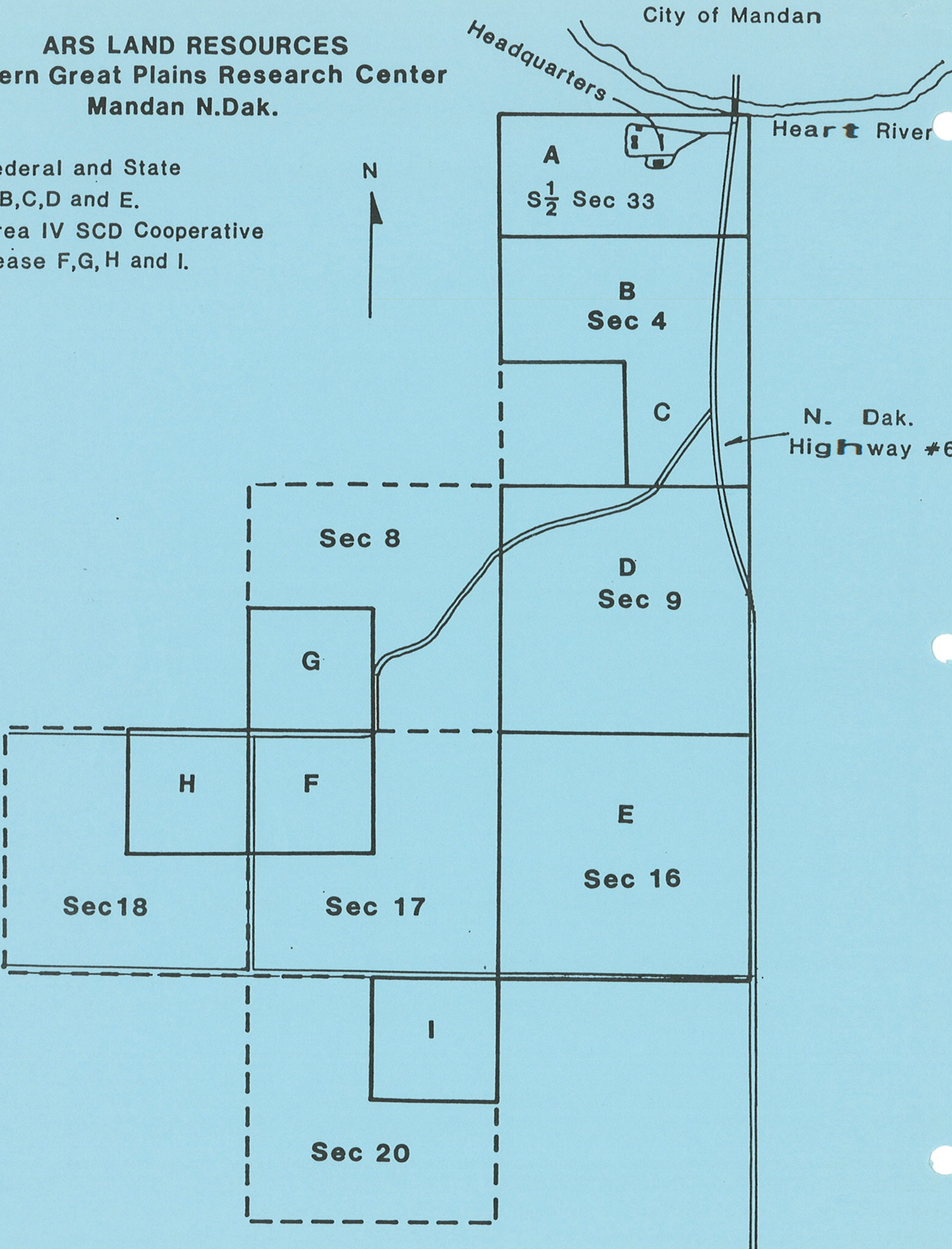
NOTICE

Acknowledgment

USDA-ARS and Area IV SCD recognize the contributions made to this research program by the following cooperators: Dow-Elanco Products Co.; Monsanto Agr. Products Co.; Haybuster Manufacturing Co., John Deere, Inc., National Sunflower Assoc.; Sigco Research Inc.; Hoechst-Roussel Agri. Vet Co.; NDSU-Agricultural Experiment Station, and NDSU-Cooperative Extension Service; and the USDA-Soil Conservation Service.

ARS LAND RESOURCES
Northern Great Plains Research Center
Mandan N.Dak.

1. Federal and State
   A,B,C,D and E.
2. Area IV SCD Cooperative
   Lease F,G,H and I.



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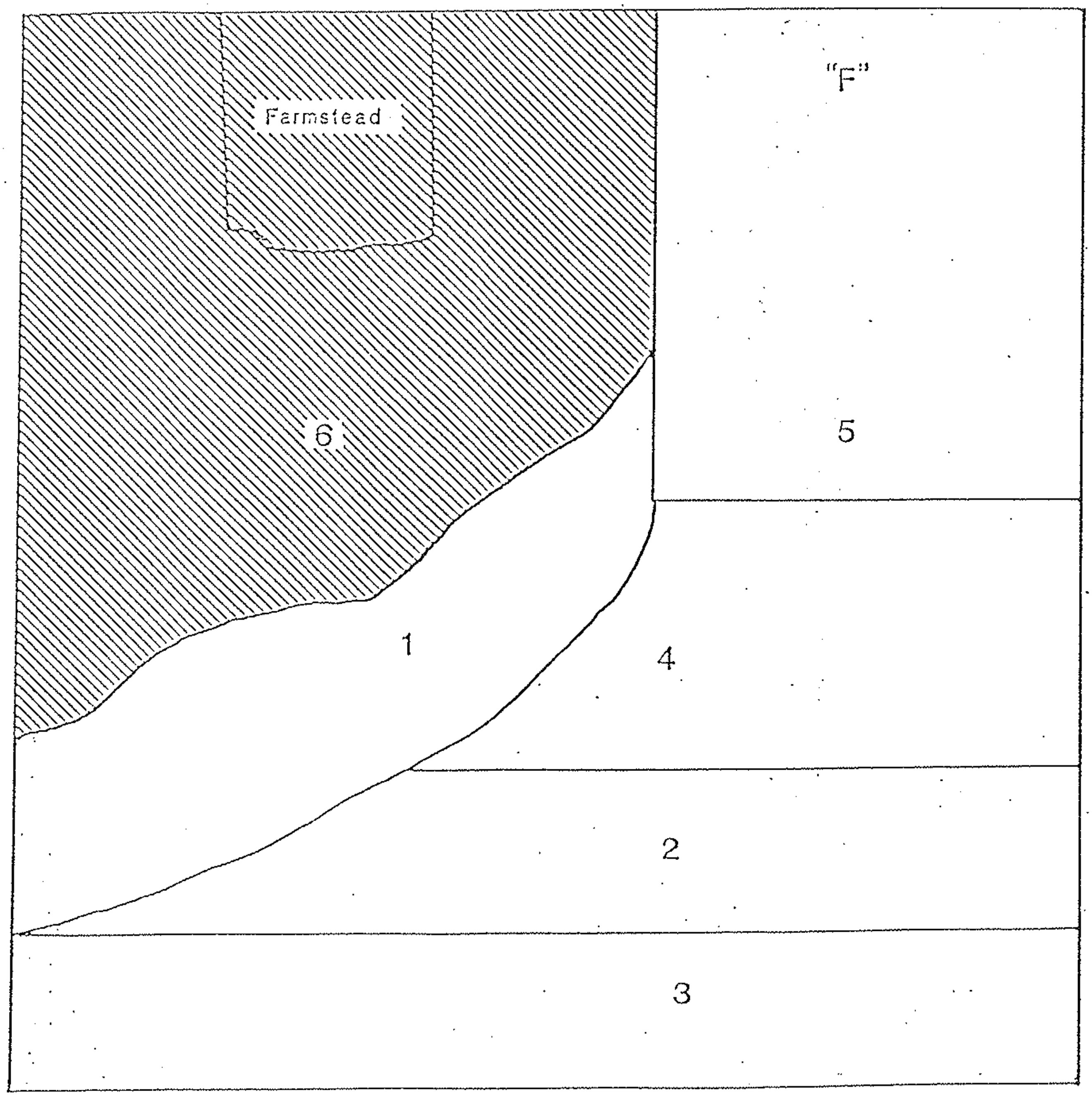


F. NW 1/4 Section 17 - Research Activities

F1. Conservation Bench Terrace Area - This hay producing area was excluded from the total acreage leased by AREA IV SCD in 1987. Total cropland leased by AREA IV SCD is 382 acres. USDA-ARS has leased 55 acres (Sec. 17 and Sec. 18) for soil and water conservation research for many years and another 30 acres (Sec. 8) for tree breeding since 1989. Total acreage leased for research purposes is 467 acres.

F2. The previous crop was spring barley 'Bowman' in 1992 which yielded about 90 bu/ac. We spot sprayed this field with Roundup plus 2,4-D amine August 31, 1992 to control volunteer grain and weeds. We no-till seeded winter wheat with a Haybuster 8010, hoe drill, single seed opener, in 10-inch row spacing at a seeding rate of 1-million viable seeds/acre on Sept. 23, 1992. Nitrogen fertilizer was contract broadcast a 40 lb N/ac using 34-0-0 as source of N on April 29, 1993. We sprayed the winter wheat for weed control May 13, 1993 using a mixture of 2,4-D (LV-ester) plus Buctril at 4.7 oz. ai/ac, respectively. The winter wheat was combined August 17, 1992 and yielded 44 bu/ac and had a test weight of 57 lb/bu and protein at 12.5%.

F3. The previous crop was winter wheat in 1992 that yielded 54 bu/ac. The 12 to 15 inch winter wheat stubble was left standing over winter to augment snow trapping and soil water storage. We applied Sonolan G-10 granules April 29, 1993 at a rate of 1.0 lb ai/ac with a Gandy granular applicator mounted on the front of the Haybuster undercutter while making the first undercutter tillage pass at a 2-inch depth to accomplish the first incorporation. The field was undercut again May 18, 1993 at a depth of 2-inches to accomplish the second incorporation. We seeded this field to sunflower 'Sigco 651', May 20, 1992 with the IH 800 Cyclo unit row planter at a seeding rate of 23000 seeds /acre with 50 lb N/ac banded beside the row using 34-0-0 as a source of N. Depth of seeding was about 1.5 inches after passage of the packer wheel. Seedlings emerged in 6 days and the plant population was about 19000 per acre. We contract sprayed for insect control with Asana XL (0.8 oz ai/ac) on July 9, 1992. The sunflowers were combined Oct. 21, 1993 and yielded about 1300 lbs/acre; with a test weight of 29 lb/bu and an oil content of 44%.

F3. A sunflower weed management study was located on the east end of this field. Purpose of the study was to compare tillage and herbicide combinations for weed control in sunflowers. Treatments are listed in Table 1. Table 2 shows the percent of the soil surface cover by winter wheat residue from winter wheat harvest to sunflower seeding. Weed samples were collected from each plot and no differences due to treatment were observed. Study was abandoned on August 9, 1993 because of herbicide drift from adjacent areas.

Table 1. Sunflower weed management treatments for 1993.

	Management	
	Fall	Spring
1.	Undercut (UC) for weed control	UC apply 1 lb/ac Treflan in April, disk before seeding in late May.
2.	UC apply 0.5 lb/ac Treflan in late October	UC apply 1 lb/ac Treflan in April
3.	------------	UC apply 1 lb/ac Treflan in April, UC in late May before seeding.
4.	------------	UC apply 1 lb/ac Sonolan in April, UC in late May before seeding.
5.	------------	Apply 1 lb/ac Sonolan, incorporate with J.D. Mulch Master (one pass)
6.	------------	No-till, apply 1 pt/ac Roundup plus 1.75 lb/ac Prowl (two weeks before sunflower seeding.
7.	----------------	No-till,. apply 1 pt/ac Roundup two weeks before seeding, Applied Blazer 1/8 lb/a plus Assure II (8 oz/ac) and 1 qt/ac crop oil when sunflowers were in the 9 to 11 leaf stage (June 28, 1993)

Table 2. Winter wheat residue surface cover from winter wheat harvest to sunflower seeding. (Technique accounts for residue flat on the soil surface.)

Treatment	After harvest (1992)	Early spring (1993	Before seeding sunflower (1993)
		%	
1.	90	81	39
2.	91	80	62
3.	88	92	57
4.	88	84	59
5.	90	92	67
6.	86	92	91
7.	87	90	87

F4. The previous 1992 crop in this field was sunflower. Nitrogen fertilizer was contract spread on this field April 29, 1993 at a rate of 40 lb N/ac. We tilled this field with the JD-mulch master May 11, 1993 and seeded spring barley 'Bowman' May 13, 1993. We sprayed 2,4-D (LV ester) plus Buctril using 5.0 ai/ac of each herbicide on June 15, 1993. We swathed this field August 20, 1993 and combined August 24, 1994. The barley yielded about 38 bu/ac and had a test weight of 44 lb/bu. The field was sprayed for after harvest volunteer grain and weed control with Roundup plus 2,4-D September 10, 1993. Winter wheat was no-till seeded into standing barley stubble (10 to 12-inch height) September 24, 1993 with 40 lb/a of 18-46-0 with the seed using the Haybuster 8010 narrow-point hoe drill.

F5.

A. Tanaka - Spring Wheat and Spring Barley Trials

Spring wheat and spring barley variety trials were initiated in 1979 in cooperation with Dickinson Research Center. Varieties were seeded with 7 foot Kirsman drill in 6-inch rows on April 16, 1993 at a rate of 1.3 million viable seeds per acre on a field that had been chemically fallowed the previous year. Prior to seeding, weeds were controlled using a Haybuster undercutter at a depth of 2 inches. Fifty-pounds N per acre as 34-0-0 was broadcast just in front of the press wheels. Weeds in the crop were controlled using Tiller (16 oz/ac) plus Buctril (16 oz/ac) on June 2, 1993. A small plot combine was used to harvest barley on August 16 and spring wheat on August 19.

Barley variety grain yields can be separated into 4 groups; 1) 60 bu/ac and above, 2) 60 to 50 bu/ac, 3) 50 to 40 bu/ac, and 4) below 40 bu/ac (Table 1). Spring wheat variety grain yields can be separated into 3 groups, 1) 50 to 45 bu/ac, 2) 45 to 40 bu/ac, and 3) 40 bu/ac and lower (Table 2). Greater quantities of barley and spring wheat straw were produced fo each unit of grain because of disease (larger straw to grain ratio than past years).

B. Krupinsky

A comparison tillage study for studying wheat diseases was started in 1993. The study includes five tillage treatments (continuous no-till, continuous maximum till, continuous minimum till, and a crop-fallow rotation with maximum tillage) and four fungicide seed treatments (Enhance [Carboxin 20% & Captan 19%]; Enhance plus Imazalil; Bayton 30; and Bayton 30 plus Imazalil).

This was the first year that plots were rated for leaf spot diseases and common root rot. No consistent differences among tillage treatments were detected for leaf spot diseases or common root rot. No differences were detected among the fungicide seed treatments when rating for common root rot but differences were detected when rating for leaf spot diseases. Three seed treatments (Enhance plus Imazalil; Bayton 30; and Bayton 30 plus Imazalil) had a lower level of leaf spot diseases than Enhance alone.

Table 1. Spring barley agronomic measurements for 1993.

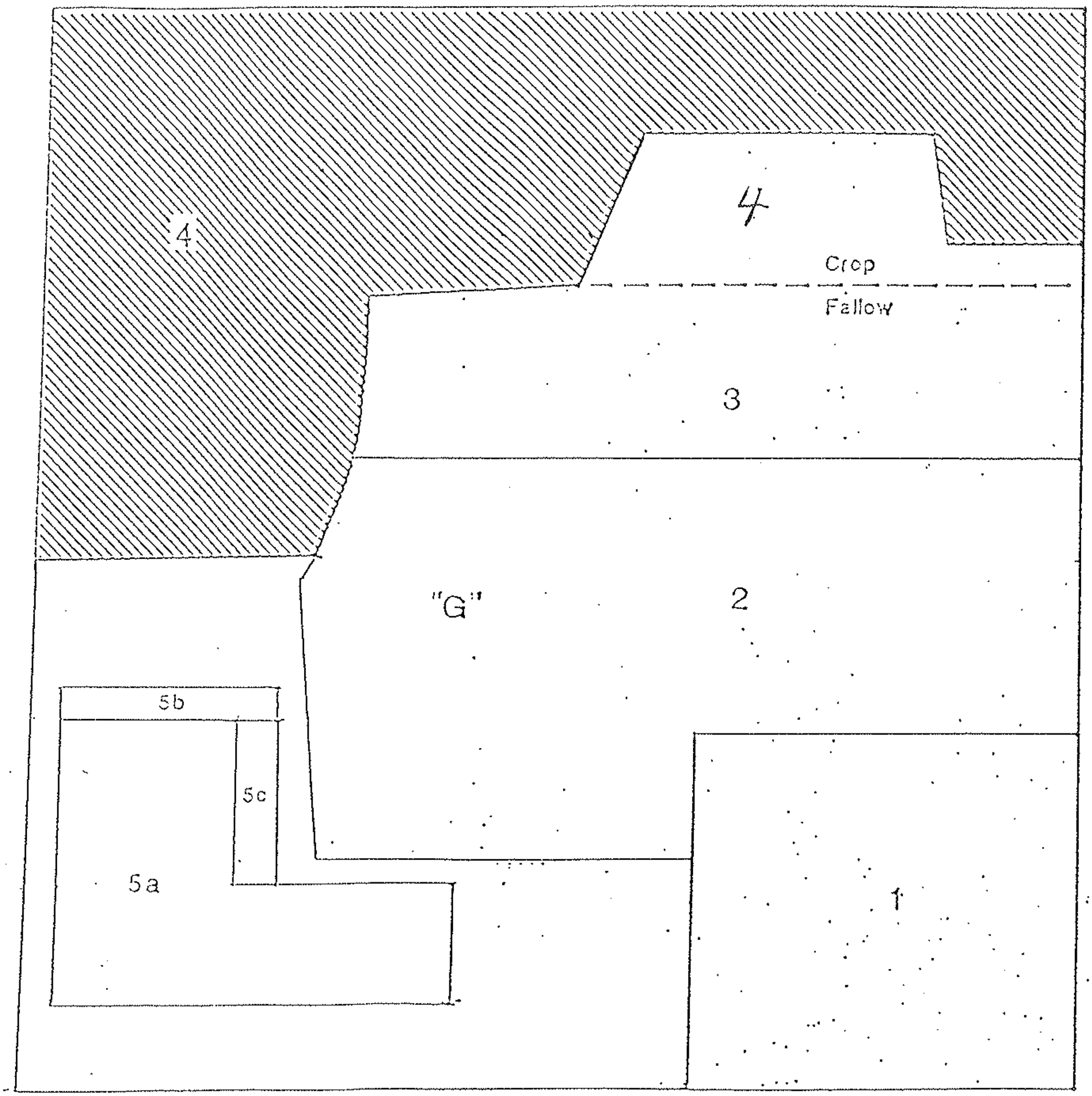
Varieties	Grain Yield (bu/ac)	Grain Protein (%)	Grain Test wt (lbs/bu)	Straw Yield (lbs/ac)	Straw to Grain Ratio	Plant Population (plants/ yd^2)	Heads per Plant (heads/ plant)	Kernel wt (mg/ kernel)	Heads (heads/ yd^2)	Kernel per Head	Plant Height (in)	Plants per Viable Seeds (%)
Azure	65.7	12.7	41.0	4510	2.0	182.5	2.1	24.1	386	23.1	33	68
Robust	57.5	13.9	42.1	4740	1.9	197.6	2.4	24.6	462	21.3	36	73
Stark	49.5	15.5	39.8	5380	2.6	170.8	3.2	22.0	556	16.9	33	70
Morex	49.0	14.4	38.7	4430	2.3	190.0	1.7	21.4	322	26.7	31	70
Gallatin	48.6	13.3	40.0	4510	2.4	178.7	3.4	20.3	617	14.2	30	71
Bowman (sd)	48.3	13.6	42.7	3970	1.8	172.0	3.2	27.2	546	14.1	26	68
Bowman (mdn)	36.0	14.3	40.1	3360	2.2	173.3	2.9	23.8	502	12.3	27	65
LSD	5.0	1.15	1.8	508	0.4	24.5	0.6	2.1	126	6.0	2	---

Table 2. Spring wheat agronomic measurements for 1993.

Variety	Grain			Straw	Straw	Plant	Heads	Plant	Kernel	Heads	Kernel	Plants
	yield (bu/ac)	protein (%)	test wt (lbs/bu)	yield (lbs/ac)	to grain ratio	Population (plants/yd²)	per Plant (heads/plant)	Height (in)	wt (mg/kernel)	(heads/yd²)	per Head	per Viable Seeds (%)
Grandin[1]	50.0	16.3	59.2	5890	2.0	192.1	2.6	36	26.5	481	21.8	73
Stoa	47.5	17.1	59.9	5510	2.1	185.9	2.1	43	26.5	501	23.8	69
Butte 86	46.5	16.3	59.4	5280	2.3	194.2	2.4	36	29.4	448	17.3	72
2375[1]	45.2	15.3	60.9	4320	2.0	175.0	2.3	31	29.9	402	16.9	67
2369[1]	43.5	15.6	59.4	4670	2.1	177.5	2.4	33	25.5	426	19.1	67
Vance[1]	42.5	16.1	56.5	6050	2.7	188.7	2.0	34	26.3	376	16.7	78
Amidon[1]	41.3	16.7	56.2	3880	2.9	218.4	2.0	40	23.5	434	21.1	68
Len[1]	34.0	17.6	56.0	4700	3.0	117.4	2.6	33	22.3	303	22.4	44
Gus[1]	33.8	18.2	55.1	5520	2.2	195.9	1.8	36	23.8	357	23.6	78
Bergen[1]	33.7	16.6	53.7	5620	2.7	194.2	2.4	31	24.8	470	17.3	75
Cutless[1]	30.2	18.0	56.5	5620	2.4	184.5	3.0	33	19.5	547	21.1	68
LSD	5.3	1.0	1.7	790	0.7	28.6	0.8	2	1.4	123	7.7	---

1 Classified as semi-dwarf varieties

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



G. SW 1/4 Section 8 - Research Activities

G1. Poplar tree breeding - clonal test site

a. Dr. Richard Cunningham and Dr. Joe Krupinsky are studying 240 hybrid popular and cottonwood clones for survival, growth rate, cold and drought hardiness and pest resistance. This long-term study was initiated in 1983 and there will be no report of results for this year.

b. Forage Grass Breeding and Genetics Report (Dr. Berdahl and Dr. Ray). Area IV SCD Research Report: Forage Grass Breeding and Genetics

Germplasm Evaluation

Progeny tests of elite western wheatgrass and crested wheatgrass parents are being conducted on Area IV SCD Research Farm. The objective of the progeny tests is to identify parents with high forage yield, seed yield, and nutritional quality for potential new cultivars of western wheatgrass and crested wheatgrass.

Two unique populations of crested wheatgrass are being evaluated. One population with extremely wide leaves has a higher chromosome number than that found in current cultivars of crested wheatgrass. The other population, Agropyron mongolicum, is one of the ancestors of standard crested wheatgrass. Some of the Agropyron mongolicum plants have moderate rhizomatous spread, in contrast to the bunchgrass habit of fairway and standard types of crested wheatgrass. Agropyron mongolicum is not well adapted to the northern Great Plains, but the species may have valuable traits that can be transferred to fairway and standard types.

Germplasm and Cultivar Releases

Two western wheatgrass germplasms, ND-WWG931 and ND-WWG932, were released for breeding and experimental purposes in 1993. These germplasms represent a sample of genotypes from two distinct environments in the northern Great plains. ND-WWG931 was derived from a collection that was made by USDA-ARS and USDA-SCS in the western halves of North and South Dakota. ND-WWG932 was derived from a collection made by Agriculture Canada in Alberta and Saskatchewan, Canada.

Improved cultivars of Russian wildrye (Mankota), intermediate wheatgrass (Reliant), and pubescent intermediate wheatgrass (Manska) were developed at the Northern Great Plains Research Laboratory and recently released cooperatively by USDA-ARS, USDA-SCS, and the North Dakota Agricultural Experiment Station. The Bismarck Plant Materials Center is producing foundation seed of these cultivars, and all current supplies have been distributed. Limited quantities of foundation seed should be available after the 1994 harvest to those interested in producing certified seed. A small amount of certified seed of Reliant intermediate wheatgrass is currently on the market, and limited quantities of certified Mankota and Manska should be available after the 1994 harvest.

Reliant intermediate wheatgrass is recommended for hay, either seeded alone or in grass-alfalfa mixtures. The upright growth habit, slow rhizomatous spread, and relatively late maturity of Reliant are traits that suit the cultivar for mixtures with alfalfa for hay. Reliant has had excellent sustained productivity under hay management compared with other cultivars of intermediate wheatgrass.

Manska pubescent intermediate wheatgrass is recommended for pasture and hay. High nutritive value is the primary advantage of Manska over other cultivars of pubescent and intermediate wheatgrass. In Nebraska tests, daily gains from yearling steers averaged 2.7 lb for Manska and 2.3 for Oahe, a popular cultivar, over two grazing periods at a high stocking rate of three steers per acre. Weight gains for the two grazing periods averaged 266 and 230 lb/acre, respectively, for Manska and Oahe. Maintenance of Manska at a high stand density under grazing would likely require prudent management to assure adequate fall-season recovery, especially when stressed by drought or exposed to high levels of winter stress in the northern Great Plains.

Mankota Russian wildrye is better suited to grazing than to hay production. Russian wildrye is usually sown alone, because its extensive root system provides high plant competition to most other forage species. Once established, Russian wildrye is tolerant of heavy grazing, and its basal leaves provide high quality forage. Fall regrowth is rapid if soil water is adequate. A valuable use for Mankota would be complementary pasture that would extend the fall grazing season when nutritional quality of most other grasses is low. Mankota has improved seedling vigor and higher forage yields compared with the current cultivar, Vinall. Mankota has higher resistance to leaf spot disease than the recent cultivar, Bozoisky-Select, from Utah.

G2. This field has been in a spring barley-winter wheat-sunflower rotation since 1983 using minimum or no-till production systems. The spring barley has averaged 40 bu/ac; winter wheat, 35 bu/ac; and sunflower about 1500 lbs/ac over the 10 year period. The previous crop in 1992 was sunflower that yielded about 2000 lbs/ac. Sunflower stalks (about 18 to 24-inches tall) were left standing overwinter and the field was tilled May 11, 1993 with the J.D.-Mulch Master and seeded May 13, 1993 to spring barley 'Bowman' or 'Stark' each occupying about one-half of the field. We used the Haybuster 1007 to seed the barley in 7-inch row spacing and to band N-fertilizer as 34-0-0 between every other pair of 7-inch seed rows at 0, 20, 40, and 60 lb N/ac in two replications in each spring barley variety. The rest of the field received 40 lb N/ac at seeding between the rows. The entire field was sprayed for weeds June 4, 1993 with a mixture of 2, 4-D (LV ester) and Buctril using 5.0 oz. ai/a of each herbicide. After yield samples were obtained from the replicated N-fertilizer trial, the field was swathed August 24, 1993 and combine harvested August 27, 1993. Combine yields of 'Stark' and 'Bowman' averaged about 60 and 38 bu/ac, respectively. The results of the N-fertilizer trial for each variety are shown in the following Table.

Spring barley yield and test weight as influenced by N-fertilizer rate and variety.

Variety	N-Rate	Grain Yield	Straw Yield	Test Weight
	lb/ac	bu/ac	lb/ac	lb/bu
Bowman	0	33.1	1840	46.8
	20	38.7	2250	48.6
	40	40.1	2580	46.5
	60	45.7	3180	46.2
Avg		39.4	2470	47.0
Stark	0	38.2	2180	48.0
	20	56.9	3810	47.9
	40	61.2	3990	49.8
	60	59.8	4270	48.8
Avg		54.0	3560	48.4

G3. This field was cropped to spring wheat in 1992 with grain yields of about 55 bu/ac and straw yields of 5200 lbs/ac. Because of the heavy straw production, weeds were suppressed during the early spring months of the 1993 summer fallow period. The summerfallow was sprayed with Fallowmaster (36 oz/a) June, 1993, and with Roundup plus 2,4-D Amine July 20 and August 17, 1993.

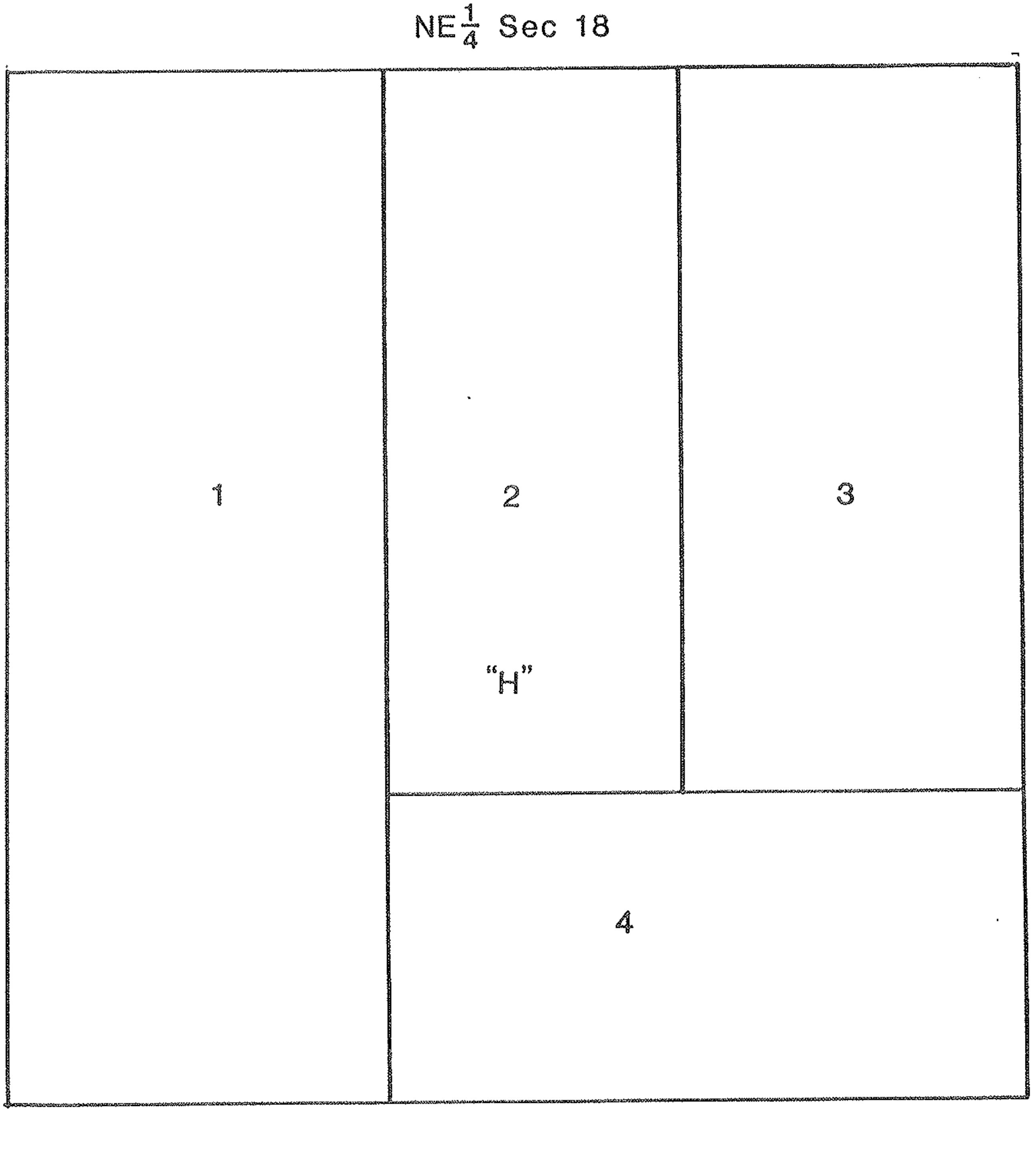
G4. This field was summerfallowed in 1992 (undercut, April 28, 1992; sprayed June 10 and July 20, 1992 using Fallowmaster and Roundup respectively). The field was tilled with the J.D. Mulch Master, April 19, 1993 and seeded to spring wheat 'Amidon' May 5, 1993 with 41 lb/ac of 18-46-0 banded with the seed. The field was sprayed June 9, 1993 with a mixture of 2,4-D (LV ester) and Buctril using 5.0 oz. ai/ac of each herbicide. This field was straight combined September 9, 1993 and yielded about 35 bu/ac, with a test weight of 58 lb/bu and 13.5% protein.

G5. USDA-ARS Leased Land - Tree Breeding Activities

5a. **Hackberry Provenance Test** - This area serves as the site for a seed source Trail of hackberry accessions collected from 180 native stands throughout the Great Plains. Planting stock was grown by the NDASCD's Oakes Nursery and distributed in 1990 to test site cooperators at 16 locations in the Great Plains from Oklahoma to Manitoba.

5b. **Siberian Elm Provenance Test** - Seedlings form 18 seed sources from Russia were planted in 10 replications in the spring of 1992. Seed was obtained as a result of a seed collection trip to the USSR in 1990. Survival averaged 97 percent and ranged from 80 to 100 percent.

5c. **Siberian Elm Clonal Test** - Fifty-five trees, from windbreaks in North and South Dakota, selected for possible disease and insect resistance were planted in four replications in 1990. The best performing clones in this test will be established in cooperation with the Lincoln-Oakes Nursery.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H. NE 1/4 Section 18 - Research Activities

H1. This large field is dedicated to the cropping systems--conservation tillage study. The study involves two cropping systems (spring wheat-fallow and spring wheat-winter wheat-sunflower), three tillage systems (conventional-, minimum- and no-till) plus a no-residue spring wheat-fallow treatment to serve as a check plot for assessing wind erodibility and plant diseases, three nitrogen fertilizer levels (0, 20, 40 lb N/A for crop-fallow, and 30, 60 and 90 lb N/A for the 3-yr annual crop rotation) and two varieties of each crop.

(A1) Spring wheat-fallow rotation (1993) spring wheat crop plots.

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

Date	Conventional-till		Minimum-till	No-till
mo/day	No Residue	<30% Cover	30-60% Cover	>60% Cover
4/26	-------------- Applied N-rates of 0, 20, 40 lb N/ac --------------			
5/3	disked	disked	undercut	-----
5/4-5	Seeded Butte & Stoa with Haybuster 1007 (DB Green + Lindane)			
6/1	Sprayed all plots with Tiller (6.6 oz. ai/ac) plus Buctril (4.3 oz. ai/ac).			
8/16 - 19	--------------- Hand harvest samples obtained ---------------			
8/20	--------------------- Swathed all plots ---------------------			
9/3	-------------------- Combined harvested --------------------			

(A2) Grain yields of spring wheat (1993) in the spring wheat-fallow rotation as affected by tillage system, N-fertilizer levels, and cultivar.

Cultivar	Rate of N Added	Conventional till No Residue	Conventional till <30% Cover	Min-till 30-60% Cover	No-till >60% Cover	Avg.
	lb N/a					
Butte 86	0	29.9	35.2	23.9	20.0	27.3
	20	36.1	35.9	30.2	27.5	32.4
	40	36.0	32.8	30.4	29.8	32.4
	Avg.	34.0	34.7	27.7	25.8	30.6
Stoa	0	30.5	22.6	25.7	21.6	25.1
	20	28.8	31.4	27.0	25.5	28.2
	40	31.3	28.9	28.5	28.8	29.4
	Avg.	30.2	27.6	27.1	25.3	27.6
Avg.	(Tillage)	32.1	31.1	27.4	25.5	

(A3) Spring wheat-summerfallow with schedule of operations performed for fallow series plots in 1993 as follows:

Date mo/day	Conventional till No Residue	Conventional till <30% Cover	Minimum-till 30-60% Cover	No-till >60% Cover
5/4	Deep disk	--	--	--
5/17	Tandem disk			
5/28	--	*Roundup+2,4-D	Roundup+2,4-D	Roundup+2,4-D
8/2	Disked	Disked	*Roundup+2,4-D	Roundup+2,4-D
8/4	--	--	Undercut	--
8/17	Roundup	--	--	--
9/21	Disked	--	--	--

*Roundup applied at 8.8 or 10.6 oz ai/ac plus 2,4-D amine at 4.4 or 1.4 oz. ai/ac, respectively on 5/28 and 8/2 using ammonium sulfate (17 lb mtl/100 gal of water) and surfactant.

H1. Schedule of operations and grain yields for the spring wheat-winter wheat-sunflower cropping system.

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

Date	Conventional-till	Minimum-till	No-till
mo/day	<30% Cover	30-60% Cover	>60% Cover
4/26-28	Broadcast 34-0-0 N-Fertilizer Treatments; 30, 60, 90 lb N/A		
5/3	disked	undercut	-----
5/4-5	Seeded Butte & Stoa with Haybuster 1007 disk drill		
6/1	Sprayed Tiller plus Buctril at 6.6 oz. and 4.3 oz. ai/ac, respectively.		
8/16	---------------- Took hand harvest samples ----------------		
8/20	-------------------- Swathed all sp. wheat plots -------------		
9/7	--------------------- Combined harvested -----------------		
9/10	disked	undercut	----
9/14	----	----	Roundup
9/22	Seeded w. wheat varieties Roughrider & Norstar with Haybuster 8010 hoe drill		

(B1) Spring wheat grain yields (1993) in the spring wheat-winter wheat-sunflower rotation as influenced by tillage system, N-fertilizer level and cultivar.

Cultivar	Rate of N Added	Tillage System			
		Conventional till	Min-till	No-till	Avg.
	lb N/a	-bu/ac-			
Butte 86	30	25.0	24.0	25.2	27.3
	60	34.6	31.5	32.4	32.4
	90	33.1	30.8	37.0	33.6
	Avg.	30.9	28.8	31.5	30.4
Stoa	30	22.5	23.5	20.9	22.3
	60	29.4	30.0	24.9	28.1
	90	29.6	31.9	31.2	30.9
	Avg.	27.2	28.5	25.7	27.1
Avg.	(Tillage)	29.0	28.6	28.6	28.7

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

Date mo/day	Tillage System: Conventional Till	Min-Till	No-Till
Sept. 10, 92	---------------- Combined spring wheat ------------------		
Sept 21, 92	Disk	Undercut	----
Sept 22-23, 92	Seeded Roughrider & Norstar Winter Wheat with Haybuster 8010 hoe drill.		
4/27-28, 93	Topdressed N-fertilizer (34-0-0) at 30, 60, 90 lb N/ac		
5/13	Sprayed W.Wheat with 2,4-D (LV ester) plus Buctril at 5 oz. ai/a of each.		
8/11	---------------- Hand harvest samples obtained --------------		
8/20	---------------------- Swathed all plots ------------------		
8/22	---------------------- Combine harvested -----------------		
8/24	----------------- Applied Roundup all plots -----------------		
11/10	----	----	BC-Sonolan 15 lb MTL/ac

B2. Winter wheat grain yields (1993) in the spring wheat-winter wheat-sunflower rotation as influenced by tillage system, N-fertilizer level and cultivar.

Cultivar	Rate of N Added	Tillage System: Conventional Till	Minimum Till	No-Till	Avg.
	lb/ac	-------------------- bu/ac	----------------		
Roughrider	30	22.7	30.1	24.5	25.7
	60	32.4	35.0	32.6	33.4
	90	29.0	35.4	31.8	32.1
	Avg.	28.0	33.5	29.6	30.4
Norstar	30	32.3	29.7	20.8	27.6
	60	35.8	38.6	32.7	35.7
	90	33.7	35.9	30.6	33.2
	Avg.	33.7	34.8	28.0	32.2
Avg.	(Tillage)	30.9	34.1	28.8	31.3

B3. Sunflower Plots: Schedule of operations for each tillage system following winter wheat harvest in the 3-year rotation.

Date mo/day	Tillage System: Conventional Till	Min-Till	No-Till
8/28/92	------------------ Sprayed all plots with Roundup ------------		
10/10/92	----	-----	Surflan
4/26	Broadcast applied N-fertilizer (34-0-0) at 30, 60, or 90 lb N/ac		
4/29	*UC/Sonolan	*UC/Sonolan	----
5/17	Tandem disk	Undercut	Roundup (10oz. ai/a)
5/18	Seeded all plots to Sigco 651 & 658 with IH 800 Cyclo seeder		
7/9	Aerial sprayed all plots-insecticide Asana XL (0.8 oz. ai/ac)		
10/12-14	---------------- Hand harvest samples obtained --------------		
10/22	-------------------- Combine harvest -------- ------------		

*U/C Sonolan; used Haybuster undercutter with front mounted Gandy granular applicator to apply Sonolan G-10 granules and to make first incorporation tillage operation.

B3. Sunflower seed yields (1993) in the spring wheat-winter wheat-sunflower rotation as influenced by tillage system, N-fertilizer level and cultivar.

Cultivar	Rate of N Added	Tillage System: Conventional Till	Minimum Till	No-Till	Avg.
	lb/ac	--------------------	bu/ac	----------------	
Sigco 651	30	1490	1510	1180	1390
	60	1460	1690	1290	1480
	90	1340	1570	1180	1360
	Avg.	1430	1590	1220	1410
Sigco 658	30	1480	1530	920	1310
	60	1530	1440	1290	1420
	90	1350	1550	1390	1430
	Avg.	1450	1510	1210	1390
Avg.	(Tillage)	1440	1510	1210	1400

H1 (D) Nine-year average annual crop yields for the period 1985 to 1993 are given in Tables 1, 2, 3, and 4.

Table 1. Nine-year average annual spring wheat yields in the spring wheat-fallow cropping system as influenced by tillage system, N-fertilizer level, and cultivar (1985 - 1993).

Cultivar	Rate of N Added	Tillage System: Conventional Till	Minimum Till	No-Till	Avg.
	lb/ac	bu/ac			
Butte 86	0	17.8	17.6	16.4	17.3
	20	17.8	17.2	16.9	17.3
	40	17.6	17.5	16.8	17.3
	Avg.	17.7	17.4	16.7	17.3
Stoa	0	17.4	17.1	16.9	17.1
	20	17.2	17.2	17.0	17.1
	40	16.9	17.0	17.5	17.1
	Avg.	17.2	17.1	17.1	17.1
Avg.	(Tillage)	17.4	17.2	16.9	17.2

Table 2. Nine-year average annual spring wheat yield in the spring wheat-winter wheat-sunflower rotation as influenced by tillage system, N-fertilizer level, and cultivar (1985-1993).

Cultivar	Rate of N Added	Tillage System: Conventional Till	Minimum Till	No-Till	Avg.
	lb/ac	bu/ac			
Butte 86	30	20.3	21.4	21.4	21.0
	60	22.3	23.4	23.9	23.2
	90	23.1	24.5	26.4	24.7
	Avg.	21.9	23.1	23.9	22.9
Stoa	30	16.9	19.7	18.6	18.4
	60	19.9	21.4	19.7	20.3
	90	20.5	23.1	24.3	22.6
	Avg.	19.1	21.4	20.9	20.4
Avg.	(Tillage)	20.5	22.3	22.4	21.1

Table 3. Nine-year average annual winter wheat grain yield in the spring wheat-winter wheat-sunflower rotation as influenced by tillage system, N-fertilizer level and cultivar (1985-1993).

Cultivar	Rate of N Added	Tillage System: Conventional Till	Minimum Till	No-Till	Avg.
	lb/ac	bu/ac			
Roughrider	30	24.3	27.6	27.8	26.6
	60	25.9	29.3	29.7	28.3
	90	26.2	29.6	31.1	29.0
	Avg.	25.5	28.8	29.5	28.0
Stoa	30	26.2	27.1	27.9	27.1
	60	25.5	28.5	30.9	28.3
	90	26.6	29.2	29.9	28.6
	Avg.	26.1	28.3	29.6	28.0
Avg.	(Tillage)	25.8	28.6	29.6	28.0

Table 4 Nine-year average annual sunflower seed yield in the spring wheat-winter wheat-sunflower rotation as influenced by tillage system, N-fertilizer level and cultivar (1985-1993).

Cultivar	Rate of N Added	Tillage System: Conventional Till	Minimum Till	No-Till	Avg.
	lb/ac	bu/ac			
Sigco 651	30	1150	1220	1150	1170
	60	1220	1340	1220	1260
	90	1230	1310	1410	1320
	Avg.	1200	1290	1260	1250
Sigco 658	30	1130	1200	1080	1140
	60	1210	1300	1190	1230
	90	1230	1340	1300	1290
	Avg.	1190	1280	1190	1220
Avg.	(Tillage)	1200	1290	1180	1240

H1 (E) Krupinsky

Conservation tillage/crop rotation plots:

LEAF SPOT DISEASES. Spring wheat and winter wheat leaves from the experimental plots were analyzed for plant pathogens present. Septoria nodorum blotch (caused by *Septoria nodorum*) and tan spot (caused by *Pyrenophora tritici-repentis*) were the most common leaf spot pathogens present. Septoria nodorum blotch was detected on 91% of the spring wheat and 77% of the winter wheat leaves tested. Tan spot was found on 77% of the spring wheat and 42% of the winter wheat leaves tested. Spot blotch (caused by *Helminthosporium sativus*) and *Septoria avenae* f. sp. *triticea* were also detected but at lower levels. This again indicates that Septoria nodorum blotch and tan spot are the two main components of a leaf spot complex present in this study.

COMMON ROOT ROT . A survey of spring wheat plants for common root rot (caused by *Helminthosporium sativum*) was conducted. Plants (300) were pulled, roots washed, and the subcrown internodes were rated as either clean, slightly infected, moderately infected, or severely infected. Overall, 99% of the plants were classified as clean. Thus, common root rot was not a disease problem in our conservation tillage plots in 1993.

COLLECTION OF FUNGAL SPORES. Rotorod spore samplers were established from 1986 through 1993 in spring and winter wheat fields with various field management treatments to study the spore production of *Pyrenophora tritici-repentis*, cause of tan spot disease. Annual fluctuations of precipitation during the growing season was a dominant factor influencing the number of spores recovered. Low spore numbers were associated with below average precipitation. The average number of conidia recovered each year was higher than the number of ascospores, indicating the importance of conidia in the epidemiology of tan spot. In the fallow fields, spore numbers were associated with the quantity of spring wheat residue present.

H1 (F) Merrill

Wind erodibility studies:

Study of the effects of conservation tillage managements of wind erodibility has continued through 1993. Started in 1988, the study will continue as long as the parent experiment and its successors provide a minimal reasonable basis. This is necessary because of the large effect of 12 to 20 year Great Plains weather cycles on wind erodibility properties and because of a considerable death of information about this subject. Of the four principle kinds of wind erodibility measure, only surface soil aggregate size distribution (ASD) is given here (the other measures are surface roughness and horizontal and vertical residue structure and amount). Table A displays ASD results as geometric mean diameter (GMD) measurements for the winter of 1992/93. The considerable recovery of soil cohesion in both fallow and cropped stubble-condition plots, greatly lowered wind erodibility overwinter is evident in the relatively large GMD values measured in the spring. This type of strong recovery occurs when GMD values are relatively low in the fall and wintertime snow fall is adequate. Average annual GMD values are shown for all years of the study in Table B. The drought years 1988-1990 featured low GMD values, indicative of poor surface soil structure and greatly increased wind erosion hazard resulting from a multiyear drought cycle. It can also be seen that overwinter recovery of surface soil cohesion was lacking in 1988/89 and 1989/90. Deterioration of surface soil condition occurred during the generally hot summer of 1992, but the notably wet summer of 1993 resulted in continuation of relatively high surface soil cohesion, as shown by high GMD values. Conservation tillage effects on ASD results are inconsistent and obviously smaller than weather cycle or overwinter effects.

Table A. Aggregate size distribution of spring wheat-summerfallow systems showing overwinter effects. Average diameters (as geometric mean diameter, GMD, in millimeters) as measured by rotary sieve, are tabulated

	Low-residue	Conventional-till	Minimal-till	No-till	Average
Fallowed '92, cropped '93					
FALL 08/17/92	1.8	1.8	1.9	3.2	2.2
10/07/92	1.5	1.6	2.1	2.8	2.0
SPRING 04/15/93	12.8	35.1	30.2	10.2	22.1
06/02/93	3.1	7.6	5.7	5.2	5.3
Cropped '92, Fallowed '93					
FALL 07/21/92	1.5	1.0	1.4	1.1	1.2
08/18/92	1.4	1.6	1.2	1.4	1.4
SPRING 04/16/93	16.7	10.8	11.8	6.3	11.4
05/19/93	13.1	20.0	20.5	14.7	17.1

Table B. Summary of aggregate size distribution measurements in spring wheat-summerfallow cropping system at various tillage/residue management levels. GMD values (see Table A. above) averaged over calendar year. C = cropped during year; F = fallowed during year.

Year	F/C	Low-residue	Conventional-till	Minimal-till	No-till	Average
1988	F	3.5	2.8	4.5	9.6	5.1*
1989	F	1.5	1.0	0.9	0.9	1.1
1989	C	1.3	5.3	3.0	2.7	3.1*
1990	F	2.9	2.4	1.8	1.6	2.2*
1990	C	1.1	1.1	0.8	0.9	1.0
1991	F	22.8	26.7	24.8	24.6	24.7
1991	C	3.2	6.2	6.0	9.9	6.3*
1992	F	2.6	5.6	4.3	3.4	4.0*
1992	C	2.2	3.0	1.6	1.5	2.1
1993	F	10.1	31.7	19.5	28.5	22.5
1993	C	8.5	21.8	21.9	15.8	17.0*

*Data from rows with asterisks are from series of field plots fallowed on even-numbered years; those without asterisks were fallowed in odd-numbered years.

Root growth and soil water use of oilseed crops.

Study of sunflower and safflower root growth and soil water use, began with the 1992 cropping season, has continued in 1993 with the same agronomic treatments: growth on fallow ground versus three levels of conservation tillage in continuous rotation for sunflowers and three planting dates for safflowers. Table C displays total root length growth per area as observed by minirhizotrons. Because of an unusually large amount of precipitation 1993, the range of values measured was large and treatment means shown here have considerably less statistical competence than in 1992 data. The trend of safflower showing higher root length of growth than sunflower in 1993 was also observed in 1992. Root length growth of oilseeds was observed to be lesser in 1993 than in 1992, and this corresponded to lower aboveground growth in 1993 than in 1992. Soil water contents and differences in wet-to-dry water content (depletion) are tabulated for 1993 oilseeds in Table D. Due to unusually wet conditions, soil water contents progressively increased through the latter part of July, and thereafter a considerable depletion of soil water occurred under drier conditions. Safflower generally used more soil water than sunflower, which corresponds to the greater total root length growth observed in safflower. In general, our observations over a two year period have shown safflower to possess an even more aggressive rooting system than sunflower, which itself is more deeply rooted than other major crop species in the Northern Great Plains.

Table C. Total root length of oilseed crops in 1993 for the indicated agronomic treatments. Data are treatment means of minirhizotron observations summed over the entire depth of observation (4 1/2 to 6 1/2 feet) and averaged for 3 dates after approximately full root growth had been achieved.

SUNFLOWER				SAFFLOWER		
Previously fallowed	----- Spring wheat previous----- Conventional till	Minimal till	No-till	1st planting date	2nd planting date	3rd planting date
------- cm/cm^2 -------						
67.5	24.5	87.7	33.9	122.7	205.1	97.9

Table D. Soil water contents and difference in soil water content (depletion) between date of approximate maximum soil water and near end-of-season date, for 1993 oilseed crops, as measured by neutron moisture meter. Units are inches of water per 6 ft. of profile depth.

Crop	SUNFLOWER				SAFFLOWER		
Treatment	Previously fallowed	---- spring wheat previous ---- Conventiona till	Minimum-till	No-till	1st planting date	2nd planting date	3rd planting date
Date	------- inches/6 ft. profile -------						
May 28	23.8	24.5	19.8	22.6	24.6	24.8	25.0
Jun 18	24.5	25.1	21.9	24.7	25.5	25.5	25.5
Jul 28	24.4	20.8	22.8	25.9	26.1	25.7	25.9
Aug 18	22.0	20.1	21.1	23.9	22.7	23.0	22.6
Aug 31	19.7	18.3	18.5	21.6	19.5	20.4	19.8
Difference Jun 18 - Aug 31	4.8	6.8	3.4	2.1	6.0	5.1	5.7

H1 (G) A. B. Frank

Effects of Temperature and Fertilizer Nitrogen on Spike Size in Spring Barley

The continental type climate characteristic of the Northern Great Plains often results in brief periods of excessively warm temperatures during early stages of small grain development. These periods of warm temperatures have an adverse effect on spike size of spring wheat, which we have documented in previous studies. This research was conducted to provide similar information on spring barley for producers, extension specialists, and the crop service industry in the Northern Great Plains barley growing region.

In our research on the physiology of spring barley, we saw the need to gain more information on morphology development of the barley spike to enhance our early grain yield prediction potential. We studied the effects of air temperature and fertilizer nitrogen on the size of the barley spike in growth chambers and the greenhouse. Results from field plantings were also included in the data analysis. Two cultivars were studied: Azure, a 6-rowed cultivar released in 1986, and Bowman, a 2-rowed cultivar released in 1985. The plants were grown 65, 72, or 79°F, watered to prevent stress, and fertilized equivalent to 0, 63, or 180 lbs nitrogen/acre. Daylength was set at 16 hours. The plants were scored for development using the Haun scale 3 times per week. During the early stages of spike development, the spike was dissected to determine when the double ridge and terminal spikelet stages developed. Double ridge is the stage when the spike changes from producing leaves to producing spikelets; the terminal spikelet stage is when the spike ceases producing spikelets and the stem starts to elongate. The spikelet development period is the time from double-ridge to terminal spikelet stage.

Bowman developed double ridges at Haun stage 3.5 and terminal spikelet at Haun 5.4. Azure developed double ridges at Haun 3.8 and terminal spikelet at Haun stage 6.0. The Haun stage for both cultivars was greater at the 79°F temperature than at either the 65 or 72°F temperature. Barley developed double-ridges 12 days and terminal spikelet 23 days after seedling emergence. Azure developed double-ridges 11 days and terminal spikelet 21 days after seedling emergence. Duration of the spikelet development period averaged 11 days across all 3 temperatures for Azure, but for Bowman duration of the spikelet development period increased as temperature increased from 8 days at 65°F to 12 days at 72°F and 19 days at 79°F temperatures. The spike on the main stem of Bowman became deformed and aborted at 79°F, but not when grown at 65 or 72°F. This sensitivity of Bowman to the higher temperatures results in more tillers being formed because the apical dominance effect was removed with death of the main stem.

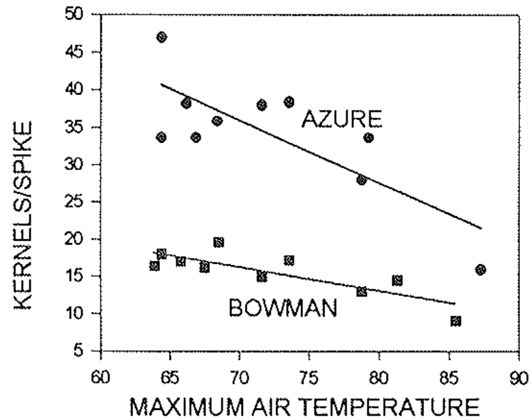


Fig. 1. Relationship between kernels per spike and daily maximum air temperature during the spikelet development stage or Haun stages 3.5 to 5.4 for Bowman and 3.8 to 6.0 for Azure.

The number of kernels per spike for both cultivars was higher on plants grown at 65°F compared to plants grown at 79°F (see Fig. 1). Based on combined data of the growth chamber study and field cultivar trials, kernels per spike decreased by 1.5 kernels per degree increase in mean maximum air temperature for Azure and 0.6 kernels per degree increase in the mean maximum air temperature for Bowman during the spikelet development period. This relationship as shown in Figure 1 can be used to predict kernel numbers per spike which along with plant population and tiller numbers has application for predicting grain yield potential 25 to 30 days after crop emergence. Obtaining yield potential at such an early date will enable producers to adjust economic inputs to match the yield potential of the crop. It is this type of research that enables us better to understand what factors determine yield potential in spring barley.

H2

This field was devoted to sunflower and safflower research in 1992 and seeded to spring barley in 1993. We broadcast 40 lb N/ac by contract April 29, 1993 using ammonium nitrate (34-0-0) as a source of N. The field was tilled at a 2-inch depth with the JD-Mulch Master May 11, 1993 and seeded to spring barley 'Bowman' May 12, 1993 with the Haybuster 1007 disk drill. The barley crop was sprayed June 11, 1993 for weed control using a mixture of 2, 4-D and Buctril each at 5.0 oz. ai/ac. The barley field yielded about 40 bu/ac and had a test yield weight of 47 lb/bu. Winter wheat varieties 'Roughrider' and 'Norstar' were no-till seeded into the 10-12 inch barley stubble Sept. 23, 1993 using the Haybuster 8010 hoe drill with 40 lbs/ac of 18-46-0 applied below the seed.

H3.

This field was no-till seeded to winter wheat varieties after spring wheat in 1992 with grain yields in the 50 to 58 bu/ac range. The 10 to 14 inch stubble was left standing overwinter to augment soil water supplies. This field was in sunflower in 1993 and we compared single-pass or two-pass incorporation effectiveness of the Haybuster undercutter and the J.D.- Mulch Master alone or in combination for first or second pass using Sonolan G-10 granules for weed control and residue cover. Granular application of Sonolan G-10 at 1.0 lb ai/ac for single or two-pass incorporation with either machine occurred April 30, 1993. Those treatments receiving the second incorporation with the same, or the other, machine occurred May 17, 1993. Sunflower varieties Sigco 651, 658, 468, and 458 were seeded with the IH-800, Cyclo, unit-row planter at a seeding rate of 22000 seeds/acre with 50 lb N/ac banded beside the row.

Observations of weed control and surface residue cover were made June 20, 1993. Weed control was good in 1992 with a single-pass incorporation at time of Sonolan application with the J.D. Mulch Master providing slightly better weed control that the Haybuster undercutter. There was 65 to 70% surface residue cover after one-pass with either machine. Excellent weed control was obtained using either, or the same, machine for the two-pass system and surface residue cover was not different between the two machines, averaging 55 to 65% cover. It appears that the J.D. Mulch Master may have potential for one-pass incorporation of Sonolan or Treflan granules, but further studies are needed to determine climate-soil moisture interactions on herbicide effectiveness over years.

The sunflowers were aerial sprayed July 9, 1992 with Asana XL insecticide at a rate of 0.8 oz. ai/ac. The sunflowers were combine harvested with an all-purpose, row-header October 21-22, 1992. The field averaged 1350 lbs of seed per acre with test weights of 29 to 30 lb/bu and an oil content of 44.0%

H4. Miscellaneous Studies

H4 (A) A sunflower variety trial was conducted on summerfallow using Treflan TR-10 granules at 1.0 lb ai/ac and the undercutter and mulch master for first- and second-incorporation. Sunflower varieties were seeded May 24-25, 1993 with the IH-800 Cyclo-seeder. The trail had virtually no weeds during the growing season. The plots were aerial sprayed July 9, 1993 with Asana XL insecticide at a rate of 0.8 oz. ai/ac. The sunflower plots were hand harvested October 15, 1993. Seed yields and test weights for each sunflower variety are presented in the following table.

Sunflower seed yield and test weight of several sunflower varieties.

Cultivar	Seed Yield	Test Weight
	lb/ac	lb/bu
Sunbred 231	2447	30.8
Sunbred X9186	2401	34.3
Pioneer 6440	2348	29.7
Sigco 458	2208	31.8
Sigco 658	2065	30.2
Sigco 651	2055	29.4
Dahlgren 3897	2053	29.5
Sigco 465A	2051	30.5
Sigco 452	2040	29.8
Sigco 468	2033	31.5
Dahlgren 1002	2026	28.8
Sunbred 277	1995	29.1
Sigco 675	1746	32.1

H4 (B). Studies to determine the influences of seeding date and N and P fertilizer combination on safflower production were conducted on the east portion of field H4. Safflower was seeded on April 28, May 11, and May 19. The April 28 date was reseeded on June 2 because of poor plant stands due to cool soil temperature and cut worm problems. Cool air temperatures along with high rainfall and high humidity at flowering reduced pollination and seed set. Safflower grain yields for 1993 were 110 lbs/ac for the May 11 seeding date, 28 lb/ac for the May 19 seeding date, and 8 lb/ac for the June 2 seeding date. Safflower did not respond to N or P fertilizer possibly due to the high residual soil N (387 lb N/ac to a depth of 6 feet).

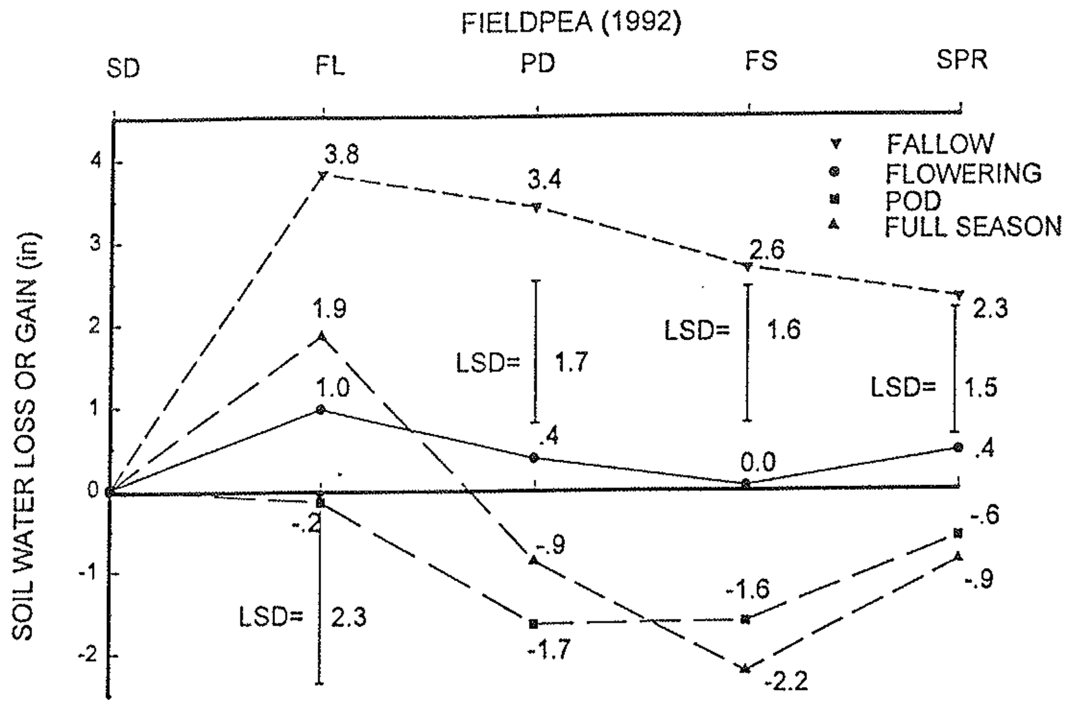
H4 (C). ARS Leased Land: Beginning in 1988 and 1989, field blocks of land were established in a spring wheat-fallow rotation to provide an opportunity to study annual legumes (Tangi flat pea, Simu field pea, and chick peas some years) as a partial summerfallow practice to provide residue for soil erosion control and 30 to 50 lb/ac of fixed nitrogen.

Peas were grown from 1989 through 1992 with Amidon spring wheat planted the following year. In 1993, Amidon spring wheat was seeded on May 4, 1993, where peas were grown in 1992, at 1.3 million variable seed per acre with an offset disk followed by a conventional press drill with six-inch row spacing. Seventy lbs/ac of 18-46-0 was applied with the seed. Spring wheat was sprayed on June 2, 1993 with 17 oz./acre of tiller plus 17 oz./acre of Buctril and harvested on August 18, 1993 by taking 1.09 yd^2 sample from each plot. Peas planted in 1992 reduced soil water storage throughout the fallow period no matter when vegetative growth was terminated (Figure 2). Peas also used soil water to about 6 feet (Figure 1). Spring wheat grain yields were less on plots where peas were grown than on fallow plots (Table 1).

Table 1. Grain yield and protein, straw yield, and straw to grain ratio for spring wheat grown after peas in 1993.

Treatment	Grain			Straw to grain
	Yield	Protein	Straw yield	grain ratio
	(bu/ac)	(%)	(lb/ac)	
Field pea				
Flowering	31	16.8	6590	3.57
Pod formation	32	16.2	6740	3.51
Full season	34	16.4	6500	3.23
Flat pea				
Flowering	35	16.8	6680	3.20
Pod formation	34	16.6	6400	3.11
Full season	38	16.9	6390	2.87
Fallow	44	15.4	6470	2.47
LSD 0.05	9	0.8	910	0.9

Figure 1. Soil water loss or gain in the 7.5 feet, for field pea and flat pea when vegetative growth was terminated at flowering (FL), pod formation (PD), or when peas were grown the fall season (FS). Soil water measurements were made at pea seeding (SD), flowering (FL), pod formation (PD), full season (FS), and prior to seeding spring wheat (SPR). All soil water measurements were compared to fallow.



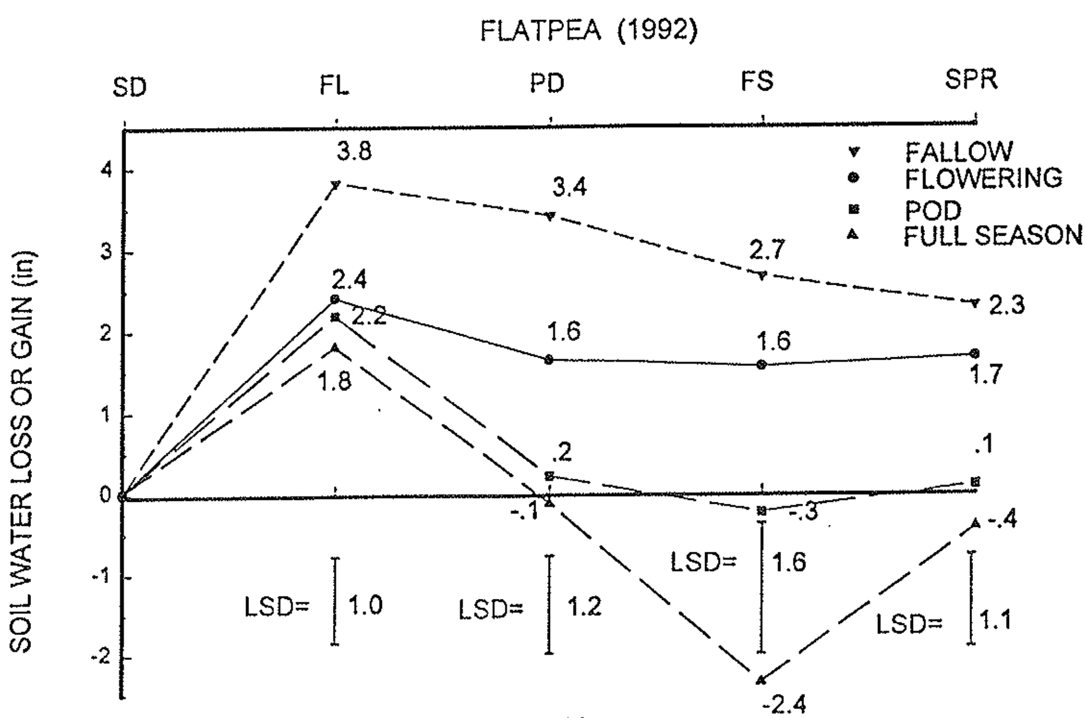
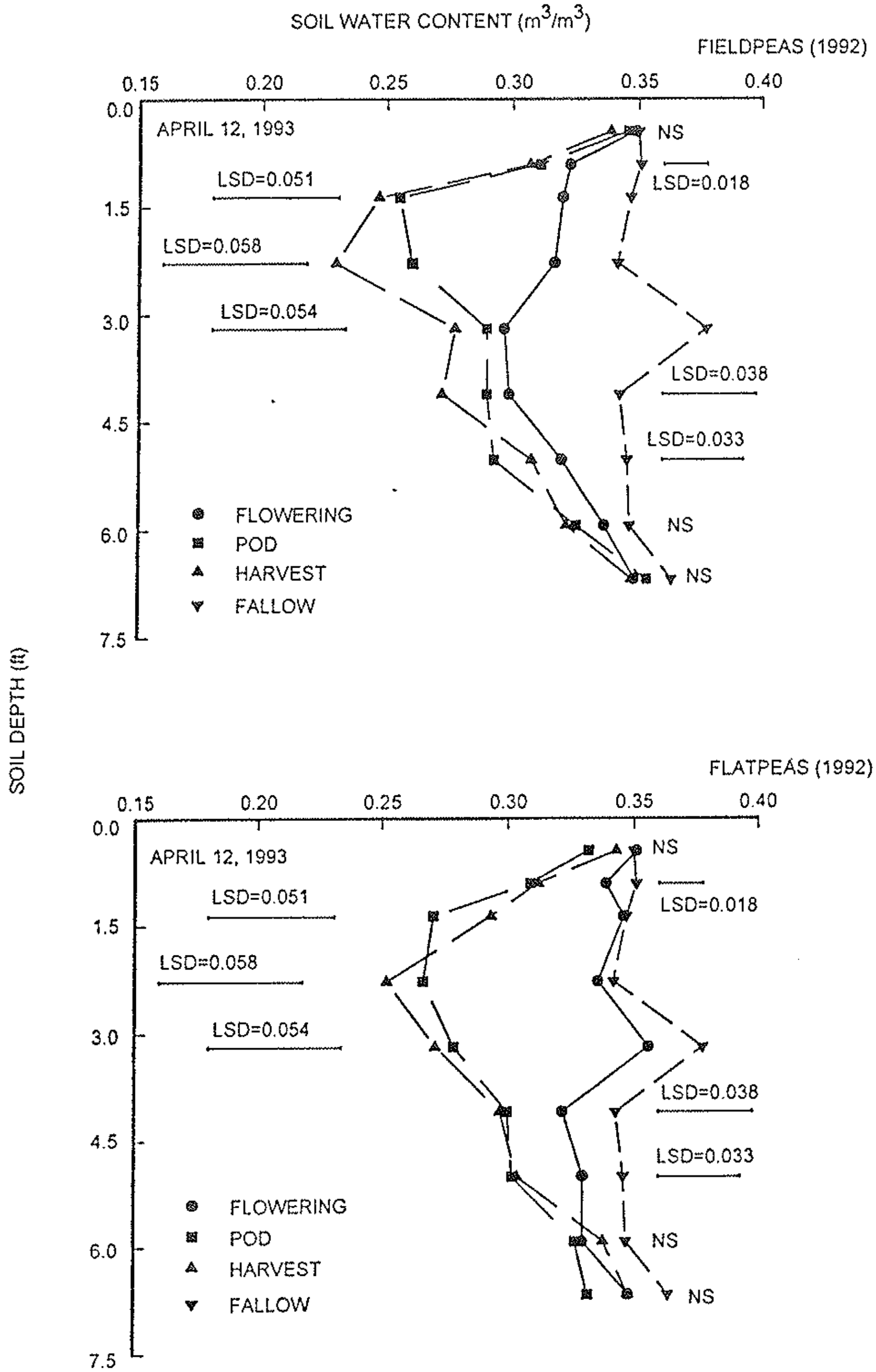


Figure 2. Profile soil water content prior to seeding spring wheat in 1993 for fallow, field pea when vegetative growth was terminated at flowing, pod formation of left for the full season and flat pea when vegetative growth was terminated at flowering, pod formation, or left for the full season.



H4 (D) A long-term study was initiated in the spring of 1993 to evaluate the influence of tillage and crop rotations on soil quality factors, especially soil C and N. All tillages and crops were in proper places in 1993 except for fall rye (spring rye substituted for fall rye). Previous crop on most of the area was sunflowers. Treatments include minimum and no-till for the following crop rotations:

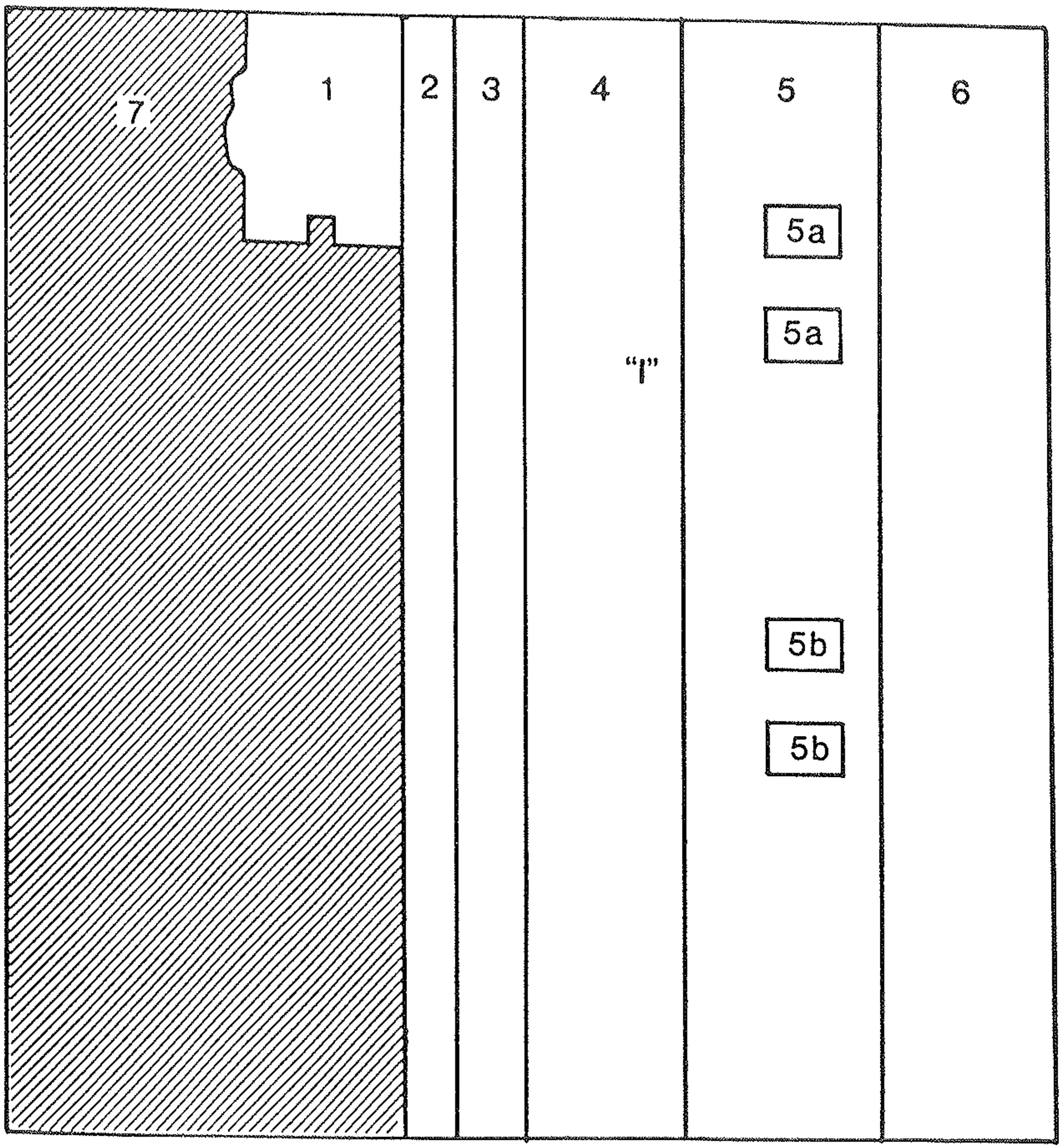
1. Continuous spring wheat (straw thorough the combine not removed)
2. Continuous spring wheat (straw run through the combine removed)
3. Spring wheat-millet
4. Spring wheat-safflower-fallow
5. Spring wheat-safflower-rye (partial fallow, cover crop)
6. Spring wheat-fallow

The 1993 crop yields were rye (growth terminated at heading) cover crop, 1000 lb/ac (60% cover); millet for hay, 1600 lbs/ac with 560 lb/ac of stubble remaining; spring wheat, 30 bu/ac with 4400 lb/ac of straw; and safflower, 128 lb/ac grain with 5600 lbs/ac of residue. Field operators are listed in Table 1.

Table 1. Field operations for each tillage systems and all crop rotations in 1993.

Date Mo/day	Minimum-till	No-till
5 /3	Applied 1 lb/ac Sonolan with undercutter on safflower plot	
5/10	Seeded spring rye, Amidon spring wheat, and Centennial safflower on all tillages. At seeding, applied 50 lb/ac (material) 18-46-0 with the seed and banded 20 lb/ac N as 34-0-0.	
5/14		Sprayed with Roundup (1 1/2 pt/ac) spring rye, spring wheat, and safflower plots.
5/25	Sprayed fallow and no-till hay millet plots (Roundup 1 1/2 pt/ac) Tilled minimum-till millet plots with undercutter. Seeded hay millet plots, 50 lb/ac 0-46-0 with seed and 30 lb/ac N as 34-0-0.	
6/16	Sprayed spring rye and spring wheat with 1 pt/ac Buctril plus 1 pt/ac 2,4-D amine.	
6/21		Sprayed safflower with a mixture of 1 pt/ac Poast, 1.5 oz/ac Pinnacle, and 1 pt/ac crop oil.
7/7		Terminated rye growth using 1 pt/ac Roundup plus 1 pt/ac 2,4-D Amine.
7/12	Terminated rye using undercutter.	
8/20	Spring wheat harvested	
9/3	Sprayed fallow and spring rye with 1 pt/ac Roundup plus 1 pt 2,4-D amine.	

NE $\frac{1}{4}$ Sec 20



I. NE 1/4 Section 20 - Research Activities

Field I1. Investigations of spring wheat root rot diseases and leaf spot diseases observations were continued in this field. This was the 9th consecutive year of continuous spring wheat cropping comparing no-till and conventional-till systems. The conventional-till (<30% cover) and the no-till (standing stubble) blocks were seeded May 6, 1993 to 'Len' spring wheat. The Haybuster 1007, no-till, disk drill was used in the conv.- and no-till blocks and 50 lbs of 18-46-0 was placed with the seed and 30 lb N/A (34-0-0) was applied between every other pair of 7-inch rows.

Investigations of wheat diseases were conducted on Len, a spring wheat cultivar, in a poor management system (nine consecutive years of continuous spring wheat cropping). Four fungicide seed treatments (Enhance [Carboxin 20% & Captan 19%]; Enhance plus Imazalil; Bayton 30; and Bayton 30 plus Imazalil) were tested in a continuous wheat field which was divided into high residue (no-till) and low residue (disking before planting).

LEAF SPOT DISEASES. Septoria nodorum blotch (caused by *Septoria nodorum*) and tan spot (caused by *Pyrenophora tritici-repentis*) were again the most common leaf spot pathogens present. Septoria nodorum blotch was detected on 77% and tan spot on 69% of the spring wheat leaves tested. Spot blotch (caused by *Helminthosporium sativus*) and *Septoria avenae* f. sp. *triticea* were also detected but at lower levels. This again indicates that Septoria nodorum blotch and tan spot are the two main components of a leaf spot complex present in this study.

Leaves of spring wheat were rated for leaf spot diseases during the growing season. Significantly higher levels of leaf spot diseases were detected on Len grown with high levels of residue (no-till) when compared to Len grown with low levels of residue. In general, no differences in percentage of leaf spot diseases among the four fungicide seed treatments were detected.

COMMON ROOT ROT . A survey of spring wheat plants for common root rot (caused by *Helminthosporium sativum*) was conducted. Plants (382) were rated as either clean, slightly infected, moderately infected, or severely infected. Since all plants were classified as clean, the survey was terminated. Thus, common root rot was not a disease problem in our plots in 1993. Since there was such a low level of common root rot no differences among the fungicide seed treatments could be detected for common root rot.

I2, I4, and I6.

These fields were summerfallowed in 1992 (undercut April, spray fallowmaster June, and spray Roundup plus 2,4-D July and Sept.). The I4 field was tilled at a 2-inch at a depth with the JD-Mulch Master for weed control of winter annuals. The I2 and I6 fields received no tillage or burndown spray and all three fields were seeded May 3-4, 1993 to Amidon spring wheat with the Haybuster 1007 no-till, disk drill. The I6-field received about 62 lbs of 18-46-0 with the seed and fields I2 and I4 received 41 lbs. of 18-46-0 with the seed. These fields were sprayed June 2-3, 1993 for weed control with a mixture of tiller plus Buctril, 17 oz. of material of each. These fields were swathed Sept. 10, 1993 and combined harvested September 14, 1993. The spring wheat in all three fields yielded about 35 bu/ac, with a test weight of 58 to 59 lb/bu and a protein content of 13.1 to 13.5%.

I3 and I5.

These fields were cropped to spring wheat in 1992 (56 bu/ac) and summerfallowed in 1993. The stubble was left standing overwinter. The stubble stayed clean of weeds until late May and we sprayed these two fields June 3, 1993 with Fallowmaster (36 oz MTL/ac). These two fields were sprayed again August 3, 1993 with Roundup plus 2-4D(LVR), 10.6 oz. ai/ac of each herbicide, respective, along with ammonium sulfate (17 lb MTL/100 gal. of water) and surfactant.