1994 Research and Cropping Results

Eleventh Annual Progress Report

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

NOTICE

The preliminary results of this report cannot be used for publication or reproduction without permission of the research scientists involved.

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.; AgrEvo; Cenex; Gustafson Inc.; NDSU-Agricultural Experiment Station; and NDSU-Cooperative Extension Service; and the USDA-Soil Conservation Service.

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INTRODUCTION TO AREA IV RESEARCH FARM

The Area IV Research Farm is the result of a specific cooperative agreement between USDA-ARS and the twelve soil conservation districts (SCD) that make up Area IV. This agreement was put in place in 1984. Through this agreement, the Area IV SCD's lease cropland from the Nelson estate for USDA-ARS to perform cooperative research projects with the Area IV SCD's. Total cropland leased by AREA IV SCD is 382 acres. In addition, USDA-ARS has leased 55 acres in Sec. 17 and Sec. 18 for soil and water conservation research for many years and another 30 acres in Sec. 8 for tree breeding since 1989. Total acreage leased for research purposes is 467 acres. See Figure 1 for location of Area IV Research Farm in relation to location from the USDA-ARS Northern Great Plains Research Laboratory facilities.

REPORT OF ACTIVITIES FOR AREA F. NW 1/4 Section 17 (see Figure 2)

Field F1. Conservation Bench Terrace Area - This hay producing area was excluded from the total acreage leased by AREA IV SCD in 1987.

Field F2. The previous crop was winter wheat in 1993 that yielded 57 bu/ac. Winter wheat stubble (12-15 inches high) was left standing over winter to augment snow trapping and soil water storage. We applied Sonalan G-10 granules May 9, 1994 at a rate of 1.0 lb ai/a 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 20, 1994 at a depth of 2-inches to accomplish the second incorporation. We seeded this field to sunflower 'Sigco 651', May 24, 1994 with the IH 800 Cyclo unit row planter at a seeding rate of 23000 seeds/a with 50 lb N/a 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. We contract sprayed for insect control with Asana XL (0.4 oz ai/a) on July 9, 1994. The sunflowers were harvested October 26, 1994, yielding about 1682 lb/acre with a test weight of 33 lb/bu and an oil content of 47%.

Field F2. Sunflower Study - Dr. Don Tanaka

A Sunflower weed study was located on the west end on this field. Purpose of the study was to compare management strategies that use combinations of tillage and/or herbicides to control weeds in sunflower and maintain surface residue for erosion control. All weed control management strategies were established in winter wheat residue. Strategies were: 1) Treflan (1 lb/ac) applied and incorporated with an undercutter (UC) in April, disk prior to seeding; 2) Treflan (0.5 lb/ac) applied in late October and incorporated with the UC, apply Treflan (0.6 lb/ac) in late April and incorporate with the UC; 3) Treflan (1.0 lb/ac) applied and incorporated in late April with the UC, UC prior to seeding; 4) Sonalan (1.0 lb/ac) incorporated with JD Mulch Master in late April (one pass); and 5) Prowl (1.75

Figure 1. Map of the land associated with the USDA-ARS Northern Great Plains Research Laboratory and the Area IV SCD-ARS Research Farm.

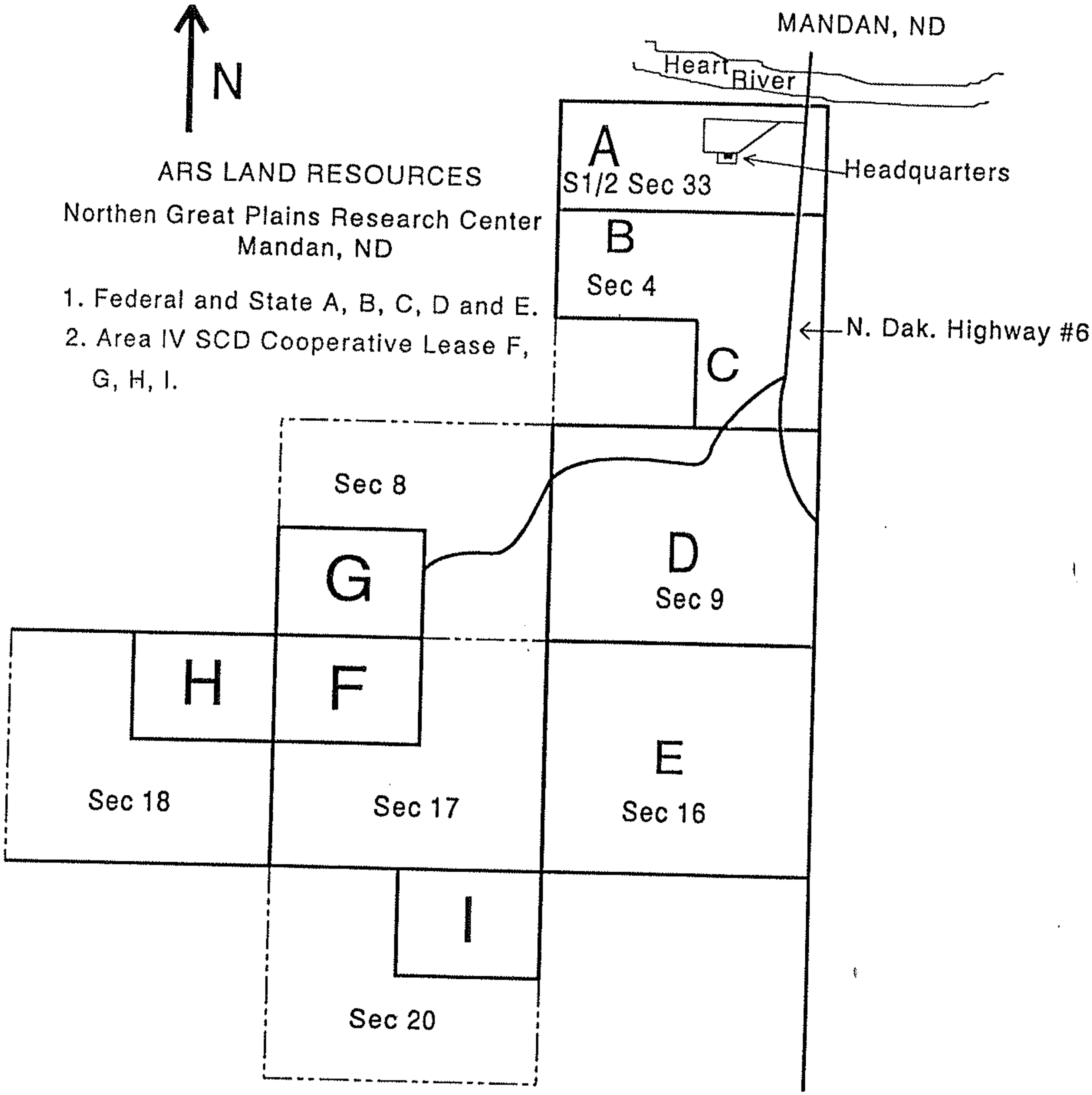
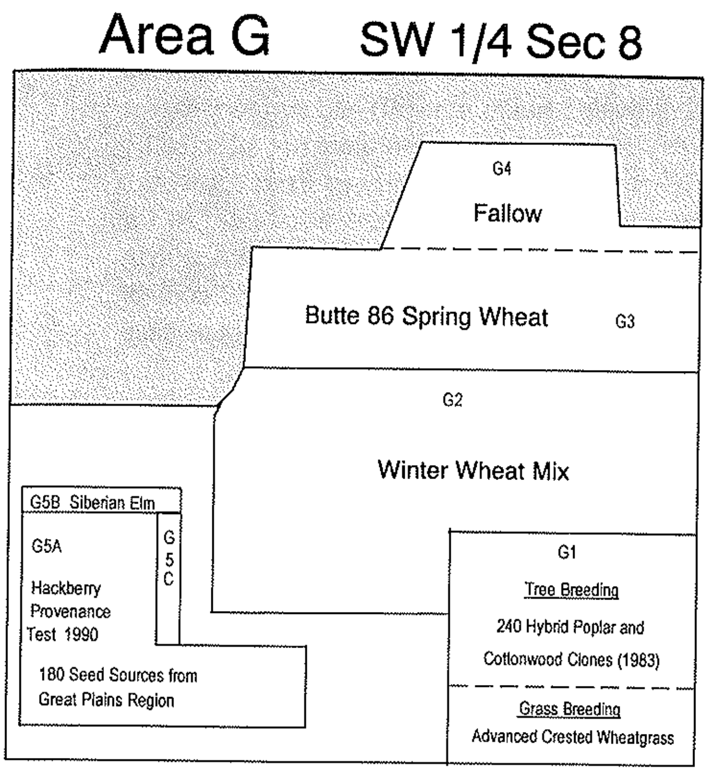
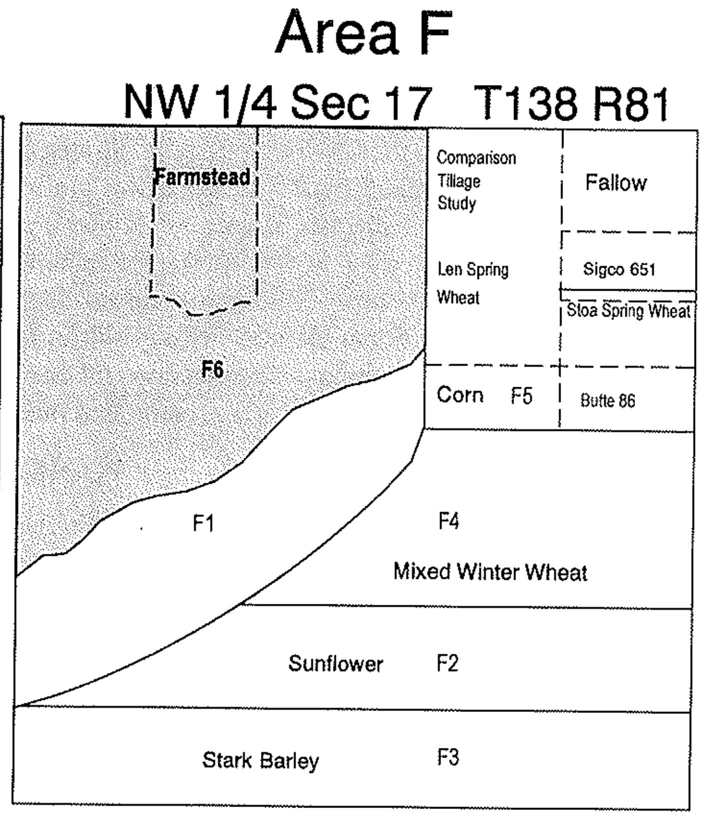
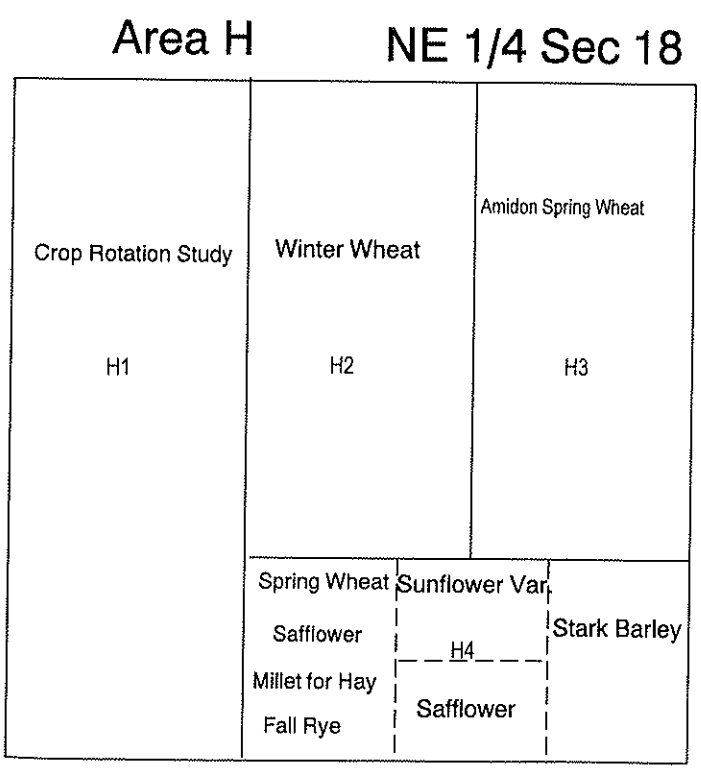
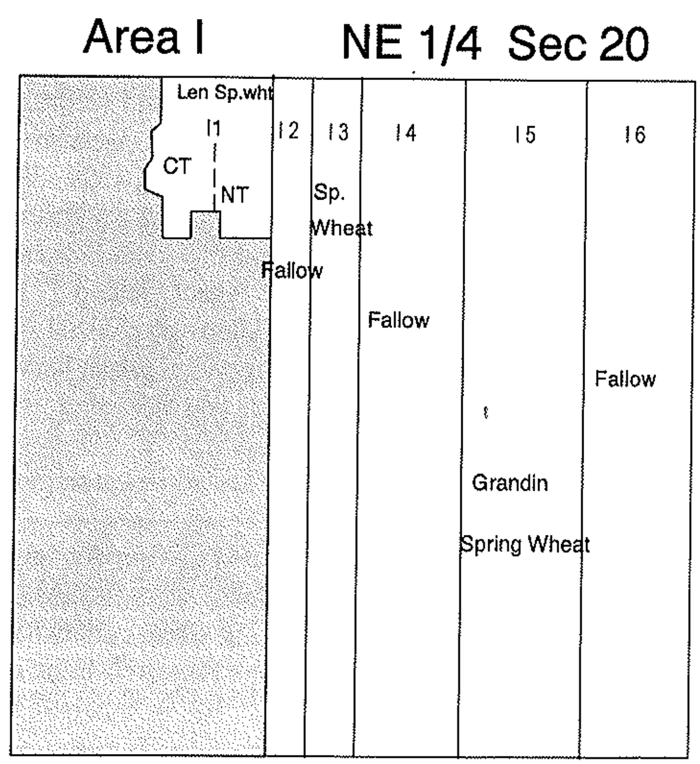


Fig. 2. Area G, F, H, and I field layouts - 1994.









lb/ac) plus Roundup (0.375 lb/ac) applied just prior to seeding (no-till). Sunflower (CV Sigco 651) was seeded on May 23, 1994 at 21,000 viable seeds per acre with 50 lb N/ac.

Surface residue cover after seeding sunflower ranged from 51% for strategy 1 (traditional method) to 97% for strategy 6. Strategies 2 through 5 (minimum-till) had surface residue cover from 70 to 80%. Sunflower grain yield and oil concentration were not affected by weed management strategies (Figure 3). Effective weed control ranged from 7.5 weeks for strategy 1 to 9.0 weeks for minimum-till strategies. No-till had weed control for about 8 weeks. Minimum- and no-till strategies produced more sunflower residue than the traditional method. Study shows that minimum- and no-till can effectively control weeds for sunflower production and that minimum- and no-till methods conserves surface residues to control soil erosion and meet government compliance requirements.

Field F3. The field was tilled with a John Deere Mulch Master on April 19, 1994 to control volunteer winter wheat that carried over from 1992. Stark barley was planted into sunflower stalks remaining from the 1993 sunflower crop. A John Deere 750 drill was used to plant the barley on April 19-20, 1994. An application of 40 lb/a of 18-46-0 was applied with the seed at planting. Nitrogen (34-0-0) was broadcast at a rate of 40 lb N/a on May 11, 1994. We sprayed the barley for weed control May 24, 1994 using a mixture of 2,4-D (LV ester, 4.4 oz ai/a) plus Buctril (5 oz. ai/ac). The barley was harvested August 1, 1994 and yielded 52.2 bu/a with a test weight of 48.5 lb/bu.

Field F4. The previous crop was spring barley 'Bowman' in 1993. The field was sprayed after barley harvest to control volunteer grain and weeds 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 8000 narrow-point hoe drill, single seed opener, in 10-inch row spacing at a seeding rate of about 1-million viable seeds/a. Nitrogen fertilizer (34-0-0) was broadcast at a rate of 60 lb N/a on May 3, 1994. The winter wheat was sprayed for broadleaf weed control on May 21, 1994 using a mixture of 2,4-D (LV-ester, 4.4 oz ai/a) plus Buctril (5 oz ai/a). We swathed this winter wheat field July 27, 1994 and combined it on August 2, 1994. The winter wheat yielded 57 bu/a. Volunteer barley was a severe problem in this field in 1994. The winter wheat was discounted significantly at the elevator. The field was sprayed after winter wheat harvest on September 29, 1994 with Roundup (8 oz ai/a) to control weeds and volunteer grain.

Field F5. This field contained research plots of Drs. Joe Krupinsky and Donald Tanaka.

A. Spring Wheat and Spring Barley Trials - Dr. Don Tanaka

Spring barley and spring wheat variety trials were initiated in 1979 and have continued with cooperation from Research Centers at Dickinson and Williston, ND.

SUNFLOWER WEED MANAGEMENT

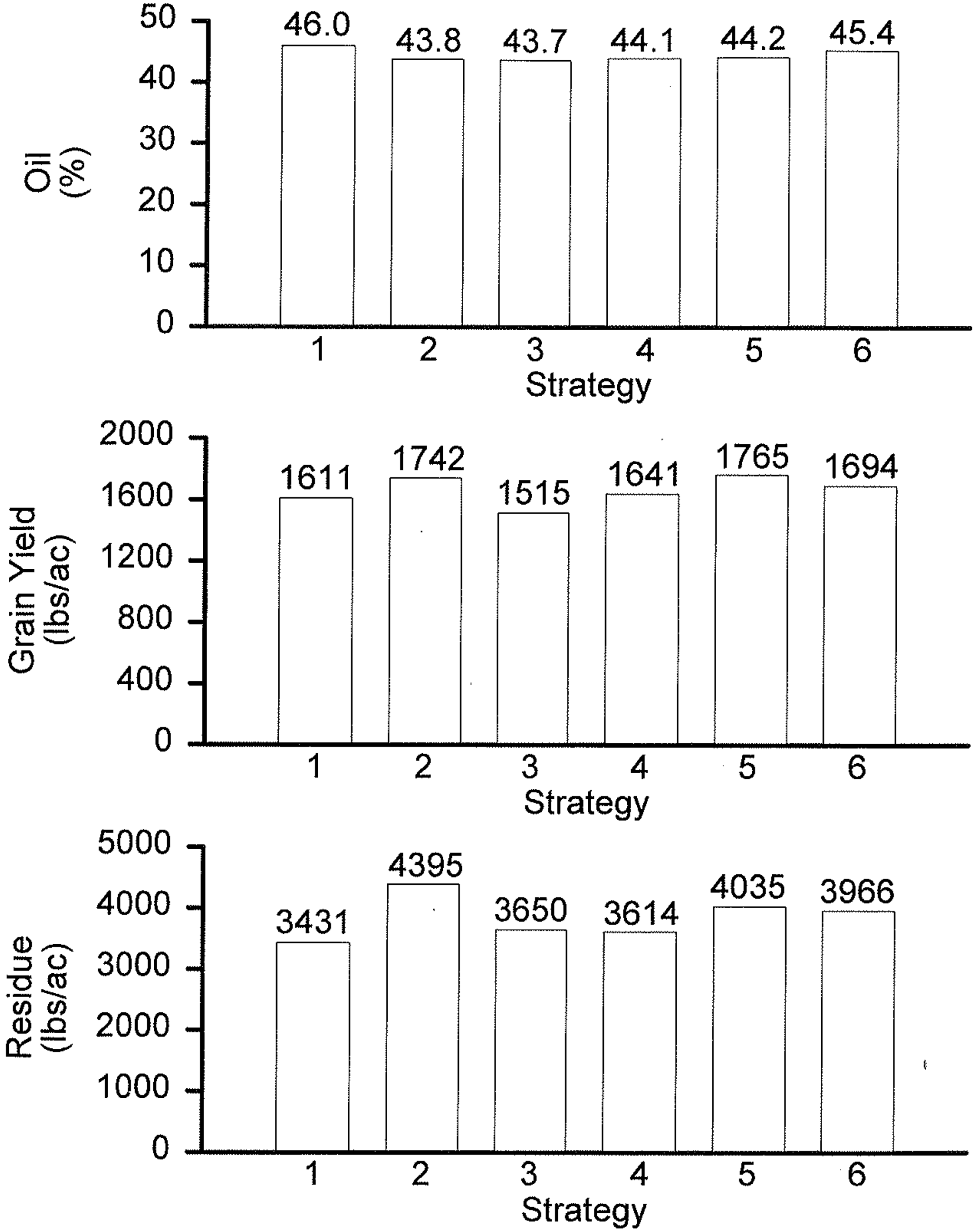


Figure 3. Sunflower agronomic measurements as influenced by management strategy.

Varieties were seeded with a 7 foot Kirschman drill in 6-inch rows on May 5, 1994 at a rate of 1.3 million viable seeds per acre. The field had been chemically fallowed the previous year and weed control prior to seeding was done with a JD Mulch Master at a depth of 1 1/2 inches. Fifty pounds N per acre and 10 pounds P per acre were applied at seeding. Weeds in the crop were controlled using Tiller (16 oz/ac) plus Buctril (16 oz/ac) on May 31, 1994.

Six row barley had greater grain yields than two row barley (Table 1). Barley grain yields fell into 4 groups: 1) 80 bu/ac and above; 2) 65 to 80 bu/ac; 3) 60 to 65 bu/ac; and 4) 60 bu/ac and below. Robust barley had poor plant establishment (41%). Spring wheat grain yields can also be separated into 4 groups: 1) 45 bu/ac and above; 2) 43 to 45 bu/ac; 3) 40 to 43 bu/ac; and 4) 40 bu/ac and below. Grandin had poor plant establishment.

B. Plant Disease Work for 1994 - Dr. Joe Krupinsky

LEAF SPOT DISEASES in Comparison Tillage Study. A comparison tillage study for studying wheat diseases was started in 1993. This study included five tillage treatments (continuous wheat no-till, continuous wheat maximum till, continuous wheat minimum till, and a wheat-fallow rotation with maximum tillage). In 1994, four fungicide seed treatments (Enhance [Carboxin 20% & Captan 19%]; Enhance plus Imazalil; Bayton 30; and Bayton 30 plus Imazalil) were also included. This was the second year that plots were rated for leaf spot diseases. No consistent differences among tillage treatments or fungicide treatments were detected for leaf spot diseases in 1994.

C. Bulk Field.

Len spring wheat was seeded on May 12, 1994 with 40 lb/a of 18-46-0 applied with the seed. In addition, 40 lb N/a was applied as 34-0-0 at planting. Tiller (5.7 oz ai/a) plus Buctril (3.7 oz ai/a) was applied on June 1, 1994 for weed control in the crop. The spring wheat yielded 41 bu/a with 13% protein.

Table 1. Spring barley and wheat agronomic measurements for 1994 at Mandan, ND.

Varieties	Grain Yield (bu/a)	Grain Test Wt. (lb/bu)	Straw Yield (lb/a)	Straw to Grain Ratio	Plant Population (plants/ yd2)	Heads per Plant (heads/ plant)	Kernel Wt. (mg/ kernel)	Heads (heads/ yd2)	Kernels per Head	Plant Height (in)	Plants per viable seed (%)
Spring Barley											
Excel	85.3	44.0	4718	1.3	145	3.0	28.7	438	32.0	29.3	54
Azure	72.7	47.8	4006	1.1	165	2.4	32.4	385	31.5	31.5	61
Robust	70.6	48.6	3690	1.1	110	3.0	33.0	322	35.0	31.5	41
Morex	67.9	43.4	4580	1.6	166	2.7	26.3	448	30.1	27.8	62
Gallatin	63.5	42.8	5112	1.9	236	2.9	27.0	682	14.1	29.5	88
Stark	59.6	46.8	4608	1.7	185	3.3	32.8	599	15.8	28.5	69
Bowman	44.5	44.3	3929	2.0	170	3.9	30.1	643	12.6	26.3	63
LSD	5.1	0.7	572	0.2	45	0.6	2.0	65	4.5	2.3	--
Spring Wheat											
Prospect	48.5	62.7	5750	1.9	162.8	2.4	30.6	386.3	25.1	33.3	61
2375	44.3	63.1	5699	2.0	208.8	2.4	32.4	494.6	19.8	34.8	78
Butte ARS	41.9	62.1	4701	1.8	164.5	2.6	31.8	426.0	19.8	35.0	61
Amidon	40.9	62.3	6314	2.5	206.5	2.1	28.8	434.4	23.3	39.8	77
Stoa	40.8	61.1	5621	2.3	192.3	2.4	26.9	454.5	22.4	37.0	72
Butte 86	40.5	62.2	5185	2.1	174.8	2.7	32.3	456.9	18.9	36.9	65
Vance	38.3	60.9	5267	2.3	136.0	2.9	30.4	385.5	22.2	34.1	51
Len	38.1	60.9	4698	2.0	202.0	2.1	29.5	386.3	19.5	30.8	75
Coteau	37.9	61.6	5776	2.5	164.0	2.3	28.6	381.3	22.0	43.5	61
ND677	37.3	63.1	5772	2.5	161.3	2.8	28.4	426.0	20.5	37.1	60
Grandin	37.1	62.2	4694	2.0	111.3	3.6	32.8	400.9	18.7	34.8	41
LSD	2.2	0.2	670	0.3	39.6	0.6	0.8	54.6	2.5	3.7	--

REPORT OF ACTIVITIES FOR AREA G. SW 1/4 Section 8 - Research Activities (see Figure 2)

Field G1. Hybrid Poplar Clonal Test - Dr. Richard Cunningham

A new hybrid poplar variety, **'CANAM'**, will be available for conservation tree plantings in the northern Great Plains in the spring of 1996. The USDA, Agricultural Research Service and the USDA, Soil Conservation Service are cooperating with a Canadian agency, the PFRA Shelterbelt Centre, Indian Head, Saskatchewan, in the release of this new variety.

CANAM poplar (*Populus* 'Canam') is a female variety recommended for use in field and farmstead windbreaks, wildlife habitat and fuelwood plantings in the northern Great Plains of North America. **CANAM** differs from other hybrid poplars in combining very rapid growth rate with excellent tolerance to drought and winter damage. The name **CANAM** was chosen to recognize the cooperation between the CANadian and AMerican agencies in the selection, testing and release of this cultivar.

In field trials with other poplar clones, **CANAM** had greater than average survival, height, and crown width and less than average crown density, dead terminal shoots, crown die-back, sprouting, defoliation by cottonwood leaf beetles, and bud deformation by the poplar bud gall mite. **CANAM** is superior to most standard nursery hybrid poplar clones in height growth, drought hardiness and reduced susceptibility to winter damage. 'Northwest' poplar and 'Walker' poplar are the only standard clones that have equal or better survival.

CANAM is recommended for planting in USDA plant hardiness zones 3a, 3b, 4a and 4b within the area of the northern Great Plains. It has not been adequately tested outside this area. Planting stock of **CANAM** can be ordered from Lincoln-Oakes Nurseries, P.O. Box 1601, Bismarck, ND 58502 (701/223-8575).

Field G1. Forage Grass Breeding and Genetics - Dr. John Berdahl

Progeny tests of 107 fairway-type and 196 standard-type crested wheatgrass entries and 240 western wheatgrass entries are being evaluated. The tests were seeded in 1993, and data were collected in 1994 on plant vigor, forage yield, and forage quality. Additional testing will be required to identify parents with high forage yield, seed yield, and nutritional quality for improved cultivars of crested and western wheatgrass. Progeny test results are not being reported this year. Genetic studies on crested wheatgrass are being conducted on additional populations. Recent hexaploid introductions from the former USSR have a robust plant type with broad leaves and may be useful in improving forage quality and yield in crested wheatgrass.

Field 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 1993 was spring barley 'Bowman' or 'Stark' each occupying about one-half of the field. Winter wheat (mixture of Roughrider and Norstar) was seeded on September 25, 1993 with a Haybuster 8000 hoe drill with 10 inch spacing. Nitrogen (34-0-0) was applied to the winter wheat on May 3, 1994 at a rate of 60 lb N/a. The entire field was sprayed for weeds May 21, 1994 with a mixture of 2, 4-D (LV ester, 4.4 oz ai/a) and Buctril (5.0 oz. ai/a). The field was swathed July 27, 1994 and combined August 3, 1994, yielding about 42 bu/a. Volunteer barley was a severe problem in this field in 1994. The winter wheat was discounted significantly at the elevator.

Field G3. This field was summerfallowed in 1993. 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. The field was tilled with a John Deere Mulch Master in the fall of 1993 and again in the spring of 1994 before spring wheat planting. The field was seeded on April 18, 1994 to Butte 86 spring wheat using a John Deere 750 no-till drill. The drill was provided by Central Dakota Equipment of Bismarck and the mulch master by Letvin Equipment Company of Dickinson. Tiller (5.7 oz ai/a) plus Buctril (3.7 oz ai/a) was applied on May 25, 1994 for broadleaf weed control. The spring wheat was swathed on August 5, 1994 and combined on August 10, 1994. The spring wheat yielded 41 bu/a.

Field G4. This field was summerfallowed in 1994 following a crop of Amidon spring wheat in 1993. The field was undercut, June 3, 1994 for weed control. Roundup was applied at a rate of 10.9 oz ai/a on June 30, 1994 and again on July 28, 1994 (9 oz ai/a) for weed control.

Field G5. USDA-ARS Leased Land - Tree Breeding Activities - Dr. Rich Cunningham

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.

REPORT OF ACTIVITIES FOR AREA H. NE 1/4 Section 18 - Research Activities (see Figure 2)

Field H1. Tillage, Nitrogen, and Cropping Systems Study - Drs. Halvorson and Tanaka

This large field is dedicated to the cropping systems--conservation tillage and nitrogen 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. The following tables (A1 through D3) report field operations and grain yield for the spring wheat, winter wheat, and sunflower crops for each rotation.

Spring Wheat-Fallow Results (Table A2): In 1994, there was no significant difference between spring wheat varieties. There was a significant response to N fertilization and tillage system. There was significant tillage x N interaction. In 1994, the clean till (no residue) plots had the highest grain yields with NT being the lowest. The 1994 spring wheat-fallow yield expressed on an annual basis averaged 15.9 bu/a. The 10-year average yield data are reported in Table A4 with an average annual yield of 16.4 bu/a.

Spring Wheat in Annual Cropping System (Table B2): In 1994, there was a significant difference between spring wheat varieties in the annual cropping system. There was a significant response to N fertilization and to tillage system. The MT system had significantly higher yields than CT or NT. There was also a significant N x tillage interaction in 1994. The 1994 spring wheat yield in the annual cropping system was more than double the annual spring wheat yield in the wheat-fallow system. The 10-year average yield data are in reported in Table B3 with a 10-yr average yield of 22.1 bu/a.

Winter Wheat in Annual Cropping System (Table C2): In 1994, tillage system had no significant affect on winter wheat yields in the annual cropping system. There was a significant difference between winter wheat varieties with Norstar yielding more than Roughrider. Both varieties responded positively to N fertilization. There was a significant tillage x variety interaction in 1994. The 10-year average yield data are presented in Table C3 with an average annual yield of 33.3 bu/a.

Sunflower in Annual Cropping System: In 1994, there was no significant affect of tillage or N fertilization on sunflower yield. The Sigco 651 (short variety) yielded significantly more than the Sigco 658 (tall variety). Sunflower yields were excellent in 1994 with an average yield of 1682 lb/a in this annual cropping system. The 10-year average grain yields are reported in Table D3 with a 10-yr average yield of 1288 lb/a.

Table A1. Spring wheat-fallow plots, 1994 schedule of operations for each tillage system following 1993 fallow.

Date	Conventional-till		Minimum-till	No-till
mo/day/yr	No residue	<30% Cover	30-60% Cover	>60% Cover
5/5/94	Applied N-fertilizer (34-0-0) treatments, 0, 20, and 40 lb N/a			
5/6/94	disked	Mulch Master	undercut	-----
5/9/94	Seeded Butte 86 and Stoa spring wheat with Haybuster 1000 disk drill (Vitavax treated seed)			
6/2/94	Sprayed all plots with Tiller (5.7 oz ai/a) plus Buctril (3.7 oz ai/a)			
8/16-19/94	Biomass harvest samples obtained using bundle cutter			
8/16-19/94	Swathed grain for plot harvest (10 ft cut across each plot)			
8/23/94	Combined plots for yield			
8/23/94	Cleaned up plots with large combine			

Table A2. 1994 Spring wheat grain yields in sp.wheat-fallow rotation as a function of tillage system, N-fertilizer level, and cultivar.

Cultivar	Rate of N added	Tillage System				Nitrogen Average
		CT		MT	NT	
		No residue	<30% Cover	30-60% Cover	>60% Cover	
	lb N/a	--------------------------bu/a------------------------------				
Butte 86	30	37.4	28.1	25.3	24.5	26.0
	60	40.3	36.3	34.7	27.5	32.8
	90	40.7	38.9	37.7	34.7	37.1
Butte 86 Average		39.5	34.4	32.6	28.9	32.0
Stoa	30	37.2	25.3	27.5	23.6	25.5
	60	42.5	35.5	34.9	25.9	32.1
	90	43.5	37.9	37.5	33.9	36.4
Stoa Average		41.1	32.9	33.3	27.8	31.3
Tillage Average		40.3	33.7	32.9	28.4	31.7

Table A3. Fallow-Spring wheat plots, 1994 schedule of operations for each tillage system for the fallow series of plots.

Date	Conventional-till		Minimum-till	No-till
mo/day/yr	No residue	<30% Cover	30-60% Cover	>60% Cover
5/6/94	Deep disked	----	----	----
6/1/94	----	undercut	undercut	Roundup
6/17-20/94	Disked	undercut	Roundup+Ally	----
7/12-13/94	Disked	*Roundup + Banvel	*Roundup + Banvel	*Roundup + Banvel
8/1/94	undercut	----	----	----
8/24/94	----	undercut	undercut	----

*Roundup (9.0 oz ai/a) plus Banvel (3 oz ai/a) with ammonium sulfate and surfactant.

Table A4. Ten-year average (1985-1994) spring wheat yields in the spring wheat-fallow cropping system as a function of tillage system, N-fertilizer level, and cultivar.						
Cultivar	Rate of N added	Tillage System				Nitrogen Average (excludes no residue)
		CT		MT	NT	
		No residue (8-yr avg)	<30% Cover	30-60% Cover	>60% Cover	
	lb N/a	---bu/a---				
Butte 86	30	30.7	34.2	31.7	30.7	32.2
	60	32.5	34.5	32.6	31.5	32.9
	90	31.4	34.9	33.8	33.2	34
Butte 86 Average		31.6	34.5	32.7	31.8	33
Stoa	30	29.9	31.9	32.6	31.9	32.1
	60	30.9	33.3	32.4	31.2	32.3
	90	30.2	32.7	33.2	32.4	32.8
Stoa Average		30.4	32.6	32.7	31.9	32.4
Tillage Average		31.0	33.6	32.7	31.9	32.7

Table B1. Spring wheat, 1994 schedule of operations in sp.wheat-w.wheat-sunflower rotation			
Date	Conventional-till	Minimum-till	No-till
mo/day	<30% Cover	30-60% Cover	>60% Cover
5/5	Broadcast 34-0-0 N-fertilizer treatments, 30, 60, 90 lb N/a		
5/6	disked	Mulch Master	-----
5/9	Seeded Butte 86 and Stoa sp.wheat with Haybuster 1000 disk drill		
6/2	Sprayed Tiller plus Buctril at 5.7 oz and 3.7 oz ai/a, respectively		
8/15-19	Swathed grain, took biomass samples and head counts		
8/23	Combined plot area for yield		
9/27-28	disked	undercut	Roundup
9/29	Seeded w.wheat with Haybuster 8000 hoe drill, 10 inch row spacing		

Table B2. 1994 Spring wheat grain yields in sp.wheat-w.wheat-sunflower rotation as a function of tillage system, N-fertilizer level, and cultivar.					
Cultivar	Rate of N added	Tillage System			
		CT	MT	NT	Nitrogen Avg.
	lb N/a	---bu/a---			
Butte 86	30	31.9	40.0	24.3	32.1
	60	32.6	40.5	34.0	35.7
	90	31.0	43.3	37.4	37.2
Butte 86 Average		31.8	41.3	31.9	35.0
Stoa	30	30.6	38.0	23.0	30.5
	60	32.7	39.8	30.7	34.4
	90	29.2	42.1	32.3	34.5
Stoa Average		30.8	40.0	28.7	33.2
Tillage Average		31.3	40.6	30.3	34.1

Table B3. Ten-year (1985-1994) average annual spring wheat yields in sp. wheat-w.wheat-sunflower rotation as a function of tillage system, N-fertilizer level, and cultivar.					
Cultivar	Rate of N added	Tillage System			
		CT	MT	NT	Nitrogen Avg.
	lb N/a	---bu/a---			
Butte 86	30	20.9	22.5	21.0	21.5
	60	22.5	24.0	23.8	23.4
	90	22.9	25.1	26.6	24.9
Butte 86 Average		22.1	23.9	23.8	23.3
Stoa	30	17.7	20.7	18.8	19.0
	60	20.4	22.1	20.3	20.9
	90	20.6	24.0	23.8	22.8
Stoa Average		19.6	22.3	21.0	20.9
Tillage Average		20.8	23.1	22.4	22.1

Table C1. Winter wheat crop plots, 1994 schedule of operations for each tillage system following spring wheat in the sp.wheat-w.wheat-sunflower rotation.			
Date	Conventional-till	Minimum-till	No-till
mo/day/yr	<30% Cover	30-60% Cover	>60% Cover
9/3/93	Combined spring wheat, cleaned up plots		
9/21/93	disked	undercut	-----
9/22/93	Seeded Roughrider and Norstar winter wheat with Haybuster 8000 hoe drill		
5/5/94	Topdressed N-fertilizer (34-0-0) at 30, 60, and 90 lb N/a		
5/21/94	Sprayed w.wheat with 2,4-D (LV ester) plus Buctril at 4.4 oz ai/a of each		
8/1/94	Swathed grain, took biomass samples and head counts		
8/4/94	Combined plots for yield		
8/8/94	Cleaned up plots with large combine		
9/27/94	undercut	Roundup	Roundup
10/31/94	----	----	Broadcast Sonalan (13 lb material/a)

Table C2. 1994 winter wheat grain yields in sp.wheat-w.wheat-sunflower rotation as a function of tillage system, N-fertilizer level, and cultivar.					
Cultivar	Rate of N added	Tillage System			
		CT	MT	NT	Nitrogen Avg.
	lb N/a	---------------------------bu/a------------------------------			
Roughrider	30	30.5	27.8	27.0	28.4
	60	30.7	29.2	30.3	30.1
	90	31.6	29.7	33.4	31.6
Roughrider Average		30.9	28.9	30.2	30.0
Norstar	30	33.7	34.4	32.1	33.4
	60	35.8	39.7	36.3	37.3
	90	37.7	39.8	39.9	39.1
Norstar Average		35.7	38.0	36.1	36.6
Tillage Average		33.3	33.4	33.2	33.3

Table C3. Ten-year (1985-1994) average annual winter wheat grain yields in sp.wheat-w.wheat-sunflower rotation as a function of tillage system, N-fertilizer level, and cultivar.

Cultivar	Rate of N added	Tillage System			
		CT	MT	NT	Nitrogen Avg.
	lb N/a	---------------------------bu/a------------------------------			
Roughrider	30	30.5	27.8	27.0	28.4
	60	30.7	29.2	30.3	30.1
	90	31.6	29.7	33.4	31.6
Roughrider Average		30.9	28.9	30.3	30.0
Norstar	30	33.7	34.5	32.1	33.4
	60	35.8	39.7	36.3	37.3
	90	37.7	39.8	39.9	39.1
Norstar Average		35.7	38.0	36.1	36.6
Tillage Average		33.3	33.4	33.2	33.3

Table D1. Sunflower plots, 1994 schedule of operations for each tillage system following spring wheat in the sp.wheat-w.wheat-sunflower rotation.

Date	Conventional-till	Minimum-till	No-till
mo/day/yr	<30% Cover	30-60% Cover	>60% Cover
9/7/93	Sprayed all plots with Roundup		
11/10/93	----	----	Broadcast Sonalan (15 lb material/a, 1.5 lb ai/a) on soil surface
5/5/94	Broadcast applied N-fertilizer (34-0-0) at 30, 60, and 90 lb N/a		
5/5/94	*undercut, applied Sonalan	*undercut, applied Sonalan	----
5/18/94	----	----	Roundup
5/25/94	Seeded all plots to Sigco 651 and 658 with IHC 800 Cyclo seeder		
7/18/94	Aerial sprayed all plots with Asana XL insecticide (0.4 oz ai/a)		
10/24/94	Hand harvested plots for yield		
10/26/94	Bulk combined plot area		

*Sonalan was applied using a Haybuster undercutter with a front mounted Gandy granular applicator. This was the first tillage operation for incorporation of Sonalan G-10 granules.

Table D2. 1994 sunflower grain yields in sp.wheat-w.wheat-sunflower rotation as a function of tillage system, N-fertilizer level, and cultivar.

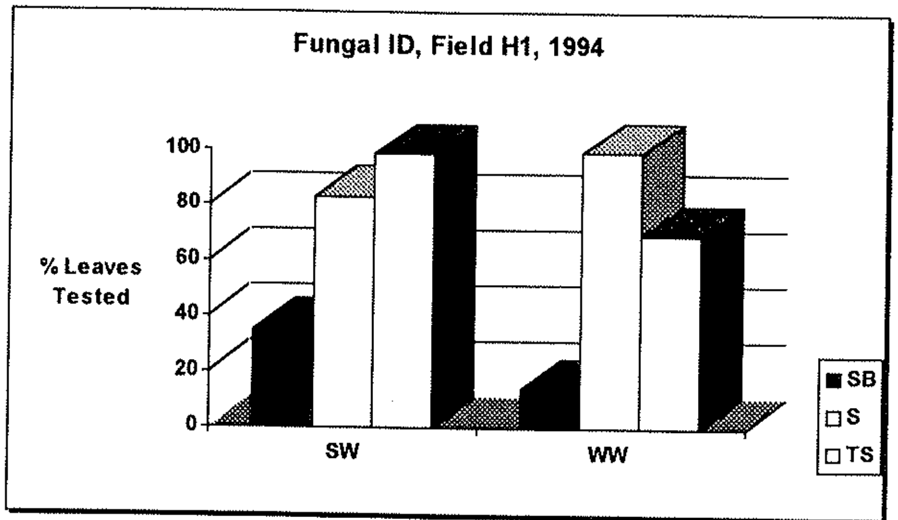
Cultivar	Rate of N added	Tillage System			
		CT	MT	NT	Nitrogen Avg.
	lb N/a	---------------------------lb/a-------------------------------			
Sigco 651	30	1819	1813	1914	1849
	60	1608	1659	1705	1657
	90	1793	1814	1708	1772
Sigco 651 Average		1740	1762	1776	1759
Sigco 658	30	1532	1544	1608	1561
	60	1543	1669	1629	1614
	90	1603	1694	1618	1638
Sigco 658 Average		1559	1636	1619	1605
Tillage Average		1650	1699	1697	1682

Table D3. Ten-year (1985-1994) annual sunflower grain yields in sp.wheat-w.wheat-sunflower rotation as a function of tillage system, N-fertilizer level, and cultivar.

Cultivar	Rate of N added	Tillage System			
		CT	MT	NT	Nitrogen Avg.
	lb N/a	---------------------------lb/a-------------------------------			
Early Maturing Cultivar	30	1215	1242	1253	1237
	60	1252	1387	1256	1298
	90	1298	1360	1452	1370
Cultivar Average		1255	1330	1320	1302
Medium Maturing Cultivar	30	1167	1272	1140	1193
	60	1239	1330	1287	1285
	90	1250	1375	1403	1343
Cultivar Average		1219	1326	1277	1274
Tillage Average		1237	1328	1299	1288

Field H1. Plant Diseases in Tillage and Cropping Systems Studies - Dr. Joe Krupinsky

LEAF SPOT DISEASES in Long-Term Cropping Systems Study. 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. Tan spot was found on 98% of the spring wheat and 69% of the winter wheat leaves tested. Septoria nodorum blotch was detected on 83% of the spring wheat and 99% of the winter wheat leaves tested. Thus, tan spot was the most common disease on spring wheat, followed by Septoria and Septoria nodorum blotch was the most common on winter wheat, followed by tan spot. 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 on wheat leaves in this study.



SB = Spot Blotch, S = Septoria, TS = Tan spot

With spring wheat and winter wheat in the continuous cropping system, there were consistent differences in amount of leaf spot diseases among cultivars and nitrogen levels in 1994. This indicates the importance of selecting disease-resistant cultivars and providing adequate nitrogen. With spring wheat in the crop-fallow system or with winter wheat in the continuous cropping system, residue treatment did not have a significant effect on leaf spot diseases in 1994. But, even though residue effects were confounded with a residue X cultivar interaction, a higher level of leaf spot disease damage was generally associated with the high residue treatment with spring wheat in the continuous cropping system.

COLLECTION OF FUNGAL SPORES in Long-Term Cropping Systems Study. Rotorod samplers with a retracting head were used to collect air-borne spores. When the motor starts, two collecting rods move into sampling position through centrifugal force and remained exposed until the motor stops. The rods rotate at a high speed (2400 rpm) impacting air-borne spores and retaining them on a sticky substance, silicone grease, which was applied to the leading edge of the rods. Four rotorod samplers were used to collect spores of

Table A. Average dry aggregate size by year in spring wheat-summerfallow. Units are inches.							
	1988	1989	1990	1991	1992	1993	1994
Cropped	---	1.2	0.4	2.5	0.8	6.7	2.7
Fallowed	2	0.4	0.9	9.7	1.6	8.9	4.4

Large variations in aggregate size and implied soil erodibility over the course of the weather cycle, as seen in Table A, contrast with the relatively small variations among conservation tillage treatments, as shown for 1994 in Table B. Significant differences among tillage treatments have been observed during only one or two years of this study.

Table B. Average dry aggregate size for conservation tillage treatments measured in 1994 in spring wheat-summerfallow. Units are inches.				
	Low-residue	Conventional-till	Minimum-till	No-till
Cropped	2.7	3.9	2	2.2
Fallowed	4.2	4.7	4.5	4

During average to wetter years, especially years with good snowcover, surface soil tends to become better aggregated -- more cohesive -- overwinter. Oversummer processes tend to degrade and disaggregate surface soil. The 1994 wheat-fallow data, averaged by dates, strongly shows this overall pattern (see Table C).

Table C. Average dry aggregate size by dates in 1994 spring wheat-summerfallow. Units are inches.							
	Apr 11-13	May 26-27	Jun 24	Jul 21	Aug 25-29	Oct 13-14	Nov 10
Cropped	9	1.8	2.1	1.4	0.9	0.9	---
Fallowed	6.3	9.9	6.5	2.9	1.7	1.5	1.7

Measurements of dry aggregation made in the 3-crop rotation in spring and fall are compared with spring wheat - fallow values in Table D. In general, it would be expected that wheat-fallow would show less surface soil tilth and aggregation than the 3-crop rotation, which produces more residue. While definite conclusions of this sort cannot be drawn from Table D data, what is shown is that different crop species will probably cause more variation in surface aggregation than conservation tillage treatments.

Table D. Average 1994 dry aggregate sizes measured in May and October in 3-crop rotation and in spring wheat-summerfallow. Units are in inches.					
	Winter Wheat (3-crop rotation)	Spring Wheat (3-crop rotation)	Sunflower (3-crop rotation)	Spring Wheat (crop-fallow) crop phase	Spring Wheat (crop-fallow) fallow phase
May	3.6	1.5	7.0	1.5	11.6
Oct.	1.6	1.4	1.9	1.1	1.6

Field H1. Crop Root Growth and Function Studies - Dr. Steve Merrill

During 1994, root growth and soil water use studies were conducted on crops in the long-term Conservation Tillage Experiment, located at the Area IV Cooperative Research Farm. All three crops of the rotation (sunflower, spring wheat, winter wheat) were compared with spring wheat-summerfallow under conventional-till and no-till. The goals were to (a) observe the effect of tillage and cropping system on the relation between root growth and water use, and to (b) gain information about the direct effects of conservation tillage on root growth under relatively wet climate conditions -- such observations had been made in past years under drier than average conditions. The principal measurements were (a) soil water made with a neutron moisture meter, (b) root growth made directly with minirhizotrons and indirectly on soil samples. Top growth, soil temperature, and surface residue measurements were also made.

Of the 1994 measurements, some of the most useful and most available for discussion are soil water data. The superior water conservation potential of no-till compared to conventional-till is shown by data displayed in Table A. Soil water amounts measured early in the cropping season, after seeding, are given for total soil depths of both 4 and 6 feet. More soil water was stored under no-till than under conventional-till in every case. If precipitation in the previous year had been average or below, it would be expected that sunflower and spring wheat under 3-crop rotation would store less water than the other two crops. The far greater than average precipitation in 1993 has apparently removed these expected differences. The fact that no-till vs. conventional-till differences are larger when measured over 6 feet of soil compared to differences over 4 feet shows that no-till is conserving more water in the subsoil in addition to water conserved in soil above the 4 feet depth.

Table A. Soil water contents measured after seeding for crops in the conservation tillage experiment in 1994 under conventional-till (CT) and no-till (NT) treatments.						
Crop	System	Date	CT	NT	CT	NT
			inches per 4 feet		inches per 6 feet	
Sunflower	3-crop rotation	6/23	14.7	16.1	22.1	24.5
Spring wheat	3-crop rotation	5/20	13.4	15.9	19.9	24.6
Spring wheat	crop-fallow	5/20	14.6	15.7	22.7	24.2
Winter wheat	3-crop rotation	5/17	14.5	15.8	21.3	24.4

A comparison of the amounts of soil water used by the wheat crops to depths of 4 and 6 feet (see Table B) shows that more water was used under no-till than under conventional-till by plants in the 3-crop rotation. Soil water depletion by spring wheat in crop-fallow was about the same for the two tillage treatments. Differences of this size between no-till and conventional-till were not observed in spring wheat in 3-crop rotation during the drought years 1988-1990.

Table B. Soil water depletion by wheat crops measured in the conservation tillage experiment during 1994 for conventional-till (CT) and no-till (NT) treatments. From May 17-20 to July 25-26.					
Spring wheat, 3-crop rot.		Spring wheat, crop-fallow		Winter wheat, 3-crop rot.	
CT	NT	CT	NT	CT	NT
----------inches per 4 feet----------					
3.7	5.3	4.5	4.2	4.7	5
----------inches per 6 feet----------					
3.2	5.6	4.7	4.4	4.6	5.5

The amounts of soil water measured in 1994 near to seeding time for spring wheat in 3-crop rotation are compared to amounts measured in the years 1988 to 1990 in Table C. Not only are the amounts considerably larger in the relatively wet 1994, but there is a greater amount of soil water available under no-till compared to conventional-till, something that is typically not observed during drought years. Observations under drought conditions, that both top and root growth are relatively greater for no-till compared to conventional-till, but tend to be more equal as water becomes more available, cannot be explained by gross amounts of soil water observed near spring wheat seeding time. Rather, no-till appears to help crop growth under drought by cutting soil evaporation and moderating heat and radiation effects in the near-surface soil.

Table C. Comparison of early season soil water contents measured in 1988-1990 and in 1994 in spring wheat growing in a 3-crop rotation (spring wheat-winter wheat-sunflower) in the conservation tillage experiment. Treatments are conventional-till (CT) and no-till (NT).

1988		1989		1990		1994	
CT	NT	CT	NT	CT	NT	CT	NT
----------inches per 4 feet----------							
8.27	7.9	0.39	10.09	7.5	7.79	13.4	15.9

Field H2. This field was seeded to spring barley in 1993 that yielded about 40 bu/a. Winter wheat varieties 'Roughrider' and 'Norstar' were no-till seeded into the 10-12 inch barley stubble Sept. 23, 1993 using the Haybuster 8000 hoe drill with 40 lb/a of 18-46-0 applied below the seed. We broadcast 60 lb N/a May 3, 1994 using ammonium nitrate (34-0-0) as the source of N. The field was sprayed May 20, 1994 with a mixture of 2,4-D ester (5 oz ai/a) plus Buctril (4.4 oz ai/a) for weed control. Volunteer barley was a severe problem in the winter wheat in 1994. The field was swathed on July 27, 1994 and combined on August 3, 1994. This winter wheat field yielded about 37.6 bu/a. Because of the barley in the winter wheat, the elevator discounted the winter wheat price significantly.

Field H3. This field was in sunflower in 1993 that yielded 1350 lb/a. The field was tilled with a John Deere 550 Mulch Master (shallow tillage depth, about 2 inches) on May 10, 1994. Amidon spring wheat was seeded on May 10, 1994 with 40 lb/a of 18-46-0 applied with the seed and 40 lb N/a broadcast applied as 34-0-0. The mulch master did a good job of maintaining the sunflower residue on the soil surface. The field yielded 39.6 bu/a. Approximately a third of the field was under water most of the season.

Field H4. Safflower Seeding Date Study - Dr. Don Tanaka

A study was initiated in 1994 to determine the influence of seeding date, variety, and plant population on safflower yield. The area had previously been in spring wheat. Sonalan (1 lb/ac) was applied on April 19, 1994 and incorporated with an undercutter. Second incorporation was on May 4, 1994 with the JD Mulch Master. The treatments were: seeding dates, May 5 (D_1) and May 17 (D_2); varieties, Montola 2000 (V_1) and

Centennial (V_2); and target plant populations of 50,000, 100,000, 200,000, 400,000, and 800,000 plants/acre (based on 70% of viable seeds producing a plant).

Safflower production in 1994 was better than normal and preliminary data suggests the largest treatment differences were for varieties (Figure 4). It appears that Montola 2000 (V_1) had greater problems establishing a plant population than Centennial (V_2). Seeding early requires more seed to reach, optimum yield than seeding later. To obtain optimum safflower production, Montola 2000 needs a field plant population of 150,000 to 200,000 plants/acre and Centennial needs a field plant population of 250,000 to 300,000 plants/acre to achieve a yield of 1,800 lbs/ac or greater.

Field H4. Soil Quality Study - Drs. Don Tanaka and Steve Merrill

A long-term study was initiated in the spring of 1993 to evaluate the influence of tillage and crop rotations on soil quality factors. Tillage, crops, and crop residues were all in the appropriate places in 1994. Treatments include minimum- and no-till for the following crop rotations:

1. Continuous spring wheat (CSW+); straw chopped and spread
2. Continuous spring wheat (CSW-); stubble left in place, straw removed
3. Spring wheat-millet for hay (SW-M)
4. Spring wheat-safflower-fallow (SW-S-F)
5. Spring wheat-safflower-rye (partial fallow, cover crop) (SW-S-R)
6. Spring wheat-fallow (SW-F)

Spring wheat was seeded at 1.3 million viable seeds per acre on April 20, 1994; Safflower was seeded at 300,000 viable seed per acre on May 5, 1994; and millet was seeded at 4 million viable seeds per acre on May 27, 1994. Rye was seeded on November 1, 1993 at 1.3 million viable seeds per acre. Recrop plots received 60 lb N/ac and 10 lb P/a while crops seeded after fallow received 30 lb N/a and 10 lb P/a. Growing season precipitation (May through August) was 5.6 inches, about 57% of the long-term average.

Spring wheat grain yield ranged from 2300 to 2800 lb/a (Figure 5). There were no differences due to tillage. The SW-S-R rotation produced as much grain as the SW-F rotation and the SW-S-F rotation produced at least 200 lb/a less grain than either the SW-S-R or SW-F rotation. Safflower grain yields were about 1400 lb/a with about 43% oil and no influence due to rotation. Rye produced about 1900 lb/a of dry matter for soil and water conservation. Millet produced 1900 lb/a of hay and we left about 2000 lb/a of residue.

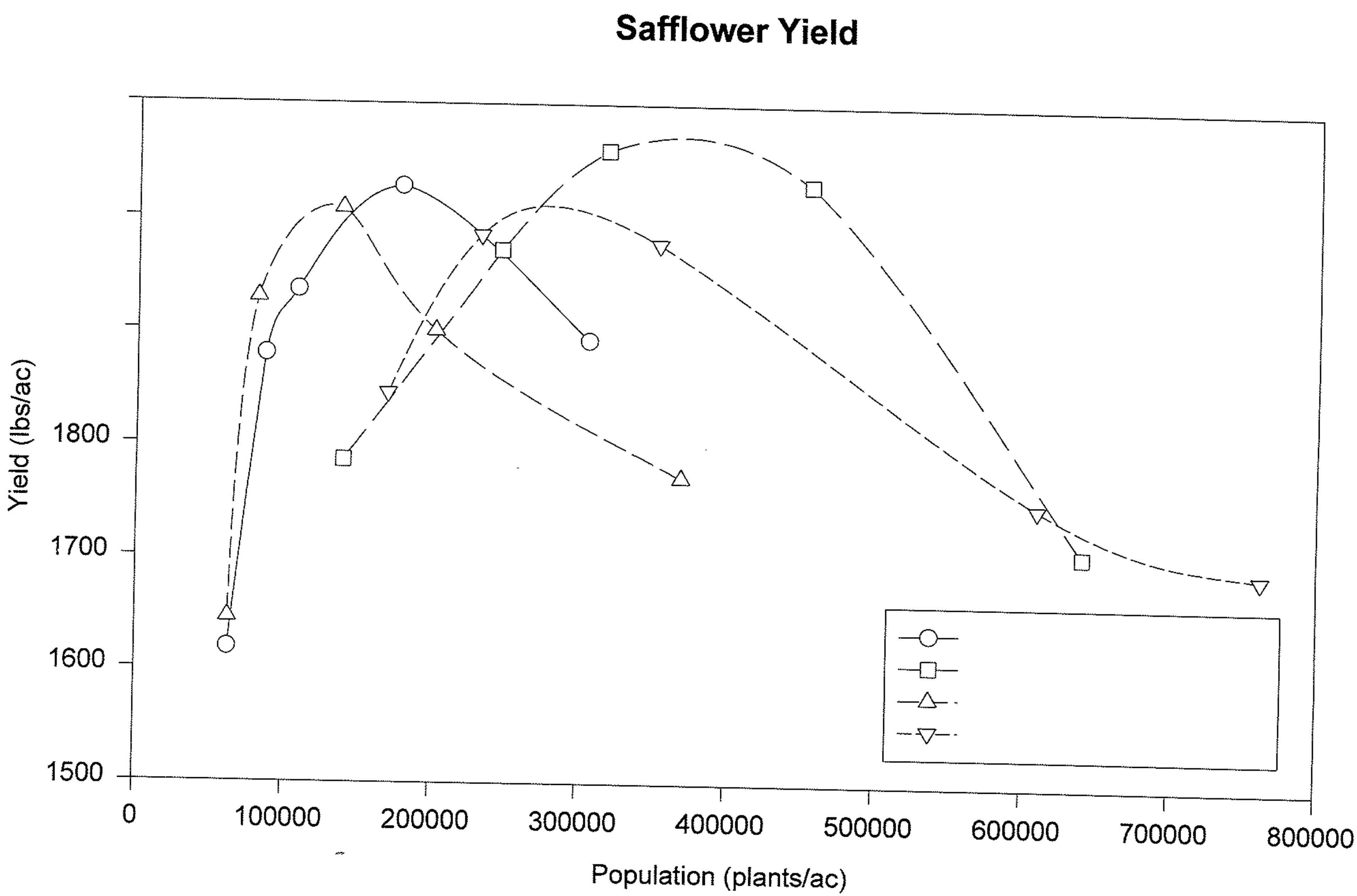


FIGURE 4. Seeding date, variety, and plant population influences on safflower yield.

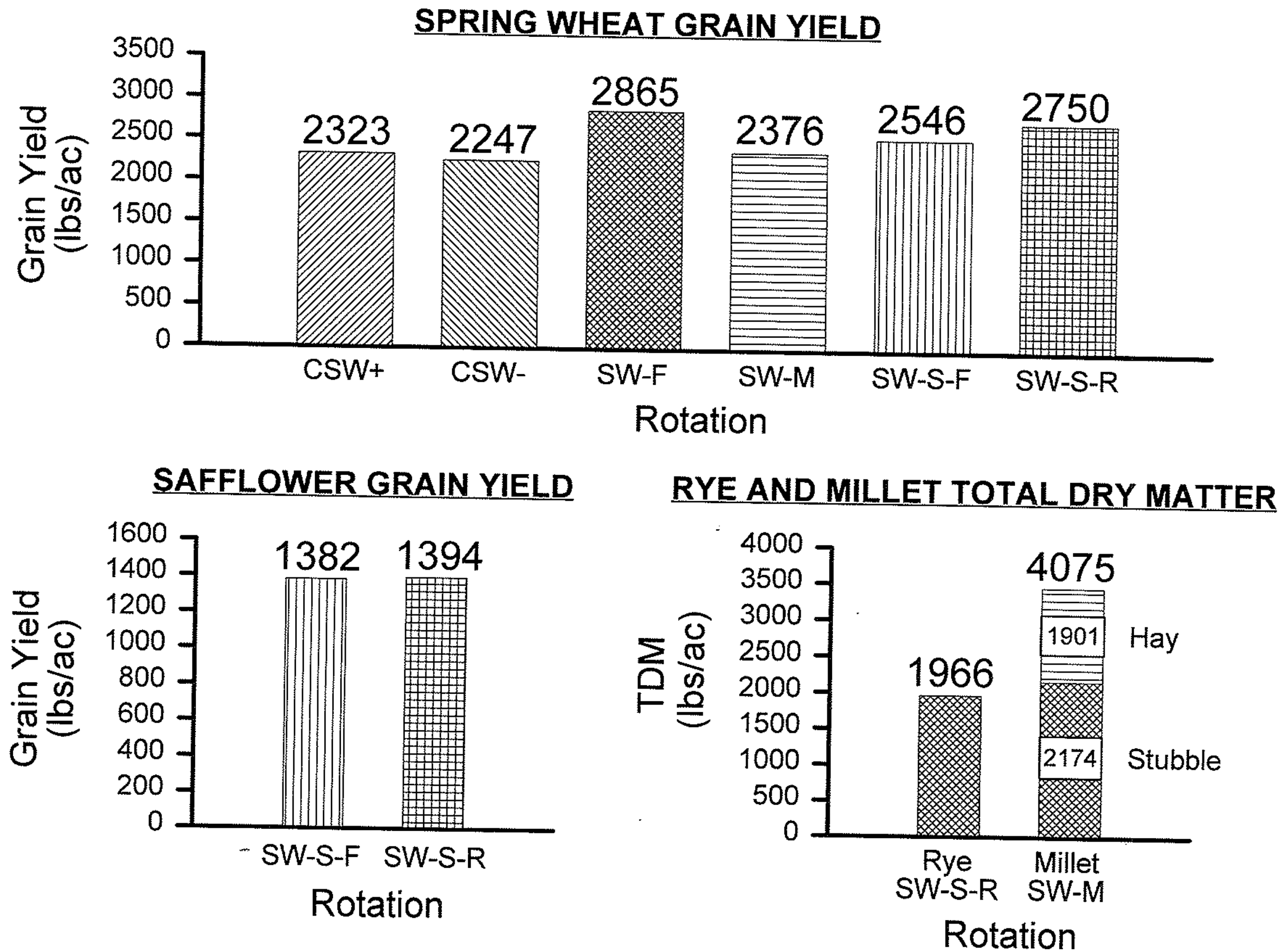


Figure 5. Spring wheat and safflower grain yield and rye and millet total dry matter production as influenced by crop rotation in 1994.

Field H4. Bulk Area. Stark barley was seeded on May 6, 1994 on the east half of field H4 with a John Deere 750 no-till drill with 40 lb/a of 18-46-0 placed with the seed. The barley yielded 65 bu/a.

Field H4. Sunflower and Safflower Variety Trials - Dr. Ardell Halvorson and Floyd Jacober

Sunflower and safflower variety trials were conducted on land that had been fallowed in 1993. Sonalan granules were applied on April 19th with undercutter and Gandy applicator. The site was disked twice on May 17, 1994 to incorporate the granules for a second time and to prepare a seedbed. Safflower varieties were seeded on May 17, 1994. The peas mixed with the forage safflower variety caused a seeding problem that was not detected. This caused a mixture in replications 2 and 3 that was discovered after plant emergence. Therefore, yield data was collected from only one replication. Sunflower varieties were seeded May 26, 1994 with the IH-800 Cyclo-seeder. The trails had virtually no weeds during the growing season. The plots were aerial sprayed July 18, 1994 with Asana XL insecticide at a rate of 0.4 oz ai/a. The safflower plots were harvested on October 13, 1994 with plot combine. The sunflower plots were hand harvested October 24, 1994. Average seed yields and test weights for each sunflower variety are presented in Table 1.

Table 1. Sunflower seed yield and test weight of several sunflower varieties.

Cultivar	Seed Yield	Test Weight	Oil Content
	lb/ac	lb/bu	%
Cargill 187	1837	31.2	46.6
Cargill 270	2312	32.0	48.3
Cenex 803	2231	32.4	45.8
Cenex 713	1964	32.1	44.5
Cenex 745	2104	32.5	44.3
Pioneer 6339	2150	32.7	48.9
Pioneer 827	1907	34.1	44.5
Pioneer 707	2013	32.9	47.4
Sigco Comet	1851	33.1	45.5
Sigco 651	1900	32.1	42.6
Sigco 658	1756	34.1	43.8
Sigco 632	2034	30.9	47.9
Sigco 458	1959	34.0	44.1

Safflower results are presented in Tables 2 and 3.

Table 2. Safflower grain, test weight, oil content, stand loss, and plant height in 1994.					
Variety	Test Weight	Grain yield	Oil content	Stand loss*	Plant height
	lb/bu	lb/a	%	%	inches
Centennl	39.5	2238	42.6	0	25
Finch	42.3	1480	37.1	17	24
S-208	37.5	1899	38.4	0	22
Oker	34.5	1389	40.0	13	23
Saffire	40.0	1841	33.5	12	20
90B2763D	32.4	1202	42.5	0	18
Montola 2001	38.2	1032	41.6	20	24
88B3006	37.1	1825	41.0	0	25
Stirling	38.6	1131	34.8	15	21
Morlin	36.5	1718	41.9	0	21
90B6011	37.5	1614	39.5	0	26
91B1282	39.0	1321	40.6	0	19
Girard	39.2	1657	40.2	0	24
SVO 3029	41.3	2194	36.0	0	30
S-541	38.0	1482	43.4	0	26
SVO 3037	41.6	2326	37.1	0	29
MT 3697	39.5	885	41.9	7	24
S317	33.3	1399	41.3	0	22
Montola 2000	35.5	1531	43.1	0	26
91B6668	37.0	1561	42.9	5	24

Table 3. Safflower yield data for forage varieties for 1994.					
Varieties	Grain Test weight	Grain yield	Grain Oil Content	Stand loss	Plant height
	lb/bu	lb/a	%	%	inches
Morlin & Peas	---	---	---	100	---
Agco 2555	42.6	2710	34.3	0	31
Agco 2108	42.8	2384	28.0	0	32
Morlin	37.5	1583	42.5	0	22
Centennl	37.1	1897	43.4	0	23
Finch	41.1	1362	38.3	0	21
Wrld Blk	44.5	2237	29.0	0	27
Peas	---	---	---	100	---
* Loss estimated due to poor germination and early survival.					

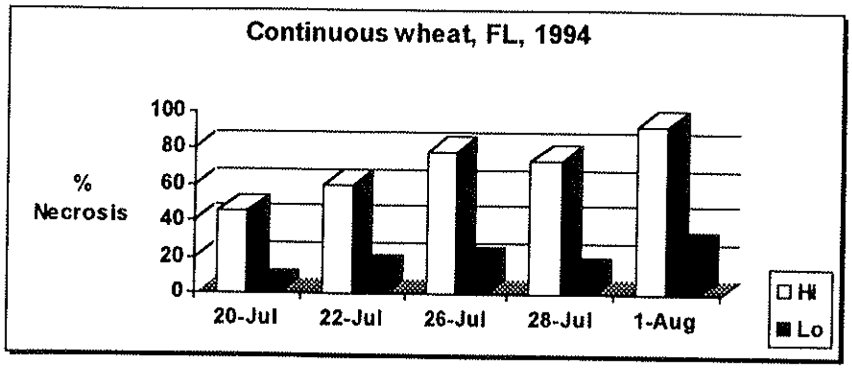
REPORT OF ACTIVITIES IN AREA I. NE 1/4 Section 20 (see Figure 2)

Field I1. Root and Leaf Disease Work - Dr. Joe Krupinsky

Investigations of spring wheat root rot diseases and leaf spot disease observations were continued in this field in 1994. This was the 10th consecutive year of continuous spring wheat cropping comparing no-till and conventional-till (J.D. offset disk for complete residue incorporation). 'Len' spring wheat was seeded with a Haybuster 107 disk drill on May 18, 1994 with 10 lb P/a applied with the seed. Nitrogen was applied at a rate of 30 lb N/a. The wheat yielded 38 bu/a.

LEAF SPOT DISEASES in Long-Term Continuous Wheat. For the last 10 years two residue treatments, no-till (high residue with standing stubble, >60% surface cover) and maximum till (low residue, disking before planting, <30% surface cover) were applied to the same spring wheat field located south of Mandan. This provides an opportunity to investigate plant disease development in a continuous wheat monoculture.

In 1994, a significantly higher level of leaf spot disease damage caused by tan spot and Septoria nodorum blotch was present on wheat grown on the high residue area (no-till) compared to wheat grown on the low residue area. This is consistent with results from several previous years.



Hi = Hi level of residue, Lo = Low level of residue

Septoria nodorum blotch (caused by *Septoria nodorum*) and tan spot (caused by *Pyrenophora tritici-repentis*) were again the most common leaf spot pathogens present. 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.

Fields I2, I4, and I6. These fields were summerfallowed in 1994. The spring wheat stubble was left standing over winter to trap snow. The fields were undercut on June 2-3, 1994 with Haybuster undercutter at about a 2 inch depth. The fields were sprayed with Roundup (9 oz ai/a) plus Banvel (3 oz ai/a) on June 30, 1994 and again on July 28, 1994 with Roundup (9 oz ai/a).

Field I3. This field was summerfallowed in 1993. The field was seeded April 20, 1994 to Amidon spring wheat with the Haybuster 107 no-till, disk drill. The I3-field received about 40 lbs of 18-46-0 with the seed. An additional 40 lb N/a was broadcast applied as 34-0-0. The field was sprayed May 26, 1994 for weed control with a mixture of Tiller plus Buctril. The field was swathed on August 8 and combined August 11-15, 1994. The field yielded 44.1 bu/a in 1994.

Field I5. This field was summerfallowed in 1993. The field was seeded April 21, 1994 to Grandin spring wheat with the Haybuster 107 no-till, disk drill. The I5-field received about 40 lbs of 18-46-0 with the seed. Additional strips of 30, 40, and 60 lb N/a were broadcast applied as 34-0-0 to see if protein content could be influenced. The field was sprayed May 26, 1994 for weed control with a mixture of Tiller plus Buctril. There was a lot of variation in plant height of the Grandin wheat (Certified seed in 1994) which made the field look rather uneven. The field was swathed on August 8 and combined August 11-15, 1994. The field yielded 33.9 bu/a in 1994. The protein content of the N-fertilizer strips was 12.5, 12.3, and 12.8% for the 30, 40, and 60 lb N/a rates, respectively.

NEW RESEARCH ON CRP AT NORTHERN GREAT PLAINS RESEARCH LABORATORY

New CRP STUDY - Drs. Don Tanaka, Ardell Halvorson, Steve Merrill, and Brian Wienhold

Beginning in October of 1994, a cooperative study was initiated to determine management methods for conversion of land in the Conservation Reserve Program (CRP) to crop production. Cooperators include the Natural Resources Conservation Service (formerly SCS) and Consolidated Farm Service Agency (formerly ASCS), Agricultural Research Service, and Mr. Keith Boehm (Farm cooperator). Treatments are: 1) hayed or nonhayed before tillage and spray operations; 2) tillage-conventional-till (<30% surface cover), minimum-till (30 to 60% surface cover), and no-till (>60% surface cover); 3) nitrogen fertilizer-0 and 60 lb N/acre; and 4) permanent reference treatments, permanent hay and permanent cover. Areas were hayed on October 11, 1994 and tillage and spray operations were done on October 14, 1994. Spring wheat will be seeded in 1995.

The attached revised page (#25) needs to be inserted in the ARS-IV booklet which was distributed to you earlier.

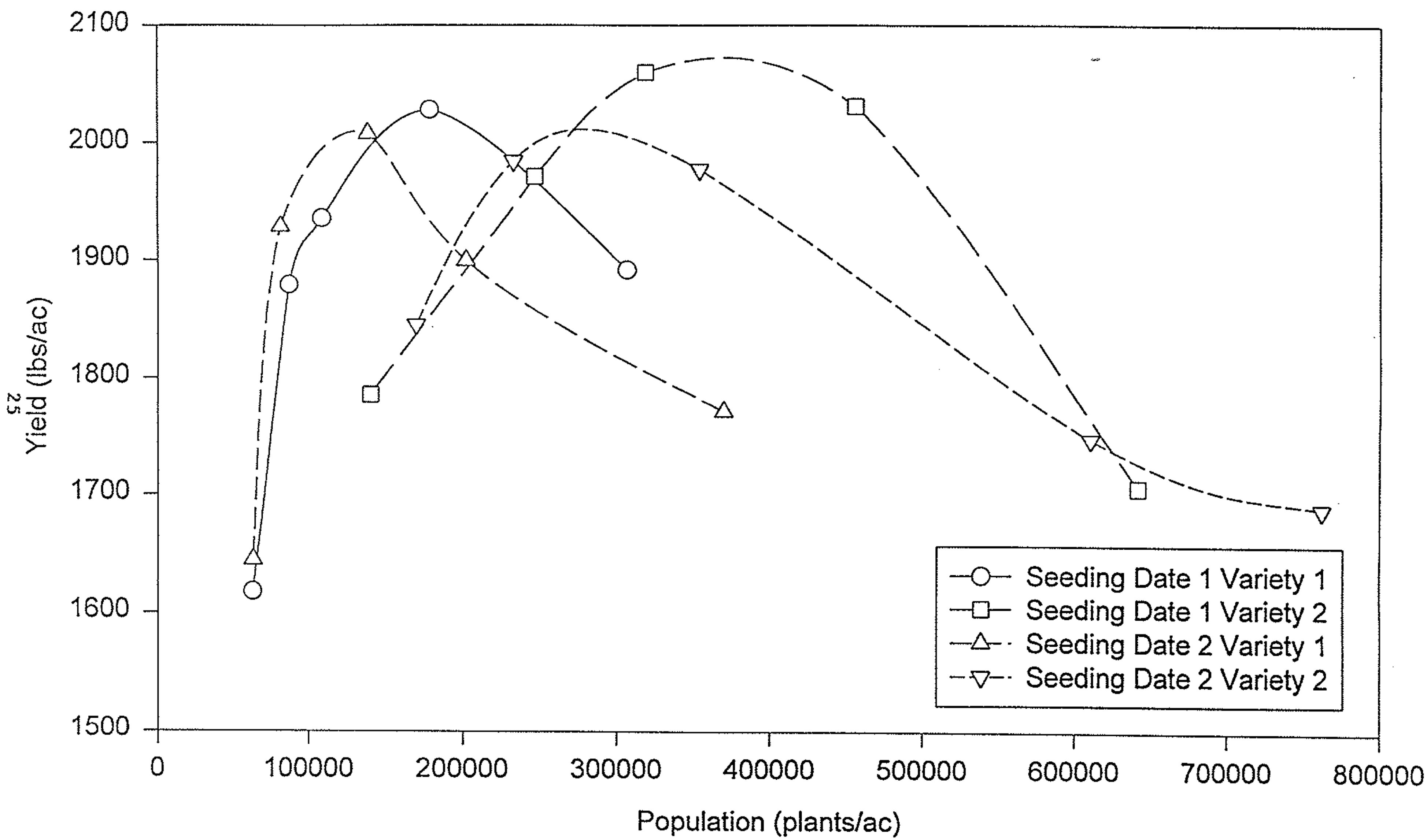


Figure 4. Seeding date, variety, and plant population influences on safflower yield.