92 DATA

1992 Research and Cropping Results

Ninth Annual Progress Report

February 17, 1993

A. L. Black, LD/Soil Scientist
Donald Tanaka, Soil Scientist
A. B. Frank, Plant Physiologist
Joseph Krupinsky, Plant Pathologist
Stephen Merrill, Soil Scientist
Richard Cunningham, Geneticist (Trees)
John Berdahl, Geneticist (Grasses)
Ian Ray, Geneticist (Grasses)

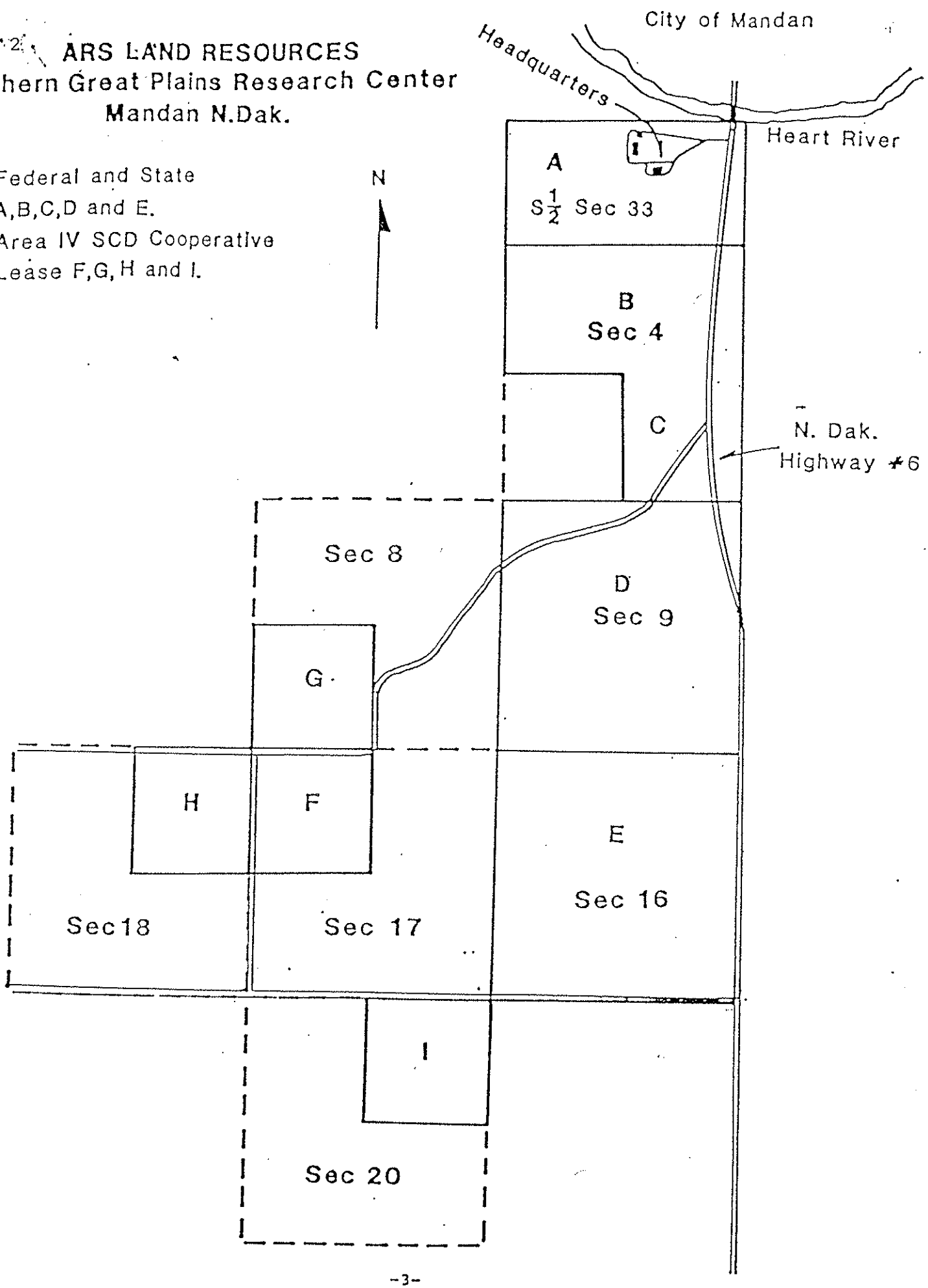
Contents Relate to Cooperative Agreement between USDA-ARS and Area IV Soil Conservation Districts represented by the Area IV SCD Research Advisory Committee.

Acknowledgment

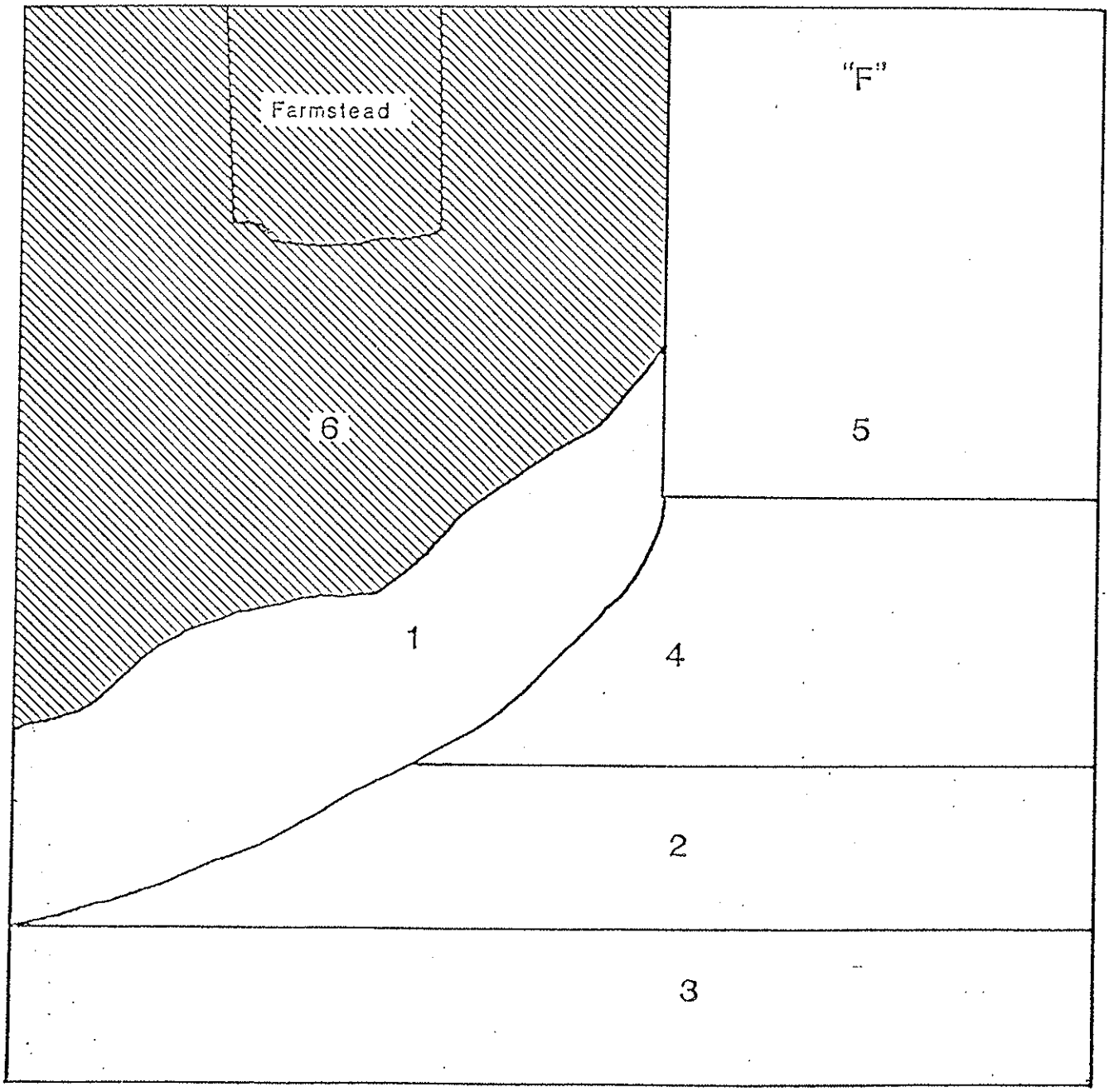
USDA-ARS and Area IV SCD recognize the contributions made to this research program by the following cooperators: Dow-Elanco Products Co.; Monsanto Agr. Products Co.; Haybuster Manufacturing Co., National Sunflower Assoc.; Sigco Research Inc.; Hoechst-Roussel Agri. Vet Co.; NDSU-Agricultural Experiment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



NW$\frac{1}{4}$ Sec 17 T138 R81



F. NW 1/4 Section 17 - Research Activities

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

F2. The previous crop in this field was sunflower. The field was undercut May 4, 1992 and seeded to 'Bowman' spring barley with the 1007 Haybuster drill, 7-inch spacings, 95 lbs/ac seeding rate, and 50 lbs/ac of 18-46-0 applied with the seed. A herbicide mixture of 2,4-D and Buctril (each at 6 oz ai/ac) was applied June 5, 1992 for weed control. The barley was swathed August 11 and combined August 14, 1992. The barley yielded about 90 bu/ac with a test weight of 50 lb/bu. Barley was sold to Heartland Elevator for seed at a .25 cent/bu premium. We spot sprayed this field with Roundup plus 2,4-D Amine August 31 to control volunteer grain and weeds and no-till seeded winter wheat with Haybuster 8010, 10-inch spacing, 1-million viable seeds/acre on September 23, 1992.

F3. The previous crop was Bowman spring barley and a mixture of winter wheat varieties was seeded September 24, 1991 with the Haybuster 8010, 10-inch spacing, one-million viable seeds per acre on September 24, 1991. On May 15, 1992, the winter wheat was sprayed with a mixture of 2,4-D LV Ester and Buctril at 4.2 and 4.4 oz ai/ac, respectively. This field was swathed August 11 and combined August 13, 1992. The winter wheat yielded 54 bu/ac, test weight of 62.0 lbs/bu and protein averaged 12.5% without any N-fertilizer applied.

F4. The previous 1991 crop in this field was winter wheat that yielded 35 bu/ac and produced about 4200 lbs/ac of straw. The stubble (12-15 inches tall) was left standing over winter to trap snow. This field had more than 3-feet of moist soil, or 6-inches of available stored soil water, in the spring of 1992. We applied Sonolan G-10 granules May 4, 1992 at a rate of 1 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 19 at a depth of 2-inches to meet the second incorporation requirement. We seeded this field to sunflower varieties, Sigco 658 and 458, May 29, 1992 with the IH 800 Cyclo unit planter at a seeding rate of 23000 seeds/acre. Depth of seeding was about 1.5 inches after passage of the packer wheel. Seedlings emerged in 6 days and we had a plant population above 19000 plants/acre 7 days after seeding. We contract sprayed the field with Asana XL (0.8 oz ai/ac), August 11, 1992. The sunflowers were combined October 13-14, 1992 yielding about 1900 lbs/ac, with 33.5 lb/ac test weight and 47% oil.

F5. This block of land has been leased by USDA-ARS for many years.

A. The west two-thirds of this block of land now contains a long-term study for evaluating plant diseases of spring wheat as influenced by tillage and crop rotation; two sub-blocks for minimum-till spring wheat and fallow; and one block each for continuous spring wheat seeded no-till into standing spring wheat stubble and into a no surface residue tillage treatment. These field plots (4 acres each) are large enough to accommodate various N-fertilizer and/or fungicide treatments.

B. A 3-acre field that had been in a sunflower variety trial in 1991 was summerfallowed after aerial spray drift damage zapped the sunflower trial in June. We undercut this field May 4, 1992 and seeded spring barley, variety Stark, on May 5, 1992 with the Haybuster 1007 drill at a seeding rate of one-million viable seeds per acre. The barely crop was sprayed June 5, 1992 with a mixture of 2,4-D LV Ester (6.0 oz ai/ac) plus Buctril (6.0 oz ai/ac). This field yielded about 100 bu/ac with a test weight of 50.5 lbs/bu.

C. Spring Wheat and Spring Barley Variety Trial

Trials were initiated in 1979 in cooperation with the Dickinson Experiment Station. Cultivars were seeded April 29, 1992 at the rate of 1.3 million viable seeds per acre on land that had been chemically fallowed. Prior to seeding, weeds were undercut at a depth of 2 inches with a Haybuster undercutter. Spring wheat and barley cultivars were seeded with a seven foot Kirshman drill in 6-inch rows. Seventy pounds per acre of 18-46-0 were applied with the seed and 30 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 May 29, 1992. Grain yields were determined from samples taken with a small plot combine. Barley harvest began on August 6 and was completed on August 14. Spring wheat harvest began on August 14 and was completed on August 28.

Table 1. Spring wheat agronomic measurements for 1992.

Cultivar	Grain Yield (bu/ac)	Grain Protein (%)	Grain Test wt (lb/bu)	Plant population (plants/yd^2)	Wheat heads (heads/yd^2)	Heads/plant (heads/plant)	Plant height (inches)	Plant/viable seeds (%)
Amidon[1]	73.5	15.9	61.2	205	464	2.7	39	77
Bergen[1]	72.6	15.0	62.7	191	488	2.6	31	70
Butte 86	75.3	16.5	63.9	200	480	2.4	38	73
Cutless[1]	61.4	15.6	60.8	178	609	3.4	37	60
Grandin[1]	75.0	15.9	62.0	203	473	2.3	38	73
Gus[1]	64.5	16.9	61.2	123	466	3.9	38	47
Stoa	75.0	15.9	60.4	177	496	2.8	40	67
Vance[1]	74.2	15.0	60.1	148	387	2.6	37	53
2369[1]	75.3	15.2	61.1	167	612	3.7	35	60
2375[1]	70.2	15.9	60.6	177	478	2.7	38	67
2375[1,2]	76.5	16.4	61.8	189	486	2.6	33	70
LSD 0.05	6.8	0.7	0.7	25	52	0.7	1.3	--

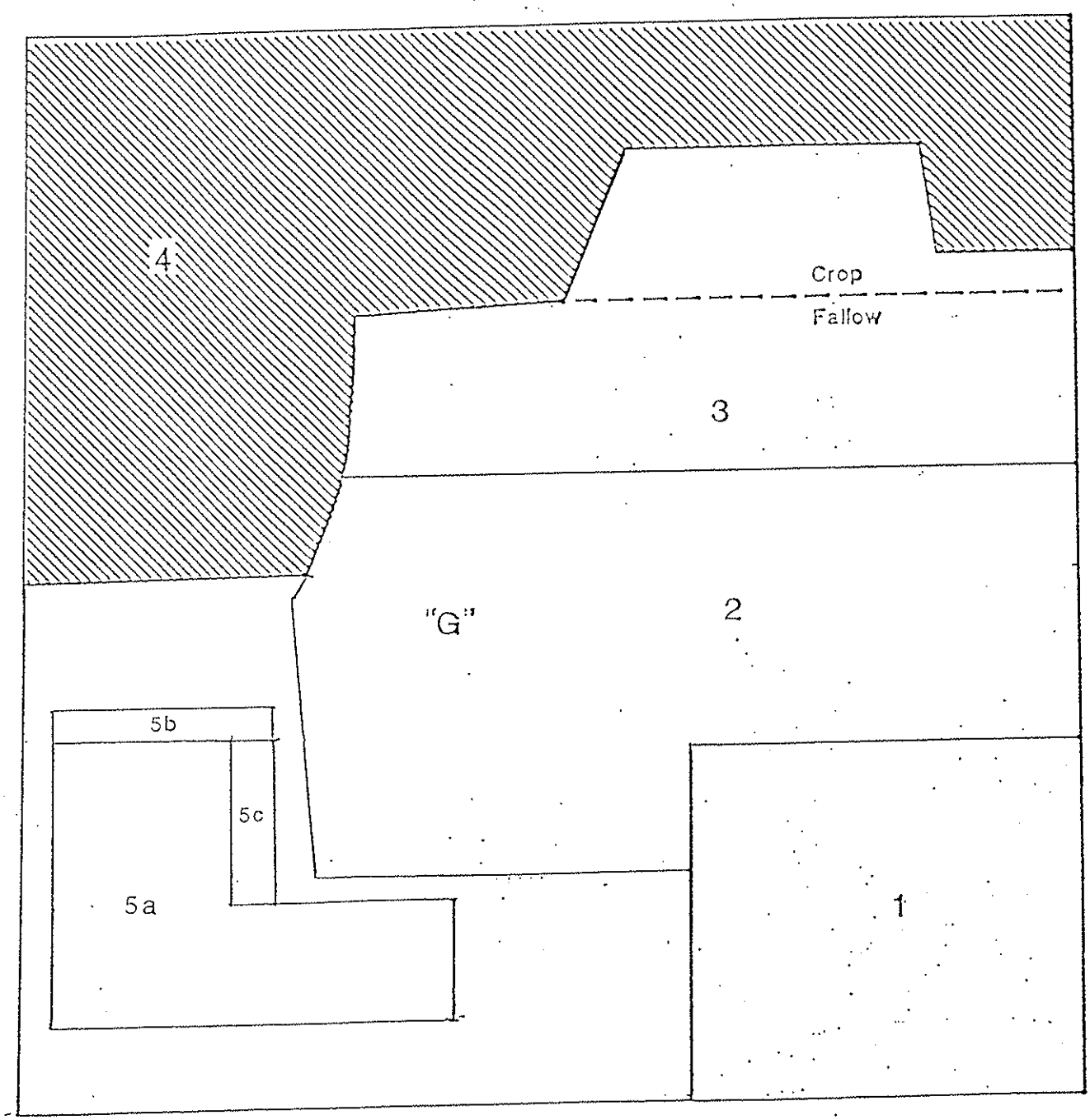
[1]Classified as semi-dwarf.
[2]Fungicide seed treatment with Bayton-30.

Table 2. Barley agronomic measurements for 1992.

Cultivar	Grain			Plant population	Barley heads	Heads/ plant	Plant height	Plant/ viable seeds
	Yield (bu/ac)	Protein (%)	Test wt (lb/bu)	(plants/yd^2)	(heads/yd^2)	(heads/plant)	(inches)	(%)
Azure	93.6	13.0	47.2	206	413	2.0	37	76
Bowman[1]	81.1	13.8	50.3	175	876	5.0	30	65
Gallatin[1]	99.9	13.2	52.5	210	819	3.9	33	78
Morex	86.6	14.9	48.3	191	444	2.4	34	71
Robust	88.7	14.7	49.4	176	391	1.9	36	65
Stark[1]	102.2	12.9	51.7	191	800	4.2	30	71
LSD 0.05	9.7	1.6	4.5	NS	62	0.6	2	--

[1]Two row barley.

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



G. SW 1/4 Section 8 - Research Activities

G1. Poplar tree breeding - clonal test site

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 is a long-term study initiated in 1983, and there will be no report of results for this year.

G2. The previous crop in this field was winter wheat (large field plots of 7 winter wheat varieties) in 1991 with an average grain yield of 35 bu/ac and straw yield of 3600 lb/ac. Stubble, of 12 to 15-inch height, was left standing overwinter to trap snow. We applied Sonolan G-10 granules at 1 lb ai/ac April 28, 1992 with a Gandy granular applicator mounted on the front of the Haybuster undercutter while simultaneously performing the first incorporation tillage with the undercutter operated at shallow soil depth of about 2-inches. We had to spray this field for volunteer winter wheat control May 13, 1992 with Roundup to insure a good weed kill. The field was undercut again at a 2-inch depth on May 19 to control weeds and fulfill the second incorporation requirement for Sonolan use leaving 2500 lb/ac of surface residue (60% cover). We seeded Sigco sunflower varieties 458,651 and 658 with the IH 800 Cyclo unit planter May 26-28, 1992 at a seeding rate of 23000 plants/ac at a 1 1/2 inch depth. Seedling emergence began in 6-days and a plant population of 19000 plants/acre was obtained after 7-days. The sunflowers were aerial sprayed for insect pest control August 11, 1992 using Asana XL at 0.8 oz ai/ac. We combined the sunflowers on October 13-14, 1992. Sigco variety 651 yielded about 2200 lbs/ac and the other two varieties yielded about 2000 lb/ac. We had to store all the sunflowers from all fields (146250 lbs clean weight) in one big pile in one of our quonsets until it could be sold. The average test weight was 33.5 lb/bu and the oil content was 47%.

G3. This field was spring wheat in 1991 and summerfallowed in 1992. The stubble field was undercut April 28, 1992; sprayed June 10, 1992 using Fallowmaster (40 oz mtl/ac) and on July 20, 1992 using Roundup (24 oz mtl/ac) plus 2,4-D Amine (15 oz mtl/ac). This field required no additional sprayings for weed control the rest of the summer fallow period.

G4. This field was summerfallowed in 1991. No tillage was performed ahead of direct seeding of Amidon spring wheat with the Haybuster 1007, no-till drill on May 1, 1992. We planted 1.5 bu/ac (1-million viable seeds/ac) and applied 42 lb/ac of 18-46-0 with the seed. Crop was sprayed June 3, 1992 with Tiller (6.3 oz ai/ac) plus Buctril (4.3 oz ai/ac) for weed control. Spring wheat was straight combined September 10-11, 1992 yielding 55 bu/ac, with a test weight of 59 lb/bu and protein content of 13.8%.

G5 - USDA-ARS Leased Land - Tree Breeding Activities

5a. Hackberry Provenance Test

A summary of the data collected this past fall, after trees had grown for three years, revealed that survival, averaged over all 180 seed sources, was 64 percent. Thirty-seven seed sources survived 100 percent. Most seed sources from Kansas and south were completely dead. The tallest seed source (5.2') was from Hutchison County, South Dakota. The shortest (1.0') was from Pratt County, Kansas. Overall height was 3.5'.

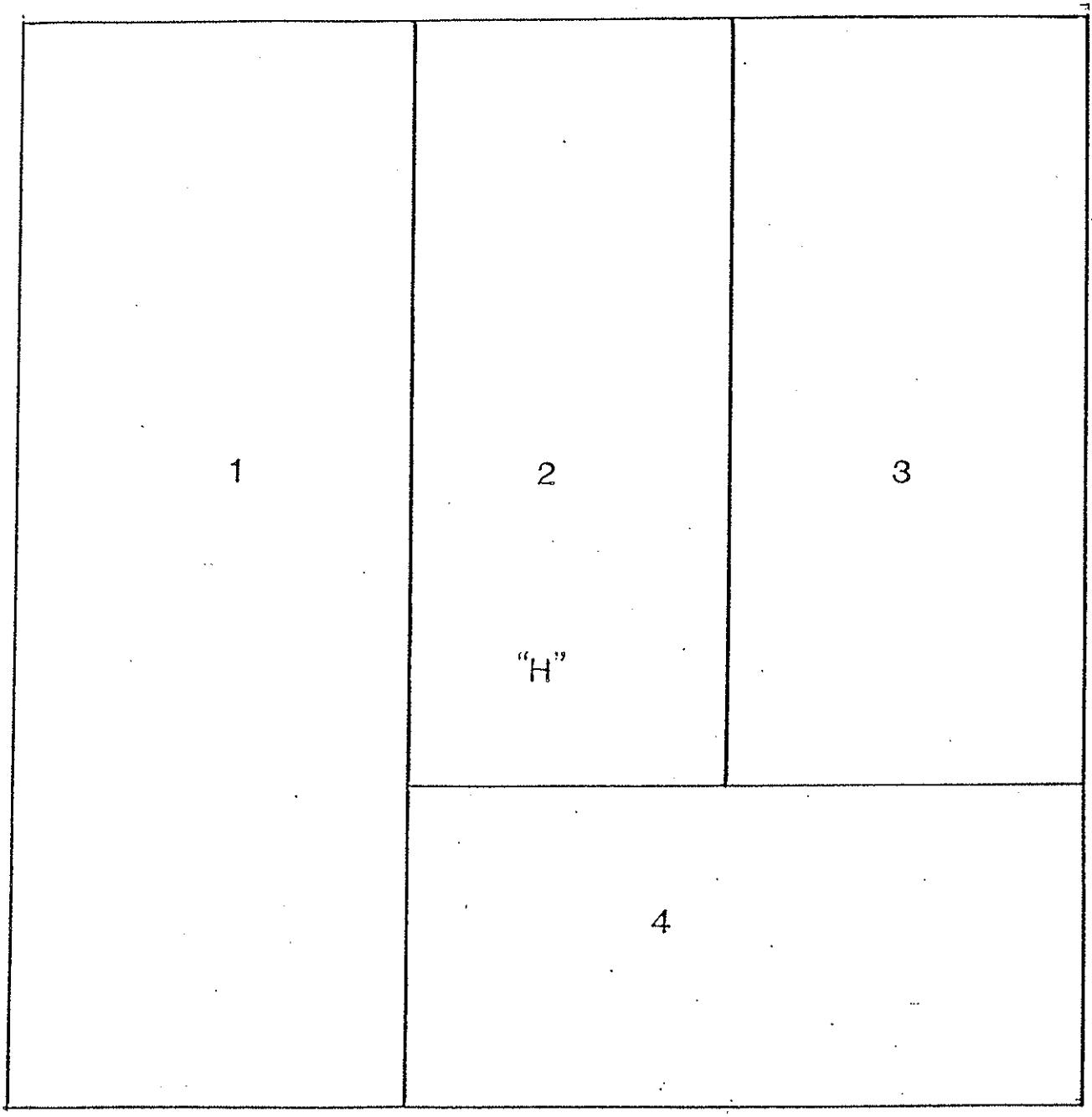
5b. Siberian Elm Provenance Test

Seedlings from 18 seed sources in Russia, using seed obtained as a result of a seed collection trip to the U. S. S. R. in 1990, were planted in 10 replications in the spring of 1992. Survival after the first growing season averaged 97 percent and ranged from 80 to 100 percent. These seed sources should be valuable new sources of genetic variation, some of which, may possess high levels of insect and disease resistance.

5c. Siberian Elm Clonal Test

Fifty-five trees, from windbreaks in North Dakota and South Dakota, selected for possible disease and insect resistance, were planted in four replications in 1990. After three growing seasons, survival averaged 81 percent. Thirty-one of the clones survived 100 percent. Two clones had died completely. Height averaged 4.8 feet, with the tallest clone 9.4 feet and the shortest at 2.0 feet. The best performing clones in this test will be propagated into a seed orchard that will be established in cooperation with the Lincoln-Oakes Nursery.

NE$\frac{1}{4}$ Sec 18 T138 R81



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 pathologist, Joe Krupinsky, three N-fertilizer levels (0, 20 and 40 lb N/A for crop-fallow and 30, 60 and 90 lb N/Ac for the annual crop rotation), and two varieties of each crop. This years data constitutes the 8th year of results.

(A1) Spring wheat-fallow rotation (1992) 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/-	- - Because of residual NO_3 carryover, no N-fertilizer applied -			
5/1	Seeded all tillage plots (Butte & Stoa) with Haybuster 1007 drill.			
5/4	- - Burndown-sprayed all tillage plots with 9 oz ai/ac Roundup - -			
5/14	- Reseeded Butte & Stoa because drill setting too shallow on 5/1.-			
6/8	Sprayed all tillage plots; Dakota (24 oz mtl/ac)+Buctril (16 oz mtl/ac)			
8/20	- - - - - - - - - Took Hand Harvest Samples- - - - - - - - - - - -			
9/13	- - - - - - - - - - - Combine Harvested - - - - - - - - - - - - - - -			

(A2) Grain yields of spring wheat (1992) in the spring wheat-fallow rotation as affected by tillage system, residual N-rates, and cultivar.

Cultivar	*Rate of Nitrogen	Conventional-till No Residue	Conventional-till <30% Cover	Minimum-till 30-60% Cover	No-till >60% Cover	Avg
	lbs N/ac	- - - - - - - - - - bu/ac - - - - - - - - - - - - - - - - - -				
Butte 86	0	63.0	62.0	62.4	61.9	62.3
	20	56.7	60.4	61.9	62.0	60.3
	40	56.5	61.4	61.4	62.1	60.3
	Avg.	58.7	61.3	61.9	62.0	61.0
Stoa	0	53.3	59.7	60.5	60.3	58.5
	20	53.7	60.1	59.9	60.0	58.4
	40	50.9	59.3	59.8	60.3	57.6
	Avg.	52.7	59.7	60.1	60.2	58.2
Avg. (Tillages)		55.7	60.5	60.5	61.1	59.6

*No N-fertilizer was applied in 1992 because of high residual carry-over.

(A3) Spring wheat-summerfallow with schedule of operations performed for fallow series plots in 1992 as follows:

Date mo/day	Conventional-till No Residue	Conventional-till <30% Cover	Minimum-till 30% to 60% Cover	No-till >60% Cover
5/04	disk plow	----	----	----
5/20	----	Undercut	Undercut	----
6/11	*Roundup	Roundup	Roundup	Roundup
6/24	Roundup	**Buctril	Buctril	Roundup
7/20	Undercut	Undercut	Roundup	Roundup
8/28	----	Roundup	Roundup	----

*Roundup applied at 11 oz ai/ac using ammonium sulfate (17 lb/100 gal of water) and Spray Booster Surfactant.
**Buctril applied at a rate of 5.8 oz ai/ac for the control of wild buckwheat.

H1B 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 mo/day	Tillage System: Conventional-till	Minimum-till	No-till
4/-	No N-fertilizer applied because of high residual NO_3-N		
4/29-30	Tandem disk	Undercut	Roundup
5/01	- - - - - Seeded Butte 86 and Stoa w/Haybuster 1007 - - - - - - - - -		
5/04	----	----	Roundup
5/14	----	----	*Reseeded - -
6/08	- - - Sprayed Dakota (24 oz mtl/ac) plus Buctril (16 oz mtl/ac) - - -		
8/18	- - - - - - - - - - - - Took Hand Harvest Samples - - - - - - - - - -		
9/13-15	- - - - - - - - - - - - - Combine Harvested - - - - - - - - - - - - - -		

*Reseeded no-till plot because of operator mistake which placed the seed too shallow on May 1.

(B1) Spring wheat grain yields (1992) in the spring wheat-winter wheat-sunflower rotation as influenced by tillage system, residual N-rates, and cultivar grown.

Cultivar	*Rate of Nitrogen	Tillage System			
		Conv-till	Min-till	No-till	Avg.
	lbs N/ac	- - - - - - - - - - - - - - - - bu/ac - - - - - - - - - - - - - - - -			
Butte 86	30	40.1	49.9	42.0	44.3
	60	37.5	44.3	42.5	41.5
	90	44.4	55.9	54.3	51.5
Avg.		41.0	50.2	46.6	45.8
Stoa	30	35.4	49.9	34.9	40.0
	60	37.2	39.7	29.1	35.3
	90	39.3	48.9	50.0	46.1
Avg.		37.3	46.2	38.0	40.5
Avg. (Tillages)		39.1	48.1	42.2	43.1

*No N-fertilizer applied in 1992 because of high residual soil NO_3-N.

(B2) Winter wheat plots; schedule of operations for each tillage system following winter wheat in the 3-year rotation.

Date mo/day	Conventional-till	Minimum-till	No-till
8/27 (91)	Roundup	Roundup	Roundup
9/19 (91)	Tandem Disk	Undercut	Roundup
9/23 (91)	Seeded winter wheat varieties Roughrider + Norstar (HB-8010)		
4/--(92)	- - No N-fertilizer applied because of high residual N- - - -		
5/13(92)	- - -Sprayed 2,4-D (4.2 oz ai/ac plus Buctril (4.4 oz ai/ac)- - -		
7/27	- - - - - - - Took Hand Harvest Samples - - - - - - - - - - - -		
8/11	- - - - - - -Swathed Winter Wheat Plots - - - - - - - - - - - -		
8/14	- - - - - - Combine Harvest all Plots - - - - - - - - - - - - -		
8/28	- - - - - - Sprayed all plots--Roundup (11 oz ai/ac) - - - - - -		

B2. Winter wheat grain yields (1992) in the spring wheat-winter wheat-sunflower rotation as influenced by tillage system, residual N-rates and cultivar.

Cultivar	*Rate of Nitrogen	Conv-till	Min-till	No-till	Avg.
	lbs N/ac	- - - - - - - - - bu/ac - - - - - - - - - -			
Roughrider	30	32.2	35.4	42.3	36.6
	60	27.8	33.3	44.1	35.0
	90	27.2	30.5	43.3	33.7
	Avg.	29.1	33.1	43.2	35.1
Norstar	30	28.1	35.9	47.1	37.0
	60	26.2	32.6	50.0	36.3
	90	26.8	36.8	43.5	35.7
	Avg.	27.0	35.1	46.9	36.3
	Avg. (tillages)	28.1	34.1	45.1	35.7

*No N-fertilizer applied because of high residual-NO_3.

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

Date mo/day	Conventional-till	Minimum-till	No Till
8/27(91)	- - Sprayed all plots with Roundup (16 oz/ac) plus 2,4-D (8 oz/ac)		
10/21(91)	----	----	Surflan (1.5 lb ai/ac)
4/9 (92)	*UC/Sonolan	*UC/Sonolan	----
4/-	No N-fertilizer rates applied; high residual N carryover.		
4/29	----	----	Roundup (9 oz ai/ac)
5/20	Tandem Disk	Undercut	----
5/22	- - - - Seeded all sunflower plots (Sigco 658 and 458) - - - - -		
8/11	- Aerial sprayed all plots/insecticide Asana XL (0.8 oz ai/ac) -		
10/5-8	- - - - - - - Took Hand Harvest Samples - - - - - - - - - - - -		
10/13-14	- - - - - - - - Combine Harvested all plots - - - - - - - - - -		

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

B4. Sunflower seed yields (1992) in the spring wheat-winter wheat-sunflower rotation as influenced by tillage system, residual N-rates, and cultivar grown.

Cultivar	*Rate of Nitrogen	Conv-till	Min-till	No-till	Avg
Sigco 658	30	1890	1780	1420	1700
	60	1860	1680	1270	1600
	90	1790	1930	2030	1920
Avg.		1850	1800	1570	1740
Sigco 458	30	1880	1850	1160	1630
	60	2000	1770	1260	1680
	90	2083	2000	1650	1910
Avg.		1990	1870	1360	1740
Avg. (Tillages)		1920	1830	1470	

*No N-fertilizer applied in 1992 because of high residual-N.

C1.- Conservation Tillage Research

LEAF SPOT DISEASES. Leaves of spring wheat were rated for leaf spot diseases during the growing season in several different rotations: i) spring wheat in a continuous cropping system (SWCC) following sunflowers, ii) spring wheat in a crop-fallow system (SWCF) with residue, and iii) spring wheat in a crop-fallow system with no residue (SWNR). No nitrogen effects were evident on leaf spot diseases in nine analyses. Tillage did not consistently effect leaf spot diseases in five analyses. In four out of nine analyses, there was significantly more leaf spot disease on Stoa in comparison to Butte 86.

Tan spot caused by Pyrenophora tritici-repentis was the most common leaf spot pathogen. The tan spot fungus was found on 87% of the leaf pieces tested for fungi present. Tan spot was followed by Septoria nodorum blotch (Septoria nodorum) on 70% of leaves tested and spot blotch (Cochliobolus sativus) which was found on only 8% of the leaf pieces tested. This again indicates that tan spot and septoria nodorum blotch are the two main components of a leaf spot disease complex common in this area.

ROOT ROT DISEASES. Spring wheat plants were rated for root rot symptoms. Plants (2,050) were pulled, roots washed, and the subcrown internodes were rated as either clean, slightly infected, moderately infected, or severely infected. Overall, 97% of the plants were classified clean, 2% were classified slightly infected, 0.01% were classified moderately infected, and none were classified as severely infected. Obviously, common root rot was not a disease problem in our plots in 1992.

C2. Wind Erodibility Studies

Wind erodibility studies were continued during 1992 in tillage treatments of the wheat-summerfallow portion of the Cropping Systems Experiment. Considerably fewer types of measurements were conducted in 1992 compared to prior years, but principal wind erodibility indicators, such as dry aggregate size distribution, and both standing and horizontal residue measurements were taken. Table A displays aggregate size distribution data for 1992 summarized as mean aggregate size (geometric mean diameter, GMD). As in prior years, GMD values tend to decline with advance of the season. GMD values of the no-till and minimal-till treatments appear to be somewhat lower than those of the less residue-conserving treatments of plots fallowed in 1991 (thus in the second year of fallow when cropped in 1992). Table B shows annual means of GMD taken across tillage treatments. The effects of the strong multi-year drought of 1988-90 are evident in these data. Average aggregate sizes were generally lower in 1992 compared to those of 1991. Evidently, conditions for overwinter increase of surface soil aggregation were poorer in 1991/92 than they were in 1990/91, or conversely, factors degrading surface soil aggregation were stronger in 1991/92 than overwinter in 1990/91.

Table A. Dry aggregate size distribution measurements taken in 1992 by rotary sieving. Average aggregate size (as geometric mean diameter) is given in millimeters.

DATES	CONVENT	LOW-RESIDUE	MINIMAL	NO-TILL	AVERAGE
PLOTS FALLOWED IN 1991:					
92-03-28	5.54	4.84	3.16	3.02	4.14
92-04-28	7.72	3.56	2.03	1.46	3.69
92-05-20	0.71	0.92	0.58	0.67	0.72
92-06-24	1.27	1.21	1.32	1.19	1.23
92-07-21	0.96	1.53	1.35	1.10	1.23
92-08-18	1.64	1.37	1.25	1.47	1.42
AVERAGE	2.98	2.24	1.61	1.46	2.07
PLOTS FALLOWED IN 1992:					
92-04-01	11.59	3.75	8.51	4.82	7.17
92-05-01	4.59	3.13	3.51	3.16	3.58
92-05-19	7.57	3.26	8.31	4.35	5.87
92-06-23	2.95	3.01	3.47	2.80	3.06
92-07-20	1.79	1.64	2.23	2.95	2.15
92-08-17	1.84	1.76	1.89	3.21	2.18
92-10-07	1.61	1.47	2.11	2.84	2.01
AVERAGE	4.55	2.58	4.29	3.45	3.72

Table B. Annual dry aggregate sizes (as geometric mean diameters, GMD) averaged over tillage treatments for calender year - fallow year combinations measured in spring wheat-summerfallow portion of the Cropping Systems Experiment. Units are millimeters.

Fallow Year	Calendar Year	Condi-tion	Mean GMD	Fallow Year	Calendar Year	Condi-tion	Mean GMD
1988	1988	fallow	5.13				
1988	1989	crop	3.07	1989	1989	fallow	1.08
1990	1990	fallow	2.17	1989	1990	crop	0.95
1990	1991	crop	5.96	1991	1991	fallow	14.53
1992	1992	fallow	3.72	1991	1992	crop	2.07

H2. This field was summerfallowed in 1991 following winter wheat in 1990. We devoted this field to sunflower and safflower research to evaluate:

(a) Seeding date and N&P fertilizer requirements for safflower (Don Tanaka) and (b) observe root growth of sunflower and safflower as influenced by tillage and fertilizer treatments (Steve Merrill).

Sonolan at 0.9 lbs ai/ac was applied on April 9, 1992 with the undercutter. Second pass with the undercutter took place on April 10. Safflower, Centennial, was seeded at 300,000 viable seeds with the Haybuster 1000 in 7 inch rows. Safflower treatments were seeding dates (April 24, seeding date I; May 5, seeding date II; and May 18, seeding date III), fertilizer (N = 0, 30, and 60 lb N/ac; P = 0, and 20 lb P/ac), and fertilizer either banded (between every other 7 inch seed row) or broadcast at seeding. Weeds which escaped Sonolan (wild mustard) were controlled with a post-emergence herbicide application on June 6. Safflower was harvested on Oct 5 (seeding date I), Oct 6 (seeding date II), and Oct 14 (seeding date III). Water use during the growing season was the same for all safflower treatments, 18.5 inches (7 inches of soil water plus 11.5 inches of rain). Mean monthly temperatures for July and August were below the long-term temperatures causing poor pollination and disappointing grain yields.

Table 1. Safflower grain yield as influenced by seeding date and method of fertilizer application.

Application Method	Seeding Date I	II	III	Mean
	lb/ac			
Broadcast	1140	910	640	900
Band	1340	950	790	1030
Mean	1240	930	720	960

Table 2. Safflower test weight as influenced by seeding date and addition of P fertilizer.

P fertilizer (lb/ac)	Seeding Date I	II	III	Mean
	lb/bu			
0	32.6	26.4	22.7	27.3
20	33.3	29.0	23.0	28.5
Mean	33.0	27.7	22.8	27.8

Table 3. Safflower kernel weight as affected by seeding date and method of fertilizer application.

Application Method	Seeding Date I	II	III	Mean
	mg/kernel			
Broadcast	36.6	29.4	21.1	29.0
Band	37.2	30.7	22.7	30.2
Mean	36.9	30.0	21.9	29.6

Table 4. Mean monthly long-term and 1992 temperatures at Mandan, ND.

Month	Long-term	1992
	°F	
June	64	62
July	71	62
August	69	63

(b.) Root Growth of Oilseed Crops

The root growth and soil water relations of oilseed crops was studied in 1992 in conjunction with several agronomic experiments. As in prior years, a special video camera was used with minirhizotron tubes to measure root growth. The three tillage treatments of continuous rotational sunflower in the Cropping Systems Experiment were observed along with sunflowers growing on fallow ground in an adjacent plot. The sunflowers observed were seeded on May 22. The safflowers observed were in an experiment having 3 planting dates as the main treatment effect. Seeding dates were 4/23, 5/5, and 5/18.

Table A indicates total root length growth. Both crops show root growth rising to a peak, and then decreasing to low values during reproductive development.. Safflower, which achieved tremendous vegetative growth in 1992, produced more gross root growth than sunflower. The first planting date had higher peak root length growth than the other two. Of the sunflower treatments, the no-till lagged behind the other treatments in rate of root growth, which corresponded to a comparable lag of above ground phenological development of the no-till plants. However, peak root length growth amounts were not greatly different among the three continuous rotational sunflower treatments. Sunflowers on summerfallow land displayed clearly greater root growth.

Table A. Total root length growth in units of cm/cm^2 for sunflower and safflower at dates indicated in 1992.

	- - - SAFFLOWER - - -			- - - - - SUNFLOWER - - - - -			
DATES	1st planting	2nd planting	3rd planting	convent cont. crop	minimal cont. crop	no-till cont. crop	summer-fallowed
5/27	24						
6/2	36	7					
6/10	65	22					
6/22-24	149	79	33	11	2	2	7
6/29				26	18	7	21
7/9	325	100	74				
7/15				96	47	23	106
7/29-31	530	306	333		58	37	159
8/5				146	98		
8/18-20	312	393	332	130	128	120	244
8/31-9/3	143	306	200	71	99	79	210
9/14-16	5	15	17	11	20	16	89
9/28				1	3	2	12

Table B shows depth distribution of oilseeds root growth. Treatment effects are not strongly apparent, although the conventional-till sunflowers appear to have a somewhat more shallow average depth of root length growth compared to the other treatments. Both sunflowers and safflowers are capable of displaying root growth at the maximum depth of the observation system, at 6 feet. Safflower growth at time of peak root proliferation appears to be better distributed over soil depth than is usually the case for many root growth observations.

Table B. Distribution of safflower and sunflower roots measured on August 18-20, near time of maximum root growth. Data are given as percentages of observed total root length occurring in depth increments.

	- - - SAFFLOWER - - -			- - - - - SUNFLOWER - - - - -			
SOIL DEPTH feet	1st planting	2nd planting	3rd planting	convent cont. crop	minimal cont. crop	no-till cont. crop	summer-fallowed
0.28	0.1	0.0	0.1	4.2	0.1	0.8	0.4
0.56	2.7	1.7	1.0	7.7	4.2	2.2	1.2
0.85	4.5	3.2	5.7	11.4	3.6	3.9	6.3
1.14	5.6	5.5	3.3	13.5	7.7	4.0	14.6
1.42	5.0	4.4	4.2	10.3	7.3	4.8	16.1
1.70	6.7	5.1	7.0	13.3	9.7	1.6	9.2
1.99	8.0	5.7	7.4	15.2	9.4	8.5	10.2
2.27	5.9	4.3	6.0	10.3	8.1	5.2	9.5
2.56	6.4	3.6	6.2	7.6	9.5	4.4	5.3
2.84	7.6	4.7	6.1	0.7	11.8	8.8	6.2
3.13	8.6	6.9	6.7	0.7	6.8	5.0	9.2
3.41	10.5	7.9	8.2	1.6	7.0	9.8	6.5
3.69	6.6	8.8	11.0	2.1	5.9	8.1	2.4
3.98	5.7	7.9	6.5	1.2	4.3	17.9	1.0
4.26	7.0	10.2	6.5	0.2	2.9	3.4	0.5
4.55	5.8	6.3	10.6	0.0	0.9	2.9	0.2
4.83	1.2	3.6	1.1	0.0	0.7	0.8	0.0
5.11	2.4	4.6	1.5	0.0	0.3	2.8	1.1
5.40	0.4	3.7	0.6	0.0	0.0	2.5	0.3
5.68	0.4	1.4	0.3	0.0	0.0	1.7	0.0
5.97	0.2	0.5	0.0	0.0	0.0	1.0	0.0

Shown in Table C are total soil water content measured at sites of root growth observation and some other areas of our plots. Initial soil water contents are some what higher for the safflowers and on the one sunflower treatment which were growing on fallow ground. Among the sunflower treatments in continuous rotation, the no-till exhibited approximately 2 inches more soil water at the initial reading than did the conventional-till, with minimal-till being intermediate. Furthermore, the no-till treatment used one inch less soil water than the conventional till during the season.

Table C. Soil water content of oilseed crops measured in areas in which root growth studies were conducted: in units of inches per 6 feet of soil profile depth.

	- - - SAFFLOWER - - -			- - - - - SUNFLOWER - - - - -			
DATES	1st planting	2nd planting	3rd planting	summer-fallowed	convent cont. crop	minimal cont. crop	no-till cont. crop
May 8	21.6	21.9					
May 15	20.9	22.0	22.0				
May 22	21.6	22.2	22.9				
May 29	21.7	22.3	22.9	22.3	19.0	20.3	21.9
June 5	21.3	22.1	22.7	22.4	19.1	20.4	21.9
June 12	20.7	21.8	22.4	22.2	19.0	20.2	21.9
June 22	21.6	22.4	23.3	23.7	20.7	22.4	24.6
June 26	21.0	22.3	23.1	23.4	20.4	22.1	24.3
July 14	20.2	22.2	22.8	23.4	20.9	23.0	25.3
July 22	18.6	20.4	21.2	22.4	20.1	22.0	24.2
July 29	17.1	18.7	19.6	21.0	18.6	20.8	23.1
Aug 14	14.9	16.4	17.2	19.1	16.9	18.7	21.3
Aug 20	13.9	15.1	16.2	17.9	16.0	17.1	19.7
Aug 22	14.2	15.2	15.8	17.8	16.4	17.2	19.9
Sept 10	14.3	15.1	15.5	17.4	15.7	16.5	19.0
Oct 2	16.5	14.8	15.3	17.7			
Oct 6	13.8						
Oct 15	14.2	14.8					

H3. This field was previously cropped to spring wheat in 1991. The spring wheat was harvested to leave a 10- to 12-inch stubble height and the field was sprayed August 21, 1991 with Roundup plus 2,4-D to control volunteer wheat and weeds. On September 24, 1991, winter wheat cultivars; Norstar, Roughrider, Agassiz, Rocky, Archer, Norwin, and Winalta were seeded in two replications with the Haybuster 8010, narrow-point, furrow drill. The crop was sprayed May 15, 1992 with 2,4-D LV Ester (4.2 oz ai/ac) plus Buctril (4.4 oz ai/ac) for weed control. We swathed all winter wheat varieties August 11 and combine harvested the crop August 13-14, 1992. The field averaged about 52 bu/ac, 62 lbs/bu test weight and 12.5% protein with no fertilizer-N applied.

We established a N-fertilizer study across all winter wheat varieties using ammonium nitrate (34-0-0) as a topdressing on April 23, 1992 at rates of 0, 30, 50, 70, 90, and 120 lbs N/ac. Grain yields of winter wheat varieties as influenced by N-fertilizer rate are shown in the following table.

Variety	Grain Yield (Bu/ac) Rate of N-Applied (lb/ac) 0	30	50	70	90	120	Avg.
	bu/ac						
Roughrider	54.0	56.1	55.5	52.1	51.3	52.8	53.6
Agassiz	49.8	44.4	49.3	48.2	48.4	53.6	49.0
Norstar	50.2	52.5	51.7	55.0	59.7	51.8	53.5
Rocky	48.4	57.0	53.3	51.8	51.6	51.4	52.2
Archer	51.5	55.0	58.4	55.0	48.0	60.0	54.6
Norwin	58.5	49.1	61.2	54.0	41.3	54.6	53.1
Winalta	51.0	52.4	47.5	44.8	46.6	49.8	48.7
(Variety) Avg.	51.9	52.4	55.3	51.6	50.0	53.4	52.2

H4. ARS Leased Land: Beginning in 1988 and 1989, field blocks of land were established in a spring wheat-fallow spring wheat rotation to provide an opportunity to study annual legumes (Tangi flat pea, Simu-S-1 peas and chick peas some years) as a cover crop (partial summerfallow) practice for soil protection and to provide 30 to 50 lbs/ac of fixed Nitrogen.

An offset disk followed by a conventional press drill with six-inch row spacing was used to seed Amidon spring wheat at 1.3 million viable seed per acre. Seventy lbs/ac of 18-46-0 was applied with the seed. Wheat was seeded where cover crops had been grown in 1991. Weeds were controlled with a post-emergence application of Tiller (16 oz/ac) plus Buctril (16 oz/ac). Wheat was harvested on August 31, 1992.

Table 1. Amidon Spring wheat grain yield and test weight after 1991 cover crops.

Cover Termination[1]	Semu		Vetch		Tinga flat		Fallow	
	grain yield	test weight	grain yield	test weight	grain yield	test weight	grain yield	test weight
	bu/ac	lb/bu	bu/ac	lb/bu	bu/ac	lb/bu	bu/ac	lb/bu
Flower	55	59	56	59	69	59	68	60
Pod Formation	59	59	61	59	69	59	68	60
Full Season	57	59	55	59	67	60	68	60
Mean	57	59	57	59	68	59	68	60

[1]Cover crop vegetation growth was terminated at flowering, pod formation, and allowed to grow for the full season.

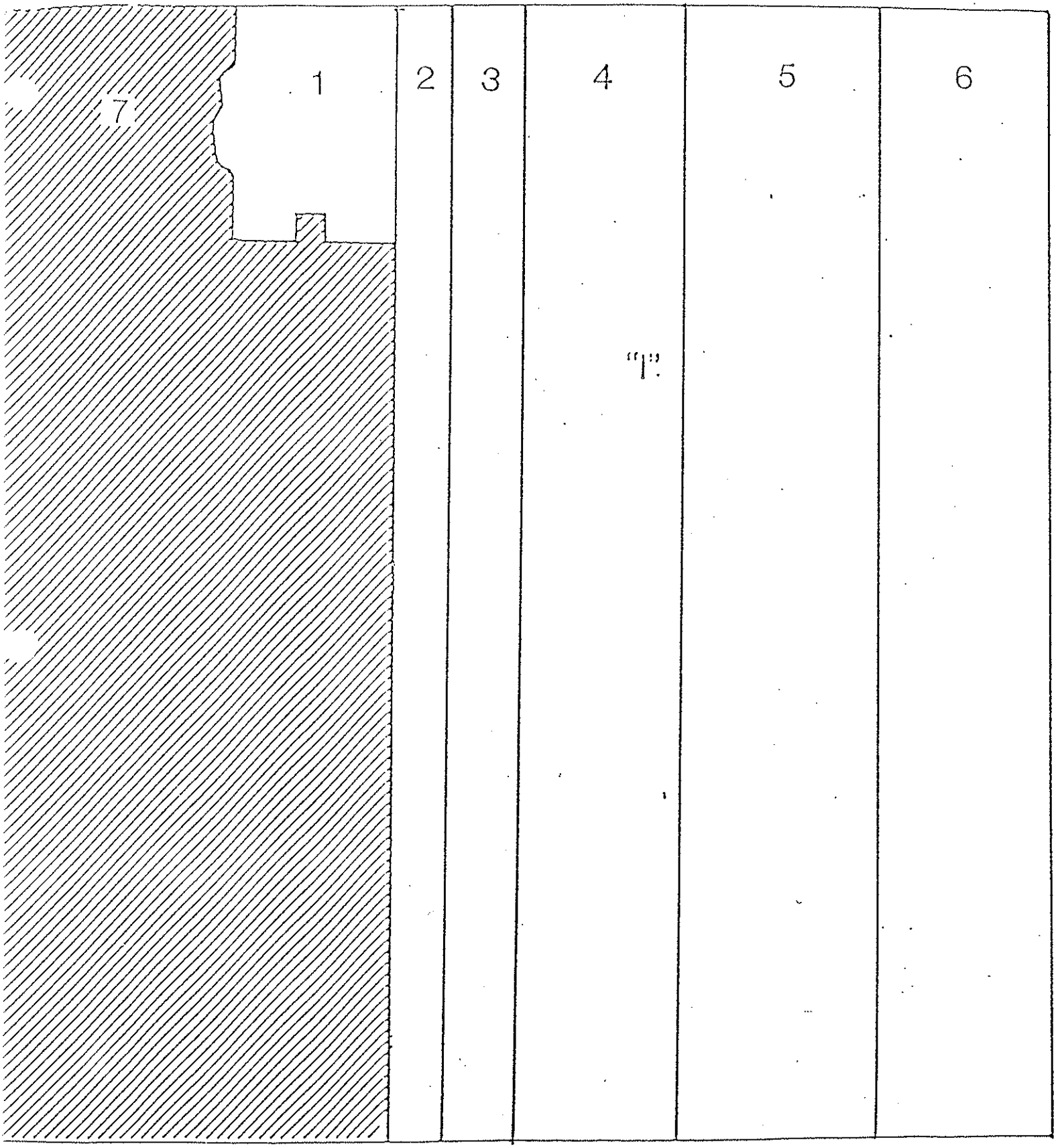
Table 2. Cover crop management practice for 1992.

Date mo/day	Cover Crop	
	Semu	Tinga flat
05/04	Applied Sonalan at 1 lb ai/ac with undercutter.	
05/15	Undercut the second time at a slight angle to first pass. Seeded Semu and Tinga flat peas at 250,00 viable seeds/ac in 7-inch rows 1 to 2-inches deep.	
07/09	Flowering, terminated growth (1/3 pt Roundup plus 1 pt/ac 2,4-D amine)	------
07/15	-----	Flowering, terminated growth (2 pt/ac Landmaster)
07/29	Both Semu and Tinga flat peas were developing pods, terminated growth. (2 pt Landmaster)	
10/01	Frost killed all peas.	

Table 3. Dry matter production, water used, and dry matter water-use efficiency (WUE) for Semu and Tinga flat peas in 1992.

Plant development stage	Precipitation from seeding to plant stage (inches)	Semu Dry matter (lb/ac)	Semu Water[1] used (inches)	Semu WUF (lb/ac/inch)	Tinga flat Dry matter (lb/ac)	Tinga flat Water[1] used (inches)	Tinga flat WUF (lb/ac/inch)
Flowering	7.5	2870	6.5	440	2270	5.1	440
Pod formation	7.8	6700	9.4	710	5680	10.6	540
Full Season	10.1	8190	12.3	670	7920	12.5	630

[1]Water used is precipitation received during the period plus soil water used to a depth of 8 feet.


7
1
2
3
4
5
6
"I"

I. NE 1/4 Section 20 - Research Activities

I1. Investigations of spring wheat root rot diseases in continuous spring wheat rotation. This was the 8th consecutive year of continuous spring wheat cropping comparing no-till and conventional-till systems.

ROOT ROT DISEASES. A continuous spring wheat field (poor management to encourage diseases) was divided into high residue (no-till) and low residue (conventional tillage) treatments. Four fungicide seed treatments for common root rot were tested. Plants (1,200) were pulled, roots washed, and the subcrown internodes were rated as either clean, slightly infected, moderately infected, or severely infected. Overall, 94% of the plants were classified clean, 5% were classified slightly infected, 1% were classified moderately infected, and none were classified as severely infected. Despite the poor management of growing continuous wheat, common root rot was not a disease problem in 1992. With the low level of root rot present, differences among the four fungicide treatments were not evident. Yield data is not available at the present time.

LEAF SPOT DISEASES. Leaf spot diseases were significantly higher in the high residue field (notill) compared to the low residue field. Based on average ratings of 2,560 leaves, leaves were 70% necrotic in the high residue field and only 15% necrotic in the low residue field. Yield data is not available at the present time. Yield comparisons will be given in the oral report at the Area IV SCD meeting.

I2, I4 & I6.
These fields were cropped in 1991 and summerfallowed in 1992. These fields produced 36 bu/ac in 1991 and had straw-residue levels of about 4500 lb/ac. These fields were undercut April 27, 1992; sprayed with Fallowmaster (40 oz mtl/ac) June 9, 1992; and with Roundup (24 oz mtl/ac) plus 2,4-D amine (15 oz mtl/ac) on July 20, 1992 and September 23, 1992. This high surface residue summer fallow management system involving an undercutter operation at 2-inch depth and three herbicide applications controlled weeds and left about 3000 lb/ac of surface residue (about 80% cover) to conserve soil water and protect the soil from erosion during the second overwinter period of the 21-month fallow period.

I3 & I5.
These two fields were summerfallowed in 1991 and had about 1500 lb/ac of surface residue (about 50% cover) remaining in the spring of 1992 after 21-months of fallow. Without spring tillage, we seeded both of these fields April 30, 1992 to spring wheat (Amidon) using the Haybuster 1007 at a seeding rate of 1-million viable seeds/acre (1.5 bu/ac). We applied 41 lbs/ac of 18-46-0 (7.4 and 8.3 lbs/ac of N and P) with the seed. The spring wheat crops were sprayed June 2, 1992 with Tiller (6.3 oz ai/ac) plus Buctril (4.3 oz ai/ac). These two fields had no weeds or green foxtail barley at harvest and the stubble remained weed free until late September when a small amount of volunteer grain appeared. The crop was straight combine harvested September 10-13, 1992. These two fields averaged about 54 bu/ac with a test weight of 59 lb/bu and a protein content of 13.5%.