Plant Science Pamphlet #19 December 1974

ANNUAL PROGRESS REPORT

CENTRAL CROPS AND SOILS RESEARCH STATION

HIGHMORE, SOUTH DAKOTA

INTRODUCTION

In the past year, an off station research area was started on the Keith and Myron Kleppin farm site. This area is located 11 miles west of Wessington Springs and 2½ miles south of highway 34. There are approximately 5 acres in the experimental area and the study is to last 3 years.

A crop tour was conducted on the central substation with emphasis placed on varieties which were suitable for the area. Many varieties grown in these test areas are not adapted to this climate and actual observation and comparison aid the farmer with his crop variety decision.

Rainfall in the late fall of 1973 and early 1974 provided adequate soil moisture to start and help the winter small grain crop to maturity. Other crops on spring tilled soil did not respond as well, due in part to the clodiness and compaction occurring from wet tilled soil. Fall tillage in 1974 was not possible because of the extreme dryness of the soil. The winter grain that was planted did not germinate properly and at this point may necessitate removal after observation in the spring. If the seed did develop a small root, the possibility of a winter grain crop may yet be realized.

NOTE: This is a progress report and therefore the results presented are not necessarily complete nor conclusive. Any interpretation given is strictly tentative because additional data resulting from continuation of these experiments may result in conclusions different than those of any one year.

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1974 CROP SEASON

Total Rainfall for Growing Season by Months with their Departure from Long-time Average at Central Substation, Highmore, S. D.

Rainfall	Inches	Departure	Greatest day	Date
April	2.46	+.57	0.75	21st
May	6.70	+4.15	2.20	21st
June	1.27	-2.70	0.40	27th
July	1.29	-1.25	0.46	3rd
August	0.36	-1.99	0.17	24th
September	0.42	-1.19	0.25	12th

Keith and Myron Kleppin Farm
Jerauld County, 11 miles West and
2½ miles South of Wessington Springs

TITLE: Weed Control for Corn and Sorghum Forage Production

OBJECTIVES OF EXPERIMENT:

1. What effect do weed control chemicals have on succeeding crops?
2. Will soil moisture be affected by these cropping sequences.
3. Do cropping sequences have any effect on the small grain crop?
4. Silage yields of corn and forage sorghum.

CROPPING SEQUENCE:

1. Corn-atrazine 74, Corn 75, Wheat 76
2. Forage Sorghum-atrazine 74, Forage Sorghum 75, Wheat 76
3. Corn-Ramrod 74, Corn-Ramrod 75, Wheat 76
4. Corn-atrazine 74, Forage Sorghum 75, Wheat 76

CROP YEAR HISTORY: Corn and Forage Sorghum

Planted: June 5
Variety: Corn, Sokota SK 54 - 18,000 plants/A
Forage Sorghum, Pioneer 931 - 65,000 plants/A
Herbicide: Ramrod, 6#/A in 7 inch band
Atrazine 80W, 3#/A broadcast
Insecticide: Thimet, 1# active/A on corn only
Replications: 4

Harvested: Sept. 20
Row Space: 36 inches
Fertilizer: 60-40-0 Broadcast
Cultivation: One
Soil Preparation: Mulch tillage with 32" sweeps once
Plot Size: 4 row plots, 114 feet long

RESULTS:

TABLE 1. FORAGE YIELDS OF CORN AND FORAGE SORGHUM. MOISTURE USE AND TONS OF FORAGE PER INCH OF WATER USED.***

Treatment Weed Control	Weeds Per Sq Ft of Row	Yield Tons/A 12% Moisture	Water Loss Inches*	Precip During Season	Loss From Profile and Precipitation Inches Used**	Tons Per Inch of Water Used***
CORN						
None	3.4	2.14	9.50	5.14	14.64	0.15
Atrazine 80W 3#/A	1.4	2.30	7.62		12.76	0.18
Ramrod 6#/A 7" Band	2.6	1.80	8.15		13.29	0.14
FORAGE SORGHUM						
None	3.4	2.54	9.49		14.63	0.17
Atrazine 3#/A	1.4	2.40	8.26		13.40	0.18

* Soil water loss in 4-foot section of the soil from June 5 to Sept. 20 when the soil was near the wilting point.

** Loss includes water used by plant, evaporation and runoff after receiving precipitation. Even though some is lost, all figure in the total used.

*** Calculated by $\frac{\text{ton of forage produced}}{\text{Loss + precipitation}}$ = tons of forage produced per inch of water used.

DISCUSSION AND INTERPRETATION OF RESULTS:

The rainfall intensity prior to planting was adequate to support active growing plants. The subsoil moisture was high at planting time, June 5th, and plant emergence was rapid. Rainfall received prior to planting was 2.05" for April, 5.23" for May, and 0.69" prior to June 5th. Total rainfall from planting time to harvest was 5.14 inches or 0.09" less than received in May.

Corn and forage sorghum yields were lower due in part by late planting and the occurrence of high winds and temperature.

The forage yields are calculated at 12% moisture. All sampling was performed with a silage chopper and the forage caught in sacks for weighing. This presents a true sample when considering machine sampling, but weeds also go in with the sample. The weight of the weeds becomes apparent when looking at yields in Table 1. of nontreated corn and sorghum, compared to the chemical treatments.

Moisture usage, by the crop, becomes an important factor in farm management. In all cases in 1974, the chemical application for weed control helped conserve moisture in this experiment, when compared to the nontreatment.

CENTRAL SUBSTATION

Highmore, S. Dak.

TITLE: Method of Planting Winter Wheat

OBJECTIVE:

1. Compare the effect of phosphorus versus no fertility treatment for crop response.
2. Which method of planting winter wheat is better, hoe drill with 12" openers, double disk press drill with 12" space or double disk press drill with 6" spaced openers.

CROP YEAR HISTORY:

Planted: September 14, 1973	Harvested: July 22, 1974
Variety: Gage	Fertility: 0-0-0, 0-15-0
Planting Rate: 60#/A	Plot Size: 6 ft. x 121 ft.

RESULTS:

TABLE 2. METHOD OF PLANTING WINTER WHEAT, WITH AND WITHOUT PHOSPHORUS FERTILIZER. 1974

Treatment Lbs/A P	Method of Planting and Spacing	Test Wt.	Yield Bu/A
0-0	Press Drill 6"	55.5	49.5
0-15	" " "	55.5	52.2 + 2.7
0-0	Press Drill 12"	55.5	43.7
0-15	" " "	54.6	47.4 + 3.7
0-0	Hoe Drill 12"	53.5	46.9
0-15	" " "	55.0	48.0 + 1.1

DISCUSSION AND INTERPRETATION OF RESULTS:

The addition of 15 pounds of phosphorus down the spout with the seed helped increase yields over the unfertilized treatments. Yields, Table 2, vary with depth of planting and row spacing this year.

Table 3. Performance Trial of Forage Sorghum Varieties, Central Substation 1974

Brand and Variety*	Heading Date	Height Inches	Number Leaves	Stem Diameter MM	Percent Lodging	Yield 12% Moisture Tons/A	Yield, Field Wet tons/A
Rudy Patrick							
55 F	8/26	63	16	25	0	2.56	7.75
Sumax	8/24	60	14	24	0	3.72	8.66
22F	8/8	57	12	18	0	3.20	7.37
Weathermaster							
Hy Mac	8/18	62	14	23	0	2.26	6.02
FS 445	8/20	59	14	23	0	2.52	6.92
FS 500 B	8/19	62	14	22	0	2.61	8.58
Pioneer							
931	---	82	18	25	0	2.95	9.14
944	8/19	60	14	20	0	2.70	7.82
988	8/20	69	12	23	0	2.99	8.11
DeKalb							
FS 4	8/31	72	14	25	0	2.76	8.02
SX 15	8/27	69	12	14	0	2.62	6.92
SX 4	9/5	67	14	15	0	2.57	7.52
Dorman and Co.							
Sure-Graze	8/30	75	12	17	0	2.72	7.89
Excel							
Chow Maker 235	---	76	16	19	0	2.71	9.26
Miller Seed							
Horizon SF 20	9/17	54	16	23	0	2.36	7.60
Horizon SF 12	9/1	76	16	24	0	2.96	8.59

* Listed in order of first replication layout for tour observation. The sorghum seed was contributed by these companies to study adaptability to this area. Planted May 23, Harvested September 27.

CENTRAL SUBSTATION
HIGHMORE, S. DAK.

Experiment Proposals

Tillage Treatments

1. Chisel plow, narrow sweeps, disk once or when needed.
2. Mulch, 32" wide sweeps, disk once or when needed.
3. Stubble, no till, or possibly chemical.
4. Fallow, black, narrow or wide sweeps + disk or duckfoot until black.
5. Fallow, some residue, narrow or wide sweeps + disk or duckfoot until nearly black.

Crop Sequence

(numbers on side refer to tillage treatments)

	Spring Grain		Winter Grain
1-2	wheat	1-2	wheat
1-2	wheat-oats	1-2	wheat-oats
1-2	wheat-Row Crop (Grain)	1-2	wheat-Row Crop (Silage)
3-4-5	wheat-Fallow	3-4-5	wheat-Fallow

Fertility

0-0-0	
0-30-0	phosphorus applied with grain
60-0-0	Nitrogen broadcaet on surface
60-30-0	

Planting Space

Small grain, 7 inch

Row Crop, 36 inch

Plot Size

20 ft. x 32 ft.

Starting Soil Samples

Every plot 0-6", 6-12", 12-18", 18-24"

Replications

Four

Other Observations

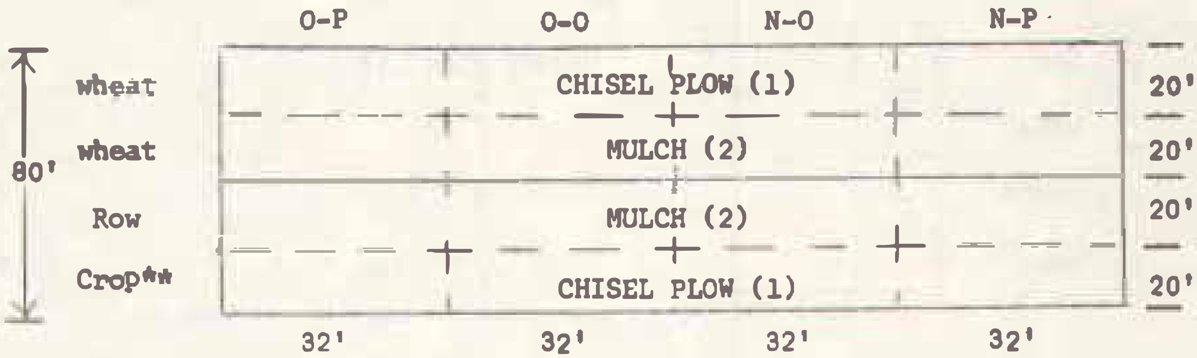
1. Soil Moisture
2. Soil temperature
3. Plant diseases
4. Plant analysis
5. Soil tests (nitrate)
6. Weed evaluation
7. Yield
8.

Objectives

1.

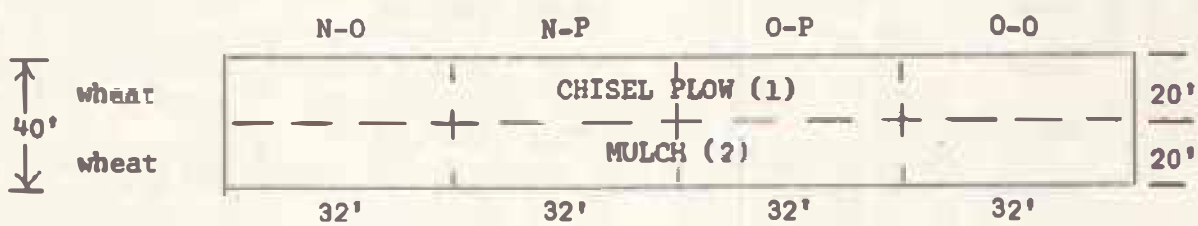
Spring Grain
One Replication Illustrated*

wheat-Row Crop
1-2 Tillage



O - no treatment
N - nitrogen
P - phosphorus

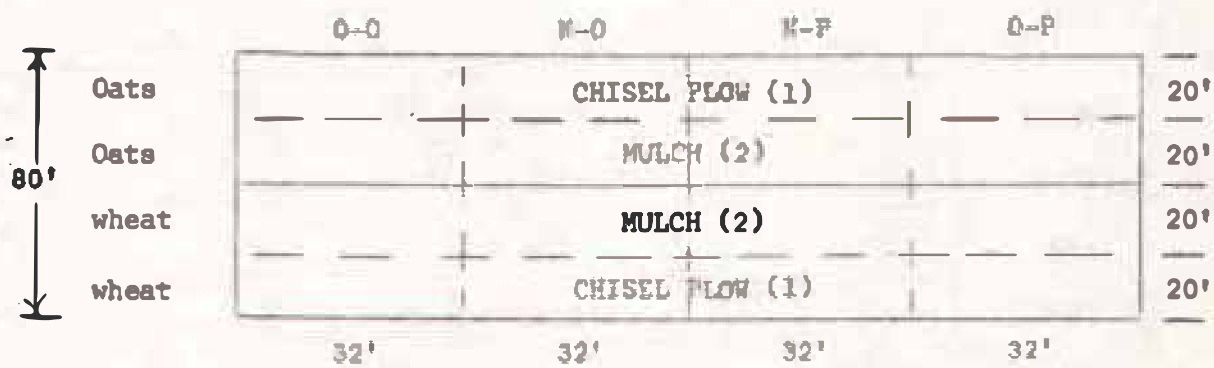
Continuous wheat
1-2 Tillage



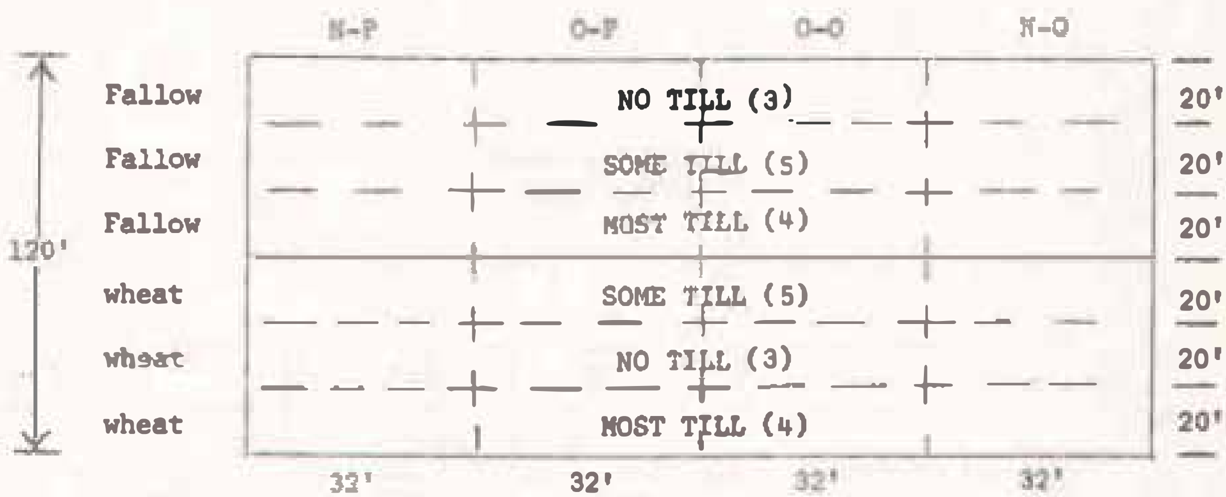
* The winter grain experiments are laid out in the same manner as spring grain.

** The row crop is sampled for grain in the spring grain phase and for silage with winter grain experiments.

Spring Grain
1-2 Tillage



Fallow Tillage
3-4-5 Tillage



Barley Improvement
Highmore
Phil Price

During 1974 spring and winter barley breeding materials were tested at the Central Substation.

The spring barley was tested in the Great Plains Barley Nursery. This is a feed barley nursery. It is a regional nursery grown at 11 locations in Colorado, Nebraska, South Dakota, Wyoming, North Dakota, and Manitoba. We are now developing barley varieties which can perform well in the drier areas of the northern Great Plains and will provide a more nutritious feed for livestock and poultry. We hope in the next decade to have feed varieties with higher lysine and amylose content, an energy content equal to corn and other features which will make it more popular with feeders.

The winter barley testing is part of the barley improvement work also being done at Brookings. We are trying to develop winter barley varieties for production in the southwest quarter of South Dakota and adjoining areas. The big obstacle to stable production of this crop is insufficient winter hardiness. We are crossing hardy winter barley varieties and selections gathered from around the world. The offspring from these crosses are increased in Arizona over winter and seeded in large strips at Highmore the following September. In a few years we'll have some idea of the progress we are making. We will have to reach the hardiness level of Nebred winter wheat if winter barley is to become a reality in the northern Great Plains.

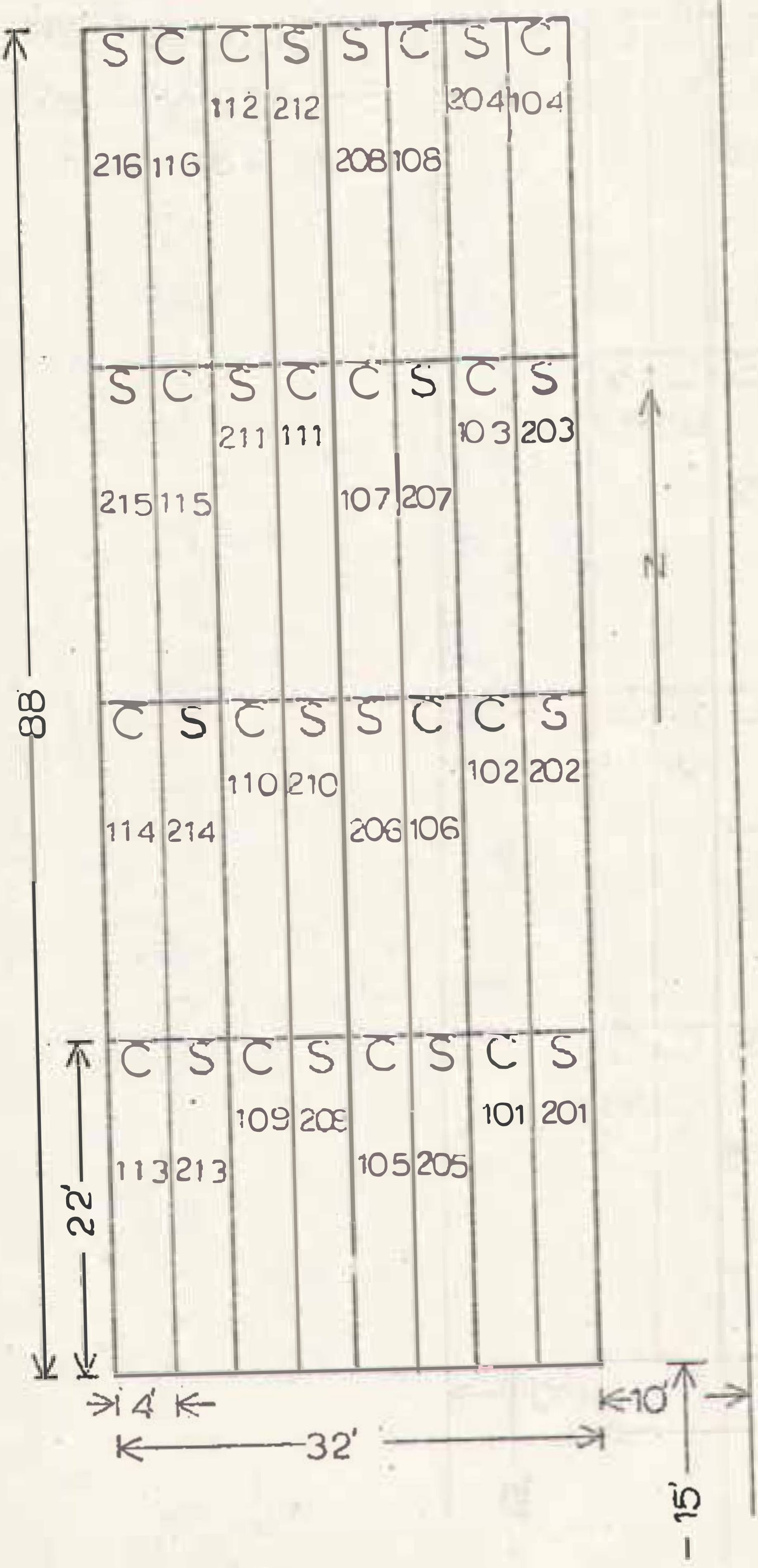
Alfalfa - Mulch Study
Highmore, S. D.
Paul Evenson

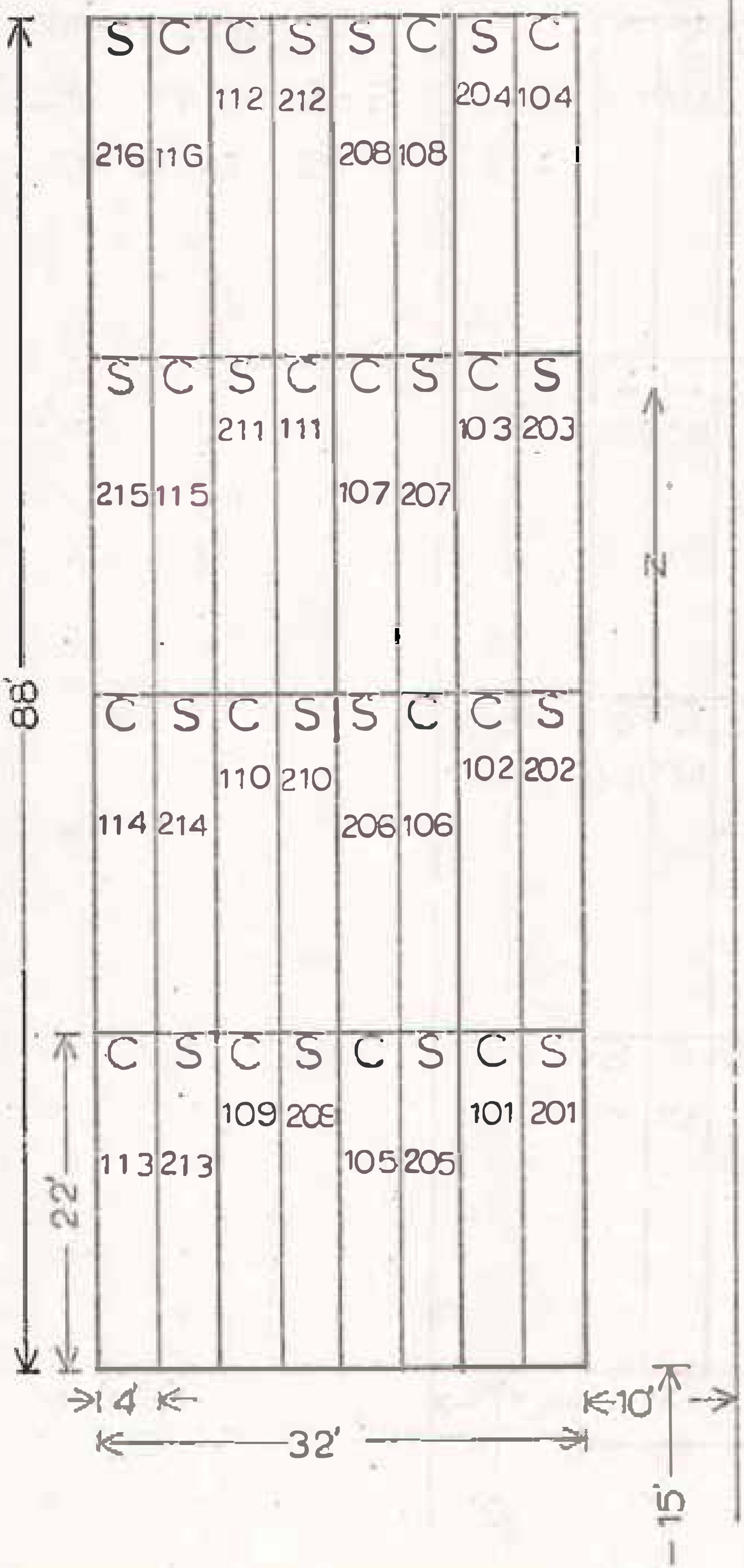
I. Objective - A straw mulch (3 tons per acre) was found to reduce soil temperatures and increase alfalfa yields at the Agronomy Farm at Brookings, South Dakota. This experiment was designed to test the effect of a straw mulch on the regrowth of alfalfa in an area which has lower rainfall than Brookings.

II. Procedure - The experimental area received 100 lbs. per acre of 40-15-0 prior to tillage in early spring, 1973. An additional 100 lbs. per acre of phosphorus was applied to the experimental area along with 20 oz. per acre of Balan. These chemicals were incorporated into the soil by double disking the land. Vernal alfalfa was planted on May 23, 1973 at a seeding rate of 7.67 lbs. per acre. The alfalfa was not harvested in 1973. In 1974, the alfalfa was harvested on June 7 and 3 tons of straw per acre was applied to the mulch plots on June 12. The mulch and the control plots were layed out in a paired arrangement with 16 replications. A second harvest was made on July 18 in which a 2 x 20 foot strip was harvested out of the center of the 4 x 22 foot plots.

Results and Discussion - The control plots yielded an average of .675 tons per acre, and the mulched plots yielded an average of .533 tons per acre. This difference was significant at the .01 level. These yields were very low due to lack of rainfall during the growing season. Also, the straw was not applied immediately following the harvest as was intended. The yield difference in favor of the check plots can not be explained at this time, and more cuttings need to be taken before any conclusions can be drawn.

C-Control-100
S-Straw - 200
REPS - 01 to 16





C-Control–100
S-Straw - 200
REPS - 01 to 16

Wheat Quality Discussion of 1973 Data, Central Substation

Robert W. Pylman, Jr.

Flour quality means different things to the ultimate user of the product. It usually represents conformance to several measurable characteristics which experience has indicated to be significant in terms of the end use.

The following quality characteristics are presented for the purpose of showing some of the differences which exist between varieties for some of the characters involved with milling and baking evaluation of Hard Red Spring Wheats.

Test Weight

One of the most widely used and simplest criteria of wheat quality ie the weight of the wheat per unit volume. Kernel size, as such, has little if any influence on test weight. Kernal shape and uniformity of kernel size and shape are important factors influencing test weight, inasmuch as they affect the manner in which the kernels orient themselves in a container. The other important factor influencing test weight is the density of the grain. Density, in turn, is influenced by the biological structure of the grain and its chemical composition, including its moisture content.

Weight per unit volume is an important factor in all wheat grading systems. Its importance lies primarily in the fact that it is at least a rough index of the yield of flour that can be obtained. There is considerable evidence that above about 57 lb. per bushel the test weight of wheat has relatively little influence on flour milling yield. At lower weights the milling yield usually falls off rather rapidly with decreasing test weight. Immature wheat or wheat that is badly shriveled as a result of drought or disease is usually low in test weight and gives correspondingly poor yield of flour. The average test weight per bushel of U. S. wheat is 60 lbs., but test weights up to 64 lbs. are not uncommon. Badly shriveled wheats may have test weights as low as 45 lbs. or less.

Protein Content

Protein content in wheat varies from about 6% up to about 20%, depending in part on variety and class but more largely on environmental factors during growth. Abundant rainfall during the period of kernel development usually results in low protein content, whereas dry conditions during that period favor high protein content of wheat.

For the production of yeast-leavened bread, flour with a protein content of at least 11% is usually preferred. To produce such flour the wheat must have a protein of at least 12%. This factor has been of concern in semidwarf wheats. Larger differences than 1% protein between whole wheat and flour protein have been reported for semidwarfs. This apparently doesn't seem to be a problem in South Dakota. In many counties climatic conditions make it impossible to produce wheat of that protein content level, and as a result these counties usually import wheat of high protein content to blend with their local wheat. In the U. S. premiums are usually paid for hard wheat of high protein content, since such wheat is in demand for blending with lower protein wheat for the production of breaf flour. Hard ~~wheat~~ in the U.S. is usually marketed on the basis of protein content in addition to grade.

Flours for purposes other than yeast-leavened bread generally are made from wheats of lower protein content, the approximate wheat protein content levels usually required for flour for different uses are shown in the following tabulation:

End Product	Wheat Protein Content (14% moisture basis) Percent
Macaroni products	13 or more
Hearth bread and hard rolls	13 - 14
Pan bread	12 - 13
Crackers	10 - 11
Biscuits	8.5 - 10.5
Cake	9 - 9.5
Pie Crust	8 - 10
Cookies	8 - 9

Ash Content

The ash content of wheat is related to the amount of bran in the wheat and hence have rough inverse relationships to flour yield. Small or shriveled kernels usually have more bran on a percentage basis and therefore more ash, and yield less flour than large plump kernels. In annual early-season crop-quality surveys, millers often locate those areas of production which ash content of the wheat is low, and then tend to give preference to wheat from those areas. Low ash content would be 0.43 to 0.45 and 0.60 would be high ash content.

Flour products which contain higher levels of ash are darker in color and may be assumed to contain greater quantities of fine bran particles or of that portion of the endosperm adjacent to the bran. Ash content is closely related to the color-influencing components of the flour (bran).

Flour Extract

Most of the physical criteria of wheat quality discussed above are based on relatively simple examinations or tests and area of value inasmuch as they reflect in some degree the milling quality of the wheat or the baking quality of the flour milled from the wheat. In experimental milling operations the yield of straight-grade flour, or semolina in the case of durum wheat, is the most important factor. Although various other characteristics are also considered in judging over-all milling quality (such as protein quantity and quality, moisture content, crude fiber, ash, etc.)

Mixing Time

Tests which evaluate mixing characteristics of gluten development in a dough are made by recording dough mixers. Mixing time is a function of protein quantity and quality as it effects the strength of flour.

Loaf Volume

The major factor accounting for variation in loaf volume within a variety is protein content. The relationship between loaf volume and protein content is essentially linear. Loaf volume at a given protein level, i.e. 13% increases sharply with mixing time from about 7/8 to about 3 minutes. Beyond 3 minutes, loaf volume at 13% protein is approximately constant with longer mixing time. Thus mixing times longer than 4-5 minutes are costly in the in line production of loaf bread.

1973 Central Substation HRS Wheat Quality Data

	Test Weight	Whole Wheat Protein	% Flour Protein	% Flour Extract	% Flour Ash	Mixing Time	Loaf Volume
Barton	52.0	17.4	17.0	60.8	0.59	4.75	201
Bonanza	53.5	16.9	16.6	59.9	0.55	6.25	183
Bounty 208	54.0	16.9	16.5	59.8	0.54	7.75	197
Chris	53.5	17.9	16.7	60.8	0.57	3.50	192
Era	52.5	17.3	16.7	62.9	0.57	5.00	192
Fortuna	55.5	17.2	16.9	61.5	0.57	4.50	208
Lark	53.5	18.1	16.3	58.7	0.54	8.00	180
Nordak	55.0	17.7	17.3	57.7	0.61	5.75	222
Nowesta	54.0	17.4	16.7	62.3	0.52	5.75	201
Olaf	54.5	17.7	16.8	59.3	0.51	7.75	208
Polk	56.5	17.1	16.5	60.6	0.52	5.00	206
Protor	55.0	17.5	17.0	59.4	0.54	19.00	200
Sheridan	54.5	17.1	16.9	57.3	0.54	5.00	188
Thatcher	53.0	17.9	17.7	57.9	0.59	3.50	197
Waldron	52.5	18.0	17.5	59.3	0.58	6.00	211
W.S. 1809	54.5	16.6	15.8	58.4	0.52	5.00	190
B-W 25	55.0	17.1	16.9	61.5	0.65	4.25	201
MINN II-64-33	50.0	18.6	18.2	56.8	0.56	4.00	190

Winter Wheat Improvement Projects Activities at Highmore in 1973-74 and Projections for 1974-75

D. G. Wells, H. S. Sandhu, and Craig Cowley

In 1973 duplicate seedings were made at Highmore in different areas of the farm to diminish the likelihood that both would be decimated by unfavorable weather. As often as not, the winter wheat plots at Highmore are badly treated by winter and spring conditions.

Each of duplicate nurseries had 299 plots of 8 rows each 9' long, rows 6" apart, alleys 5'wide. Both seedings survived very well in one of the most favorable winters we have experienced. We harvested all of one location and part of the other. On the attached table is a report of the Northern Regional Performance Nursery at Brookings, Presho and Highmore.

Homestead was highest yielder at Highmore and over the 3 locations. SD 72193 was best of SD entries and ranked 6th over the 3 test sites.

Leaf rust was severe on some leaves of susceptible varieties. Stem rust was rare. Because of drought, both rusts were unimportant. Shattering in the regional tests was measured July 13 in field 100c and in August 5 in field 300c. The old check variety Kharkoff shattered the most, over half its seeds being lost across locations at Highmore. All commercial varieties in the tests shattered about 50% or worse. Most resistant to shattering were the SD selections.

In Advanced Winter Wheat 3, replicated twice and having 18 entries, the data are incomplete because of our trying to use the Hege equipped with the wrong sprocket influencing cylinder speed. Some of the entries yielded better than the checks, notably SD 72158 which also did not shatter while both checks shattered. Several entries have gone into 1975 tests.

Reselections for purifying mixed SD lines were grown in 76 plots. The entire nursery, however, proved to be over-run with volunteer wheat both in and between plots so purification was not very successful.

Twelve SD selections were space seeded for purification and increase. We rogued the better appearing ones and either combined them or took out many plants separately.

For the 1975 tests we seeded 688 plots in dry soil. The seed remains dry to this date of writing.

Seed increases were made of Gent, Scout 66 and Gage for comparisons of their milling and baking qualities by the Hard Red Winter Wheat Quality Council. Less seed was produced than the 20 bushels of each wanted by the Council for its 35 collaborating laboratories so only 3 1/3 bushels was requested by the Council for limited evaluation. Gent is a backcross derived Scout type and therefore so similar to Scout that there is no question at all of its suitability for the milling and baking industries.

Table __. Advanced Winter Wheat 3, Highmore, 1974.[b]

Entries	Grain yields[c] Field 100A grams		Field 100A Bu.	Field 300C grams		Field 300C Bu.	TW 100A #	TW 300C #	Field 300C Pl. ht. cm	Field 100A % shattering 7/13 [a]	ch color	1973[a] % flour pro.	1973[a] Curve type
Bronze ck	188	180	36.8	---	---	---	52	54	109	11	B	--	--
SD72 98 SSD8Wmt/Hume//NE semi-d	214	204	41.8	---	173	---	55	57	99	1	B	14	C-
SD72100 "	290	253	54.2	177	---	---	56	57	95	3	B	--	--
SD72127 "	184	155	33.9	150	128	27.8	56	56	105	20	B	16	M
SD72142 "	206	212	41.8	142	188	33.0	55	56	100	20	B	15	M+
SD72158 "	382	336	71.7	176	212	38.8	58	59	75	0	B	14	M+
SD72170 "	276	232	50.7	196	---	---	61	57	92	1	B	14	C-
SD72193 "	273	175	44.8	174	172	34.6	59	57	97	3	B	15	C
SD72210 SSD8Wmt//Wrr/III 54-12	216	196	41.2	178	186	36.4	51	56	95	30	W	16	M
SD72213 "	270	208	47.8	204	168	37.2	52	56	91	1	W	--	--
SD72214 "	244	305	54.8	266	---	---	56	56	89	5	B	16	C+
SD72215 "	246	242	48.8	200	198	39.8	53	55	92	20	B	15	C+
SD72228 "	206	231	43.7	200	212	41.2	54	56	100	20	W	--	--
SD72230 "	187	195	38.2	186	172	35.8	51	55	95	13	B	--	--
SD72283 Atl 66/Con//SSD8Wmt	90	---	---	222	140	36.2	49	57	79	10	W	--	--
SD73309 Agent/4* Sut	148	165	31.3	122	162	28.4	53	53	108	25	W	--	--
Centurk ck	100	132	23.2	---	175	---	53	54	103	20	W	14	C
SD72196 SSD8Wmt/Hume//Ne semi-d	302	240	54.1	---	---	---	56	--	98	1	B	14	C+
Minter, 1973												15	M
Centurk, 1973												14	C

[a] C = Centurk type of curve
M = Minter type of curve

[b] Area cut by hand: 4 rows 4' long = 2' x 4' = 8 sq. ft. harvested per plot.

[c] Missing plots due to faulty equipment.
Conversion factor: $\frac{43560}{8 \times 2 \times 454 \times 60}$ = 0.0999 x yield of 2 plots

Annual Progress Report, Central Substation, Highmore, South Dakota for Woody Ornamental Horticulture Research

J. E. Klett and N. P. Evers

Six new cultivars of North Central-7 regional trial plants were planted. These plantings were made in triplicate and are located along the North entrance just South of an existing shelterbelt. Also, one, five, and ten year planting and performance evaluations were recorded. All plant materials over ten years in age were marked for removal during fall and winter of 1974-75. The area that will be cleared will be used for additional research in woody ornamentals in the future.

Annual Progress Report, Central Substation, Highmore, South Dakota for Forestry Research

P. E. Collins

Windbreaks around the homestead were planted in the 1940's to provide protection and test several species. In the early 1950's, the south windbreak was planted to observe the hardiness of Chinkota elm and Harbin pear. A spacing study was planted north of the main windbreak in 1955, testing between-row spacings of 10' and 20'. Much breakage of Eastern redcedar and ponderosa pine occurred in the blizzard of the 1960's. Except for snow breakage, pine and redcedar have survived and grown well at Highmore.

Effect of Wheat Residue on Plant Pathogens on Spring Wheat in 1974

G. W. Buchenau and J. D. Smolik

Introduction:

Crop residue on the soil surface reduces wind and water erosion, improves the water-catching capability of the land and reduces water lost to evaporation.

Certain diseases of wheat, however, are more serious under high levels of residue, due to the fact that propagules of pathogens carried on straw are not decomposed as rapidly at the soil-straw interface as they are when buried. *Pyrenophora trichostoma*, the cause of yellow leaf spot of wheat, is such a pathogen. This disease is rarely seen in plow-disc-harrow operations, but can destroy 30% or more of the crop under stubble-mulch practices.

Other wheat diseases may become more serious on surface residue culture. Among those suspected but not definitely known to be aggrevated by surface residues are: Septoria leaf spot, common root rot, and root feeding nematodes.

The experiments reported herein are the initial steps in a study to clarify the influence of surface residue on these diseases and to control them in stubble-mulch culture on spring wheat.

Materials and Methods:

A. Plot details: The site chosen for this study had been planted to a spring wheat breeding nursery in 1973. In April of 1974, cultural practices were conducted to simulate surface residues associated with the planned cultural practices (Table 1).

The split plot design with sub-units in stripe was arranged as follows: The whole units (4.9 x 39m) in a randomized complete block design, were divided into sub-units of 6.1 x 4.3m. Sub-units were applied in strips across each whole unit replication, randomized between reps. Two varieties were planted with each sub-plot in continuous strips across all main plots. Alleys (1.53m) beside each drill strip and between replications permitted easy access for application of fungicides and nematicides to the sub-plots.

Planned sub-plot treatments included 1) a soil nematicides, 2) a foliage fungicide, a combination fungicide-nematicide, an untreated check and an unassigned treatment to be used as desired.

As no foliage diseases developed due to an extremely dry season, the foliage fungicides were applied only once in 1974, and represented additional checks for all practical purposes.

The nematicide, Furadan 10-G, was applied with the seed with a drill-box fertilizer attachment at a rate of 210 kg/ha (21 kg/ha or 18.7 lbs/A active ingredient).

Plots were planted and nematicide treated on 16 April with a 2.14m press drill; swathed and combined on 24-27 July.

B. Soil samples were taken from the plots on 16 April (pre-plant), 13 June (early heading) and 27 June (7-12 days past heading), and 27 July (harvest).

Plant parasitic nematodes were extracted from the 16 April, 13 June and 27 July soil samples by a Modified Christie-Perry method, and the relative populations were determined for those genera that occurred frequently.

C. Soil moisture was determined on the 27 June soil sample.

Results:

Surface residue did not significantly affect either soil moisture at heading or yield (Tables 1, 2, and 3). Plant parasitic nematodes, however, were significantly less numerous under surface residue than under black tillage by harvest time (Table 3). This response to surface residue is discussed in more detail below.

Effect of Residue on Plant Parasitic Nematodes:

A short time after the surface residues were established there was an apparent difference between residue levels in nematode numbers; those plots with substantial residue had nearly 3 times more plant parasitic nematodes than those with minimal residue. Variability in nematode numbers was great however, and comparisons of levels 1, 2, and 3 vs. 4 were not significant at the 5% level.

During the next 99 days nematode populations declined under residue levels 1, 2, and 3 but increased under minimal residue. Total parasitic nemas were significantly higher under residue levels 4 than under 1, 2, and 3 at this time. Only residue level 2 provided a significant regression coefficient of $\log_{10}$ nematode numbers vs. time when block effects were removed by covariance analysis. However the regression coefficients of residue levels 1, 2, and 3 vs. level 4 were significantly different.

Nematode Control with Furadan:

Furadan reduced plant parasitic nematode populations to less than half that of the untreated checks by heading time (Table 5). By seasons end however, Furadan was effective only in residue level 4; the nematode decline associated with residue had apparently erased any effect of Furadan. These results are graphically depicted in Figure 1.

Yields were significantly reduced by the heavy Furadan treatment. Although Furadan is not generally phytotoxic to wheat, the high dosage used combined with the dry season could have resulted in such toxicity although this was not obvious to the eye during the season.

Discussion:

The data from this first year at Highmore should be interpreted with care due to the very dry season. Some complexities of the dry soil-plant-nematode-Furadan interaction are noted below.

1. It is unlikely that surface residue established in April achieved more than a very small fraction of their water catching and holding potential.

2. Nematode reproduction was very slow, probably due to the very limited moisture supply.

3. Extreme variation in nematode poplutions is common, but apparently intensified in this season. Moisture pockets and previous alleyways likely compounded this situation.

4. Furadan toxicity was probably increased by the dry soil.

The apparent decline in nematode populations under surface residue may be due to the establishment of a microclimate favorable to biological enemies of nematodes such as nematode trapping fungi. Decomposing organic matter is known to favor such activities, though generally at much higher levels of organic matter.

If this hypothesis proves true, a simple method for biological control of nematodes may be possible.

Table 1. Planned and actual preplant surface residues, 1974.

	Planned cultural practice (Simulated spring '74)	Target residue gms/m²	Target residue lbs/A	Actual residue 16 April gms/m²	Actual residue 16 April lbs/A
1.	Noble blade, fall, spring	400	3570	567[a]	5061
2.	Chisel fall, disc spring	200	1785	338[b]	3017
3.	Disc fall, spring	100	892	361[ab]	3222
4.	Plow fall, disc spring	>50	446	45	402

[a]Means with the same letter do not differ significantly at the 5% level. Variance was proportional to mean, therefore data were transformed to $\log_{10} X$ for analysis.

Table 2. Effect of surface residue and nematicide treatment on yield of WS 1809 spring wheat in 1974.

	Residue level lbs/A	Nematicide Furadan bu/A	Nematicide None bu/A	Residue means bu/A
1.	5061	20.5	32.0	27.4
2.	3017	28.3	30.7	29.8
3.	3222	24.9	30.2	28.1
4.	402	24.9	31.9	29.1
	Nematicide means	24.7	31.2	

Table 3. Effect of surface residue on plant parasitic nematodes and soil moisture, 99 and 72 days after planting, respectively.

	Residue level lbs/A	Parasitic nematodes per quart of soil	Soil moisture %
1.	5061	1949	11.7
2.	3017	1537	12.0
3.	3222	1315	12.0
4.	402	2857	11.4

Table 4. Effect of surface residue on 3 genera of nematodes in 1974.

Residue level lbs/A	Nematode Genus	Sample Date 0	58	99	Regression coefficient $b^{1/}$ Log$_{10}$ nemas/day
		nemas/qt. of soil			
1. 5061	Tylenchorhynchus	1939	1537	1750	
	Tylenchus	662	776	114	
	Paratylenchus	1121	178	85	
	Total	3722	2491	1949	-0.0033 NS
2. 3017	Tylenchorhynchus	2133	2308	1376	
	Tylenchus	534	1003	95	
	Paratylenchus	1201	416	66	
	Total	3868	3727	1537	-0.0042*
3. 3222	Tylenchorhynchus	2777	3727	1183	
	Tylenchus	856	1163	99	
	Paratylenchus	776	236	33	
	Total	4409	5126	1315	-0.0048NS
4. 402	Tylenchorhynchus	440	1107	2663	
	Tylenchus	553	676	52	
	Paratylenchus	676	203	142	
	Total	1669	1986	2857	+0.0011NS

Day 99: Total parasitic nematodes CP4 vs. rest: F = 6.00*
Tylenchorhynchus: CP4 vs. rest: F = 4.89*

1/ Data transformed to log$_{10}$ nemas/200 cc for regression analysis, check data (no nematicide) only.

Comparison of regression coefficients: Residue levels 1,2, and 3 vs. 4. Significant at .05.

Table 5. Effect of Furadan on total parasitic nematodes [a] under spring wheat at heading, Highmore, 1974.

Residue level	Furadan	Check	Residue mean[b]
	nemas/200 cc		
1. 567	111	493	302
2. 338	284	734	509
3. 361	388	962	675
4. 45	339	629	484
Nematicide mean	280	705	

[a] Total nematodes adjusted to initial counts by covariance analysis.

[b] Residue means NS at .05.
Nematicide means significantly different at .01.

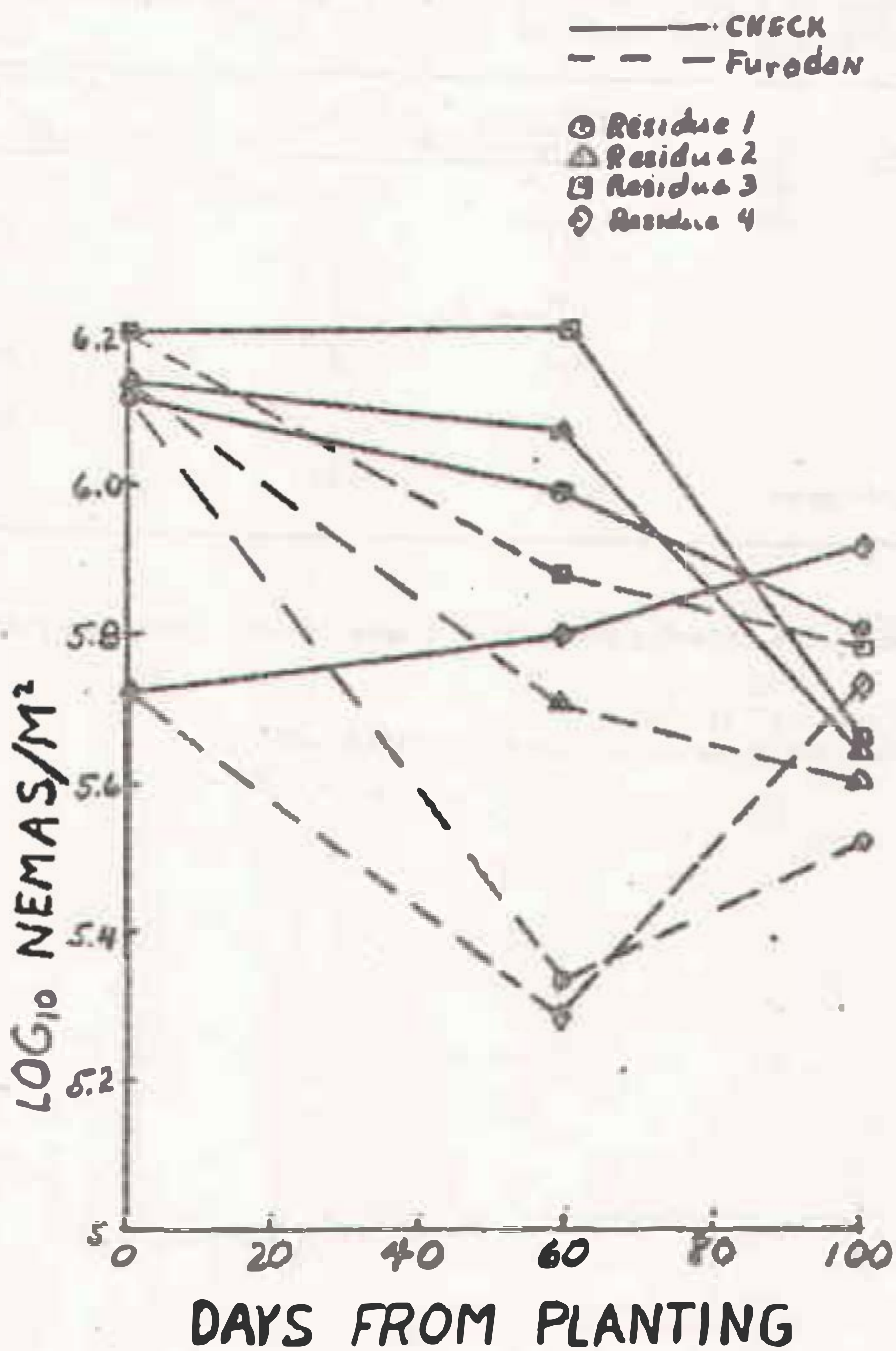


Figure 1. Total plant parasitic nematodes per meter^2 to a depth of 30 cm under four surface residues. See table 1 for residues.

Sunflowers

Q. S. Kingsley

The sunflower plantings for four areas of the state are listed in order of the field layout on the farms. Each company supplied the seed used for the 1974 tests and the yields are shown for your own interpretation.

There was no fertility or herbicide applied to the soil, because the land had been in fallow in 1973. Soil tests indicated no further fertility was needed.

The planting rate was 18,000 plants per acre with a final stand of about 16,000 plants per acre.

SUNFLOWER YIELD IN POUNDS PER ACRE 1974

LOCATION

NAME	HIGHMORE #/A	HIGHMORE 50% * Bloom	REVILLO #/A	REVILLO 50% * Bloom	WATERTOWN #/A	WATERTOWN 50% * Bloom	REDFIELD 50% * Bloom	FOUR SITE Average Bloom
Semauer								
POI 896	2113	65	508	65	1452	71	68	67
POI 301	1296	64	503	66	1443	66	68	66
POI 304	1865	62	745	66	1549	67	65	65
Interstate Seed								
896	1670	63	480	65	1673	62	68	65
8946	1559	63	441	64	1343	62	64	63
8941	1519	64	458	63	1696	67	68	66
Cargill								
Sputnik	1430	62	403	63	1595	68	66	65
101	1712	63	544	65	1761	64	67	65
201	2049	62	575	65	1840	62	66	64
102	1886	65	526	67	1444	68	69	67
111	901	65	208	67	1505	62	71	66
Other Entries								
Krasnodarets	1375	58	280	61	808	65	63	62
Sundak	1185	63	364	64	1693	68	67	66
Record	1416	63	432	66	1357	65	71	66
Peredovik	1513	64	432	64	1302	68	69	66
Outlook	1236	57	41	60	493	63	64	61

Highmore	Revillo	Watertown	Redfield
1st plant May 23 2nd plant June 18 Harvest Sept 27 4 Reps	Plant May 24 Harvest Sept 23 6 Reps	Plant May 24 Harvest Sept 23 4 Reps	Plant May 24 Bird Harvest

* Days from planting to 50% Bloom.
Data by Quentin Kingsley

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