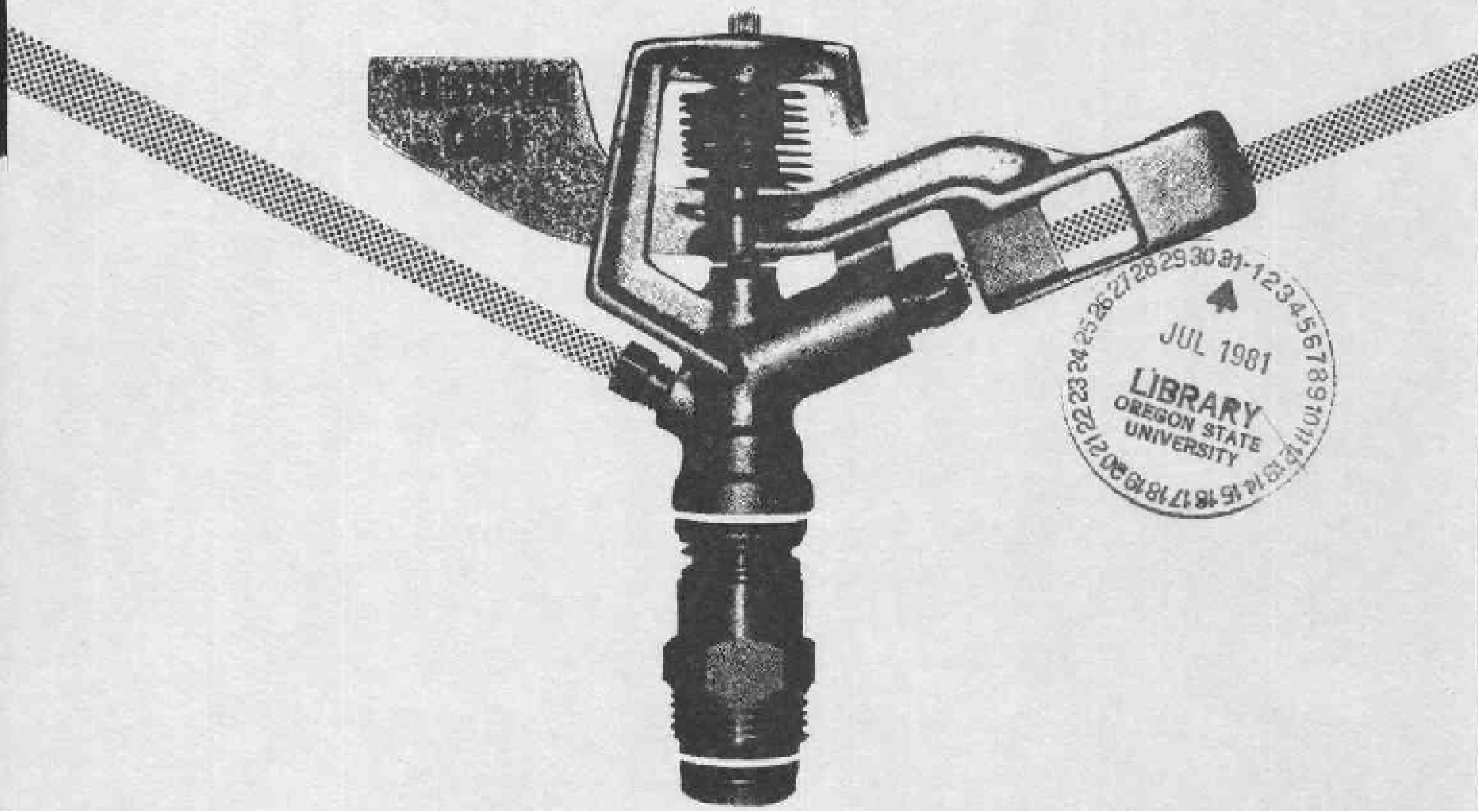
Irrigated Crop Research in Oregon's Columbia Basin



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COLUMBIA BASIN AGRICULTURAL RESEARCH AND EXTENSION CENTER
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The Umatilla Irrigation Project was founded by passage of the "General Reclamation Act" signed by the President of the United States on June 17, 1902. Concurrent with the U. S. Reclamation Service's development of the Umatilla Irrigation Project in 1909, the Oregon Agricultural Experiment Station and the Division of Western Irrigation Agriculture, USDA, agreed to cooperatively establish local research programs (now the Columbia Basin Agricultural Research and Extension Center).

Operations of the Umatilla Experiment Station began in 1909 on a 40-acre tract.

On April 16, 1931, an executive order signed by President Herbert Hoover set aside the present tract to meet increased research demands.

This research center has conducted research on livestock and poultry production, and is now actively studying problems related to soil and water management as well as fruit, vegetable, and field crop production.

In October 1977, the center's capabilities were expanded when western Umatilla County Extension personnel moved to the center. Now research results are more directly available to Extension agents as are the grower's production problems better related to researchers.

Field trials in 1981 include potato yield and disease trials, potato production in reduced tillage, alfalfa yield trials, fall grazing crops, grape variety observations, oil crop evaluations, corn and cereal yield trials, wheat, barley, and triticale breeding trials, water use patterns, cereal diseases, weather observations, lawn grass variety trial, bean production, and breeder seed production.

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AUTHORS

1. T. P. Davidson, Assistant Professor Emeritus of Horticulture, Columbia Basin Agriculture Research and Extension Center, Hermiston, Oregon 97838

2. Luther A. Fitch, Umatilla County Extension Agent, Columbia Basin Agriculture Research and Extension Center, Hermiston, Oregon 97838

3. Lynn F. Hall, Umatilla County Extension Agent, Columbia Basin Agriculture Research and Extension Center, Hermiston, Oregon 97838

4. Mark E. Halsey, Research Assistant, Botany and Plant Pathology Department, Oregon State University, Corvallis, Oregon 97331

5. D. C. Hane, Research Assistant, Columbia Basin Agriculture Research and Extension Center, Hermiston, Oregon 97838

6. Mathias F. Kolding, Senior Instructor, Columbia Basin Agriculture Research Center, Pendleton, Oregon 97801

7. A. R. Mosley, Associate Professor, Crop Science Department, Oregon State University, Corvallis, Oregon 97331

8. R. L. Powelson, Professor of Plant Pathology, Botany and Plant Pathology Department, Oregon State University, Corvallis, Oregon 97331

9. F. V. Pumphrey, Professor of Agronomy, Columbia Basin Agriculture Research and Extension Center, Hermiston, Oregon 97838

EARLY LODGING OF SOFT WHITE WHEAT

F. V. Pumphrey[1]

An unexpected amount of lodging has occurred in some fields of soft white wheat. Many of these lodged wheat fields were intensively managed and sprinkler irrigated to produce high yields of good quality grain. Observations during the spring indicated an excellent yield potential; unfortunately, by the time the plants were heading most of them had lodged.

The knowledge that early lodging of grain reduces yield and test weight of the grain has been known for centuries. Additional difficulties are encountered where the plants have lodged. Two or more tons of extra straw per acre may have to be put through the combine which reduces both the mechanical efficiency and the productivity of the combine. Lodged wheat is also slower to dry which results in later maturity and harvesting.

Several factors may contribute to this unexpected and undesirable lodging. Present varieties were selected for their larger, heavier heads. Intensive management of several factors as fertilizing, irrigating, and weed control results in dense vegetative growth. Sprinkler irrigating has a modest "beating down" effect on the plants. The combination of winds of high velocity, wet plants, and wet soil is a cause of lodging. Diseases, especially the foot and root rots so common in the area, are a cause of lodging.

Plant breeders, after careful testing and selection, release only those varieties which exhibit good resistance to lodging. Thus, lodging in presently grown varieties should not result from a weakness of the straw.

The purpose of this study was (1) to measure the effect of the early lodging on yield, test weight, and milling and baking qualities of the grain and (2) to identify the cause or causes of this unexpected, excessive lodging.

PROCEDURE

Samples for grain yield and grain quality were taken at harvest time from lodged and standing wheat in the same field. Fields sampled were those in which most of the wheat had lodged before or during heading. Locations of sampling within a field were selected so lodged and standing samples were as close to each other as possible; usually the distance between them was less than 30 feet. The straw at the crown was examined for foot and root rot diseases. If evidence of disease was observed, the location was discarded and another location was selected. Five samples of lodged and nonlodged wheat were taken in each field. Four sprinkler irrigated fields were sampled each year for three consecutive years.

[1]Professor of Agronomy, Columbia Basin Agricultural Research and Extension Center, Oregon State University, Hermiston, Oregon 97838.

Grain yield and test weight of the lodged and nonlodged wheat were determined. Grain samples from five fields were analyzed by the Western Wheat Quality Laboratory, Pullman, Washington, for milling and baking qualities.[2]

RESULTS AND CONCLUSIONS

Grain yields of the standing wheat were consistently higher in each field than the yield of the lodged wheat (Table 1). The least difference in yield within a field was 12 bushels per acre and the average difference was 22 bushels per acre.

Test weight of the grain from the standing wheat was 3 to 7 pounds per bushel heavier than grain from lodged wheat. Grain from the lodged wheat graded one to four grades lower because of the lower test weight.

From an economic standpoint, the lodging was costly. The average yield reduction was 22 bushels per acre (Table 1). Dollar loss for individual fields ranged from $45 to near $100 per acre less income from grain. The lodged grain graded lower causing an additional loss of several dollars per acre. Harvesting costs of the lodged grain were several dollars per acre higher because of the larger amount of straw having to go through a slower traveling combine.

Characteristics desired by millers and bakers in grain and flour of soft white wheat are high test weight, high flour yield, high milling score, low flour ash, low protein in the flour, and less moisture absorption by the flour. Grain from the standing wheat was consistently better in each of these qualities than grain from lodged wheat (Table 2). Three characteristics where the grain from the standing wheat was much better were flour yield, milling score, and protein content.

Low moisture absorption by cookie dough and large cookie diameter are desirable characteristics. Cookie diameters were corrected to flour of 10 percent protein as a means of comparing cookie diameter as a standard protein content. Grain from the standing wheat produced cookie dough which absorbed less moisture and cookies of larger diameter (Table 2).

These limited data indicate yield, test weight, milling, and baking quality differences between grain from standing and lodged wheat were not affected by the variety of wheat grown (Tables 1 and 2).

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[2]The assistance of Gordon L. Rubenthaler, Western Wheat Quality Laboratory, Pullman, WA is greatly appreciated.

Lodging as the plants were heading and flowering was associated with large, excessive early plant growth. The large, early growth resulted from a combination of moderately early planting and excessive applications of nitrogen fertilizer (150 to 250 pounds per acre) in the fall and/or before rapid spring growth. Also, the wheat followed some crop (potatoes or peas) which had been well fertilized and produced plant residue which rapidly decomposed. Large fall and early growth is not needed to produce high (100 or more bushels per acre) yields of irrigated wheat.

HOW TO AVOID EARLY LODGING

Date of planting, fertilizing with nitrogen, and irrigating should be coordinated to grow a plant in the fall which has crown roots and a few tillers (3-6). The plant will be large enough to have good winter survival. Where overwinter water or wind erosion is a problem, plants should be large enough to minimize erosion. Apply most if not all the nitrogen fertilizer in the spring when the wheat is starting to make rapid growth; that is, when the plants are actively tillering and before jointing has started. More efficiency from nitrogen fertilizer, higher yields, less straw growth, and less lodging are obtained from fertilizing at this time.

Table 1. Grain yield and test weight of standing and early lodged wheat grown under irrigation in the Columbia Basin, 1978-80

Field and year	Standing Wheat		Lodged Wheat		Variety
	yield	test weight	yield	test weight	
	(bu/A)	(lbs/bu)	(bu/A)	(lbs/bu)	
1-78	108	60	73	55	Stephens
2-78	100	60	88	57	Stephens
3-78	83	59	63	56	McDermid
4-78	97	59	75	54	McDermid
1-79	89	60	60	53	Stephens
2-79	94	60	79	56	Twin
3-79	94	61	52	54	Stephens
4-79	86	57	67	52	Twin
1-80	79	58	61	54	Hyslop
2-80	102	59	86	55	Stephens
3-80	83	60	62	53	Stephens
4-80	118	59	99	54	Stephens
Average	94	59	72	54	

Table 2. Milling and baking qualities of soft white wheat grain samples from standing and lodged wheat grown under irrigation in the Columbia Basin, 1978-1980

				Flour			Cookie		
Wheat[1] sample	Test weight	Flour yield	Milling score	ash[2]	protein[2]	absorption score[3]	absorption score[3]	diameter	corrected diameter[4]
	(lbs/bu)	(%)			(%)			(cm)	(cm)
1 Standing	61.8[5]	71.6	82.7	.42	10.9	58.8	57.9	8.91	9.01
1 Lodged	56.0	68.1	76.6	.42	11.1	61.0	59.9	8.72	8.85
2 Standing	61.2	71.2	81.2	.45	8.9	55.9	57.0	9.25	9.13
2 Lodged	58.4	70.4	78.6	.46	10.1	57.4	57.3	8.81	8.82
3 Standing	60.8	70.7	81.7	.40	9.2	59.0	59.8	8.97	8.89
3 Lodged	55.3	68.5	77.7	.41	10.3	60.6	60.3	8.80	8.83
4 Standing	53.7	67.2	72.1	.49	10.8	60.0	59.2	8.42	8.51
4 Lodged	52.5	67.6	72.2	.50	12.3	63.9	61.6	8.24	8.49
5 Standing	59.6	71.3	79.0	.49	7.6	58.0	60.4	8.67	8.41
5 Lodged	52.8	66.4	69.5	.52	10.4	59.4	59.0	8.21	8.26

[1]Results from Gordon L. Rubenthaler, Western Wheat Quality Laboratory, Pullman, Washington

[2]Observed values corrected to 14% moisture basis.

[3]Absorption at 14% moisture basis.

[4]Observed values corrected to 10% protein.

[5]Wheat varieties: Samples 1, 3, and 5 -- Stephens; sample 2 -- Twin; sample 4 -- Hyslop.

EVALUATION OF FIVE CULTURAL PRACTICES IN AN ALFALFA TO POTATO ROTATION

D. C. Hane and F. V. Pumphrey[1]

Soil erosion from strong winds is a continuing production problem on Northcentral Oregon's irrigated sandy soils. One area of concern revolves around management methods used when rotating from alfalfa to potatoes. The moldboard plow is often used to incorporate the alfalfa crop and, whether this operation is done in the fall or spring, the resulting seedbed is exposed to potential soil erosion by wind.

OBJECTIVES

This research was initiated in the fall of 1978 to evaluate several seedbed preparation methods for rotating from alfalfa to potatoes. The major objectives were (1) to reduce the potential for soil erosion from wind by having more plant residue on the soil surface while the potatoes were sprouting and emerging, and (2) to reduce the tillage operations normally used in preparing a seedbed for potatoes. The soil surface of the potato field is usually bare and a potential erosion hazard, for 40 or more days, from the time the seedbed is prepared until the young plants are large enough to protect the soil surface and minimize soil erosion.

METHODS

This research was conducted for two consecutive growing seasons on a fine sandy soil at the Hermiston Research and Extension Center. In both years, the alfalfa was sprayed with 2,4-D in late September. Seedbed preparation treatments were then applied as described in Table 1. Basically, fall plowing with a cover crop of winter wheat planted after plowing and three spring tillage treatments without plowing were compared to conventional spring plowing. One tillage operation, Treatment 5, (subsoiling under the row before planting, which is a common practice in this area) was uniformily applied throughout the experiment year. Preplant subsoiling under the row also marked the potato row location. All subsequent potato cultural practices following the preplant practices were the same for all treatments. The potato variety 'Russet Burbank' was grown each year.

In 1979, all plots were sprayed with Roundup before potato emergence. To control the wheat cover crop in 1980, Treatment 1 was sprayed with five pounds per acre of Dalapon before row marking.

In 1979, plant residue remaining on the soil surface after planting was obtained from two subsamples per plot, oven dried, and weighed. Each subsample was 18 x 68 inches. Two, 20-foot rows per plot were harvested in 1979 for yield and quality evaluation. Two, 25-foot rows were used in 1980.

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[1]Research Assistant and Professor of Agronomy, Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon 97838.

Table 1. Description and sequence of fall and spring tillage operations for potato seedbed preparation

Treatment	Description
1	Fall--plowed, disked, cover crop (wheat) planted Spring--rows marked, potatoes planted
2	Spring--plowed, disked, rows marked, potatoes planted
3	Spring--rows marked, 17" sweep centered over rows, potatoes planted
4	Spring--Noble sweep (8' blade) entire plot, rows marked, potatoes planted
5	Spring--rows marked, potatoes planted

RESULTS AND DISCUSSION

The fall application of 2,4-D successfully killed the alfalfa crop. Alfalfa crowns and residue on the soil surface were sufficient to prevent any winter soil erosion by wind. The Noble sweep was successful in undercutting the alfalfa and loosening the soil to a depth of four to six inches.

Table 2 shows the surface residue after planting for the five treatments. The Noble sweep, which only minimally disturbed the surface soil, left the most plant residue on the soil surface. The fall plowing, "17-inch sweep, and mark only" plots (Treatment 5) were essentially the same with respect to surface plant residue. Spring plowing left a minimal amount of residue on the surface.

A minimal amount of soil disturbance, such as only marking the rows (Treatment 5), was expected to leave the greatest amount of residue on the surface (Table 2). These data do not support such a view. Possibly the fluffing action of the Noble sweep (Treatment 4) lifted and exposed more alfalfa crowns and roots to the surface. Plant residue on the soil surface of the fall plowing treatment (Treatment 1) was mainly from the fall planted winter wheat cover crop. This type of ground cover is upright, dies slowly when sprayed with Dalapon, is 6 to 8 inches tall when dead, and provides excellent protection against soil erosion while the potatoes are emerging. Movement of implements through the soil in all treatments was hindered by roots accumulating on the equipment.

Yield and quality of potatoes grown under the various treatments are shown in Tables 3 and 4. Total yields were acceptable. In 1979, the Noble sweep treatment was significantly lower in total yield than the fall plow treatment. Yields of No. 1 potatoes, however, were not significantly different. Overall quality in 1979 (Table 3), as indicated by the low percent of No. 1 tubers, was poor.

Table 2. Oven-dry plant residue remaining on the soil surface after potato planting in five cultural treatments, 1979

Treatment		Plant residue
		(Pounds per acre)
1.	Fall plow and cover crop	257
2.	Spring plow	167
3.	17" sweep	281
4.	Noble sweep	511
5.	Mark	243
	5% LSD	122
	5% LSD	170

Total yields in 1980 (Table 4) were very consistent for all treatments. There was only a 33 hundred weight per acre difference between the high and low yields. The overall quality, indicated by percent No. 1 tubers, was very acceptable for 'Russet Burbank.' There was no significant differences in yield of No. 1 potatoes.

CONCLUSION

Seedbed preparation by plowing in the spring left the least plant residue remaining on the soil surface after potato planting. Fall plowing, establishment of a winter wheat cover crop, and reduced spring seedbed preparation left the most residue on the soil surface to minimize soil erosion by wind. Earlier breakdown (decomposition) of alfalfa roots in the fall plowing is advantageous during row marking and potato planting. There were esentially no differences in tuber yield and quality in response to the five seedbed preparation treatments.

Except for spring plowing, the treatments would provide reasonable protection against wind erosion during potato emergence and probably would provide a cost savings over fall plowing. Follow-up operations, such as hilling and breaking out the center of the row, can be handled normally once the potatoes have established themselves. Therefore, the management practices studied give protection against soil erosion by wind without a sacrifice of potato yield or quality.

Table 3. Total yield and yield of Number 1 and percent of Number 1 and 2 potatoes grown following five seedbed treatments, Hermiston, Oregon, 1979

Treatment	Total yield	Yield and grade U.S. #1		U.S. #2
	cwt per acre	cwt per acre	Percent	Percent
Fall plow	569	171	31	47
Mark	540	198	37	45
17" sweep	507	166	33	44
Spring plow	480	169	35	43
Noble sweep	448	143	32	40
5% LSD	116	NS	-	-

Table 4. Total yield and yield of Number 1 and percent of Number 1 and 2 potatoes grown following five seedbed treatments, Hermiston, Oregon, 1979

Treatment	Total yield	Yield and grade U.S. #1		U.S. #2
	cwt per acre	cwt per acre	Percent	Percent
Spring plow	583	383	65	23
Fall plow	581	381	66	24
Noble sweep	579	422	73	18
Mark	579	357	62	25
17" sweep	561	372	66	19
5% LSD	NS	NS	-	-

GROWING-DEGREE UNITS FOR CORN IN THE HERMISTON AREA

Lynn F. Hall[1]

Various systems were devised over the years to classify and compare corn varieties by the number of days from planting to maturity. Calendar days are not accurate enough for comparison purposes to cover the wide range of diverse geographical areas where corn is grown.

Often corn varieties are compared by corn companies and dealers in terms of "days to maturity." This term is often a misnomer since its primary use is to compare the relative maturity of one variety versus another, but it still does not answer the question about when a farmer could reasonably expect a variety to mature when planted on a given date. This has important implications with regard to variety selection for a given geographical area and the length of season available to the grower.

In attempts to quantify corn maturity in measureable terms, numerous methods were also devised. A system in widespread use throughout most corn-growing regions is referred to as the "National Weather Service" method. This method assumes that temperatures above 86° F. are not beneficial to corn growth as are, likewise, temperatures below 50° F. Any extremes above or below these temperatures are equated to them.

The formula used for computing daily corn-growing degree units is as follows:

$$GDU = \frac{\text{Daily Max. Temp. } (\leq 86^\circ \text{ F.}) + \text{Daily Min. Temp. } (\geq 50^\circ \text{ F.})}{2} - 50^\circ \text{ F.}$$

Corn growing-degree units were calculated for the Hermiston area using this formula and daily weather information collected over the last 10 years from the National Weather Station at the Columbia Basin Agriculture Research and Extension Center at Hermiston, Oregon. Growing-degree units were calculated on a daily basis starting from April 15, which is the usual start of corn planting in the area as determined by soil temperatures, last spring frost date, and irrigation water availability. The information was accumulated until the first fall frost.

Farmers can now match varieties of corn to the season available in this area by using these data. Also, if corn is planted as a double crop, this information can be utilized to determine the last possible planting date to have a mature corn crop before frost sets in. Harvest dates can be optimized to reduce corn drying, water, and fertilizer costs if the farmer has a method of estimating plant maturity.

[1]County Extension Agent, Oregon State University Extension Service, Hermiston, Oregon 97838.

Table 1. Corn growing-degree units computed over the last 10 years from weather data collected from the Columbia Basin Agriculture Research and Extension Center, Hermiston, Oregon

Month	Yearly accumulations											
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Ave.	Accum.
April 15-30	102	100	130	128	91	102	170	100	120	176	122	122
May	416	414	424	325	358	398	268	311	375	342	363	485
June	422	533	522	556	470	442	596	508	481	404	493	978
July	660	666	670	638	724	662	603	592	622	604	644	1622
August	714	672	646	650	562	579	650	564	635	560	623	2246
September	384	350	442	514	478	504	369	378	488	456	436	2682
October to 1st frost	198	0	20	53	192	190	31	56	286	144	117	2799
Total heat units 4/15 to 1st frost	2898	2734	2854	2865	2876	2876	2686	2508	3008	2684		2799
Last spring frost	4/22	5/1	4/8	4/17	4/29	4/23	4/20	4/23	4/21	4/11	4/20	(Ave.)
First fall frost	10/17	9/25	10/3	10/5	10/24	10/5	10/4	10/5	11/1	10/10	10/11	(Ave.)

HERMISTON AREA ALFALFA VARIETY TRIALS

Lynn F. Hall and Luther A. Fitch[1]

An alfalfa grower, in trying to decide which variety to plant, is often confronted with literally hundreds of choices confounded by new releases each year from public and proprietary alfalfa breeding programs.

Conditions exist, wherever alfalfa is grown, which are unique to that particular local. Alfalfas are bred to conform to given sets of conditions which help determine the ultimate success of varietal adaptation. Characteristics such as disease and insect resistance, winter hardiness, reaction to methods of irrigation, nematode resistance and crop recovery after cutting all influence the success of a variety in a given local.

All the trials were planted in a randomized block design with each variety being replicated four times. Each plot is three feet wide by 20 feet long. Yields are reported in approximate tons per acre on an adjusted 12 percent dry matter basis using a calculated formula based on the green forage weight of each plot weighed immediately after harvest.

Trial 1. Because of the need for growers to obtain valid comparative information about alfalfa varieties marketed in the Hermiston area, a variety trial was established by Luther Fitch in June 1974, at the Columbia Basin Agricultural Research and Extension Center in Hermiston. This trial had 24 public and private varieties available in the area through commercial sources (Table 1). This particular trial was terminated in 1978 because of severe stand depletion caused by verticillium wilt.

The discovery was made in 1976 that verticillium wilt is infective of alfalfa and is a casual factor in shortening alfalfa stand life. Verticillium wilt is now recognized as a major problem in the Columbia Basin alfalfa growing region, and since Trial 1 and other subsequent trials in this location were infected with verticillium wilt, they also provided an important role in the selection for verticillium resistance in alfalfa varieties.

Trial 2. A variety trial, consisting of 22 varieties, was planted May 1976 at the Columbia Basin Agricultural Research and Extension Center in Hermiston. After 15 cuttings, this trial was also severely depleted by verticillium wilt and was terminated after the second cutting in 1980. The results of this trial are summarized in Table 2. A visual stand rating was made in October 1979, and again in September 1980, to help show that the stands were being rapidly decimated, and to also show a relationship between yield and density of stand.

Trial 3. A third on-station trial was begun May 1979, to replace the trial mentioned in Table 1. This trial consists of 27 public and proprietary varieties submitted by USDA and private breeding programs. The results for this trial are summarized in Table 3. The results reflect only about

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[1]County Extension Agents, Oregon State University Extension Service, Hermiston, Oregon 97838

one-third of the total information expected from the completed trial, so the information reported may not reflect comparative performance over the normal rotation life expected by most growers.

The soil type in which all Experiment Station plots were established is loamy sand. Plots are sprinkler irrigated. Harvest frequency is four times annually.

Table 1. Yield comparison of 24 alfalfa varieties and selections planted at the Columbia Basin Agricultural Research and Extension Center, Hermiston, in June 1974

	13 Cutting total yield		13 Cutting increase over Vernal	
Variety	Tons per acre	As a % of Vernal	Tons per acre	Value @ $60 per ton
Pacer	25.1	150	8.4	$504
Valor	24.2	145	7.5	450
W9-SRI[1]	22.3	133	5.6	336
WL 306	21.8	130	5.1	306
Action	21.2	127	4.5	270
Beltsville 72	21.1	126	4.4	264
Agate	20.7	124	4.0	240
WU-SI[1]	20.5	123	3.8	228
Bonus	20.2	121	3.5	210
Haymaker	20.0	121	3.3	198
Anchor	19.7	118	3.0	180
Team	19.7	118	3.0	180
Moapa 69	19.3	116	2.6	156
Thor	19.0	114	2.3	138
Narragansett	18.8	113	2.1	126
Saranac	18.5	111	1.8	108
DuPuits	18.0	108	1.3	78
Apalachee	17.6	105	0.9	54
Beltsville 71	17.4	104	0.7	42
W-1350[1]	16.8	101	0.1	10
Vernal	16.7	100	0.0	0
Lahonton	16.2	97	-0.5	-30
Washoe	16.2	97	-0.5	-30
W-DS3[1]	15.7	94	-1.0	60

[1]Breeding lines developed from the USDA Alfalfa Variety Program, Irrigated Agriculture Research and Extension Center, Prosser, Washington.

Table 2. Yields of 22 alfalfa cultivars under sprinkler irrigation at the Columbia Basin Agriculture Research and Extension Center, Hermiston, Oregon in May 1976

Variety	Yield in tons per acre						15-Cut yield as % of Vernal	Visual rating of stand[1]	
	2 Cuts 1976	2 Cuts 1977	3 Cuts 1978	4 Cuts 1979	2 Cuts 1980	Total of 15 Cuts		10/2/79	9/9/80
ORE GXC[2]	3.2	9.6	7.7	7.1	3.8	31.4	130	8.0	5.3
WL 309	4.3	9.0	7.2	6.8	3.7	30.1	125	8.0	5.3
ORE GXE[2]	3.0	8.9	7.3	6.6	3.8	29.6	122	6.8	4.3
WL 318	3.7	9.2	6.7	6.5	3.3	29.4	122	7.3	5.3
AT-1	3.8	8.9	6.6	6.6	3.3	29.2	121	6.5	5.0
WL 310	3.7	8.6	6.7	6.7	3.4	29.1	121	5.0	5.0
AT-4	3.0	7.9	6.6	6.9	4.3	28.7	119	8.8	5.8
Pacer	3.5	8.9	6.4	6.2	3.2	28.2	117	5.0	3.3
WL 306	3.5	8.8	6.3	5.8	2.8	27.2	113	5.8	4.3
Gladiator	3.6	8.7	6.7	5.6	2.6	27.2	112	5.5	2.5
AT-5	3.4	8.3	6.4	5.7	2.9	26.7	110	4.8	3.5
ORE GXB[2]	3.0	8.0	6.3	5.8	3.2	26.3	109	7.5	4.5
AT-2	3.7	7.7	5.8	5.0	2.7	24.9	103	3.3	2.5
Polar I	3.8	7.8	5.8	5.0	2.1	24.5	101	3.8	2.0
Vernal	3.0	7.7	5.6	5.4	2.5	24.2	100	4.0	2.5
Beltsville 72	2.8	8.1	6.0	4.8	2.2	23.9	99	3.5	2.0
Anchor	3.4	7.6	5.5	4.6	2.2	23.3	96	3.0	2.0
Resitador II	3.2	7.6	5.3	4.6	1.6	22.3	92	3.0	1.5
AT-3	3.0	7.8	5.3	4.2	1.8	22.1	92	3.0	1.5
Vista	3.5	8.0	5.2	3.9	1.3	21.9	91	1.5	1.3
Washoe	2.7	6.9	5.2	4.6	2.1	21.5	89	3.0	2.3
AT-6	3.2	6.2	4.6	3.8	1.6	19.4	80	2.0	2.3

[1]Based on stand of alfalfa remaining rated on a scale of 0 to 9 with 9 being a perfect stand.

[2]Lines developed from single-plant selections and hardy plants remaining in old established fields in the Hermiston-Buttercreek area in 1960s.

Table 3. Yield of 27 alfalfa cultivars established May 1979 under sprinkler irrigation at the Columbia Basin Agricultural Research and Extension Center, Hermiston

Variety	Tons per acre: 1979 Yield[1] (1 Cutting)	1980 Yield (4 Cuttings)	Total yield (5 Cuttings)
Syn xx	3.7	8.6	12.3
WL 309	3.6	8.4	12.0
Gladiator[2]	3.4	8.4	11.8
WL 311	3.3	8.3	11.6
Valor	3.3	7.7	11.0
451 OR	3.3	7.5	10.8
AT-2	3.3	7.2	10.5
W-34	3.2	7.3	10.5
WL-318	3.5	6.9	10.4
Hi-Phy	3.2	7.2	10.4
AT-1	3.3	7.1	10.4
455 A	3.4	6.9	10.3
Agate	3.2	6.9	10.1
F-60	3.2	6.8	10.0
AT-3	3.2	6.8	10.0
K4-120	3.1	6.8	9.9
NK 78014	3.3	6.6	9.9
K7-29	3.4	6.4	9.8
Pacer	3.1	6.7	9.8
H-67	3.3	6.4	9.7
359 A	3.1	6.6	9.7
AS-49R	3.2	6.3	9.5
AT-4	2.7	6.7	9.4
AS-49	2.8	6.4	9.2
Weevilcheck	3.0	5.9	8.9
Classic	2.8	6.1	8.9
W-35	2.7	5.4	8.1

[1]Herbicide skip affected yields on some first cutting replication in 1979, so averages calculated without weedy replications.

[2]Results inadvertantly biased upward because of random location of two of the Gladiator replications in a low verticillium area of the plot.

Trial 4. An alfalfa growing region exists in the Buttercreek area near Hermiston with conditions sufficiently different to warrant the establishment of a separate alfalfa variety trial. Some conditions which exist on Buttercreek alfalfa fields as opposed to the rest of the Hermiston area in general include heavy silt loam soils, limited irrigation, and stem and root knot nematode problems. In March 1976, seven varieties (Table 4 and 5) were planted in a replicated trial on the Mike McCarty farm in Buttercreek.

Table 4. Yields of 7 alfalfa cultivars established in March 1976 on the Mike McCarty Farm, Buttercreek, Oregon

Variety	Tons per acre				
	2 Cuts 1977	3 Cuts 1978	3 Cuts 1979	3 Cuts 1980	Total of all cuttings
Pacer	4.9	8.0	9.6	6.9	29.4
ORE GXE[1]	4.6	7.7	9.3	7.5	29.1
ORE GXC[1]	4.2	7.7	9.3	7.2	28.4
ORE GXB[1]	4.2	7.2	9.5	7.3	28.2
Washoe	4.3	6.9	8.9	6.4	26.5
Anchor	4.1	7.0	9.1	4.9	25.1
Vernal	3.9	6.4	8.2	5.2	23.7

[1]Lines developed from single-plant selections of hardy plants remaining in old established fields in the Hermiston and Buttercreek area in the 1960s.

Table 5. Hay quality factors on Hay samples collected May 23, 1980 from variety trial on the Mike McCarty Farm, Buttercreek, Oregon

Variety	Crude protein	Acid detergent Fiber	Neutral detergent Fiber	Relative[1] feed value
	(Percent)	(Percent)	(Percent)	
ORE GXE[2]	16.3	37.5	45.2	121
ORE GXC[2]	16.0	35.9	46.4	122
ORE GXB[2]	16.0	37.9	46.8	117
Washoe	16.2	38.5	46.1	117
Vernal	15.9	38.4	45.5	118
Anchor	16.6	38.9	46.1	116
Pacer	15.6	40.8	48.4	108
WL 306	15.9	38.3	47.5	115

[1]A calculated value derived from ADF and NDF results and adopted by the Oregon Hay Growers Association as a means of comparing acceptability and palatibility of different hay lots. In general, the higher the value, the better the quality.

[2]Lines developed from single-plant selections and hardy plants remaining in old established fields in Hermiston and Buttercreek area in the 1960s.

CORN SILAGE AND GRAIN VARIETY PERFORMANCE

F. V. Pumphrey[1]

Corn variety tests for grain and silage yields were conducted in 1980 on the Hermiston Research and Extension Center. The varieties in the tests in 1980 were selected by the participating companies listed in Table 1. Each company was limited to three entries per test. The trials were conducted to determine the grain yield or silage yield and maturity of each variety. Desirable and undesirable characteristics were noted.

TESTING PROCEDURE

Soil of the test area was Ephrata sand; however, the soil survey presently in progress is expected to designate this soil as Adkins fine sand. The previous crop was corn which had been fertilized with N-P-K and trace elements.

Minimum tillage was used; the only soil disturbance was marking of rows in the corn stalks remaining from the previous year. Wind erosion was controlled. A 10-20-10 fertilizer at 425 pounds per acre was banded as the rows were marked. A total of 280 pounds per acre of additional nitrogen was applied in three applications after emergence and before pollination of the corn.

Each test consisted of five hand-planted replications in a randomized block design. Individual plots were 2 rows wide and 15 feet long. Rows were spaced 34 inches apart.

Approximately 15 percent more seed was planted than was needed for the desired stand. Germination, emergence, and early growing conditions were excellent. Loss of stand to rodents and birds, mainly pheasants, was minimal. The resulting stand was approximately 10 percent above the stand desired. Plant populations at harvest were 32,000 plants per acre for the grain test and 36,000 plants per acre for the silage test. The tests were planted May 1 and 2.

Irrigation water was applied as needed via sprinklers. During the greater part of the growing season, sprinkling occurred three times weekly. Approximately 1.75 inches were applied weekly from mid-June into early September. Excellent weed control was obtained from an application of atrazine applied when the corn was 4 to 8 inches tall.

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[1]Professor of Agronomy, Columbia Basin Agricultural Research and Extension Center, Oregon State University, Hermiston, Oregon 97838.

Climatic conditions were favorable for corn. No frosts occurred in the spring after the corn was planted. No frosts had occurred before harvesting of the silage test; no hard, killing frosts had occurred before grain harvest on October 21 and 22. A hard frost in early October probably would have aided the drying of the grain corn. No severe, adverse winds or extremely hot days occurred.

The corn in the silage trial was cut and weighed, and subsampled immediately for dry matter during the week of September 8-12. The subsamples were oven dried at 70^{o}C. The corn grain test was picked and weighed on October 20-21. Grain samples were taken for moisture determinations.

Table 1. Companies contributing varieties in the 1980 corn performance tests at the Hermiston Research and Extension Center of the Columbia Basin Agricultural Research Center

Brand	Company	Address
Cenex	Cenex	St. Paul, Minnesota 55164
SS,CX	Crookham Company	Caldwell, Idaho 83605
DeKalb	DeKalb	DeKalb, Illinois 60115
Ferry Morse	Ferry Morse Seed Co.	Modesto, California 95352
Funk	Germain's Inc.	Fresno, California 93777
NC^+	NC^+	Lincoln, Nebraska 68501
PX	Northrup King	Bloomington, Minnesota 55420
Pioneer	Pioneer Hi-Bred International, Inc.	Des Moines, Iowa 50308

RESULTS

Silage Test

Green forage weight, percent dry matter, and silage yield at 70 percent moisture are presented in Table 2. Green forage yields ranged from a low of 31.9 to more than 45 tons per acre. A trend existed for the higher yielders to be less mature and lower in dry matter content; however, the less mature varieties were beginning to dent at the time they were harvested. The higher silage yields were associated with those varieties having the higher green weights.

These results indicate there are many varieties which can produce excellent yields of good quality silage. The varieties listed in the grain corn test as being too tall may have potential as silage corn.

Grain Test

Grain yields and moisture content of the grain at time of harvest are presented in Table 3. Moisture was undesirably high in all varieties considering the date of harvest (October 21-22) and the reasonably good drying conditions of the fall weather; however, a hard frost had not occurred before harvest.

There was a normal, positive relationship between high yield of grain corrected to 15.5 percent moisture content and high moisture in the grain when harvested. A later-maturing variety makes better utilization of sunlight and heat but is less mature at the normal harvest time. Often the late-maturing varieties are a disaster in cool seasons or when earlier-than-average frosts occur.

No adversities such as lodging, dropped ears, diseases, or insects were observed. No strong winds which might cause lodging occurred before harvest. The varieties Crookham 'SS60' and 'SS70', DeKalb '72A', Ferry Morse 'GT3020', NC$^+$ '59', and Northrup King 'PX59', 'PX69A', and 'PX74' were exceedingly tall for grain production. Ear height was five feet or higher.

Pollination was much better than in 1978 or 1979. No definite reason for the difference in pollination between years was obvious. Mite, aphid, and ear worm infestations were observed to be less in 1980 than the two previous years.

Table 2. Green weight, dry matter, and silage yields for varieties in the 1980 silage test at the Hermiston Research and Extension Center of the Columbia Basin Agricultural Research Center

Company	Variety	Green forage	Dry matter		Silage 70% moisture
		(Tons/A)	(percent)	(Tons/A)	(Tons/A)
Cenex	2203	36.6	24.2	8.86	29.5
Cenex	2371	37.9	26.0	9.92	33.1
Cenex	8380	42.3	24.5	10.37	34.6
Crookham	SS60	43.1	23.0	9.92	33.1
Crookham	SS70	45.9	22.3	10.24	34.1
Crookham	SS503	31.9	28.0	8.94	29.8
DeKalb	XL75A	37.8	24.9	9.42	31.4
DeKalb	XL362AA	37.9	25.3	9.59	32.0
DeKalb	442	35.9	26.4	9.47	31.6
Ferry Morse	GT493	45.6	21.3	9.72	32.4
Ferry Morse	GT3020	43.8	24.5	10.73	35.8
Ferry Morse	GT9770	35.3	27.1	9.57	31.9
Funk	G-4574	42.3	25.3	10.71	35.7
Funk	G-4673	45.3	21.7	9.82	32.7
Funk	G-5757	40.5	21.1	8.54	28.5
NC^+	59	42.4	24.5	10.38	34.6
NC^+	2999	33.3	28.1	9.35	31.2
NC^+	5881	41.1	26.2	10.78	35.9
Northrup King	PX72	46.5	23.0	10.69	35.6
Northrup King	PX74	42.8	22.2	9.51	31.7
Northrup King	PX76	36.1	25.1	9.26	30.9
Pioneer	3360	44.9	24.3	10.92	36.4
Pioneer	3369A	43.1	22.0	9.88	32.9
5% LSD		3.6		0.90	
1% LSD		4.8		1.20	
C.V.%		7		7	

Table 3. Grain yields and moisture content at harvest for varieties in the 1980 grain corn test at the Hermiston Research and Extension location of the Columbia Basin Agricultural Research Center

Company	Variety	Grain yield 15.5% moisture	Moisture at harvest
		(Bu/A)	(percent)
Cenex	2106	170	30.8
Cenex	2108	174	31.7
Cenex	2119	180	34.7
Crookham	SS60[1]	193	34.7
Crookham	SS70[1]	209	36.7
Crookham	CX9501	173	32.3
DeKalb	XL25A	154	30.9
DeKalb	XL55A	192	32.7
DeKalb	XL72A[1]	189	39.1
Ferry Morse	GT2080	190	36.3
Ferry Morse	GT3006	184	33.9
Ferry Morse	GT3020[1]	208	37.6
Funk	G-4141A	158	29.1
Funk	G-4224	164	29.9
Funk	G-4315	172	34.4
NC+	59[1]	191	40.0
NC+	2999	188	31.8
NC+	3990	196	33.6
Northrup King	PX59[1]	179	33.1
Northrup King	PX69A[1]	197	36.6
Northrup King	PX74[1]	205	38.9
Pioneer	3541	207	34.8
Pioneer	3732	198	33.3
Pioneer	3780	170	30.4
5% LSD		15	
1% LSD		20	
C.V.%		6	

[1]Varieties having an undesirably high height (ears 5 feet or higher).

EARLY FRESH MARKET POTATO VARIETY TRIAL
HERMISTON, 1979 AND 1980

D. C. Hane and A. R. Mosely[1]

The number of potato acres grown in north central Oregon for the early fresh potato market fluctuates significantly from year-to-year. Fresh market potatoes were grown on 20 percent (6,800 acres) of this region's total acreage in 1977. In 1980, fresh market potato acreage was only 10 percent (2,000 acres) of the potatoes grown in north central Oregon.

Since its release in 1964, 'Norgold Russett' is the most popular potato variety grown in the Northwest for the early fresh market. Though both mature later than 'Norgold Russett', newer varieties, such as 'Targhee', released in 1973, and 'Butte', released in 1977, have found acceptance as fresh market varieties.

Early fresh market potatoes will remain an important aspect of the potato industry in this area because they fill a unique niche in the seasonal supply of fresh potatoes.

PROCEDURE

This trial is conducted annually to evaluate early maturing potato lines and varieties. Information on growth, yield, and quality characteristics related to fresh market potato standards is gathered.

Procedures were the same for 1979 and 1980. The evaluated potato lines were laid out in a randomized block design with four replications. All plots were 1 row, 25 feet long. Row spacing was 34 inches and plants were spaced 9 inches apart within the rows. All plots were uniformly managed using locally accepted practices.

One hundred pounds of nitrogen per acre were applied when the potatoes were planted. An additional 170 pounds of nitrogen per acre were applied during the growing season. In addition, 150 pounds of phosphorous, 150 pounds of potash, 60 pounds of sulfur, and one pound of boron per acre were applied at planting time.

In 1979, 17 lines were evaluated. Entries were planted on March 8 and harvested on August 6. Vines were killed July 23.

Eighteen lines were evaluated in 1980. Plots were planted March 27 and harvested August 7. Vines were killed July 27.

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[1]Research Assistant, Columbia Basin Agriculture Research and Extension Center, Oregon State University, Hermiston, Oregon 97838, and Associate Professor, Crop Science Department, Oregon State University, Corvallis, Oregon 97331.

RESULTS AND DISCUSSION

Table 1 summarizes the overall performance of the varieties tested in 1979. Yields were acceptable for potatoes being grown for the fresh market.

Total yields of the top nine entries were statistically the same; however, the range of 73 hundred weight per acre is meaningful in dollars to the growers. Packout, the percentage of the harvested crop which meets USDA grade standards, is the important quality figure for fresh market potatoes stated in percent of U.S. No. 1's. When the percentage of U.S. No. 1's falls below 85 percent, the variety becomes unprofitable as a fresh market variety.

Table 1. Total yield, yield and percent U.S. No. 1 fresh market grade, and specific gravity of entries in the early fresh market potato variety test at the Columbia Basin Agriculture Research and Extension Center, Hermiston, Oregon, 1979

Variety	Total yield	U.S. No. 1's		Specific gravity
	cwt/A	cwt/A	Percent	
Norgold 35	480	420	88	1.075
Lemhi	460	393	85	1.084
AC67560-1	456	403	88	1.074
Lemhi (Neb.)	439	391	89	1.085
Norgold L	439	359	82	1.073
Norgold H	431	396	92	1.075
Bison	428	363	85	1.075
Norgold 19	421	378	90	1.074
Norgold M	407	368	90	1.075
Norgold (Neb. Check)	405	356	88	1.079
A70383-24	403	324	80	1.069
NDA8694-3	401	361	90	1.078
Norgold 7	383	335	88	1.075
B7024-81	363	287	79	1.090
Norgold 10	355	311	88	1.079
Norgold	349	325	93	1.077
NDA9249-3	334	280	84	1.081
5% LSD	73	66		.003

Potato production was enhanced by the cool 1980 growing season. Total yields in 1980 were high (Table 2). The No. 1 yields also were good, although most were below 85 percent of the total yield.

Table 2. Total yield, yield and percent U.S. No. 1 fresh market grade, specific gravity and average tuber size of entries in the early fresh market variety test at the Columbia Basin Agriculture Research and Extension Center, Hermiston, Oregon, 1980

Variety	Total yield	U.S. No. 1's		Specific gravity	Average tuber weight
	cwt/A	cwt/A	Percent		Ounces
Lemhi	621	506	82	1.080	7.5
Norgold-7	589	469	80	1.071	8.9
Norgold-H	585	481	82	1.072	7.4
Chieftan	570	514	90	1.066	7.6
Norgold-35	559	440	79	1.072	7.5
Norgold-L	536	434	81	1.072	8.2
A72602-2	526	454	86	1.084	7.4
Norgold-M	522	407	78	1.072	8.6
NDA 9249-3	469	363	77	1.077	7.9
NDA 8694-3	461	363	79	1.075	6.4
Norgold-Neb.	437	378	87	1.074	6.4
Norgold-10	432	361	84	1.074	6.3
A69870-6	403	334	83	1.066	7.6
Targhee	375	298	80	1.074	6.7
A70283-24	373	260	70	1.068	7.6
WN630-5	351	229	65	1.078	11.3
Norgold-Ore.	348	268	77	1.076	6.4
A7465-8	270	203	75	1.085	7.6
5% LSD	101	10		.003	

The check entry, 'Norgold'-Ore., should have more yield potential than indicated in the 1980 data. Since yield is influenced by seed source, the previous growing conditions, storage temperatures and humidity, and tuber transmitted diseases may have affected the performance of this entry.

The 'Norgold' check from Nebraska ('Norgold'-Neb.) was included in this study because it was grown and stored under similar conditions as the other 'Norgold' strains that were tested. The yield of U.S. No. 1 potatoes was significantly higher for the Nebraska check than for the Oregon check.

'Lemhi' had high yield and quality in most trials; however, it has a bruising problem. Since the 'Lemhi' variety has good shape and size, good skin texture and color, high percentage of U.S. No. 1 tubers, good total yields, and resistance to net necrosis, it will be tested further, and attempts will be made to identify factors that influence its susceptability to bruising.

Several potato lines yielded better than currently grown varieties; however, potatoes sold on the fresh market must meet certain quality standards. Consumers are concerned with exterior and interior appearance as well as tuber size. Storability after harvest is important. Continued testing will aid decision making as to either retaining or eliminating new potato lines.

WESTERN REGIONAL POTATO VARIETY TEST AT THE COLUMBIA BASIN AGRICULTURE RESEARCH AND EXTENSION CENTER HERMISTON, OREGON, 1980

D. C. Hane and A. R. Mosely[1]

The Western Regional testing program was initiated in 1978 and now involves researchers from six western states and Canada. Each participating member is allowed to contribute potato varieties or lines to the testing program. The tests in this program provide research information which is used to predict the adaptability of potato varieties or lines to specific areas or large regions.

PROCEDURES

In 1980, 11 potato lines plus two check varieties, 'Russett Burbank' and 'Norgold Russett', were evaluated in the Western Regional test at Hermiston. All seed was hand cut and treated with Captan, a fungicide. The potatoes were planted April 9 in a randomized block design with four replications. Each plot consisted of one, 25 foot row. Rows were spaced 34 inches apart and plants were placed 9 inches apart within the row. Marker (border) hills were used at both ends of each plot. The crop was grown using management practices conducive to raising potatoes in the Hermiston area. Insecticides and pesticides were used as needed. At planting, 100 pounds of nitrogen (N), 150 pounds of phosphorous (P_2O_5), 150 pounds of potash (K_2O), 60 pounds of sulfur (S), and one pound boron (B) per acre was banded on either side of the seed piece. An additional 80 pounds of N per acre was sidedressed before row closing and another 135 pounds of N per acre was applied through the water during the growing season. Vines were killed on September 11 and plots were harvested on September 30. All plots were graded according to potato processing grade standards. A 25-tuber subsample was taken from each plot and evaluated for internal and external defects.

[1]Research Assistant, Columbia Basin Agriculture Research and Extension Center, Oregon State University, Hermiston, Oregon 97838, and Associate Professor, Crop Science Department, Oregon State University, Corvallis, Oregon 97331.

One of the biggest problems in 1980 was shatter bruising. Shatter bruising is a condition in which breaks occur on the outer surface of the tuber during harvest, thereby predisposing the tubers to disease infestation during storage. There was a varietal difference in the amount of shatter bruising in 1980. The best yielding line, WC521-12, had 62 percent of the tubers with shatter bruise. 'Lemhi', the most recently released variety, was more prone to shattering than 'Russet Burbank', 15 percent versus 11 percent (Table 2). Internal bruising also appeared to be a problem with 'Lemhi'.

Strong acceptance of a new variety by the processors is essential if it is going to survive. Processors are very familiar with 'Russet Burbank' and know how it will react in their processing management. A new variety will have to have superior fry color, storability, yield potential, internal quality, and disease resistance for it to be readily accepted.

Table 2. Internal and external quality characteristics of entries in the 1980 Western Regional Potato Variety Test at the Columbia Basin Agriculture Research and Extension Center, Hermiston, Oregon

	Internal			External			
Variety	Hollow heart	Brown center	Shatter bruise	Tuber shape	Skin color	Scab	
	Percent	Percent	Percent			1/	2/
R.B.	5	23	11			0.6	0
WC612-13	0	1	21	Round	Tan-light Russet	3.6	12
A72545-2	0	0	16	Oblong-Egg	Tan-light Russet	1.9	0
Atlantic	5	7	19	Round	Tan-light Russet	1.6	2
AD7377-1	6	0	25	Oblong	Tan-Russet	1.1	0
WC521-12	3	2	62	Round	Tan-light Russet	0.7	2
AD7267-1	4	0	27	Oblong-long	Tan-Russet	0.5	0
WD641-10	1	0	10	Round	Dark-Russet	0.9	0
Lemhi	0	0	15	Oblong	Tan-Russet	1.1	4
B6987-201	1	0	5	Round-flat	White	2.0	5
AC67560-1	0	0	9	Round	Red	3.1	17
WC672-2	6	20	16	Round-flat	Tan-Russet	3.7	18

1/ 1 to 5, 1 = trace, 5 = severe

2/ Percent of tubers with more than 5 percent of skin covered

RESULTS AND DISCUSSION

The weather during 1980 provided excellent growing conditions for potatoes. Yield, tuber size, and specific gravity of the entries in the Western Regional trial are summarized in Table 1. 'Russett Burbank', the variety most representative of the Hermiston area, was near average in total yield. The 67 percent yield of the U. S. No. 1 potatoes for 'Russett Burbank' was typical. For processing, both No. 1's and No. 2's were considered usable enabling 'Russett Burbank' to remain competitive with other varieties. Some experimental selections yielded better than 'Russett Burbank'; however, Table 2 indicates problems encountered with some of the new lines as well as some of the existing varieties.

Table 1. Total yield, yield of U.S. No. 1 and No. 2 grade potatoes, specific gravity and average tuber weight of entries in the 1980 Western Regional Potato Variety Test at the Columbia Basin Agriculture Research and Extension Center, Hermiston, Oregon

Variety	Total yield	U.S. No. 1's		U.S. 2's	Specific gravity	Average tuber weight
	cwt/A	cwt/A	Percent	Percent		Ounces
WC521-12	714	614	86	7	1.099	15.5
Lemhi	645	567	88	8	1.087	13.9
AD7267-1	623	537	86	9	1.074	14.3
WC612-13	613	558	91	5	1.091	12.3
WC672-2	593	554	93	3	1.086	11.9
A72545-2	582	534	92	3	1.083	11.2
RB	563	378	67	21	1.091	9.6
AD7377-1	552	474	86	7	1.072	14.2
Atlantic	496	463	93	2	1.092	9.3
B6987-201	453	378	83	7	1.099	9.1
AC67560-1	441	392	89	4	1.071	10.4
Norgold	407	343	84	0	1.071	7.9
WD641-10	228	185	81	2	1.080	8.3
5% LSD	135	119			0.003	

A TURNIP AND FODDER RADISH VARIETY TRIAL

Lynn F. Hall[1]

Acreage in the greater Hermiston area planted to *(Brassica)* crops has increased from 200 acres in 1976 to more than 14,000 acres in 1980. This increase is a response to a demand for late planted forage crops which produce large amounts of inexpensive cattle feed. This acreage is primarily devoted to turnips planted as a double crop following the harvest of small grains, peas, or early potatoes.

Farmers have been concerned about which turnip varieties and other *(Brassica)* species will produce the greatest amount of feed and retain desirable characteristics such as resistance to cold weather damage, high feed accessibility, and palatibility. These characteristics are necessary for maximum utilization of the crop. Cattle or sheep graze both tops and root of turnips as the root develops on the ground surface.

Limited variety work is done in Washington State by Extension and research personnel. Most of this research is concerned with an early optimum harvest day for making yield comparisons. Little work has been done on utilization of fodder radishes. With the potential involved using *(Brassica)* crops and their impact on the local livestock industry, additional work is needed to provide answers to grower questions about the raising of these crops.

Given the average frost date for the Hermiston area as October 11, growers and researchers generally concede that the middle of August is the latest turnip planting date to produce acceptable crop yields. Of concern to growers is the field keeping qualities of various *(Brassica)*species as they are left in the field to be harvested by animals in grazing. Most *(Brassica)* types are cold, hardy, and will continue growing even after experiencing several mild frosts. Some are more susceptible than others to cold. It has been noted that turnips, in particular, will tolerate quite severe frost conditions. This is desirable as it helps extend the grazing season and provides greater utilization of the crop.

OBJECTIVE

The objective of this trial is to compare relative yields of different *(Brassica)* species, especially as they relate to various winter harvest dates. Since much of the crop is grazed in late winter, this will demonstrate possible winter damage and keeping problems.

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[1]County Extension Agent, Oregon State University Extension Service, Hermiston, Oregon 97838.

METHODS

Seed for the *(Brassica)* was obtained from Pendleton Grain Growers, Barenbrug U.S.A. Inc., and Great Western Seed Company. Turnip varieties planted included 'Purple Top', 'Barkant', 'Barive', and 'Trofee.' Three fodder radish varieties were planted and included 'Bar RS011 B', 'Barsati', and 'Barbas.' 'Tyfon' was included in the trial and is from a cross between a cow turnip and Chinese cabbage. Plots were planted on August 18, 1980, and harvested on November 11, 1980, December 10, 1980, and January 8, 1981. The results are summarized in Table 1. Weights are given on a converted green weight per acre basis.

Table 1. A turnip and fodder radish variety trial planted August 18, 1980, on the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon

Species or Variety	Tons of green feed per acre								
	Harvested 11-7-80			Harvested 12-18-80			Harvested 1-8-81		
	Tops	Roots	Total	Tops	Roots	Total	Tops	Roots	Total
TURNIPS:									
Purple Top	22.5	8.8	31.3	16.7	17.3	34.0	13.3	24.7	38.0
Barkant	--	--	--	18.1	9.1	27.2	17.3	13.2	30.5
Barive	20.4	6.9	27.3	12.6	6.7	19.3	11.2	9.8	21.0
Trofee	--	--	--	8.1	3.0	11.1	15.2	11.1	26.3
COW TURNIP X CHINESE CABBAGE:									
Tyfon	30.0	--[1]	30.0	20.3	--	20.3	9.9	--	9.9
RADISH:									
Bar RS011	57.6	--[1]	57.6	0	0	0	0	0	0
Barsati	51.6	--[1]	51.6	0	0	0	0	0	0
Barabas	40.0	--[1]	40.0	0	0	0	0	0	0

[1]Roots were not weighed as they were generally inaccessible as a source of feed.

RESULTS AND CONCLUSION

The results of the trial demonstrated the ability of turnips ('Purple Top', 'Barkant', 'Barive', and 'Trofee') to retain feed value through inclement winter weather. After the first severe fall frost, all the fodder radish species (Bar RS011 B, 'Barsati', and 'Barabas') began to disintegrate and were unharvestable by the second and third harvest periods.

'Tyfon', which is from a cow turnip x Chinese cabbage cross, held up very well until the final harvest period when it also began to disintegrate. Only Bar RS011 B of the radish varieties had a tendency to bolt.

'Purple Top' turnip had the firmest root at the time of the last harvest period and provided the greatest amount of harvestable feed.

SEARCH FOR AN IRRIGATED WINTER FEED WHEAT

Mathias F. Kolding[1]

The feed grain winter wheat trials at the Columbia Basin Agricultural Research and Extension Center at Hermiston are grown to distinguish the better experimental winter wheat selections for the irrigated sandy soil area. To measure progress, the most popular local wheat varieties are grown as check varieties within an experiment.

Though many of the cultural practices and disease problems related to raising winter wheat are common to other winter wheat areas, several factors in the irrigated sandy area near the Columbia River require special attention. Barley Yellow Dwarf Virus becomes a larger problem as more green plants in late summer are providing a favorable environment to aphids. Wind driven sand in newly emerged seedlings cause leaf damage. Overhead irrigation water, often applied during windy periods, causes lodging. Extremely dry and brittle ripe heads shatter and shell easily during July and August wind storms. The root and foot rots are a severe problem when wheat follows alfalfa or wheat. Leaf rust is a potential problem in these irrigated acres. Winter freezing and desiccation becomes prominent as soils dry during winter months. Since the organic matter is low, pesticides can cause residue or severe application damage. Growers need varieties which can offer a protective soil cover during the winter.

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[1]Senior instructor, Oregon State University, Columbia Basin Agricultural Research Center, Pendleton, Oregon 97801.

METHODS

The feed wheat trials at Hermiston started in 1973 as disease and herbicide tolerance screening trials. After disease resistant wheat lines were discovered they were put in trials for comparative yield measurements. The more promising types are then tested at other irrigated sites. Most of the winter wheat selections now growing at the Experiment Station at Ontario, Oregon, originated from selections grown at Hermiston. Those lines or sets of lines from the same progeny are increased and reselected to find the best types within a population.

The yield trial in Table 1 is ordinarily planted near the middle of October when the danger of aphid damage is usually past. Though an early, cool fall may restrict seedling development to the three or four leaf stage, as a rule there is adequate time to develop a well tillered plant having a good secondary root system. The plots usually receive more than 150 pounds, but less than 200 pounds of nitrogen per acre as ammonium nitrate. Irrigation is accomplished by a solid set sprinkler irrigation system.

The four yield trials reported in Table 2 are primarily comparative yield estimate trials in which plant type and disease reactions are also observed. When seed of a selection in the breeding material is increased enough for yield trial plots, that selection usually has several desirable characteristics such as stiff straw, blocky and fertile heads, vigorous growth patterns, and a desirable maturity range. These trials are the first trials where one estimates a selection's grain production and quality. The trials have inherent weaknesses since the observer hopes to perform cultural practices which benefit the types possessing the highest long-term yield potential. Fortunately, wheat as a crop does compensate or adjust to less than individual ideal fertility needs, water availability, seeding dates, stand densities, and herbicide applications. The attrition rate of wheat selections in these trials is so high, that fewer than 10 percent are tested more than two years. Attrition is from the variable environmental influences encountered over several years. For example, one cold winter may freeze out tender types, rust may abound another year, or maybe the trial area is an ideal root disease media. Probably one of 1,000 selections is yield tested more than five years.

The yields in Table 2, however, are given to demonstrate yields obtained in trials under less than ideal conditions, but close to where yield potential is realized. These particular trials were on a field left fallow after potatoes. Three hundred pounds of 16-20-0 (ammonium phosphate) were incorporated before the early October seeding date. Water was applied just before seeding. An unidentified seedling disease caused extensive damage to parts of the trial area. Three hundred pounds of ammonium nitrate 33-0-0 were broadcast in the spring just before the jointing stage.

The trials are standard replicated trials designed to accommodate mechanical harvesting.

Table 1. Yield summary, heading date and plant height of winter wheats grown in an irrigated Winter Feed Wheat Trial, Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon (managed by Vance Pumphrey for optimum grain production)

Selection	Identity number	Year in trial 1977	1978	1979	1980	Ave.	Heading date	Plant height
		(bushels per acre)					(May)	(inches)
Luke	CI 14586	109	109	124	80	105	18	32
Stephens	CI 17596	110	132	125	72	110	18	30
McDermid	CI 14565	114	135	117	94	115	18	32
WA4995/Hyslop	FW73577P05		126	124	103	118	22	32
Rb/1523-Dc	FW73830-826			132	105	118	18	36
Rb/1523-Dc	FW73830-829			135	93	114	18	32
Rb/1523-Dc	FW73830-835			144	89	116	18	34
Cama/JJG/2/FW-127	FW771664G				86	86	18	
Yh/Mdm/2/Ts/3/S/R 4/ID725055	FW75334-104				125	125	18	36
FW72244/FW74419	FW741018-709				98	98	20	30
Tob/Bomen/2/JJG/ 71CB128	FW74301-860				106	106	18	40
65116/Mdm/2/Cama/3/ FW72001/ISRN 1342	FW741037-85				99	99	18	36

RESULTS

Grain yields of nine experimental feed wheats and three checks are given in Table 1. The yields are from an irrigated trial given special attention by Vance Pumphrey[1]. Optimum management practices were followed. In 1977, the first trial year, and 1980, the grain yields were below the yield potential, probably because of lodging and soil borne pathogens.

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[1]Professor of Agronomy, Columbia Basin Agricultural Research and Extension Center, Oregon State University, Hermiston, Oregon 97838.

Table 2. Grain yield, bushel weight, heading day, and plant height of five locally grown winter wheats and the highest yielding experimental feed wheat in each of four yield trials grown at the Hermiston site of the Columbia Basin Agricultural Research and Extension Center in 1980

Selection	Identity number	Yield trial[1] EOWW	HSFW-1	HSFW-2	HWFW	Ave.
		(Bushels per acre)				
Stephens	CI 17596	137	121	122	137	129
McDermid	CI 14565	96	122	116	125	115
Luke	CI 14586	121	118	112	120	118
Daws	CI 17419	128	106	121	123	120
Nugaines	CI 13968		114	107	122	114
WA4995/Hyslop	FW73577715	140				140
Yh/Mdm/2/Ts.3.S.R.4.NE/Hys/2/ Backa	FW75336-906		127			127
Rb/1523-Dc	FW73830CP04			137		137
71CB125/6720-69-13	FW73525-03				130	130

[1]Yield trial

EOWW, Eastern Oregon winter wheat trial

HSFW-1, Hermiston screening feed wheat-1 trial

HSFW-2, Hermiston screening feed wheat-2 trial

HWFW, Hardy winter feed wheat trial

Stephens wheat did not yield as well as McDermid in this trial, but did better than Luke (Table 1). The experimental lines tested in 1977 have been replaced with lines superior in one or more characteristics. The WA4995/Hyslop selection FW73577P05 and other selections from this cross were particularly good for winter hardiness and straw strength, but their susceptibility to common smut, *(Telletia caries)*, deletes them as potential varieties. The Rb/1523-Dc series is the most promising. It includes stiff-strawed, non-shattering, good quality, soft white wheats which are winter hardy, fast emerging types well suited to the irrigated area. Their resistance to the common diseases found at Hermiston is satisfactory. The last five experimental lines in Table 1 are hardy, stiff-strawed types which need further testing.

Grain yields from four 1980 feed grain yield trials are given in Table 2 for five white winter wheats, and the highest yielding feed wheat selection in each trial.

CONCLUSION

Contemporary Oregon grown soft, white winter wheat varieties are well adapted to Oregon's wheat production acreage. Each modern variety does have several deficiencies. None is resistant to all the different races of rusts, smuts, and root diseases, nor do the varieties possess resistance to the same races. The spectrum of available varieties, however, does contribute to the total success of Oregon's wheat production.

A wheat improvement program endeavors to provide additional varieties which may fill deficiencies or actually replace several varieties. At other times a particular improvement goal is directed at meeting old problems a different twist to them or to meeting new problems.

The feed wheat breeding effort at Hermiston is aimed at finding genetic backgrounds which will help improve adapted wheats. Adaptation of experimental resistant wheats measured in yield trials has demonstrated yield capacities equivalent to control varieties and at times much above. Yields in performance trials, however, need verification, so trials are conducted in several locations. New lines are planted in seeding rate, seeding date, and the fertility trials to ascertain their superiority. At times growers are asked to grow small acreages for their evaluation.

Possibly several of the Rb/1523-Dc selections now under the expanded phase of testing will find their way into the irrigated fields near Hermiston within the next year or two.

GREEN PEACH APHID SURVEY[1]

Luther A. Fitch[2]

Approximately one million dollars per year is spent by the potato industry in the Hermiston-Boardman area to control green peach aphids--vectors of leafroll virus disease of potatoes. In 1976, an intensive two-year study of this insect vector was started by the OSU Department of Entomology under the direction of Dr. Richard Clarke. One facet of the study, a trapping program to monitor seasonal movement and buildup of aphid populations, was seen by the growers as a valuable seasonal guide. The Growers Association has funded this program under the supervision of the local Extension potato agent since that time.

METHODS AND MATERIALS

Yellow, 4-gallon, plastic pans are positioned at appropriate locations throughout the potato growing area. These are filled 2/3 full with water. On a weekly basis all aphids are collected from the traps and placed in numbered vials to denote trap location. The remaining contents of the pan are discarded and the trap-pan refilled with fresh water. A few grains of $Cu\ SO_4$ are placed in the pan to control growth of algae.

Once all traps are collected, green peach aphids are identified under a microscope. A report is developed and sent out to growers and service industry personnel reporting the weekly count of green peach aphids and other aphids by location.

RESULTS

Areas differed in peak populations trapped (Figure 1), but peaks were reached at approximately the same time in any given year at all locations. The time peaks are reached varies from year to year.

It is of interest that the highest number of aphids were found each year in traps in close proximity to towns in each area, and that traps fartherest distance from towns generally had the lowest counts. Had it not been for traps located within 4 miles south and east of Boardman, counts in Area 1 would have been as low or lower than they were in Area 3. In like manner, the traps in the northwest corner and in the northeast corner of Area 3 accounted for most of the aphid populations in that area.

Trapping was continued later in the season in 1980. A sharp upswing in aphid numbers was noted in late September. According to insect specialists, the increased

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[1] An Extension Service Project founded by the Blue Mountain Potato Growers Association.

[2] County Extension Agent, Oregon State University Extension Service, Hermiston, Oregon 97838.

numbers are caused by the fall flight migrating to their overwintering peach tree hosts. This was verified by numerous observations of winged peach aphids on peach tree leaves during and after the migration.

CONCLUSION

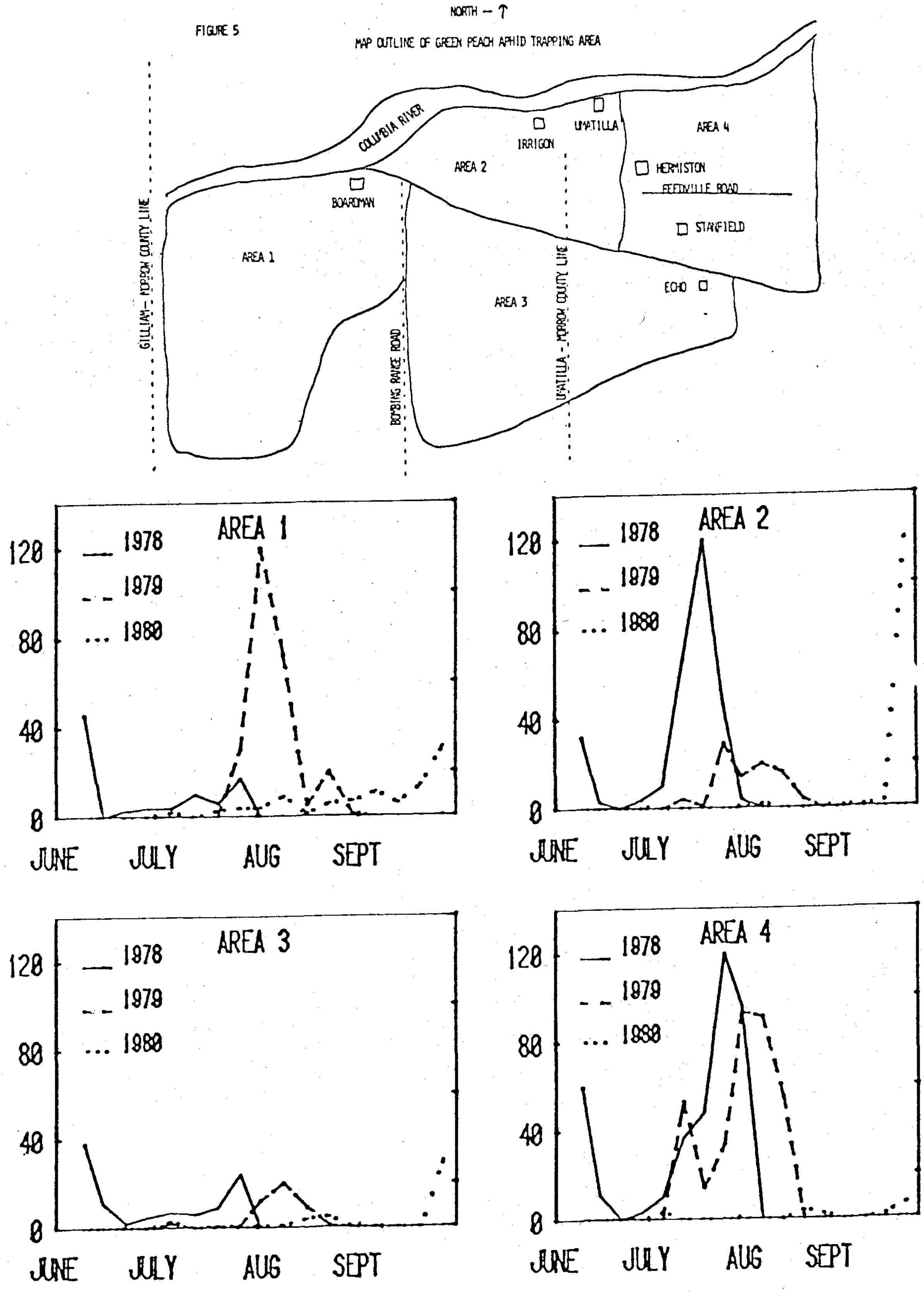
Green peach aphids are perpetuated and disseminated from local overwintering population centers on peach tree hosts. Spread outward from those overwintering centers appears progressive over time, reaching peak populations which correspond closely to time periods when grain fields with an understory of volunteer potatoes are being dried down for harvest and when early harvested 'Norgold' potatoes are being killed down and readied for harvest. Another phenomenon that occurs at about this same time is the natural maturation of winter annual broadleaf weed hosts such as mustards. It is, however, the flights of aphids from either volunteer potatoes, or from early harvested potato fields that are of prime concern, since these aphids are the greatest potential vectors of leaf-roll virus.

Date	Data points for aphid graphs											
	Area 1			Area 2			Area 3			Area 4		
	1978	1979	1980	1978	1979	1980	1978	1979	1980	1978	1979	1980
June 9	46	0	0	32	0	0	38	0	0	60	0	0
15	0	0	0	3	0	0	11	0	0	11	0	0
22	3	0	0	0	0	0	2	0	0	0	0	0
29	4	0	0	4	0	0	5	0	0	3	0	0
July 6	4	0	2	10	0	0	7	2	3	10	0	3
13	10	0	0	66	4	0	6	0	0	37	53	0
20	6	0	3	120	1	0	9	1	0	48	14	0
27	17	30	4	46	29	0	24	1	0	120	34	0
Aug. 2	0	120	4	4	14	0	0	12	1	96	93	0
9	0	72	9	0	20	2	0	20	1	0	91	0
16		5	1		16	0		9	4		55	0
23		20	6		4	0		1	5		0	4
30		1	7		0	0		0	0		0	2
Sept. 6		0	11		0	1		0	0		0	0
13			6			1			0			0
20			14			3			0			2
27			31			120			30			7

NORTH — ↑

FIGURE 5

MAP OUTLINE OF GREEN PEACH APHID TRAPPING AREA



SELECTION OF WINTER BARLEY CULTIVARS WITH TOLERANCE TO BARLEY YELLOW DWARF VIRUS AND GREENBUG

Mathias F. Kolding[1]

Oregon's irrigated acreage has expanded to include nearly one-half of Oregon's agriculture acreage. A considerable portion of recent expansion has happened in the desert soils in eastern Oregon, so the former July-August dry or dead cereal and grassland period no longer exists. Aphid populations which moved away or died during the cereal and grass drying and dying period are now maintained and increased in lush grain, grass, or cornfields until the fall planted cereals emerge.

Crop damage caused by viruliferous Oat Bird Cherry Aphids *(Rhopalosiphum padi)* is usually spread over larger areas than damage caused by the Greenbug, *(Schzaphis graminum)*. The Oat Bird Cherry Aphid is a superior vector of Barley Yellow Dwarf Virus (BYDV) and can transmit most BYDV strains or combinations of strains. During the rainstorms, the Oat Bird Cherry Aphid aggressively moves to sheltered areas for protection, while the Greenbug either is knocked off the leaves or else is sensitive to high levels of moisture. In cold weather, both aphid species tend to migrate towards the underground portions of the plant. The Oat Bird Cherry Aphid responds rapidly to warm winter periods. In late December 1980, for example, gravid Oat Bird Cherry Aphids in the BYDV screening plots moved from their retreats and were soon producing young aphids. The Greenbug, however, generally kills its host plant, so with its food source gone, it either must migrate or die.

Though we associate crop damage with the aphids, it is not the aphids feeding on the plant, but it is the virus (BYDV) which they spread from plant to plant which causes economic losses. The Greenbug aphid also exudes a toxic lubricant from his stilet (mouth part) which often kills the plant. BYDV infection symptoms in resistant plants are absent when hosting only a few aphids per plant, but, if large numbers are feeding, even resistant plants may yellow, stunt, or have reduced tillering.

Attempts to chemically control aphids in fall-sown grains have some success with small migrations. The prime benefit of chemical control, however, is the slowing of aphid spread within a field, and subsequent migrations to other fields.

BYDV damage is difficult to assess for several reasons: (1) Damage is usually spotty in fields. (2) BYDV is often unrecognized and attributed to nutrient shortages, spray damage, and lack of water. (3) The plant populations compensate for reduced tillering caused by BYDV. (4) BYDV predisposes the plants to other diseases. (5) Western Beet Yellows give similar symptoms. (6) Stunted root growth is not visible. (7) Losses in yield and grain quality are credited to other causes or not measured.

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[1] Senior Instructor, Columbia Basin Agriculture Research Center, Oregon State University, Pendleton, Oregon, 97801.

Resistance to BYDV in barley is reported to involve two recessive genes, YD_1 and YD_2, but resistance is not as definitive as expected. Aphid numbers and species, BYDV strains and combinations of strains, time of the year, weather patterns, and size of the plant interacting with the genetic background in a barley selection produce a variable, perplexing range of BYDV symptoms.

Greenbug damage is often found after the insect has disappeared. One fall, (1974) a grower and several researchers nearly concluded that an aerial applicator had dumped a load of paraquat on a wheat field. Visits to other scattered sites with similar damage and symptoms, however, determined the cause. That particular fall, the Greenbug had made a transitory visit. The evidence of its visit provided some essential clues to damage observed in feed grain plots on the Columbia Basin Agricultural Research and Extension Center.

OBJECTIVE

The objectives of the Barley Yellow Dwarf Virus screening trials are to: (1) Assess resistance to natural infections of BYDV in winter barley cultivars. (2) Select winter barley cultivars resistant to BYDV. (3) Evaluate BYDV resistant winter barley cultivars for plant type, winter hardiness, and disease resistance. (4) Grow the more desirable new winter barley selections in comparative yield trials. (5) Reevaluate the previous year's selections in the BYDV screening trials. (6) Release superior selections to growers.

METHODS

Since 1974, every entry in each winter feed barley yield trial is also grown in the BYDV screening trial at the Columbia Basin Agricultural Research and Extension Center at Hermiston. Entries are planted in single, four-foot long rows near August 31 so plants are usually in the two-to five-leaf stage during the mid-September aphid migrations.

Resistant selections are recorded, used for crosses and reevaluated in next year's BYDV screening trial. Heads are picked from the most promising lines and planted in head rows. During the growing season the head rows are periodically checked, and those with BYDV symptoms or undesirable traits are pulled and discarded. The resistant lines are harvested and planted in larger plots in the BYDV screening nursery. The following year, the better selections are planted in yield trials as well as having a sub-sample placed in the BYDV screening trials.

RESULTS

Two winter barley crosses, Lth/Hpr and 7107/Hpr, are in the final reselections process for the 1981-1982 early and late planted winter barley trials. In 1978, their yields (Table 1) were higher than the check varieties in an early planted trial. Boyer, Hesk, and Mal were heavily damaged by BYDV. Hudson, though fairly resistant, does not have the yield capacity of the other varieties. Schuyler has about the highest level of BYDV tolerance of the commercially available winter barleys. The selections from the two crosses had some damage, but yielded 9 to 33 percent better than Schuyler.

Table 1. 1978 Hermiston Winter Barley Screening Trial-1 seeded September 24, 1977

	Variety		BYDV[1]	Pounds per acre	Percent of Boyer
1.	Boyer	CI 15559	8	2786	100
2.	Hesk	CI 15816	8	3015	108
3.	Mal	CI 15817	8	3066	110
4.	Hudson	CI 8067	3	3533	126
5.	Schuyler	CI 11887	4	4594	165
6.	FB77803	Lth/Hpr	2	5766	207
7.	FB77804	Lth/Hpr	2	6125	220
8.	FB77816	7107/Hpr	2	5580	200
9.	FB77818	7107/Hpr	2	5013	180

[1]Ratings 0-9 where 1-3 = resistance, 4-6 = intermediate, 7-9 = susceptible

Luther-Hiproly, (Lth/Hpr) This cross was identified as a source of BYDV resistant individuals in a 1976 F-4 individual plant plot trial. Several sub-lines were discarded because of low yields. Heads were picked from a high yielding resistant sub-selection (-235) and planted in the 1980 screening trial. Susceptible types were discarded. Sixty remaining head plots were harvested. The seed from each was divided and planted in the 1981 BYDV screening trial at Hermiston, and in a trial at Pendleton. The bulk (-235) selection was entered in the Western Regional Winter Barley Trial.

7107/Hiproly, (7107/Hpr) This cross had BYDV resistance in the 1976 F-4 individual plant plot trial. In the fall of 1978, the plant foliage of selections from this cross froze, but recovery was excellent. This line was head rowed in the 1980 BYDV screening nursery and rogued until 100 selections remained. These remaining selections are planted in the 1981 BYDV screening nursery at Hermiston and at Pendleton. Several of the 100 are resistant to both BYDV and mildew so far in 1981.

DISCUSSION

Winter barley cultivars with resistance to BYDV should help prevent the erratic, (maybe now consistent) losses from viruliferous aphids in fall planted barleys.

Growers should still stay within the normal September 10 to October 10 planting dates since earlier dates encourages excessive fall plant growth and the hosting of BYDV and other diseases. The purpose of seeding early (August 31) in the screening nursery is to, more or less, assure a consistent exposure to BYDV and other diseases and not to encourage such a seeding date. Selections from 7107/Hpr and Lth/Hpr are hybridized with other hardy or BYDV resistant barley selections, so a continuing array of BYDV selections should appear.

"BACTERIZATION" SEED TREATMENT AND BANDED FERTILIZERS FOR SUPPRESSION OF TAKE-ALL ROOT ROT OF WHEAT

Mark E. Halsey and R. L. Powelson[1]

Take-all root rot (TARR) of wheat is incited by *(Gaeumannomyces graminis)* var. *(tritici)*, a fungus which survives on previously colonized plant host debris in the soil. The pathogen, which can grow up to one centimeter through the soil to make contact with a wheat root, grows along the root surface by means of dark runner hyphae. It infects directly through the epidermis, colonizes the cortex and the stele, and destroys root function.

Disease development depends on good soil aeration, high moisture levels, moderate pH (greater than 5.0-5.5), and the absence of a soil microflora suppressive to the pathogen. These factors favoring the pathogen are present when wheat follows wheat after noncereal crops on the irrigated circles of the Columbia Basin.

Banding ammonium fertilizers with the seed at fall planting has given suppression of early season root rot development. The addition of chloride with ammonium in the band as NH_4Cl or $(NH_4)_2SO_4$plus NaCl or KCl at 30 lb N/A, 60 lb KCl/A has suppressed take-all root rot and given greater yields in TARR infected sites. Studies on banded ammonium at Washington State University and ammonium with chloride at Oregon State University have demonstrated that this suppression of TARR is negated when soils are heat treated (60° C.) or fumigated (methyl bromide). This implies that biological entities are involved; a variety of evidence suggests that fluorescent pseudomonads (saprophytic soil bacteria) contribute to the biological mediation of TARR suppression under ammonium fertilization. Growth of TARR runner hyphae could be restricted by nutrient competition, physical blockage, amtibiotic production, or acidification of the environment by pseudomonad metabolites. The efficacy of ammonium and chloride appears to stem from increases in pseudomonad bacteria numbers or their antagonistic capability, mediated by changes of the physical or chemical properties in the rhizoshpere (zone close to the roots).

"Bacterization," seed treatment with live bacteria for the control of TARR, is expected to be most effective under ammonium fertilization, and that chloride would have an additive effect. Native phizoplane bacteria, or those introduced on the seed, should respond similarily to soil nutritional changes induced by fertilization so ammonium with chloride could be a key to the success of bacterization for TARR control. To test this hypothesis, field plots were established at the Hermiston site of the Columbia Basin Agriculture Research and Extension Center, and at the North Willamette Experiment Station in the fall of 1980.

[1]Research Assistant and Professor of Plant Pathology, Botany and Plant Pathology Department, Oregon State University, Corvallis, Oregon 97331.

EXPERIMENTAL DESIGN

Experiments were multifactorial using untreated and methyl bromide fumigated soil, natural and reintroduced inoculum, banded fertilizer amendments and bacterial seed treatments (Figure 1). This design allows evaluation of bacterial-pathogen interaction in a natural (non-fumigated) soil, and in a soil where most microfloral competition was removed by fumigation. Bacterial effect on the host can be evaluated in the absence of the pathogen on the fumigated-noninfested soil.

Factor	Factor treatments
A. Soil	Fumigated by methyl bromide, not fumigated by methyl bromide
B. Pathogen, G. graminis	Fumigated soil infested, fumigated soil not infested, non-fumigated soil with natural inoculum
C. Fertilizer used in banding	Calcium nitrate, ammonium chloride, ammonium sulfate, plus potassium chloride
D. Bacterial isolates used	1, 2, 3: isolates which best controlled TARR in greenhouse; 4: no control of TARR; control: no added bacteria

Figure 1. Treatments used in 1980-81 "Bacterization" seed treatment and banded fertilizer versus take-all root rot, *(Gaeumannomyces graminis)* var. *(tritici)* at the Hermiston site of the Columbia Basin Agriculture Research and Extension Center and North Willamette Experiment Station.

Bacteria for this study were isolated from wheat roots in various experiments under different fertilizer regimes. Twelve isolates, all showing good *(in vitro)* antagonism to the pathogen on Potato Dextrose Agar (PDA), were tested in a greenhouse pot study for control of TARR as indicated by increased fresh weight of winter wheat seedlings. Growth on PDA as a measure of rhizoplane competitive ability and antagonism to the pathogen on $CaCO_3$-PDA medium were both estimated. Since acidification of the rhizosphere by bacterial products may be a form of antagonism to the pathogen, isolates were chosen which displayed no inhibition of pathogen growth in $CaCO_3$-PDA (acidification may be important to antagonism) and good inhibition (acidification not important to *(in vitro)* antagonism). Three isolates (isolates 1, 2 and 3) that gave the best control of TARR or growth response in the greenhouse, and one (isolate 4) that gave no control of TARR or growth response were chosen for the field study. Table 1 shows the sources of bacterial isolates chosen, their characteristics on a medium (KMB-ACC) selective for *(Pseudomonas spp.)* growth on PDA media, and results of their performances in pot tests.

Table 1. Source, growth, and inhibition characteristics of *(Pseudomonas spp.)* isolates, and wheat seedling response (TARR index and freshweight) to bacterization with these isolates in two greenhouse studies.

Pseudomonas isolate number	Fertilizer treatment	Growth characteristics on KMB-ACC[1] media	Inhibition of pathogen on $CaCo_3$-PDA	Growth on potato dextrose agar	TARR index[2]	Seedling response freshweight
					Percent	milligrams
1	AmCl	F, S	Good	Excellent	11.8	424
2	AmS	LF, S	Trace	Good	14.7	503
3	AmCl	F, R	None	Good	12.7	508
4	CK	W	Excellent	Good	19.8	329
Control					17.6	440

[1]F = fluorescent, LF = lightly fluorescent, S = smooth colony edge, R = rough colony edge, W = white, non=fluorescent

[2]TARR index: Percent of root surface attacked by TARR

Seedlings from the nonfumigated soil were sampled in early December 1980 (3 leaf stage). Number of roots, number of infected roots, and number of large lesions (greater than one centimeter) were determined for one meter of row in each plot sampled. Further sampling will include root rot estimation in April 1981, fresh weight at soft dough stage, and grain yield.

RESULTS AND DISCUSSION

Data for percent roots infected and percent roots with large lesions were analyzed for both the North Willamette Experiment Station site and the Columbia Basin Agriculture Research and Extension Center, Hermiston site (Table 2). Site had the greatest influence ($p = .01$) on both disease parameters. This influence was caused by major differences in TARR levels between North Willamette Experiment Station and the Columbia Basin Agriculture and Extension Center, Hermiston.

Both fertilizer and the fertilizer-bacterial interaction affected lesion growth (large lesions, $p = 0.1$ and .05, respectively), whereas, only the latter influenced disease incidence (infected, $p = 0.1$). Hence, ammonium and "bacterization" act more strongly against spread along host roots than against initial establishment of the fungus on the root. The statistical interaction term is of special interest, since it indicates that particular bacterial treatments influenced the effect of certain fertilizer amendments on TARR.

Table 2. Analysis of variance for root rot parameters (a) percent of roots infected and (b) percent of roots with large TARR lesions (greater than 1 cm) across both North Willamette Experiment Station, and the Hermiston branch of the Columbia Basin Agricultural Research and Extension Center sites.

a. Infected			b. Large lesions		
Factor	F	Sig	Factor	F	Sig
Site	54.0	1%	Site	10.8	1%
Fertilizer	1.6		Fertilizer	3.4	10%
Bacteria	0.4		Bacteria	1.2	
Replication	1.4		Replication	0.6	
Site x bacteria	0.2		Site x bacteria	0.8	
Fertilizer x bacteria	2.1	10%	Fertilizer x bacteria	3.4	5%

Graphs of the response of TARR to fertilizer amendment and bacterization at Columbia Basin Agriculture Research and Extension Center, Hermiston (Figures 2 and 3) help to visualize their interaction. Seed treatment with bacteria No. 4 (ineffective in pot tests) increased both percent infection and lesions in the ammonium chloride treatment, but decreased them with calcium nitrate. Bacteria No. 2 and No. 3, in which *(in vitro)* antagonism depended on acidification of the medium, increased root rot with calcium nitrate and decreased it with ammonium chloride. Lowest levels of both measures of root rot occurred with bacteria No. 3 where ammonium chloride was banded with the seed.

CONCLUSION

In this study, ammonium nitrogen starter fertilizer and, to a lesser extent, the anion associated with ammonium (Cl^- or $SO_4^{=}$) influenced the efficacy of bacterial seed inoculants in suppressing TARR. The response to ammonium-with-chloride without "bacterization" may result from stimulation of indigenous microflora antagonistic to the pathogen.

Greatest suppression of TARR was with ammonium chloride and a bacterial isolate displaying no inhibition of the pathogen on a neutral medium. Hence, the ability of the inoculant to produce acidic metabolites or substances requiring an acidic environment for *(in vitro)* inhibition of the pathogen appears to be positively related to its ability to suppress TARR in the field. This characteristic could prove useful in preliminary screening of isolates for future "bacterization" for suppression of TARR experiments.

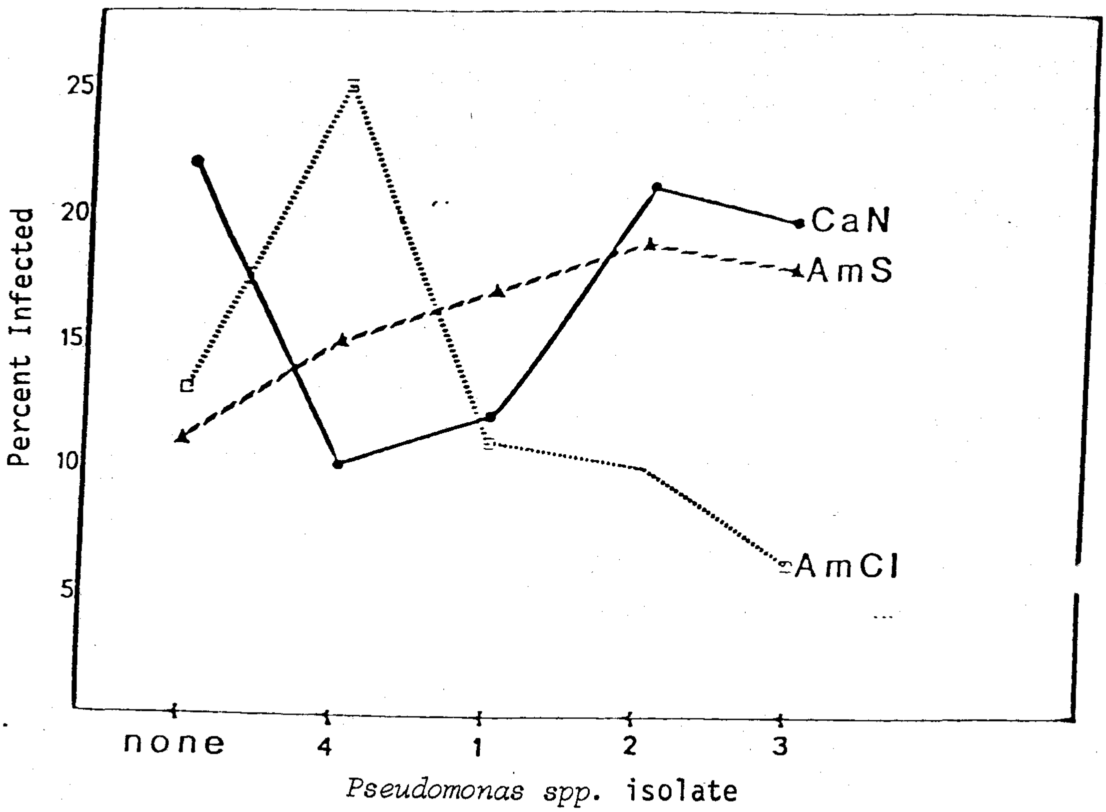

Figure 2. Effect of bacterial *(Pseudomonas spp.)* seed treatments and banded fertilizers on the percent of winter wheat roots infected with take-all root rot (TARR) in non-fumigated soil, at the Hermiston site of the Columbia Basin Agriculture Research and Extension Center. LSD .05 = 11% CaN = calcium nitrate, Ams = ammonium sulfate, Am Cl = ammonium chloride, all banded at the rate of 30 pounds of nitrogen per acre

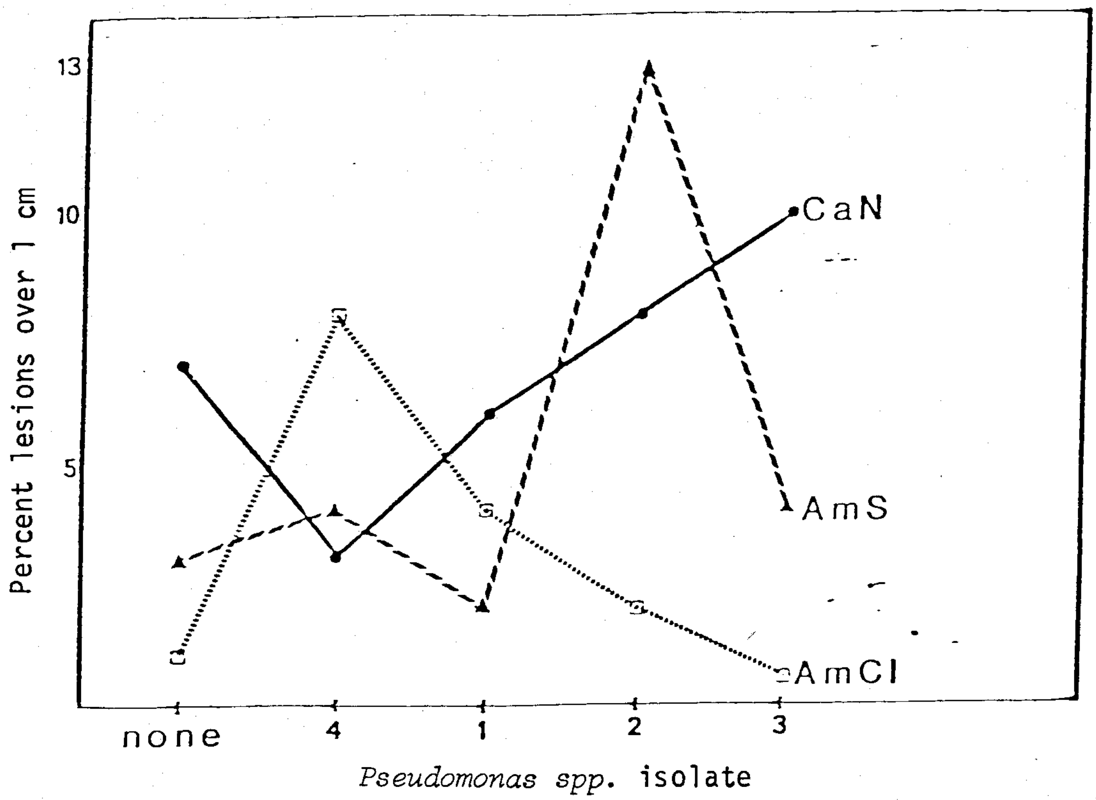

Figure 3. Effects of bacterial *(Pseudomonas spp.)* seed treatments and banded fertilizers on the percent of winter wheat roots with larger than 1 cm take-all root rot (TARR) lesions in non-fumigated soil at the Hermiston site of the Columbia Basin Agriculture Research and Extension Center. LSD .05 = 6% CaN = calcium nitrate, AmS = ammonium sulfate, AmCl = ammonium chloride, all were banded at the rate of 30 pounds of nitrogen per acre

Weather Extremes from 1932 through 1980

Temperature Extremes - Degrees Fahrenheit

	January	February	March	April	May	June
High	1971, 69	1972, 74	1960, 82	1934, 93	1951, 101	1951, 108
Low	1957, -31	1950, -29	1955, 8	1972, 19	1954, 22	1951, 37

	July	August	September	October	November	December
High	1939, 112	1961, 113	1944, 102	1943, 88	1934, 77	1941, 70
Low	1962, 39	1980, 38	1965, 27	1935, 7	1955, -12	1972, -11

Precipitation Extremes

Most precipitation per month, inches

Jan. 1970	Feb. 1940	March 1957	April 1974	May 1962	June 1948
3.06	2.70	2.72	2.13	2.20	2.19

July 1968	Aug. 1979	Sept. 1946	Oct. 1957	Nov. 1973	Dec. 1973
1.02	1.83	1.99	3.91	3.77	3.45

Most precipitation in a year, 1957, 13.99 inches
Least precipitation in a year, 1967, 4.43 inches

Most precipitation in a 24-hour period: October 2, 1957, 3.36 inches

Snow records from December 1946 through 1980

December 14, 1948, 7 inches in a 24-hour period
January 10, 1980, 12 inches on ground at 8:00 AM

Frost-Free Days

Latest frost in fall 1937, November 4, 32° Fahrenheit
Earliest frost in fall 1970, September 14, 30° Fahrenheit
Latest frost in spring 1964, May 23, 30° Fahrenheit
Earliest last frost in spring 1958, March 27, 29° Fahrenheit
Longest frost-free period in 1937, 211 days
Shortest frost-free period in 1970, 126 days

METEROLOGICAL DATA
COLUMBIA BASIN AGRICULTURE RESEARCH AND EXTENSION CENTER
HERMISTON, OREGON

T. P. Davidson[1]

Temperatures, Monthly Mean, Fahrenheit

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1980	26	35	45	53	59	63	71	68	64	50	43	38
1932-80	31	37	45	53	61	65	74	73	64	53	41	36

Temperatures, Monthly Mean Maximum, Fahrenheit

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1980	34	42	56	68	72	87	82	78	64	51	45	
1932-80	40	46	56	66	75	82	90	88	80	68	51	44

Temperatures, Monthly Mean Minimum, Fahrenheit

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1980	18	30	35	37	46	50	56	54	49	37	35	31
1932-80	23	29	33	39	47	47	58	58	48	39	31	27

1980 Temperatures, Monthly Maximum and Minimum, Fahrenheit

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Max	53	59	62	86	86	85	100	96	92	86	65	67
Min	-4	15	23	24	37	40	44	38	38	24	23	11

Precipitation, Inches

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1980	2.23	1.22	.75	.23	1.37	.62	.09	T	.75	1.03	.93	1.63
1932-80	1.22	.91	.73	.64	.65	.60	.20	.28	.41	.76	1.14	1.27

Total Precipitation in 1980, 10.85 Inches

Average Total Precipitation 1932-80, 8.81 Inches

Evaporation - Inches

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1980			3.65	5.98	7.06	8.31	11.03	9.64	6.55			
1932-80				5.27	8.07	9.65	11.24	9.63	6.23			

Wind Velocity - Miles Per Hour Average

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1980	1.8	1.5	4.9	3.3	3.5	3.8	2.9	3.0	3.1	1.3	1.7	2.0
1932-80	2.5	2.9	3.8	4.3	4.0	4.1	3.6	3.2	2.6	2.2	2.3	2.5

Frost Free Days

1980	April 11	October 10	182 Days
1932-80	April 23	October 10	170 Days

[1] Assistant Professor Emeritus of Horticulture, Columbia Basin Agriculture Research and Extension Center, Hermiston, Oregon 97838