Irrigated Crop Research in Oregon's Columbia Basin

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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 Services'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 1983 include potato yield and disease trials, insect studies, alfalfa yield trials, fall grazing crops, grape variety observations, corn and cereal yield trials, wheat, barley, and triticale breeding trials, water use patterns, cereal diseases, weather observations, and lawn grass variety trial.

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POTATO VARIETY PERFORMANCE TRIALS IN NORTH CENTRAL OREGON, 1982

Dan Hane[1]

The potato (*Solanum tuberosum* L.) variety performance trials are integral to the potato variety development program at the Columbia Basin Agricultural Research Center near Hermiston. They serve as a scoreboard for a new line's adaptation to the Hermiston area. These performance trials provide information about yield, quality, growth habits, disease resistance, storability and processing potential. Insights to management techniques particular to a line also surface.

PROCEDURES

Trials are planted from late March through mid-April in a randomized block design with four replications (three in off-station trials). The soil type at the Research Center is an Adkins loamy fine sand. Soil types in commercial fields vary from loamy sand to sandy. All seed is hand cut, treated with fungicide and bagged for individual plots. 'Russet Burbank', 'Lemhi' and 'Norgold Russet' are included as check varieties. Each plot consists of one 25-foot row. Rows are on 34-inch centers and plants are spaced nine inches apart in the row. A five-foot border is maintained between replications.

Management practices suitable to the Hermiston area are applied in the trials. Pesticides are applied as needed. A per acre fertilizer mix of approximately 100 pounds of nitrogen, 150 pounds of phosphorous, 150 pounds of potash, 60 pounds of sulfur and needed minor elements is banded at planting. During the growing season 200 to 275 pounds of additional nitrogen per acre is applied through the irrigation system. Frequent sprinkler irrigations, generally three times per week, are required to supply needed water.

RESULTS AND DISCUSSION

The 1982 off-station variety trial results are summarized in Tables 1 and 2. Varieties did not retain the same yield ranking from location to location, but the overall average indicates their comparative performance. The highest yielding variety, AL9870-3, shows some overall promise except for minor internal defects. Management directed towards keeping tuber size smaller should, however, minimize its internal problems. The next highest yielder, AD74135-1, has potential for the fresh market, since it usually has a high percent of number ones.

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Table 1. Total yield, yield of U.S. No. 1 and No. 2 potatoes, specific gravity, average tuber weight and percent internal defects for entries grown at four grower locations near Hermiston, Oregon in 1982

Entry	Total yield	U.S. No. 1's	U.S. No. 2's	Specific gravity	Average tuber weight	Hollow heart	Brown center	Internal brown spot
	cwt/acre	percent			ounces	percent	percent	percent
A69870-3	630	87.9	3.7	1.081	10.4	3.8	0.3	0.3
AD74135-1	630	67.5	17.1	1.078	12.2	0.5	0.0	0.0
Lemhi	561	69.2	13.8	1.082	10.8	7.0	0.0	0.0
A74393-1	558	80.6	7.3	1.081	10.8	23.0	0.0	0.0
Targhee	532	76.9	7.1	1.082	9.5	2.3	0.3	0.0
Russet Burbank	530	58.0	19.0	1.080	9.3	2.8	1.3	1.0
Butte	450	61.8	11.0	1.085	8.4	0.5	1.5	0.0

Table 2. Potato tuber description and comments on entries grown at four grower locations near Hermiston, Oregon in 1982

Entry	Tuber Description	Comments
AD74135-1	Long-oblong, light russet	Fair, but won't fry
A74393-1	Round-oblong, medium russet	Too much hollow heart
Targhee	Round-oblong, heavy russet	Fair
Russet Burbank	Long-oblong, medium russet	Tuber shape poor
Butte	Oblong, medium russet	Poor yield
Lemhi	Oblong, medium to heavy russet	Excellent except for internals and storage
A69870-3	Round-oblong, flat, medium russet	Good, except possibly internals

Table 3. Total yield, percent U.S. No. 1 and No. 2 tubers, specific gravity, average tuber weight, percent internal defects, and fry color for entries selected from the 1982 statewide variety trial at the Columbia Basin Agricultural Research and Extension center, Hermiston, Oregon

Entry	Total yield	U.S. No. 1's	U.S. No. 2's	Specific gravity	Average tuber weight	Hollow heart	Brown center	Internal brown spot	Fry[1] color
	cwt/acre	percent	percent		ounces	percent	percent	percent	
A72685-2	902	89.1	6.2	1.088	11.2	1	0	0	2.8
A74212-1	899	81.6	12.6	1.077	9.9	0	0	0	2.7
Lemhi	820	91.6	6.2	1.087	11.9	16	0	0	0.7
RTB 80VTSC	815	76.0	13.3	1.083	11.1	0	1	0	2.5
A74123-7	808	80.7	12.9	1.085	9.9	2	0	0	2.3
ND385-4	782	91.0	3.1	1.079	8.1	0	0	0	2.1
A71997-8	779	92.1	1.8	1.082	10.0	0	0	0	1.0
A69087-3	755	95.8	2.0	1.082	10.1	3	0	6	1.1
A7279-12	724	82.7	11.5	1.094	11.0	0	0	0	1.1
A7242-3	705	95.1	2.7	1.085	9.4	1	0	0	2.9
A68678-2	685	86.2	9.1	1.076	15.3	1	0	0	3.1
ND681-3	674	84.8	3.6	1.084	8.2	1	2	0	---
Norgold	613	90.5	3.2	1.084	10.5	6	0	3	2.8
5% LSD	200			0.006					

[1]0 = very light 4 = very dark

Table 4. Total yield, percent U.S. No. 1 and No. 2 tubers, specific gravity, average tuber weight, percent internal defects, and fry color for entries in the 1982 Western Regional Variety Test at the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon

Entry	Total yield	U.S. No. 1's	U.S. No. 2's	Specific gravity	Average tuber weight	Hollow heart	Brown center	Internal brown spot	Fry[1] color
	cwt/acre	percent	percent		ounces	percent	percent	percent	
A74212-1	999	82.0	11.8	1.076	10.9	0	0	1	3.1
A72685-2	901	85.5	9.1	1.087	11.9	6	3	6	3.2
*A70365-6	818	84.0	9.7	1.075	14.6	2	0	2	2.9
Lemhi	774	88.4	5.9	1.084	10.6	10	0	0	0.2
Russet Burbank	767	63.8	24.2	1.084	10.6	3	1	0	2.6
AD74135-1	748	65.8	23.5	1.077	12.1	1	0	0	2.8
A74133-1	735	93.5	24.0	1.077	9.5	1	0	0	3.8
A7596-1	718	89.6	7.1	1.089	12.0	5	0	5	1.7
BC9289-1	716	88.1	3.5	1.076	7.2	6	0	3	3.1
*A74127-2	623	75.0	19.0	1.076	12.6	1	0	0	2.6
*A74104-8	511	75.5	15.2	1.074	11.6	3	1	5	2.4
WC285-18	490	77.1	8.8	1.076	9.1	3	0	0	3.0
Norgold	441	86.5	2.2	1.075	6.8	1	0	0	3.3
WC630-2	420	82.5	6.5	1.076	8.8	6	0	0	3.1
WC567-1	418	68.4	16.6	1.069	7.4	0	0	0	3.2
ND9474-6	332	81.4	0.3	1.068	6.6	1	1	2	1.2
*Nooksack VR	304	78.5	3.7	1.090	7.7	1	0	0	3.2
WC708-6	295	80.8	5.6	1.071	7.8	3	0	0	3.2
5% LSD	203			0.005					

[1] 0 = very light 4 = very dark

* These entries entered only at the Hermiston location.

Thirteen out of 45 lines tested in the statewide trial were selected for testing in 1983 (Table 3). Two of the high yielding lines, A69870-3 and A74212-1, are of especial interest. A69870-3 yields are high in this trial, but it is borderline on acceptance because of hollow heart and internal brown spot. A74212-1 is a line with fresh market possibilities due to its percent of No. 1 tubers, tuber size and desirable internal structure.

Although there are high yield potentials in some lines in the Western Regional Trials (Table 4), they generally have one or more undesirable factor like the check varieties 'Russet Burbank', 'Lemhi' and 'Norgold '. Developing and identifying lines genetically superior to 'Norgold', 'Lemhi' and 'Russet Burbank' are more likely now that Oregon and the Northwest have increased efforts in breeding and selection. New potential lines may require management alterations to realize their full potential.

A74212-1 and A7596-1, selections from Aberdeen, Idaho, were entered in the Western Regional Trial by Oregon State University after initial screening trials indicated a potential worth. High yield, grade-out No. 1 tubers, low percent of hollow heart, brown center, and internal brown spot in A74212-1 favor a fresh market potential. Bottleneck-shaped tubers and general roughness seen in 1982 need further evaluation. A7596-1 processes very well, has high yield, grade-out, and specific gravity, and tubers are large. Its high percent of internal defects, hollow heart and internal brown spot, may deter this line's release. Management practices are being studied in an effort to reduce these defects to an acceptable level.

CORN GRAIN AND SILAGE VARIETY PERFORMANCE IN THE COLUMBIA BASIN OF OREGON

F. V. Pumphrey[1]

Field corn grain and silage variety trials were conducted in 1982 on the Hermiston Research and Extension Center. The varieties in each trial were entered by the companies listed in Table 1. Grain yield and silage yield (green field weight) comparisons were the main objectives of these trials.

PROCEDURE

The soil survey presently in progress is designating the soil of the test site as Adkins fine sand; fine sand is four to five feet deep over fine gravel.

Residue from the 1981 crop, field corn, was disced in late fall. Prior to planting, precision subsoiling (subsoiling where each row was to be planted) was done. Fertilizer at the rate of 375 pounds per acre of 10-20-10 was incorporated into each row with a 16-inch wide rototiller. A total of 280 pounds per acre of additional nitrogen was applied in three applications after plant emergence and before pollination.

Each trial consisted of five replications with plots two rows wide and fifteen feet long. Rows were placed 34 inches apart. The trials were hand-planted April 26 and 27. Plant populations at harvest were 33,000 plants per acre for the grain trial and 36,000 for the silage trial.

Germination, emergence, and early growing conditions were excellent. Extremely rapid early growth appeared to have contributed to plants being taller than normal and highly susceptible to damage from a strong wind in early July. The lodging reported in Tables 2 and 3 resulted primarily from the wind storm in early July.

Irrigation water was applied as needed via sprinklers. Sprinkling frequency was three times per week from mid-June to mid-August, approximately 1.9 inches of water were applied weekly during this period. Atrazine was applied preemerge to control weeds.

Climatic conditions were favorable for corn production except for the damaging wind in early July. No frosts occurred in the spring after the corn was planted or before the silage corn was harvested in mid-September. Several light frosts occurred before the grain trials were harvested October 18 to 21.

The grain trial was picked and weighed, and grain samples were obtained for determining moisture in the grain. The silage trial was cut, weighed, and subsampled immediately for dry matter determinations. The subsamples were oven dried at 70 degrees C.

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Table 1. Companies contributing varieties to the 1982 Corn Variety Tests at the Research and Extension Center, Hermiston, Oregon

Brand	Company	Address
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
N. W.	Green Thumb	Caldwell, Idaho 83605
Jacques	Jacques	Prescott, Wisconsin 54021
PX	Northrup King	Bloomington, Minnesota 55420
Pfizer	Pfizer Genetics, Inc.	Olivia, Minnesota 56277

Table 2. Green forage weight, percent ears, dry matter, plant height and lodging in the 1983 Corn Silage Test at the Research and Extension, Hermiston, Oregon

Company	Variety	Green forage	Plant height	Lodging	Ears	Dry Matter	
		tons per acre	feet	percent	percent		tons per acre
Crookham	SS70	40.0	11.2	30	27.2	25.5	10.2
Crookham	SS605	43.3	11.2	58	22.5	25.0	10.8
Crookham	CX01063	39.1	11.2	10	29.1	26.9	10.5
Crookham	CX01064	38.1	10.3	14	26.4	25.4	9.7
DeKalb	XL67	41.6	11.7	60	28.8	24.4	10.1
DeKalb	XL73	43.2	10.7	20	23.6	24.7	10.7
DeKalb	XL74A	40.0	12.1	23	26.4	27.5	10.8
DeKalb	640	40.9	10.9	43	23.3	24.7	10.1
Ferry Morse	GT A493	42.9	11.3	0	21.6	24.4	10.5
Ferry Morse	GT 4025	42.7	10.8	3	24.8	22.9	9.8
Germain's	G-4657	42.4	11.3	37	24.6	27.9	11.8
5% LSD		3.7	----	--	3.5	----	0.5

Table 3. Grain yield, moisture in the grain at harvest, plant height and lodging for varieties in the 1983 Grain Corn Test at the Research and Extension Center, Hermiston, Oregon

Company	Variety	Grain yield 15.5% moisture	Moisture at harvest	Plant height	Lodging
		bushels per acre	percent	feet	percent
Crookham	SS305	147.3	30.3	11.4	5
Crookham	CX01065	170.1	32.3	11.1	19
Crookham	CX01042	149.8	30.6	11.6	1
Crookham	SS53	162.2	32.5	11.7	22
DeKalb	XL71	196.9	35.5	11.3	36
DeKalb	XL72A	173.8	35.7	11.3	10
DeKalb	XL73	192.5	34.6	11.6	7
DeKalb	XL74B	189.9	36.8	12.1	26
Ferry Morse	GT2006	182.9	30.9	10.4	0
Ferry Morse	GT2008	180.7	33.5	11.5	16
Ferry Morse	GT3006	184.2	35.0	11.5	13
Ferry Morse	GT3020	183.3	35.3	11.9	30
Germain's	G4323	166.2	32.1	10.9	26
Germain's	G4507	195.2	35.7	11.1	30
Green Thumb	N.W.6	167.6	31.8	10.2	0
Green Thumb	N.W.7	195.5	32.5	10.9	0
Green Thumb	N.W.8	184.6	28.8	11.0	1
Green Thumb	N.W.9	179.6	34.7	10.2	0
Green Thumb	N.W.10	191.4	32.3	10.7	2
Jacques	7780	188.2	35.5	10.9	20
Jacques	JX179	189.2	34.5	11.2	10
Jacques	JX180	174.3	35.5	11.0	21
Jacques	JX247	198.0	36.4	12.0	16
Northrup King	PX39	177.7	30.9	11.6	10
Northrup King	PX72	213.0	36.5	11.2	50
Northrup King	PX74	196.2	36.4	11.5	56
Northrup King	PX9454	149.4	32.9	10.5	1
Northrup King	PX9573	198.5	35.7	11.8	43
Pfizer	T1000	188.3	31.6	10.2	0
Pfizer	T1100	198.2	34.2	10.9	16
Pfizer	T1230	190.7	36.2	12.2	7
Pfizer	TXS115A	179.8	35.7	11.4	34
5% LSD		16.5			

RESULTS

Grain yield, moisture content of the grain at harvest, plant height and lodging information are presented in Table 3. Most varieties produced good yields. Some differences in grain moisture between grain varieties were measured, however, all varieties contained higher moisture than desirable for storage.

Lodging caused by the wind storm in early July varied considerably between varieties. Lodging was only weakly correlated to the varieties' mature plant height.

Green forage weight, percent ears in the grain forage, percent and tons dry matter, plant height, and lodging are presented in Table 2. Green forage weights were all excellent; however, the percent dry matter was rather low. Tons per acre dry matter were approximately the same as in previous years.

The varieties with higher percent ears (husks and ear) generally were the varieties with the higher percent dry matter and lower tons green forage.

A SUMMARY OF GRAIN SORGHUM (*SORGHUM BICOLOR* [L.] MOENCH) SCREENING TRIALS IN EASTERN OREGON

Mathias F. Kolding[1]

Grain sorghum (*Sorghum bicolor* [L.] Moench) is grown as both an irrigated and dryland crop. It is a summer annual raised from southern Texas to central South Dakota. As climatic conditions change in the corn-sorghum interface, the sorghum acreage increases during droughty periods, but is displaced by corn in the wetter years. At various intervals, when growers or dealers feel new varieties may prove acceptable, trial acreages are planted in the western states. Ross and Webster (2) write that although "Sorghums include such basic groups as milo, kafir, durra, hegari, feterita, shallu, and koaling, pure line varieties derived by hybridizations, and selection, and F-1 hybrids," most modern sorghum varieties are based on introductions from 1874 to 1908. They further state that grain sorghums harvestable by grain combines were not generally accepted until the World War II era when manpower shortages promoted mechanical harvesting. By the 1950's shorter varieties as 'Martin', 'Caprock', 'Plainsman', 'Norghum', 'Redbine', 'Redlan', and 'Reliance' were in production. Soon hybrid sorghums became available and constituted nearly 100% of the sorghum acreage in the 1960s.

Sorghum is a warm weather crop. Leonard et al. (1) set 45^o to 50^{o}F as the minimum temperature range for germination, and a 70^{o}F daily average as the most favorable for plant development.

Dr. Shree P. Singh (personal communication), former sorghum breeder for CIMMYT, International Center for Improvement of Maize and Wheat, Mexico, selected sorghum lines which would germinate, grow, set seed, and mature in low temperatures. As a part of his breeding program, he sent "cool tolerant" variants in bulk populations to cooperators.

Ross et al. describe sorghum as a small seeded crop. Seed size will range from 1/16 inch to nearly 3/16 inch in diameter. Seeding rates of 100,000 seeds per acre are common. Care is required when seeding to place seeds at a one-inch depth if moisture is available, but not deeper than two inches in drier soils. For a dryland situation plant densities may vary from 20,000 to 50,000 plants per acre. Plant populations should range from 100,000 to 120,000 plants per acre in irrigated fields.

Drought resistance, as described by Leonard et al., (1) is largely due to several visible factors. Sorghum leaves have a cutinized layer which inhibits desiccation; these leaves fold inward during drought periods. Mature sorghum roots are adventitious, fibrous, and profusely branched.

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Sorghum can yield five tons per acre in irrigated Texas and Oklahoma fields.

Though sorghum distribution is limited by cool temperatures, it has a wealth of variability. For example, plant height extends from eighteen inches to twelve feet. Plants may have one to a dozen tillers. Stems vary from 1/2 inches to 1 1/2 inches in diameter. Kernel colors range from white to reds to black. Sorghum may have leaves as narrow as sudan grass, or as wide as corn. Panicles range from those nearly as open as oats to compact types which appear as a solid seed clump. Flowering dates in some selections are as early as 60 days after planting while others remain vegetative in northern day-length regimes. Late season watering stimulates unwanted tillering in certain cultivars. Sorghum's variability and potential yield suggests that the search for variants adapted to cooler zones could be productive.

METHODS

As a part of the more vigorous effort to develop or discover high yielding feed grains for Oregon, a representative collection of private and public cultivars was assembled in 1972. A grain yield trial (Table 1) was planted near Pendleton, Oregon, on May 19. Next to the trial, a randomly mated F-3 bulk selection population from CIMMYT in Mexico was planted as a pollen donor around a 'Reliance' male sterile (ms) selection received from Dr. Allyn O. Lunden, South Dakota State University, Brookings, South Dakota. Ten and four-tenths inches of water were applied through sprinkler irrigation: 2.3 inches presoak, 2.6 at tillering, and 5.2 during anthesis. The Reliance male sterile selection was harvested, and 1743 selections were taken from the F-3 bulk.

On July 2 and 3, 1973, the 1743 selections, the Reliance ms 1972 bulk plus 180 heterogeneous lines in the Cool Tolerant Sorghum Trial (distributed by CIMMYT) were planted on the Umatilla National Wildlife Refuge northwest of Irrigon, Oregon. The late planting date delayed anthesis until a time when cool night temperatures reduced seed set. Selections were made from plants having 90 to 100 percent seed set. No mature hard seed was obtained in the Cool Tolerant Sorghum Yield Trial, but selections were made within 14 populations.

In 1974 selections were grown at the Pendleton site of the Columbia Basin Agricultural Research Center and on Malcolm Fargher's ranch at Dufur, Oregon. Subselections were taken from within populations at both sites.

A sorghum trial was established at Carl Keyser's farm at The Dalles, Oregon, in 1975, from which 1660 lines were selected for 1976.

In 1976 the Reliance ms bulk was grown as border plots around the sorghum trials. In 1977 it was planted on about two acres on the Thompson-Schuening farm near Helix, Oregon. This latter area, higher and cooler than at Pendleton, provided a more stressful selection environment.

In 1978 selections were evaluated at the Research and Extension Center near Hermiston. Reliance types were selected from the Reliance ms bulk in 1979. In 1981, 724 selections were taken (Table 3) from 1227 lines, and the Reliance types were increased in isolation.

RESULTS

In the initial sorghum trial eight selections produced more than 5300 pounds of grain per acre (Table 1 and 2). None were dry enough for grain storage even though bundles were shocked and allowed to dry for a week before threshing. Some of the dampness was due to late tiller formation. Bushel weight and plant heights were acceptable. The Reliance male sterile line and plants selected from the F-3 bulks, however, were mature.

Moisture determinations in Table 4 are closer to actual field conditions since standing plants were harvested directly. Grain yields for the 120 entries tested at Paul Keyser's near The Dalles, Oregon, ranged from 637 to 6130 pounds per acre. Observations about nine of the cultivars grown are given in Table 4.

As a part of the sorghum breeding effort, 315 heterogeneous fertile, matured lines were submitted to CIMMYT in 1974.

Table 3 lists 724 open pollinated "cool tolerant" bulks and their pedigrees in the feed grains germplasm collection.

Head selections from the Reliance male sterile x "cool tolerant" CIMMYT bulks grown in isolation are now ready for a breeders seed plot.

DISCUSSION

Profitable sorghum production is probably not at its geographic limit. Sorghum could fit into Oregon's irrigated rotations along the Columbia River after a cereal is harvested for forage, where irrigation water is limited, or protective crop residue covers sandy soil.

If a three and one-half ton grain yield per acre is possible with a modest effort, such as used in the yield trials, then an intensive management system should produce four or more tons per acre.

Though row spacing, plant populations, dates of planting, proper herbicide applications, and watering schedules are essential practices, they were not studied. Most effort was to find cultivars adapted to Oregon. Cool night temperatures in the Columbia Basin appear to slow plant growth, interfere with seed set, and seed maturation. Random mating with and between the CIMMYT populations and the male sterile Reliance have produced a wealth of helpful germplasm.

The Reliance male sterile bulk has enabled the selection of "cool tolerant" types. The type selected for breeders seed is male fertile. It is 40 to 48 inches tall with medium-thick stems. The panicle is semi-open with medium-sized pinkish white seeds. After breeders seed is produced, it will be offered to growers and form a base for testing other experimental sorghum selections.

Table 1. Yield, bushel weight, heading day, days to heading, plant height of eight sorghum varieties (*Sorghum bicolor* [L.] Moench) in an irrigated yield trial grown near Pendleton, Oregon, 1972

Cultivar or source	Identity	Yield per acre	Bushel weight	Day headed	Days to heading	Plant height
		pounds	pounds	50 percent		inches
South Dakota	506	6748	57.2	8-4	76	50
Northrup King	121	6138	57.7	7-27	68	43
Dorado	"E"	6011	56.8	8-16	88	44
South Dakota	503	5923	56.5	8-8	80	52
Texas AM	RS626	5848	54.3	8-8	80	49
Pronto	"B"	5778	54.3	8-8	80	49
PAG	354	5679	54.7	8-6	78	41
Northrup King	133	5377	55.2	8-10	82	48

Table 2. Kernel maturity, tillering type, sterility and grain moisture of eight sorghums (*Sorghum bicolor* [L.] Moench) in an irrigated yield trial grown near Pendleton, Oregon, 1972

		August 29		September 25		
Cultivar or source	Identity	Kernel[1] maturity	Late tillering	Kernel[1] maturity	Sterile heads	Grain moisture
			percent		percent	
South Dakota	506	M	20	M-HD	nil	15.0
Northrup King	121	MD	5	HD	nil	14.3
Dorado	"E"	M	20	MD	15	15.7
South Dakota	503	M	20	M-HD	15	15.1
Texas AM	RS626	M	30	MD	5	16.4
Pronto	"B"	SD	30	MD	20	14.3
PAG	354	M	20	HD	5	16.4
Northrup King	133	M	60	SD	nil	15.2

[1]Kernel maturity. M = milk, SD = soft dough, MD = mid-dough, HD = hard dough.

Table 3. List of sorghum (*Sorghum bicolor* [L.] Moench) cultivars selected from open pollinated "cool tolerant" bulks grown from 1972 through 1981 in north central Oregon

	Identity	Source or pedigree	Number of selections
1.	FS75621-814	T75A-1614	10
2.	FS77712	BJ-105	12
3.	FS73015-701	Bulk (Morrow)	13
4.	FS77713	BJ-39	8
5.	FS77712-812	BJ-105	13
6.	FS77714	BJ-168	13
7.	FS75618-810	P75AP-613	18
8.	FS75620-811	T75A-1443	17
9.	FS75620-813	T75A-1443	21
10.	FS77717	BJ-238	17
11.	FS77719-816	(Africa/Outcross) P74A-S175/BJ-6	32
12.	FS73015-503	Bulk (Morrow)	21
13.	FS77713	BJ-74	37
14.	SD-106	South Dakota	9
15.	FS77721-816	Bulk	20
16.	FS77716	BJ-197	6
17.	FS75625	T75A-1307	10
18.	FS77S-T-01	Helix Reliance type	7
19.	FS75724-811	T75A-2037	11
20.	FS77715	BJ-28	21
21.	ST-Helix	Reliance Types "CT"	33
22.	FS75621-812	(Short, early) T75-1614	11
23.	FS75622-815	(Early) T75A-1774	21
24.	FS72-BAT-215	(Tall) Man. 42-1	8
25.	Early Reliance	Reliance ms	11
26.	FS77715	BJ-28	18
27.	FS73015	Bulk (Morrow)	23
28.	FS75628	FS72BAT 263-503	31
29.	FS75621-811	T75A-1614	21
30.	FS75623-811	T75A-1811	29
31.	FS75623-811	T75A-1811	7
32.	FS77718-816	71L-816/BJ330	33
33.	FS77736	45875/CT37-5	6
34.	Early Reliance	Reliance ms	20
35.	FS77737	TAMBK47/CT41-2	10
36.	S-T	Helix "CT"	10
37.	FS77738	SA5875/CT37-3	12
38.	FS72BAT215-701	Man 42-L	11
39.	FS73015-506	Bulk (Morrow)	24
40.	FS7406-627	Dufur Bulk	12
41.	FS77711 (Short)	BJ-84	10
42.	FS77717-812	BJ-238	37
43.	FS77735	Bulk	20
44.	White Reliance	Reliance ms	10
		Total number of selections	724

Table 4. Yields, tillering ability, plant height, head type, bushel weight, grain moisture and kernel characteristics of nine grain sorghums (*Sorghum bicolor* [L.] Moench) grown in a yield trial on the Paul Keyser farm near The Dalles, Oregon, 1975

Identity	Grain yield	Tiller[1] ability	Plant height	Head[2] type	Bushel weight	Grain moisture
	pounds		inches		pounds	percent
FS7315-4004	5367	yes	42	3	55.4	19.8
FS7315-4014	4887	yes	42	3	54.0	21.3
FS7315-4043	4962	no	46	3	52.3	22.5
FS7315-4057	4606	yes	37	3	53.1	22.2
FS7315-4069	4693	no	58	2	54.5	16.9
FS7315-4086	6131	yes	52	3	53.4	21.6
FS7315-4087	5375	yes	39	3	54.2	22.0
SD.-106	5200	no	39	3	54.1	22.5
Reliance ms	2575 (3)	yes	46	3	54.1	21.0

[1]Tendency to tiller.

[2]Density of panicle: 1 is dense, 2 is intermediate, 3 is open.

(3) Extensive bird damage.

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SELECTING FOR A NEW POTATO VARIETY AT HERMISTON, OREGON

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

Growth in north central Oregon's potato (*Solanum tuberosum* L.) industry paralleled development of center pivot irrigation in the region, and the area soon became the leading potato producing area of the state. Land new to potatoes provided a relatively disease-free environment for crop growth and yields were high. As the development of new land stabilized and cropland was rotated back into potatoes, disease buildup reduced yields. Responding to the needs of the industry, with direction from the Oregon Potato Commission, Oregon State University increased its efforts to find disease-resistant varieties adaptable to Oregon.

Local selection of early generation potato lines for evaluation in the Hermiston variety trials is an important part of the total variety development program. Selections are recovered from: 1. single hills of first generation tubers, 2. single hills for reselection, and 3. true potato seed (TPS) from open-pollinated lines planted directly into the field.

PROCEDURES

Cultural practices for single hill plots were similar to those of commercial plantings except that selections were spaced three feet apart within the row. Identities were maintained throughout the growing season.

TPS plantings required more critical management. Cover crop and weeds were killed with glyphosate. Rows were marked with a 17 inch rototiller which also incorporated dyfonate and eptam. TPS was planted in early May with a modified flex planter that drops approximately three seeds every nine inches. Frequent, light, irrigations were used to insure good germination. Since seedlings are not competitive, weed control was critical and although herbicides were used, several hand weedings were necessary.

RESULTS

In 1982, 852 first generation tubers, 1265 second generation tubers and twenty open-pollinated lines of TPS were planted at Hermiston.

Table 1 lists the pedigrees of the nine hills selected from the first generation tubers. Second generation single hill plot pedigrees are in Table 3. Forty hills were saved from the initial 1265 plantings. The open-pollinated lines and number of tubers selected from each are given in Table 2. The 206 tubers selected from the TPS planting will be grown as 4-hill plots at Hermiston in 1983 to evaluate tuber size, type, general yield potential and internal quality factors.

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Table 1. Parents and hills selected from the 1982 first generation single hill plots at the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon

Oregon identification	Parents	Number of hills selected
AH8092-(1-3)	A68113-4 x A74389-1	3
AH80536-1	WnC612-13 x A74579-3	1
AH80648-(1-3)	Nooksack x WnC612-13	3
AH80588-(1-2)	Butte x WnC612-13	2

Table 2. Identity of open pollinated true potato seed and number of tubers selected from each line at the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon 1982

Identity	No. of Tubers Selected
Lemhi	14
Allagash Russet	4
WnC316-1	11
WnC316-1	11
WnC612-13	17
WnC672-2	16
A67142-1	11
AD7267-1	10
A72602-2	16
AD7377-1	10
AD74112-4	16
A74595-17	13
A7596-1	7
A75188-3	11
NebA7672-1	6
B 868668	5
Mass Intercross	13
WnC521-12	6
Explorer	1
Unknown	8

Table 3. Parents and hills selected from the 1982 second generation single hill plots at Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon

Oregon identification	Parents	Number of hills selected
A79120-H1	A69327-5 x A66102-16	1
A79130-H1	A69327-5 x FL1154	1
A79141-H1	A69657-4 x Lemhi	1
A79164-H1	A69741-2 x Lemhi	1
A79236-H1	A72685-2 x A6948-4	1
A79239-H(1-3)	A72685-2 x A70365-6	3
A79242-H1	A72685-2 x A74393	1
A79247-H(1-3)	A72685-2 x NDA9729-2	3
A79248-H1	A72685-2 x WnC345-15	1
A79357-H1	B7024-81 x Lemhi	1
A79366-H1	B7024-81 x WnC345-15	1
A79377-H1	BC8370-4 x Belrus	1
A79424-H1	NDA9729-2 x Nooksack	1
A79431-H1(1-2)	WnC318-9 x Lemhi	2
A79454-H1	A69236-1 x Russette	1
A79491-H1	Butte x Russette	1
A79494-H1	Butte x WnC345-15	1
A79513-H1	Russet Burbank x A6948-4	1
A79545-H1	Norland x AC67560-1	1
ND1370-H1	Lemhi x TND14-1 Russ	1
ND1411-H1	Minn. 9152 x Lemhi	1
ND1447-H1	Wisc. 738 x Norchip	1
ND1465-H1	ND115-21R x ND390-4R	1
ND1500-H1	ND329-4 Russ x TND14-1 Russ	1
ND1503-H(1-2)	ND383-9 x Norchip	2
HD1532-H1	ND412-2 x Wischip	1
TX768-H1	Atlantic x TX6-086-2RU	1
C07906-H1	WC230-14 x Wn284-1	1
C07914-H1	WC316-1 x Centennial	1
C07916-H(1-2)	WC521-12 x BC8370-4	2
C07919-H1	WC521-12 x WC316-1	1
C07924-H1	WN451-2 x WN284-1	1
C07926-H1	Nooksack x WC230-14	1

Single hill selections will go into 10-12 hill preliminary nonreplicated 1983 yield trials. Information obtained at this level will determine a lines potential for the Hermiston area and future testing.

Earlier generation selection gives us more input in developing lines adaptable to the Columbia Basin of Oregon. It is anticipated that this program will expand as Oregon's potato evaluation program gains momentum.

GREEN PEACH APHID (*Myzus persicae*) SURVEY FOR THE HERMISTON-BOARDMAN AREA OF OREGON'S COLUMBIA PLATEAU[1]

Luther A. Fitch[2]

Approximately one million dollars per year are spent by the potato industry in the Hermiston-Boardman area to control green peach aphids *Myzus persicae*--vectors of leaf-roll 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 Richard Clarke. One facet of the study, a trapping program to monitor seasonal movement and buildup of aphid populations, is continued as a seasonal guide. The grower association is funding this program under the supervision of the local Extension potato agent.

METHODS AND MATERIALS

Yellow, four-gallon, plastic pans two-thirds full of water are positioned at 30 or more selected locations throughout the potato growing area. The growing region was arbitrarily divided into four areas in 1978 to determine direction of invasion. Areas are delineated in (Figure 1). A few grains of Cu S04 are placed in the pan to control growth of algae. All aphids are collected weekly and placed in numbered vials (containing 70 percent alcohol). The remaining contents of the pan are discarded and the trap-pan refilled with fresh water.

After all traps are collected, aphids are removed from the vials The green peach aphids are identified and counted under a microscope. A report, sent to growers and service industry personnel, lists the weekly count of green peach aphids and other aphids by location.

RESULTS

The same general trend was seen in aphid populations trapped in 1982 (Figure 3) as in previous years (Figure 2). (See special Research Report #664, July 1982, pages 63-66). This was true particularly in regard to relative population trends between areas with highest populations coming from areas nearest urban and suburban centers.

Aphids appeared earlier in traps in 1982 than in previous years except 1978, built to slightly higher populations during the July through August period, and held the population levels up over a longer period of time than in years previous.

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

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

CONCLUSIONS

Population patterns continue to support the evidence that local populations are perpetuated on the overwintering host peach trees. With relatively mild winters such as in 1981-1982 it is probable that adult aphids survived at low levels on other host plants.

Even with peach aphid high populations in 1982, the incidence of leaf-roll virus disease was relatively low in the area. This was due to careful selection, by most growers, of disease-free seed and use of routine control sprays and timely sanitation (clean-up) of volunteers and culls. All of these measures must continue to be followed rigorously because as a vector of leaf-roll virus, green peach aphids continue to pose a potential threat to the local potato industry.

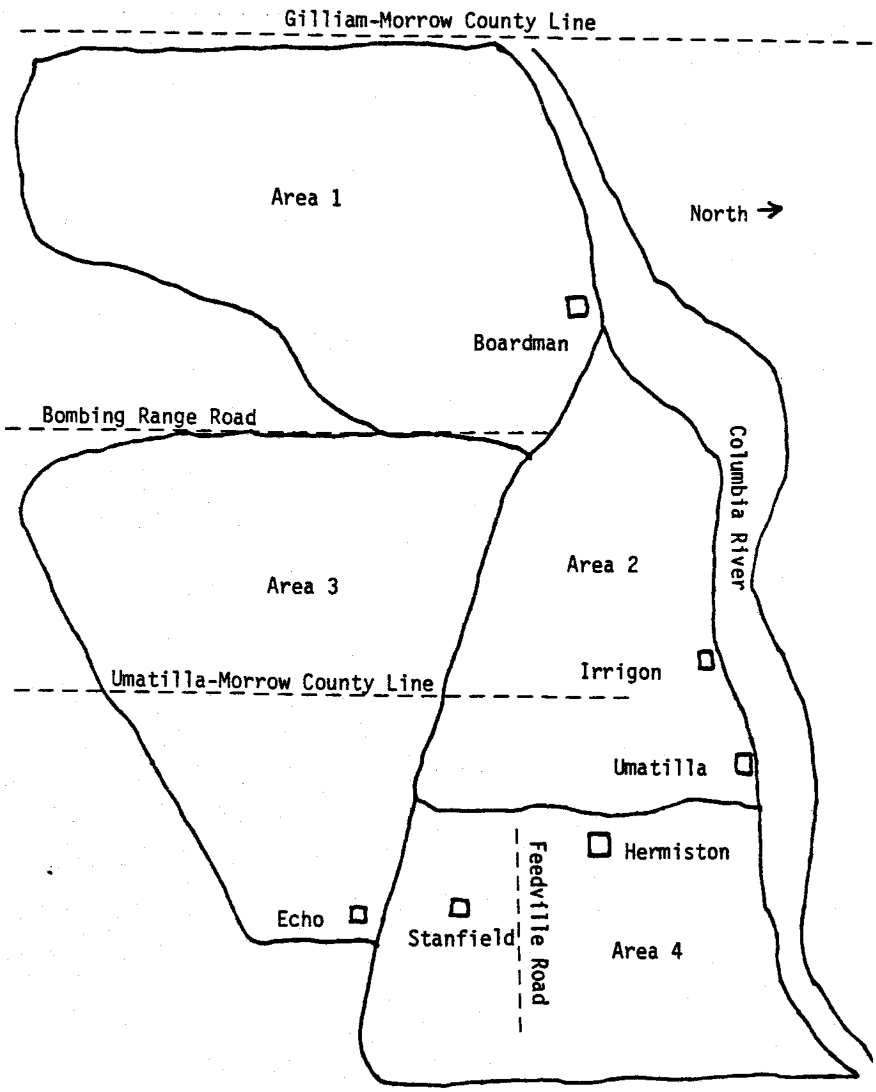

Figure 1.

Map Outline of Western Umatilla - North Morrow County Potato growing region showing the four area divisions used for aphid trapping.

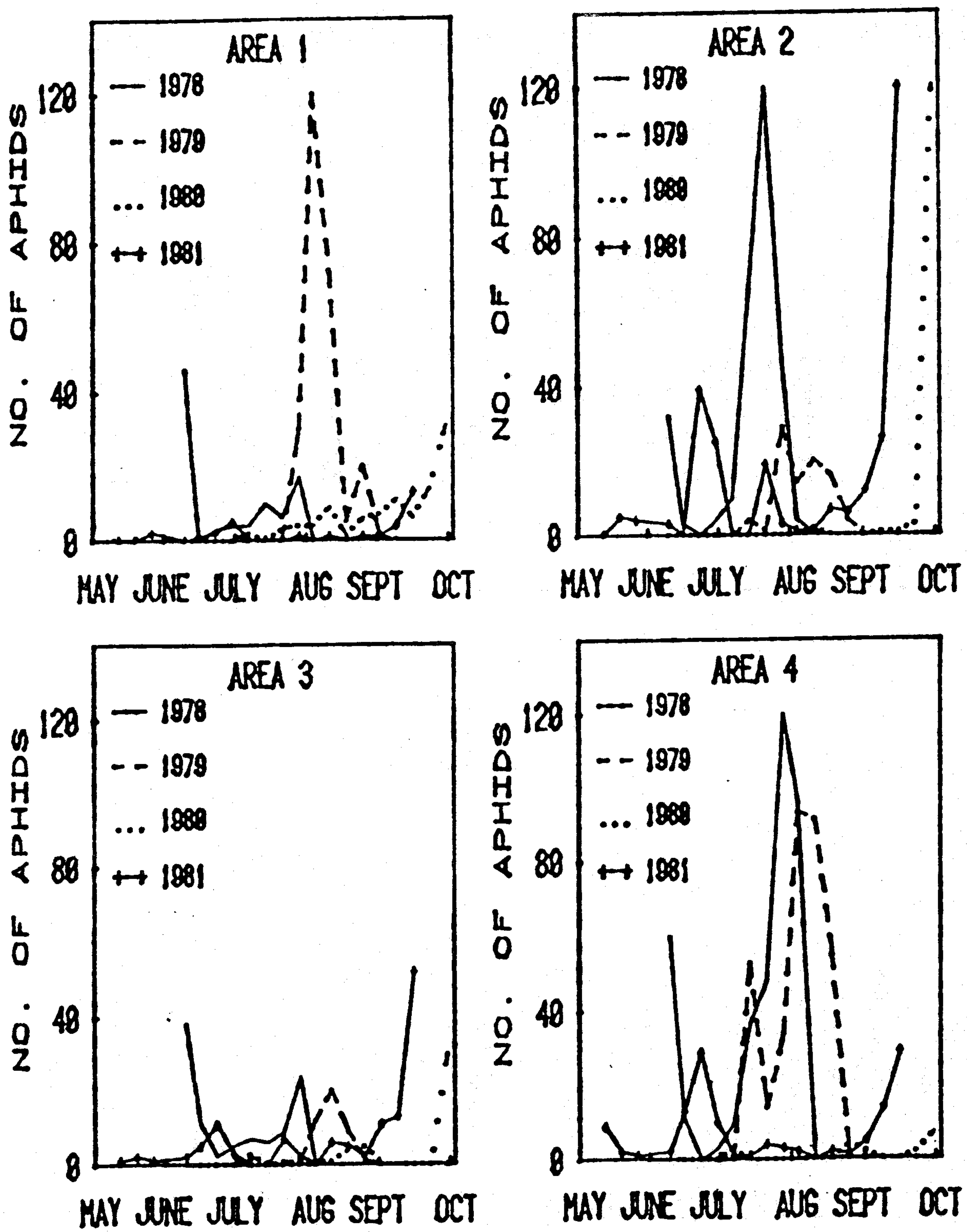

Figure 2. Numbers of Green Peach Aphids trapped from May to October in four Morrow and western Umatilla county areas during 1978 through 1981.

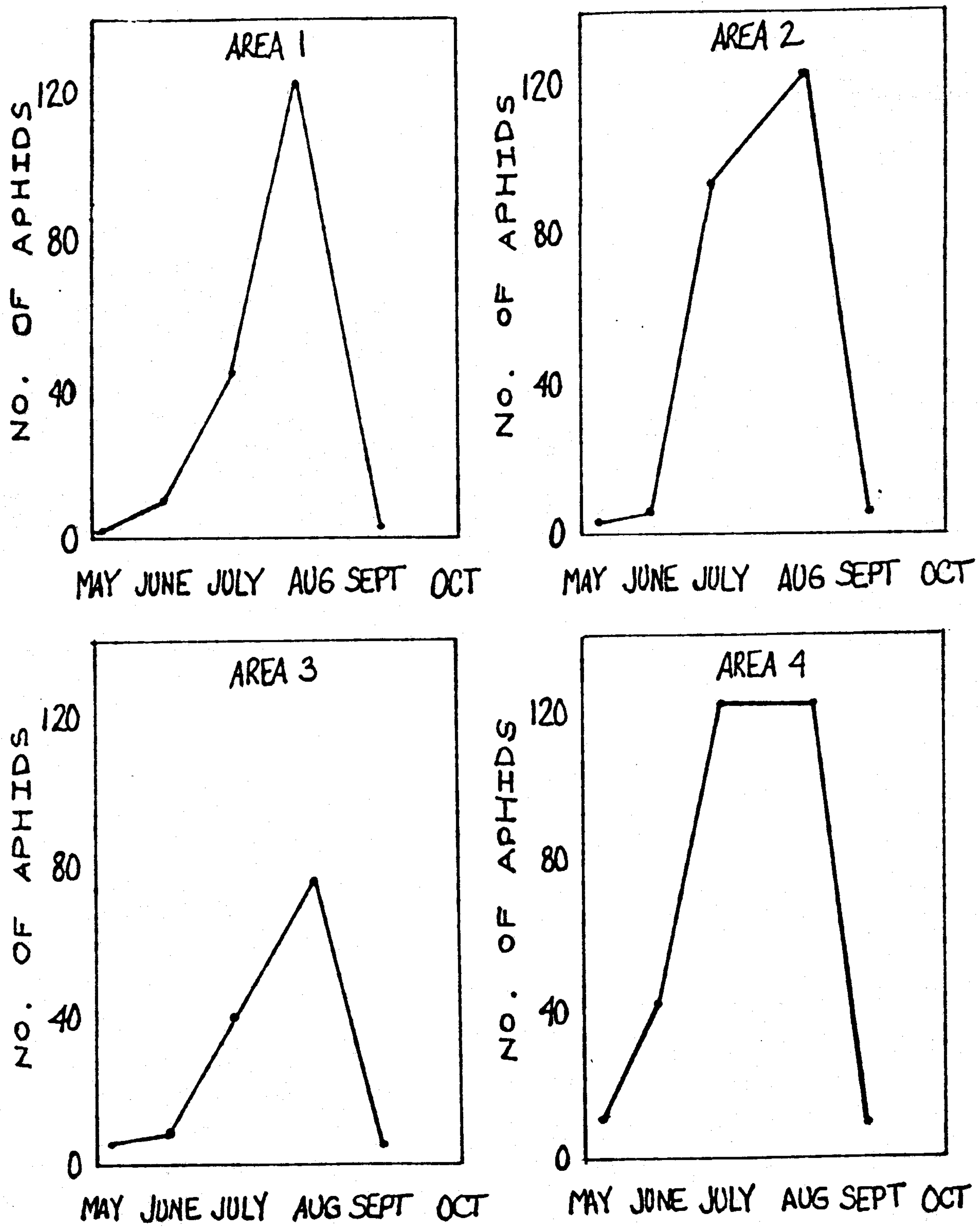

Figure 3. Number of Green Peach Aphids trapped from May to October in four Morrow and western Umatilla county areas during 1982.

BARLEY YELLOW DWARF VIRUS (BYDV) AN IMPORTANT CONSIDERATION WHEN SELECTING WINTER TRITICALE (*X TRITICOSECALE*, WITTMACK) FOR OREGON

Mathias F. Kolding[1]

Sources of resistance (tolerance) to Barley Yellow Dwarf Virus (BYDV) in barley (*Hordeum vulgare* L.) are nearly established in: Suneson's (9) report of the recessive yd 1 gene in the cultivar 'Rojo', Rasmussen's and Schaller's (7) discovery of the dominant YD 2 gene in several Ethiopian barley introductions and untraced sources in winter barley such as 'Post' where Grafton et al. (4) found a high BYDV tolerance, but unexpected since it is not knowingly related to the Ethiopian lines carrying Yd2.

Resistance to BYDV wheat (*Triticum aestivum* L.) is more vague than in winter barley. Cultivars reported resistant in Oklahoma and Illinois, for example, are not resistant in Oregon screening trials.

In BYDV selection trials at Hermiston, Oregon, Kolding (6) reports only two named wheats, 'Moldova' and 'Riebesel', as not having visible BYDV symptoms. Those varieties were not tested for yield effects, nor was an attempt made to recover BYDV isolates. Moldova and Riebesel have either a chromosome addition, or substitution from an *Agropyron sp.* so the question remains whether resistant selections from Moldova or Riebesel crosses would have immunity, or serve as tolerant BYDV reservoirs.

Carrigan et al. (1) write that the environment has a sizable influence on field symptoms so they are not a reliable criteria to use when selecting for BYDV resistance. In their trials some wheat lines without yellowing had reduced yields, while other lines with extensive chlorosis had negligible yield losses. At times BYDV influenced both decreases and increases in head counts. BYDV, however, usually reduced the number of fertile florets.

Some of the confusion about visually evaluating BYDV resistance versus susceptibility in cereal grains could have a relationship to subtle predominant isolate changes lined to aphid specie changes as suggested by Rochow (8).

Though the usefulness of visual field symptoms is doubted by some, they were useful to Cisar et al. (2) when evaluating wheat x tall wheatgrass (*Agropyron elongatum* [Host] Beauv.).

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Grafton et al. (4) noted plant height reduction, tillering changes, predisposition to winter injury, smaller seeds, and yield loss in BYDV infected winter barley.

Gill (3) found indirect effects such as changes in baking, or milling quality, reduced seed size, and germinability in 'Gleanlea' and 'Neepawa' spring wheats supported the use of BYDV visual infection indexes. He also found reduced kernel weight, less kernels per head, stunting, and early yellowed leaves that died quicker than non-yellowed. Infected leaves and stems darkened prior to ripening in a manner similar to saprophytic bacteria and fungi invasions of dead tissue.

A literature search through the "agricola" reference system used by the Oregon State University did not reveal any reports of BYDV symptoms in rye (*Secale cereale* L.).

Differential BYDV symptoms were observed in winter triticale at Hermiston, Oregon. BYDV symptoms in triticale are similar to those described in barley and wheat except they are not as striking.

PROCEDURE

Each fall, since 1974, heads from promising selections, advanced lines, and introduced winter triticale were hand planted as close to August 31 as practical on the Hermiston site of the Columbia Basin Agricultural Research Center. Head selections taken from both within the BYDV trials and other triticale trials are planted as whole heads. Plants emerge rapidly during the usual warm early September days so they are in the two to three-leaf stage for mid-September gravid aphid flights. Plots are observed weekly during September and October to ascertain aphid presence and the predominant specie. No attempt is made to destroy the aphids in the plot area. Fall and spring BYDV symptoms are recorded. Promising lines not having BYDV symptoms are tagged and harvested for the next year's BYDV screening trial. In some instances seed lots are divided, and "resistant" lines are entered in yield trials. During the growing seasons infected head rows are removed. Seed harvested from the remaining rows is planted in larger plots for increase and re-evaluation. Those larger plots which appear nearly symptomless to BYDV plus other diseases especially associated with early fall planting are entered into yield estimate trials.

A winter triticale germplasm development and exchange program was started with Dr. Robert Metzger, USDA, ARS, Corvallis, Oregon, in 1976. The first material received from him was grown at the Columbia Basin Agricultural Research Center near Pendleton, Oregon. In 1977 the better appearing lines were grown on the Wulff ranch near Flora, Oregon. Dr. Metzger and the author selected plants from the best surviving populations, as well as those not infected with Cephalosporium stripe (*Cephalosporium gramineum* Nis and Skata). Selections were grown near Hermiston in 1978 for seed increase. During 1979 they were entered into yield trials and the BYDV screening system. Nearly all wheat and barley lines were lost due to cold temperatures in the 1980 BYDV trials. In 1981 heads of M76-6292 and M75-8655-55 (8655) were grown in a nuclear breeders planting. Other lines were planted in the unthreshed head row BYDV screening trial. Seeds from the better rows were planted in larger plots (4 feet x 15 feet) for the 1982 evaluations.

RESULTS

Though aphids are not collected and individual specie counts made, the oat-cherry aphid (*Rhopalosiphum padi* L.) is usually the predominant specie. The greenbug (*Schzaphis graminuim* L.), corn-leaf aphid (*Rhopalosiphium maides* Fitch), and the English grain aphid (*Macrosiphium avenae* Fab.) are also present in varying densities in different years. Usually over 300 aphids per foot of row are counted when plants are in the two to five-leaf stage.

Tables 1 and 2 list observations concerning triticale cultivars growing in the 1983 winter triticale trials. The triticale have an excellent winter survival record in Oregon. In Table 1 leaf damage is reported as an estimate of BYDV expression in the plot. A reading of one to three is considered resistant. Four to five is either segregating or has questionable resistance. Seven to nine is susceptible. A bacterial leaf, stem and head infection was prevalent throughout the triticale plot area in June 1982. Most of the selections in Table 2 had good resistance, but M76-6920-507 was exceptionally clean.

Triticale selections in Table 2 have good stripe rust (*Puccinia strii formis* West) and fair *Septoria spp.* resistance. BYDV resistance is excellent. Yields ranged from a low (Nugaines) of 94 bushels per acre to a high (M75-8655-50) of 122 bushels per acre. A bacterium probably causes stand reductions during mild winters in the Willamette valley. Only one selection, M76-96A-72, was given a resistant rating. Entry 3, 8655, is in a foundation seed increase. Application for permission to release this selection to growers is planned for 1983.

DISCUSSION

BYDV symptoms in winter triticale appear as a modification of wheat symptoms, or maybe as an intermediate between susceptible wheat and resistant rye. The most severe symptoms observed in winter wheat at Hermiston were reduced tillering, dwarfing, small heads, but no rosetting or plant death as found in winter barleys. In winter triticale there is leaf yellowing and purpling in plants during warm weather that tends to disappear as fall temperatures drop. Symptoms tend to reappear after fast growth periods prior to anthesis. Sometimes plants are reduced in size and tillering may be suppressed, but not to the extent observed in wheat.

Probably the most benefit derived from exposing and selecting triticale in the BYDV trials is indirect. Damaged or infected plants may have an increased vulnerability to freezing, drought and bacterial

Table 1. 1983 BYDV winter triticale yield trial, leaf damage observed in 1981 and 1982 due to disease infection in winter triticale when seeding early (August 30 to September 5) at the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon

Identity	Pedigree	Leaf damage[1] February 3 1981	Leaf damage[1] November 9 1982
M75-8645-441	Kiss/Elt	1	1
M75-8645-446	Kiss/Elt	1	1
M75-8645-456	Kiss/Elt	1	1
M76-6153-481	Kiss/E2-241-A3-71-57M	1	2
M76-6881-490	AM 2147	1	1
M76-6881-491	AM 2147	1	1
M76-6881-496	AM 2147	1	1
M76-6920-503	Kiss/Elt BYDV	1	1
M76-6920-504	Kiss/Elt BYDV	1	1
M76-6920-505	Kiss/Elt BYDV	1	1
M76-6920-507**2	Kiss/Elt BYDV	1	1
M76-6920-511	Kiss/Elt BYDV	1	1
M76-6920-513	Kiss/Elt BYDV	1	2
M76-7244-515	Kiss/Elt BYDV	1	1
M76-7244-516	Kiss/Elt BYDV	1	2
M76-7244-517	Kiss/Elt BYDV	1	1
M76-7244-523	Kiss/Elt BYDV	1	2
M76-7244-524	Kiss/Elt BYDV	1	1
Novi Sad	879-4, wheat	-	1
Stephens	wheat	3	3
CP04	wheat	3	1
Mal	winter barley	5	4

[1]Leaf damage is an estimate of BYDV resistance. Readings are 0 to 9 where 1 to 3 is resistant, 4 to 6 questionably resistant, and 7 to 9 susceptible.

Table 2. Stripe rust (*Puccinia striiformis* West), septoria leaf, or glume blotch (*Septoria spp.*), and bacterial *Pseudomonas spp.* readings at Corvallis, Oregon, and BYDV leaf damage, and yield of triticale selections at Hermiston being tested during 1983 in eastern Oregon triticale yield trials

Identity	Pedigree	Stripe[1] rust	Septoria[2] 1981	BYDV[3] 1981	BYDV[3] 1982	Bacterium[4] Corvallis 1982	Yield[5]
							bushels per acre
M76-6292	Kiss/Elt Hardy	1R	2	1	1	7	109
M75-8655-50	Kiss/2/193-803/358, F-77	1R	2	1	1	8	122
M75-8655-55 (8655)	Kiss/2/193-803/358, F-77	1R	3	2	1	7	120
M76-96A-72	Kiss/2/193-803/358, F-77	1R	3	3	1	2	119
M76-7480-87	Flora sel. 1977	1R	4	1	1	4	117
TA76-88-56	Flora sel. 1977	1R	3	1	1	5	110
M75-8655-49	Kiss/2/193-803/358	--	4	2	1	7	113
TA76-88-50	Flora sel. 1977	--	3	2	1	4	111
CI 17596	Stephens, wheat	1R	7	5	3	1	114
FW73830CP04	RB/1523/DC, wheat	1R	5	1	2	6	100
CI 13968	Nugaines, wheat	1R	8	4	3	1	94
CI 17419	Daws, wheat	1R	6	3	3	1	112

[1]Stripe rust. 1 = 1 percent leaf area infected. R is resistant.

[2]Septoria. (1 to 9) 1 is resistant. 9 is susceptible. May 18, 1981.

[3]Barley yellow dwarf virus (BYDV) (1 to 9) 1 is resistant. 9 is susceptible. November 14, 1981 and November 9, 1982 respectively.

[4]Bacterium. (1 to 9) 1 is resistant. 9 is susceptible. April 30, 1982.

[5]1981-82 yield trial planted September 16, 1981, harvested July 29, 1982, at the Hermiston site.

or fungal disease. Triticale selected from trials at Flora or the Willamette valley have good winter hardiness and winter disease resistance, but their being cycled through the BYDV trials appears to delineate the superior lines and sub-selections.

The germplasm supplied by Dr. Metzger and consequent exchange is strengthening triticale development in Oregon. Triticale selected and tested from the BYDV trials are often used in his crosses for seed and fertility improvement.

If 8655 is released to growers, it should help to substantiate triticale's yield potential and give growers an opportunity to evaluate triticale as an acceptable crop.

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SOIL NITRATE QUANTITY AND MOVEMENT AS RELATED TO IRRIGATED WINTER WHEAT IN NORTHEAST OREGON

F. V. Pumphrey and P. E. Rasmussen[1]

The formation and retention of nitrate nitrogen (NO_3-N) in the soil are important in non-legume crop production. Temperature, moisture, the quantity and nitrogen (N) content of soil organic matter, N fertilizer application, and plant growth interact and influence the amount of available nitrate in the soil. Nitrate, because it is water soluble, is mobile in the soil and is moved by water percolating deeper into the rooting zone or possibly below the rooting zone.

The quantity, movement, and recovery of native and fertilizer NO_3 and ammonium nitrogen (NH_4) were studied in irrigated winter wheat (*Triticum aestivum* L.) fertilizer experiments conducted from 1978 through 1981. This paper reports data on soil nitrate changes from fall to spring, overwinter nitrate movement in the soil, the influence of preplant ammonium fertilizer application on the overwinter NH_4-N level in the surface soil, and the relationship between soil nitrate, fertilizer nitrogen (N) application, and grain yield.

PROCEDURE

Soil samples were taken at intervals from preplant (September or October) to late-tillering (March or April). Soil samples were air dried immediately and analyzed for NO_3-N and NH_4-N.

The Union County experiments were in fields which had received high rates of fertilizer for maximum grass seed production. Two of these experiments, A-78 and A-79, were in fields producing wheat for the second and third consecutive year. Experiment A-78 was the only experiment located where a water table developed in the rooting zone overwinter. In Umatilla and Morrow Counties wheat followed potatoes in a wheat-potato rotation.

Preplant N fertilizer was broadcast as ammonium sulfate and worked into the seedbed. Spring applied N was topdressed as ammonium nitrate when the wheat was resuming rapid growth after winter dormancy. 'Stephens' and 'Daws', soft white winter wheat varieties, were grown. Irrigation water was sprinkler applied.

Precipitation and temperature data were obtained from U. S. Weather Bureau locations at Hermiston and Union, Oregon. Grain yield was determined by harvesting with a self-propelled plot combine.

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RESULTS

Soil nitrate Nitrate-N in the upper four or five feet of soil prior to planting ranged from 11 to 301 pounds per acre (Table 1). The lowest amount of N was found in a wheat field which had produced more than 130 bushels per acre. The straw had been worked into the seedbed, and dry soil following harvest inhibited nitrification. From 44 to 301 pounds per acre of nitrate-N was found where wheat was planted after potatoes. This range in nitrate reflects variations in fertilization practices plus favorable conditions following potato harvest for decomposition of leaves and vines.

Soil nitrate in sandy soils decreased substantially between preplant October, 1977, and March, 1978 (Table 1). Extensive late summer and fall irrigating plus above average winter precipitation (Table 3) leached nitrate-N below the rooting zone. In the other years, all sites except A-80 contained as much as or more nitrate-N in March than the previous fall.

Overwinter soil nitrate changes were also affected by the amount of N taken up by the wheat. Small wheat (1-2 tillers) in the spring has 200 to 300 pounds of dry matter per acre containing 10 to 15 pounds of N per acre. Moderate growth (3-5 tillers) has 500 to 600 pounds of dry matter per acre containing 25 to 30 pounds of N. Wheat plants in this study had small growth except for those in E-78 and A-80, which had moderate overwinter growth.

Total nitrate-N in the soil profile in the 1980 and 1981 experiments remained the same or increased during the fall and winter months (Table 2); however, nitrate-N moved downward in the soil profile during the fall and winter. By February or March, several of the sites contained only minimal amounts of nitrate-N in the upper one or two feet. Part of the decrease in nitrate in the surface soil can be attributed to absorption of nitrate by the wheat plants, but most of the decrease is the result of leaching.

Irrigated wheat normally absorbs most of the nitrate in the upper three feet of soil during growth from jointing through grain filling. After-harvest sampling indicated that the wheat had removed most of the nitrate in the upper three feet of soil (Table 3). Irrigated wheat frequently does not utilize all the nitrate-N below a depth of three feet. Nitrification was restoring nitrate-N to the upper foot in experiment E-80.

Soil ammonium The low ammonium-N content of nonfertilized soil in October (Table 4) indicates rapid conversion to nitrate at this time of year. Ammonium-N in nonfertilized soil increased as temperatures became cooler (from October to December), indicating microorganisms were converting organic-N to ammonium-N faster than ammonium-N was being absorbed by the wheat or being converted to nitrate-N. Ammonium-N in two of the three fertilized soils decreased during the fall months and progressively decreased in all soils after January.

Grain yield, grain yield increase from N fertilization, and soil nitrate Grain yields of nonfertilized wheat ranged from 42 to 109 bushels per acre (Table 1). Grain yield of nonfertilized wheat was not related to either the preplant or March nitrate-N in the soil. Fertilizing with N increased grain yield significantly in each experiment. Yield increases ranged from 19 to 64 bushels per acre. Yield increases from N fertilization were not related to the amount of nitrate-N in the soil at seeding or in February or March.

DISCUSSION

Grain yield of unfertilized wheat was not related to the nitrate-N quantity in the soil prior to planting or the following March. The lack of correlation was unexpected since a reasonable relationship exists in dryland production: soil with high nitrate-N content produces higher yields and needs less nitrogen fertilization for optimum yield than soil with low nitrate-N. Greater diversity in previous crops and cropping practices increase the difficulty in accurately predicting fertilizer N requirements of irrigated wheat.

All the soils were moist prior to wheat planting to the depth sampled (4 or 5 feet) because most irrigators apply sufficient water before planting to wet the soil to a depth of several feet. Also, most irrigate after the wheat has emerged if there has been minimal fall rain. Excess irrigation water and/or precipitation will leach soluble nutrients from upper soil depths. Above-average precipitation and liberal fall and early spring irrigation practices in 1977-78 (before the present increase in energy costs) were sufficient to leach nitrate-N below 5 feet depth. In subsequent years of less overwinter precipitation and fall irrigation, nitrate-N decreased in the surface soil; but total nitrate in the soil profile did not decrease. Minimum fall and early spring irrigation necessary for wheat will help reduce overwinter leaching of soluble nutrients to lower depths or out of the rooting zone.

High amounts of nitrate in some fields following potatoes are associated with potato fertilization practices. It appears that considerably more N fertilizer was applied in some fields than was used by potatoes.

Plant residue from previous cropping contributes potato vines, pea vines, and/or grass roots and crowns which have potential for rapid decomposition and release of N to the following crop. September and October soil moisture and temperature conditions are favorable for nitrification and producing nitrates in excess of that needed by young wheat plants. Ammonium-N accumulates during the winter months in soils when temperatures are so low that nitrification of ammonium does not occur or occurs very slowly. When ammonium fertilizer is applied at favorable soil temperatures, ammonium converts rapidly to nitrate.

The complex interactions between fall irrigation, overwinter precipitation, previous cropping practice, and residue decomposition makes soil testing for nitrate-N of limited usefulness in predicting N-fertilizer need of irrigated winter wheat.

Table 1. Location, soil depth, soil texture, previous crop, fall and spring nitrate-N content, grain yield, and yield increase from N fertilization for irrigated wheat fertilizer experiments in northeast Oregon, 1978-80

Experiment		Soil		Previous	Soil nitrate-N[3]		Grain yield	Yield[4]
No.	Co.[1]	Text.[2]	Depth	crop	Preplant	March	No N applied	increase from N
			feet		pounds per acre		bushels per acre	
A-78	UN	sil	0-4	wheat	66	91	66	19
B-78	UN	vfsl	0-5	peas	99	41	56	28
C-78	UMA	fsl	0-5	potatoes	220	116	53	39
D-78	UMA	fsl	0-5	potatoes	123	86	63	34
E-78	MO	fsl	0-5	potatoes	100	8	61	40
F-78	UMA	ls	0-4	potatoes	54	29	49	49
A-79	UN	sil	0-5	wheat	11	52	71	64
A-80	UN	sil	0-5	peas	120	78	109	21
B-80	UN	sil	0-5	peas	44	83	84	40
C-80	UMA	ls	0-5	potatoes	192	216	48	48
D-80	UMA	fsl	0-5	potatoes	168	231	42	54
E-80	UMA	sl	0-5	potatoes	55	105	63	35
F-80	UMA	fsl	0-5	potatoes	301	307	90	20

[1]County location: UN = Union, UMA = Umatilla, MO = Morrow

[2]Soil texture: sil = silt loam, vfsl = very fine sandy loam, fsl = fine sandy loam, ls = loamy sand, sl = sandy loam

[3]Nitrate-N in non-fertilized soil; ammonium-N was low in each soil

[4]Yield increase resulting from optimum N fertilization. Details on rate and time of N fertilization are in Oregon Agricultural Experiment Station Circular of Information 691, 1982. Winter wheat fertilization in Northeast Intermountain Region of Oregon, F. V. Pumphrey and P. E. Rasmussen.

Table 2. Overwinter and after harvest soil nitrate-N content by depth in the rooting zone of irrigated winter wheat in northeast Oregon

		Feet					
Experiment	Month	0-1	1-2	2-3	3-4	4-5	Total
		Nitrate-N, pounds per acre					
A-80	October	37	23	21	21	18	120
	November	20	32	27	40	25	144
	March	13	9	20	19	17	78
B-80	October	30	6	1	3	4	44
	November	52	10	7	4	3	76
	March	19	30	22	7	5	83
C-80	October	35	24	37	49	--	145
	November	61	84	44	31	--	220
	December	24	50	45	26	--	145
	February	15	46	71	89	--	221
	March	15	15	60	56	--	146
	August	7	6	5	17	--	35
D-80	October	67	23	21	28	29	168
	November	61	72	40	38	31	242
	December	43	96	58	40	26	263
	January	22	55	70	48	37	232
	February	13	37	119	74	53	296
	March	10	13	50	76	82	231
E-80	October	34	6	4	4	7	55
	November	20	30	20	16	15	101
	December	15	23	19	5	6	68
	January	8	19	30	24	11	92
	February	6	14	27	42	23	112
	March	9	7	26	36	27	105
	August	17	1	1	7	14	40
F-80	October	152	70	39	20	20	301
	November	103	59	44	30	14	250
	December	49	102	62	36	28	277
	January	21	101	111	60	29	322
	February	20	67	143	117	50	397
	March	13	14	138	108	34	307
A-81[1]	October	33	36	18	11	--	98
	November	22	35	18	10	--	85
	December	12	32	38	14	--	96
	January	7	21	33	27	--	88
	February	2	13	36	30	--	81
C-81[2]	October	106	74	56	28	42	306
	November	129	70	36	30	20	285
	December	88	124	78	42	40	372
	January	32	93	46	28	30	229
	February	4	38	78	45	31	196

[1]Loamy sand soil, Umatilla County, previous crop - potatoes

[2]Sandy loam soil, Umatilla County, previous crop - potatoes

Table 3. Precipitation and temperature averages for November 1 to March 1 at Hermiston and Union, Oregon as compared to long-term means, 1978 to 1980

Crop year	Nov. 1 to Mar. 1 precipitation Hermiston	Union	Nov. 1 to Mar. 1 temperature average Hermiston	Union
	inches		^{o}F	
1977-78	6.96	6.02	36.8	37.5
1978-79	4.58	4.40	29.0	27.3
1979-80	5.60	3.62	34.0	35.5
1980-81	5.08	5.06	39.3	37.8
1932-81	4.58	4.61	36.8	34.3

Table 4. Overwinter ammonium-N content in the top foot of nonfertilized and ammonium fertilized soil growing winter wheat in northeast Oregon

Experiment	Fertilizer N applied[1]	Month sampled Oct	Nov	Dec	Jan	Feb	Mar
	pounds per acre	Ammonium-N pounds per acre					
F-80	0	--	--	--	--	32	8
A-81	0	7	12	19	18	8	--
	50	28	35	42	17	13	--
	100	91	79	38	23	16	--
C-81	50	42	19	16	17	8	--

[1]Ammonium sulfate applied prior to planting.

DETERMINING WATER REQUIREMENTS OF RUSSET BURBANK POTATOES IN NORTH CENTRAL OREGON

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

The potato (*Solanum tuberosum* L.) is sensitive to deficit and excessive supplies of water, however, yield and quality suffer most noticeably when water is in short supply. Supplying water to the growing potato crop as needed, and in correct amounts, improves yield and quality and reduces production costs through water and energy conservation. Since estimating exact water needs is difficult, relationships of the potato growth stage and environmental demands are needed for scheduling irrigation water. Though visual estimates of growth stage are easily determined, estimations of environmental demands upon the crop are more difficult to obtain.

PROCEDURE

To uniformly wet the soil to a depth of more than 40 inches, water was applied before and within a few days after potato planting.

Before plant emergence, a sprinkler line was installed in the center of the plot parallel to the rows. Neutron probe access tubes were placed in the ground in two rows 55 feet apart perpendicular to the sprinkler line. Tubes within each row were 68 inches apart. The tubes closest to the line source were 51 inches from the line source. Soil moisture was determined weekly at depths of 6, 18, and 30 inches.

Water scheduling was based on an estimated crop coefficient (K) which changed with growth stage and evaporation from a Class A Weather Bureau evaporation pan (EP) located within 1/4 mile of the experimental sites. Water applications as suggested by KEP were adjusted to equal field capacity in the upper 24 inches of soil approximately 23 to 26 feet from the sprinkler line.

Irrigation water applied was caught in cans placed on top of the access tubes and measured immediately after each irrigation. During most of the growing season, irrigations were applied early in the morning to minimize wind interference. Forty-four irrigations were applied in 1980 and 48 in 1982. No surface runoff occurred.

Experiments were located on Adkins loamy sand (mixed, mesic, Xerollic Camorthids). Available water holding capacity was 1.69 inches in the 0-12 inch depth, 1.45 inches in the 12-24 inch depth, and 1.53 inches in the 24-36 inch depth.

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A 20-foot length of row on each side of each access tube was harvested for tuber yield and quality determinations. Optimum potato yield was determined to be the maximum yield obtained with efficient water use as designated by using linear regression to establish relationship between water consumed and tuber yield.

Weekly ET was calculated using the equation:

$$ETw = (Si - Sf) + I + P$$

where

ETw = evapotranspiration each week
Si = initial soil moisture
Sf = final soil moisture
I = irrigation water
P = precipitation

Weekly coefficients of evapotranspiration (Kw) were calculated for the growing season as:

$$Kw = \frac{ETw}{EPw}$$

ETw data used in calculating Kw were from areas within the experimental site where optimum potato yields were produced.

RESULTS AND DISCUSSION

The potatoes were planted in early April, emerged during the first week in May, and initiated tubers during the last of May and early June.

Full ground cover was achieved by mid-June. Maximum leaf area index (LAI) of about three occurred over a period of three to four weeks from late June to after mid-July followed by increasing senescence up to vine kill.

Potatoes adjacent to the line source used over 55 percent more water than the optimum yielding potatoes (Figure 1). Potatoes at the outer edge of the experimental site used 50 percent less water than the optimum yielding potatoes. Plants growing more than 20 to 23 feet from the line source depleted most of the soil moisture from the 24 to 36 inch depth by the time of tuber initiation. Since soil moisture at the 24 to 36 inch depth was less than field capacity during the remainder of the growing season, it is assumed that no water percolated below the rooting zone. Thus, water consumed (11.8 to 26.5 inches) from the outer edge of the line source to within 20 to 23 feet of the line source was water consumed in ET.

Total yield and yield of marketable potatoes increased at a mean linear rate until the optimum yield was obtained (Figures 1 and 2).

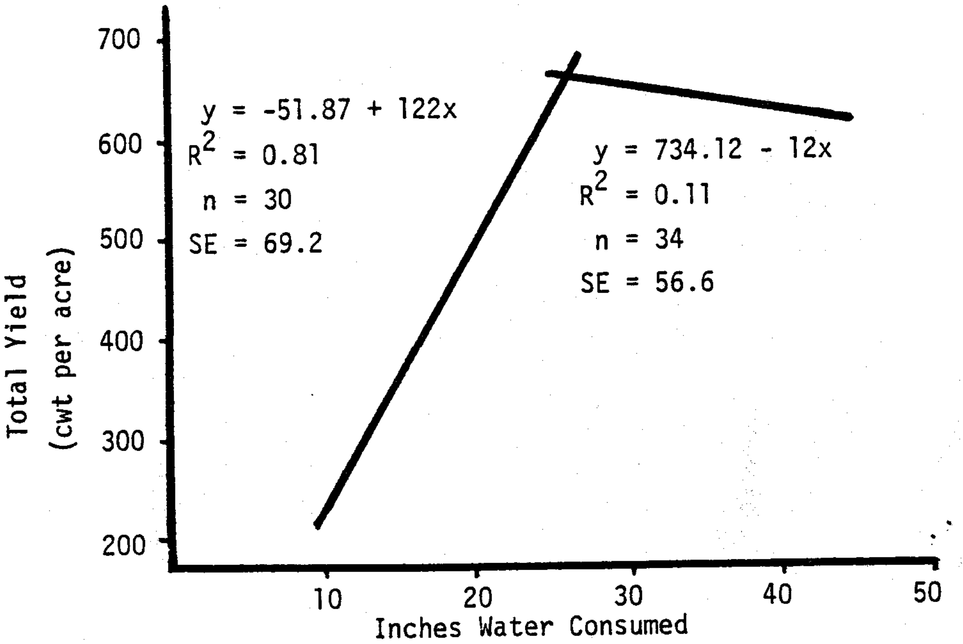

Figure 1. Relationships between water consumed and total tuber yield of frequently irrigated Russet Burbank potatoes, Hermiston, Oregon, 1980 and 1982

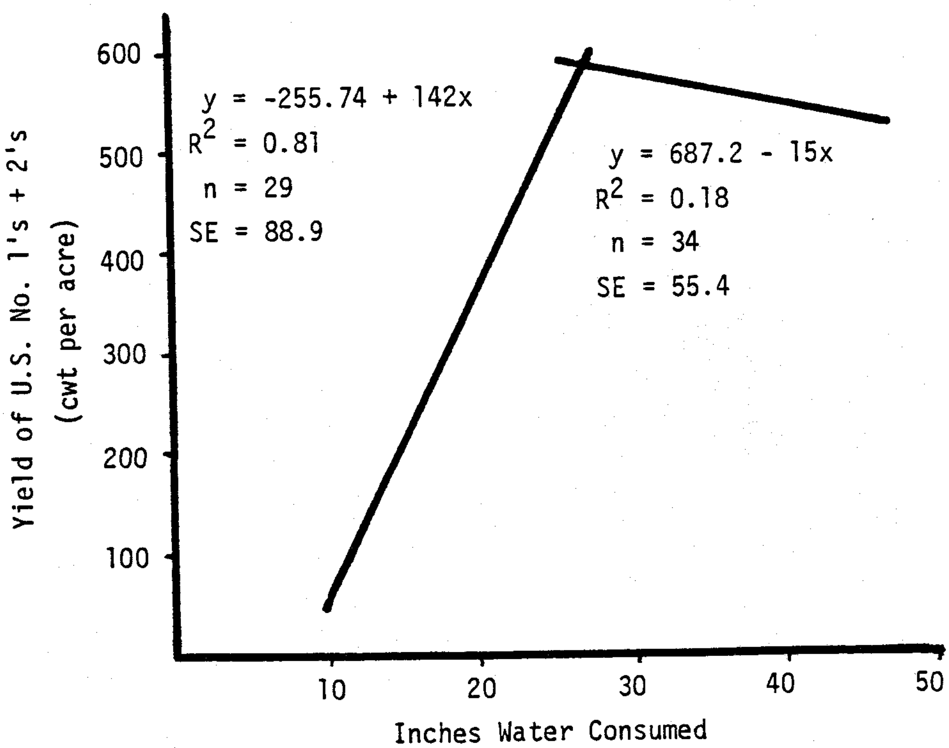

Figure 2. Relationships between water consumed and yield of No. 1 and 2 tubers of frequently irrigated Russet Burbank potatoes, Hermiston, Oregon, 1980 and 1982

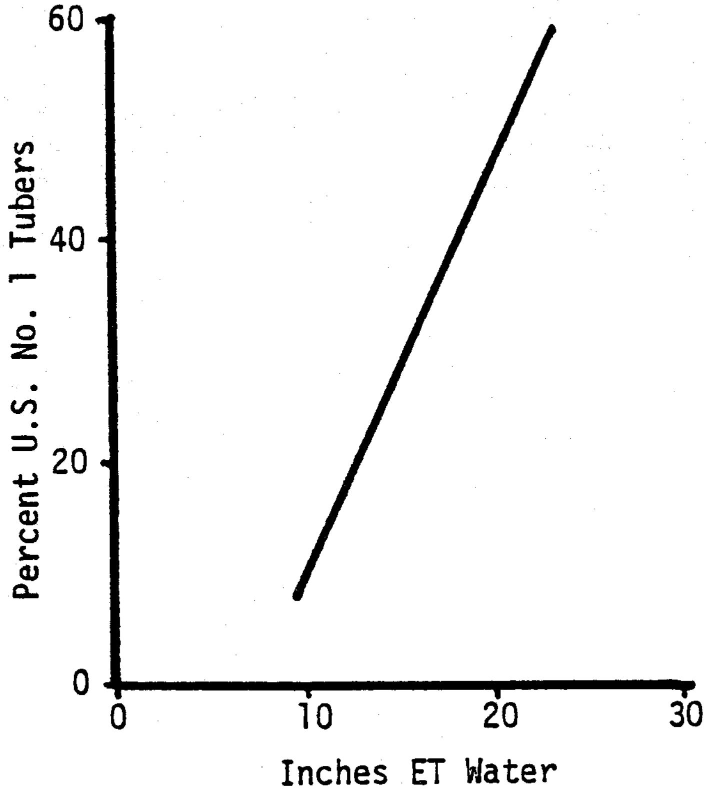

Figure 3. Relationship between percent U.S. No. 1 tubers, variety Russet Burbank, and evapotranspiration (ET), Hermiston, Oregon, 1980 and 1982

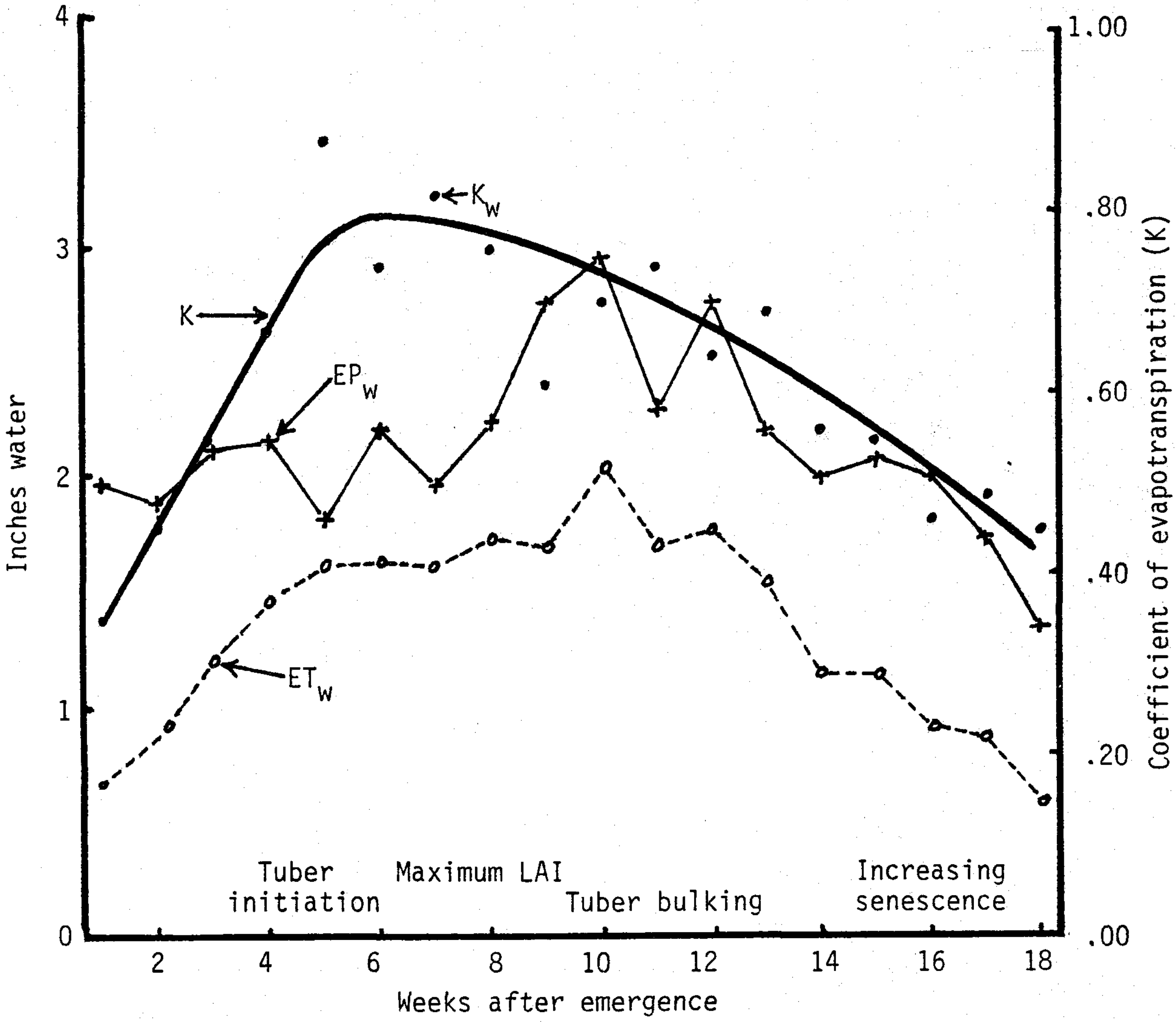

Figure 4. Weekly evapotranspiration (ET_w), pan evaporation (EP_w), and coefficient of evapotranspiration (K_w) and growing season curve of coefficient of evapotranspiration (K) of frequently irrigated Russet Burbank potatoes, Hermiston, Oregon, 1980 and 1982

Total yield increase per inch of ET was 27.6 cwt/acre. Yield of No. 1 and No. 2 tubers increased 32.15 cwt/acre per inch of ET. Optimum yield occurred where 24.5 to 25.5 inches of water were consumed which is slightly less than the maximum water consumed in ET. The percent No. 1 potatoes increased linearly with increased ET (Figure 3). Water consumption above 23.5 inches had no consistent effect on percent of No. 1 potatoes, however, enlarged lenticels and more field rotting were observed where water application exceeded ET.

Specific gravity and percent internal defects, hollow heart, brown center, and internal brown spot were lower at ET's of less than 65% (17 inches). Water consumption above 65% had no consistent effect on specific gravity, or internal defects although there was a tendency towards more internal defects at higher ET's. Internal defects were near 0% at less than 50% ET.

Average tuber size increased as water consumption increased from 50% to 90% ET. Above 90% ET average tuber size did not increase. In 1980 there was a reduction in tuber size above 135% of ET due to early plant death.

Weekly EP changed from two inches at the time of plant emergence to a maximum of 2.75 inches in mid-summer to less than 1.2 inches at the end of the growing season (Figure 4). ET of optimum yielding potatoes increased rapidly from plant emergence through tuber initiation, increased slightly during the period of maximum leaf area, and declined gradually with increasing plant senescence. K increased from 0.35 at plant emergence to near 0.8 during maximum plant physiological activity (rapid vegetative growth and initiation of reproduction) and remained between 0.7 and 0.8 during the period of maximum leaf area. With senescence of the plants, K gradually declined from 0.7 to less than 0.5.

Applying water at less than 100% of ET reduced yields by 27 cwt/acre per inch of ET. An additional 5 cwt/acre per inch of ET was lost in No. 1 and 2 yields due to external deformities and smaller tuber size.

CONCLUSIONS

Optimum yielding potatoes used 0.1 to 0.17 inches of water per day from emergence to early tuber initiation. Daily water use increased to over 0.25 inches per day during maximum leaf area and early tuber bulking and then gradually declined as plant leaves senesced and plants matured.

The importance of coordinating the coefficients (K) used in water scheduling with growth stage is evident by the changes seen in K during the growing season. Coefficients of evapotranspiration increased from .3 early in the season to over .8 during peak demand.

The use of daily pan evaporation and coefficients of evapotranspiration for the various growth stages provides a valuable tool for irrigation scheduling of potatoes.

A CEREAL SCREENING TRIAL GROWN ON A HIGH pH SANDY LOAM SITE IN NORTH CENTRAL OREGON

Mathias F. Kolding[1]

Improved irrigation technology combined with high quality water and soil resources stimulates the development of Oregon's irrigatable semiarid soils. If changes in these soil resources follow the trends found in other irrigation complexes as reported by Bresler (1), at least one-third will accumulate some undesirable degree of salinity.

If salinity accumulation is to become a problem in Oregon's irrigated soils, then some exploratory assessment for salinity tolerance in Oregon's cereal breeding populations seems desirable.

In California trials Richards (3) (personal communication) reports that barley (*Hordeum Vulgare* L.) generally has a higher salt tolerance than other non-halophytic crops. When examining barley grain and biomass production, a substantial genotype x salt concentration interaction was observed. Ried, et al., (4) reports that barley is the least tolerant cereal crop to acid conditions, but it is the most dependable for alkali conditions and grows better in soils pH 6 and above.

Bresler et al. (1) write that plant sensitivity to salinity in cereals is highest during emergence and seedling growth stages. When toxic symptoms appear, significant yield losses have already occurred.

Richards (2) explains that tolerance to saline conditions during germination is essential since good stand establishment leads to better yields. Further, there are three criteria for evaluating a crop's tolerance to saline conditions: 1. Ability to survive. 2. Yield on saline soils. 3. Relative yield on saline versus non-saline soils. A measurement of survivability is helpful but by itself does not tell grain yields also needs evaluation in non-saline conditions to determine relative yield reduction, or consistency.

Crops or variants within crops need testing within local environments since the environmental effects on tolerance according to Richards et al. (3) lead to variable tolerance responses.

METHODS

An experimental area was established in an irrigated field where effluent from a potato processing plant was the main irrigation water source. The potato effluent contained a considerable portion of organic matter, as well as, the hydroxides used in the potato processing plant.

The soil sample taken from this Quincy soil series had a pH of 9 at the sowing date, March 23, 1982, (Table 1.).

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Table 1. Soil test results from the Quincy soil series irrigated with potato plant effluent. Test sample taken at the test location near Hermiston, Oregon, March 23, 1982

pH	P	K	Ca	Mg	Na	Total N	Organic matter
	ppm	ppm	meg/ 100g	meg/ 100g	meg/ 100g	percent	percent
9.0	66	115	5.3	1.9	1.6	0.04	0.66

Five trials were established in the experimental area. The International Spring Barley Yield Trial (50 entries), distributed by the International Center for Improving Maize and Wheat, CIMMYT, Mexico, was two row plots fifteen feet long spaced with twelve inches between the rows. Each line was replicated twice. The Preliminary Spring Feed Barley (35 entries), Eastern Oregon Spring Barley (18 entries), Spring Malting Barley (12 entries) and Spring Triticale Yield Trial plots were replicated four times and planted in four row plots fifteen feet long with a twelve inch row spacing.

The soil surface was dry at sowing. Winter rains and fall irrigations provided adequate moisture at sowing depth (1-2 inches) for good stand establishment.

Irrigation water was not applied until plants had tillered or were nearly finished tillering.

The scale of 1 to 9 used to estimate plant response at four dates is described in Table 2.

RESULTS

Damage was severe in most spring barley plots. Cultivars listed in Table 3 give examples of values assigned. Except for 'Conquest', 'Glenn', and 'Morex', the first thirteen entries eventually exhibited excessive sensitivity. 'Gus', entry 13, and 'Steptoe', entry 21, appeared tolerant at first, but were very sensitive during flowering and kernel filling. 'Gus' and 'Steptoe', the two varieties used by the grower in the field surrounding the trial, yielded less than 4,000 pounds per acre.

Yields were not estimated within the trial area, but twelve of the best appearing entries were harvested on July 17 for the 1983 trials.

No spring triticale survived the seedling stage.

Table 2. Scale used to estimate damage to cultivars and expected yield performance from cultivars grown in the 1982 high pH tolerance trials near Hermiston, Oregon

Scale value[1]	Observed performance	Expected grain yield
1	Plants died prematurely	0
2	Severe damage, premature plant death expected	0
3	Damage, some grain yield (few heads)	less than 20%
4	Stunting, moderate damage (missing plants)	less than 40%
5	Would expect 1/2 yield loss (lack tillers)	50%
6	Moderate tolerance expect yield loss to more than 20% (distortions)	more than 60%
7	Damage, suspect yield loss, more than 10% (leaf burn)	more than 70%
8	Highly tolerant, could not estimate yield loss	more than 80%
9	No visible effect	more than 80%

[1]Scale value: 1 to 3 is sensitive, 4 to 6 is intermediate, 7 to 9 is tolerant.

Table 3. Evaluations of selected spring barley cultivars from four spring barley trials grown in a pH 9 site near Hermiston, Oregon

	Variety	Pedigree	Evaluation of tolerance[1] May 12	May 20	May 31	July 8
1.	Armar	CI13626	2	2	2	-
2.	Jupiter		2	2	2	-
3.	Zepher	CI 13667	2	2	2	-
4.	Betzes	CI 6398	4	2	2	1
5.	Klages	CI 15478	4	2	2	1
6.	Glenn	CI 15769	4	4	6	5
7.	Larker	CI 10648	4	5	5	4
8.	Conquest (2)	CI 11638	4	6	6	6
9.	CM67		5	3	2	-
10.	Kombar	CI 15694	5	4	4	2
11.	Arivat	CI 6573	5	4	3	-
12.	Morex	CI 15773	5	5	6	5
13.	Gus		6	5	4	2
14.	Apizaco (2)		6	5	5	6
15.	Manker		6	6	6	-
16.	CMB75A-354.0Y	Beacon/2/CM-67/Mona	6	6	6	-
17.	FB78475-003 (2)	CI 13490/Vale70	6	7	6	6
18.	A16	M-21/Karl	6	7	6	-
19.	A20	Ja/1285/2/Stp	6	7	6	-
20.	D 7	Kg/M-22/2/Karl	6	7	6	-
21.	Steptoe (2)	CI 15229	7	4	4	3
22.	Prato	CI 15815	7	6	4	4
23.	FB80504 (2)	H72-045/CI 1064-1, AL 73212-003	7	6	6	6
24.	E-13	Ja/2*Kg	7	7	6	-
25.	Summit		8	7	5	4
26.	FB78418-007 (2)	FB73782/FB741209	8	7	6	3
27.	FB80511 (2)	M76-160, (Rasmussen)	8	8	6	6
28.	FB78410-007 (2)	FB73782/FB741209	8	8	7	4
29.	FB78418-003 (2)	FB73782/FB74109	8	8	7	5
30.	FB78427-005 (2)	FB741209/Vale 70	8	8	7	5
31.	FB80509 (2)	M76-95, (Rasmussen)	8	8	8	5
32.	FB80505 (2)	WA6194/SW, AL 73069-002	8	8	8	7
33.	CMB75A-1714.0Y		8	8	8	8
34.	M-3 (2)	Mn 66-85/Calaya	8	8	8	8

[1]Scale used from Table 2.

(2) Cultivars placed in the 1983 high pH tolerance trial.

CONCLUSIONS

Spring barley cultivars in the feed grains field germplasm inventory range from very sensitive to tolerant in alkaline soil field conditions. Though it appears that those cultivars in the intermediate tolerant range would have yielded less than if grown in a more neutral soil media, it is suspected that the more tolerant selections suffered yield loss in the high pH media.

It is possible that soil pH increased during the growing season since the potato effluent was the only water source until grain filling. The irrigation water during the last May observation, for example, seemed especially highly alkaline since moisture on the plant leaves caused a burning sensation on the author's hands.

The local identity of alkaline tolerant barley varieties will help in plans for future barley crosses in the breeding program.

Those named cultivars which are tolerant will give the growers a better choice about which variety to grow on their higher pH soils.

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HERBICIDE EVALUATION ON WATERMELON CROPS IN OREGON'S COLUMBIA BASIN

L.F. Hall[1] and R. William[2]

(*Citrullus lanatus* [Thumb.] Mansf.) and other cucurbit crops grown in the Oregon counties of Umatilla and Morrow since the early 1900's has stabilized at 800-1000 acres due to market considerations. Growers are able to solve most of their crop cultural problems with two exceptions. The first is a fungus disease called fusarium wilt which builds up in the soil and attacks commercially grown melon varieties when they are rotated too often on the same piece of ground. The second problem is inadequate weed control.

Cucurbits are a minor crop, and very few effective herbicides are registered for use on them. To compound the problem, melon crops in northeast Oregon are primarily grown on sandy loam soils with less than 1% organic matter which can accentuate herbicide injury problems on the crop by those few registered herbicides.

Cucurbits are poor competitors with most common weed species. Not only is yield loss due to competition for water, light, and nutrients by weeds, but weeds can also interfere with the harvest process. When Longspine Sandbur (*Cenchrus longispinus* L.) and puncturevine (*Tribulus terrestris* L.) are in the fields, it becomes almost impossible to find hand labor to harvest the crop, so the farmer can suffer great economic loss.

During a melon grower meeting held in June, 1981, at the Columbia Basin Agricultural Research Center in Hermiston, the general concensus of melon growers present was that hand weeding costs generally ranged from $100-200 per acre. This amount makes it unprofitable to grow melons, so a definite need exists to develop procedures to use either new or existing herbicides on melon crops.

PROCEDURES

The plot design was a randomized block design replicated four times. Application of herbicides was made to the soil surface two days after planting. The plots were watered lightly with sprinklers to incorporate the materials. The plots were rated on June 3, 1981, for vigor, phytotoxic effects, and also for relative weed control. The results are presented in Tables 1 and 2.

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In 1982 two promising herbicides, ethalfluralin and napropamide, from the 1981 watermelon trial were applied to watermelons in a three replication trial similar to 1981. In addition, a nailboard was used as a harrow immediately after application to enhance incorporation of one herbicide.

It was reasoned that napropamide was not sufficiently incorporated by post application irrigation, so a nailboard was designed to incorporate the product into the surface 1/2 to 1 inch of soil. The nailboard consisted of three overlapping 2 inch x 12 inch planks nailed in an overlapping fashion. In each board two rows of holes were drilled with each hole 2 inches apart and each row also 2 inches apart. Large nails were fitted loosely in each hole and bent backward on the underside of the board. The nails were free to move in the holes and were designed to lightly rake the soil as the board was pulled across the surface.

RESULTS

Although the most effective herbicide combination (Tables 1 and 2) used in the 1981 trial was bensulide plus naptalam, phytotoxic problems precluded their use. None of the post-emergence grass killers proved effective, since early weed competition suppresses watermelon growth. Early competition is critical to melon growth and once it occurs, the melons never "catch up," and ultimate production is delayed or reduced.

Although not registered, ethalfluralin had the greatest promise in controlling weeds when it was applied immediately post-plant and water incorporated.

In the 1982 trial (Table 3) ethafluralin and napropamide were used since these two unregistered products were thought to have the best chance for registration approval.

Percent of weed control ratings are given in Table 3, and watermelon plant vigor ratings in Table 4. Time required for hand weeding, as a measure of weeds controlled, is given in Table 5. In addition, end of season residual weed control ratings are given in Table 6.

The nailboard incorporation of napropamide (Table 4) was the most effective full-season treatment for melon weed control. Ethafluralin, on the other hand, gave excellent early weed control, and the melons exhibited the greatest vigor following its use of any of the products.

Labels have been submitted to the EPA for the use of both ethafluralin and napropamide. If they are approved, their use should significantly improve watermelon production in the Columbia Basin.

Table 1. Vigor ratings as influenced by weed population and herbicide application for watermelons grown at the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon, 1981

		Watermelon vigor[2]					
Herbicide	Rate[1]	Replication 1	2	3	4	Average	Comments
Check		10	3	5	4	5.5	severe weed competition
Bensulide	2.00	10	2	4	7	5.8	
Bensulide	4.00	10	10	3	4	6.8	
Bensulide	6.00	10	7	6	8	7.8	
Naptalam	2.00	9	8	7	7	7.8	slight injury early
Naptalam	4.00	4	6	8	4	5.5	
Bensulide-Naptalam	2+2	8	9	8	8	8.3	
Bensulide-Naptalam	4+4	9	1	6	2	4.5	more injury in moist areas
Napropamide	.50	10	4	5	7	6.5	
Napropamide	1.00	10	6	8	4	7.0	leaves cupped and stunted, severe weed competition
Napropamide	2.00	6	3	2	8	4.8	growth stunted, leaves slightly cupped
Ethalfluralin	.96	8	9	7	10	8.5	
Ethalfluralin	1.31	10	6	10	10	9.0	excellent vigor
Ethalfluralin	1.50	8	8	4	10	7.5	
UBI-5734	1.00	3	8	7	6	6.0	
UBI-5734	1.50	3	3	2	3	2.8	weed competition
Diclofop	1.00	3	4	1	4	3.0	severe weed competition
Diclofop	2.00	3	3	4	4	3.5	melons stunted, weed competition
BASF 9052 OH	.50	5	1	2	7	3.8	weed competition
BASF 9052 OH	1.00	4	6	1	3	3.5	severe weed competition

[1]Pounds per acre of active ingredient applied.

[2]Rated on a scale of 1 to 10 with 10 exhibiting the most vigor.

Table 2. Weed control rating for herbicides applied on watermelons at the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon, 1981

Herbicide	Rate[1]	Percent weed control Redroot pigweed	Lambsquarter	Barnyard grass	Foxtail
Control		0	0	0	0
Bensulide	2.00	84	17	39	50
Bensulide	4.00	51	17	73	0
Bensulide	6.00	45	33	70	75
Naptalam	2.00	93	50	89	100
Naptalam	4.00	92	67	95	100
Bensulide-Naptalam	2+2	95	100	92	75
Bensulide-Naptalam	4+4	97	92	100	100
Napropamide	.50	29	0	34	0
Napropamide	1.00	50	0	78	50
Napropamide	2.00	0	0	78	100
Ethalfluralin	.96	68	83	75	100
Ethalfluralin	1.31	78	92	72	50
Ethalfluralin	1.50	79	58	66	75
UBI-5734	1.00	59	67	94	50
UBI-5734	1.50	74	0	100	100
Diclofop	1.00	0	0	0	25
Diclofop	2.00	0	0	16	0
BASF 9052 OH	.50	0	0	20	0
BASF 9052 OH	1.00	0	0	53	0

[1]Pounds per acre of active ingredient applied.

Table 3. Weed control ratings for herbicides applied on watermelons grown at the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon, 1982

Herbicide	Rate[1]	Weed control ratings[2] replications 1	2	3	Average
Check	-	0	0	0	0
Ethalfluralin	1.0	6	6	6	6.0
Ethalfluralin	1.3	8	7	6	7.0
Ethalfluralin	1.5	9	8	5	7.3
Napropamide	1.0	6	6	2	4.6
Napropamide	1.5	5	2	2	3.0
Napropamide	2.0	3	7	2	4.0
Napropamide (incorporated)	1.0	6	4	6	5.3
Napropamide (incorporated)	1.5	8	6	6	6.6

[1]Pounds per acre of active ingredient applied.

[2]Rated on a scale of 1 to 10 with 10 exhibiting the greatest weed control.

Table 4. Vigor ratings as influenced by weed population and herbicide application on watermelons grown at the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon, 1982

Herbicide	Rate[1]	Vigor ratings[2] replications 1	2	3	Average
Check	-	3	5	-	4.0
Ethalfluralin	1.0	8	8	7	7.6
Ethalfluralin	1.3	8	9	7	8.0
Ethalfluralin	1.5	9	8	7	8.0
Napropamide	1.0	7	7	7	7.0
Napropamide	1.5	5	2	-	3.5
Napropamide	2.0	4	8	3	5.0
Napropamide (incorporated)	1.0	6	-	-	6.0
Napropamide (incorporated)	1.5	9	5	-	7.0

[1]Pounds per acre of active ingredient applied.

[2]Rated on a scale of 1 to 10 with 10 exhibiting the most vigor.

Table 5. Hand weeding time required for watermelons with herbicides versus no herbicides grown at the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon, 1981

Herbicide	Rate[1]	Hand weeding time[2] replications 1	2	3	Average
Check	-	22	30	15	22.3
Ethalfluralin	1.0	18	22	8	16.0
Ethalfluralin	1.3	14	11	10	11.6
Ethalfluralin	1.5	2	15	3	6.6
Napropamide	1.0	15	26	15	18.6
Napropamide	1.5	8	28	24	20.0
Napropamide	2.0	24	4	12	13.3
Napropamide (incorporated)	1.0	10	9	10	9.6
Napropamide (incorporated)	1.5	8	3	13	8.0

[1]Pounds per acre of active ingredient applied.

[2]Minutes per plot.

Table 6. Late season weed control rating in a watermelon herbicide trial at Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon, 1982

Herbicide	Rate[1]	Late season weed control[2] replications 1	2	3	Average
Check	-	0	0	0	0
Ethalfluralin	1.0	3	3	2	2.7
Ethalfluralin	1.3	4	3	2	3.0
Ethalfluralin	1.5	4	4	2	3.3
Napropamide	1.0	4	5	2	3.7
Napropamide	1.5	3	1	1	1.7
Napropamide	2.0	6(3)	5(3)	3	4.7
Napropamide (incorporated)	1.0	5	4	3	4.0
Napropamide (incorporated)	1.5	6	5	2	4.3

[1]Pounds per acre of active ingredient applied.

[2]Plots rated on a scale of 0 to 10 with 0 being no weed control and 10 being perfect control.

(3) Wet corner of field on which some flooding occurred which caused excessive water incorporation of napropamide.

Table 7. Weed species present in the 1982 watermelon herbicde plots, and weed competition exhibited by different weed species as affected by herbicide treatment

Herbicide	Rate[1]	Watergrass (*Echinochloa crus-galli*)	Cheatgrass (*Bromus tectorum*)	Green Foxtail (*Setaria virdis*)	Sand Love Grass (*Eragrostis diffusa*)	Large Crabrass (*Digitaria sanguinalis*)	Henbit (*Lamium amplexicaule*)	Prickly Lettuce (*Lactuca serriola*)	Redroot Pigweed (*Amaranthus retroflexus*)	Lambsquarter (*Chenopodium album*)	Purslane (*Portulaca oleracea*)	Cutleaf Nightshade (*Solanum triflorum*)	Hairy Nightshade (*Solanum sarachoides*)	Tansy Mustard (*Descurainia pinnata*)	Mares-Tail (*Conyza canadensis*)	Annual Sow Thistle (*Sonchus asper*)	Mallow (*Malva neglecta*)
		percent of total weed population															
Check		12	2	3	8	0	8	0	58	0	2	3	0	0	0	3	0
Ethalfluralin	1.0	12	0	2	0	2	7	0	67	3	5	0	0	0	1	0	3
Ethalfluralin	1.3	2	2	0	0	0	8	0	57	0	25	5	2	0	0	0	0
Ethalfluralin	1.5	3	2	0	0	0	4	4	33	2	40	2	2	2	3	2	2
Napropamide	1.0	0	2	1	1	0	13	0	75	3	5	0	0	0	0	0	0
Napropamide	1.5	3	3	0	1	0	12	2	62	7	0	7	0	0	2	0	0
Napropamide	2.0	3	0	0	0	0	5	2	75	2	12	0	0	0	2	0	0
Napropamide (incorporated)	1.0	0	12	0	5	0	13	0	65	0	3	5	0	3	0	0	0
Napropamide (incorporated)	1.5	12	2	0	5	3	20	2	33	7	2	12	2	0	0	2	0

[1]Pounds per acre of active ingredient applied.

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

D. C. Hane[1]

Temperatures, Monthly Mean, Fahrenheit

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1982	35	37	45	48	58	69	70	71	61	49	37	36
1932-82	32	38	45	54	61	64	74	73	64	53	41	36

Temperatures, Monthly Mean Maximum, Fahrenheit

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1982	43	48	57	62	72	82	86	86	74	61	46	43
1932-82	40	46	56	70	76	82	90	88	80	67	51	44

Temperatures, Monthly Mean Minimum, Fahrenheit

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1982	27	27	33	34	44	55	55	56	47	37	28	28
1932-82	23	29	33	38	47	47	58	58	48	39	31	27

1982 Temperatures, Monthly Maximum and Minimum, Fahrenheit

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Max	60	69	69	80	85	98	100	99	88	71	67	67
Min	-5	5	24	23	29	42	43	48	34	21	16	18

Precipitation, Inches

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1982	1.27	.37	.75	.92	.30	.84	.36	.04	1.77	1.75	.51	1.86
1932-82	1.23	.90	.72	.63	.66	.62	.21	.27	.44	.78	1.10	1.30

Total Precipitation in 1982, 10.74 Inches

Average Total Precipitation 1932-82, 8.86 Inches

Evaporation - Inches

	Mar	Apr	May	June	July	Aug	Sept
1982	3.52	5.48	8.70	9.53	11.77	10.00	5.33
1932-82	3.29	5.31	8.10	9.60	11.30	9.60	6.20

Wind Velocity - Miles Per Hour Average

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1982	3.9	3.4	3.5	3.9	2.8	3.6	4.3	3.4	2.5	2.3	1.8	2.0
1932-82	2.5	2.9	3.8	4.3	4.0	4.1	3.6	3.2	2.6	2.2	2.3	2.5

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WEATHER EXTREMES FROM 1932 THROUGH 1982

Temperature Extremes - Degree 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	Mar. 1957	Apr. 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 1982

December 14, 1948, 7 Inches in a 24-Hour Period
January 10, 1980, 12 Inches on Ground at 8:00 AM

Frost-Free Days

1982	May 5	October 10	157 Days
1932-82	April 23	October 10	170 Days

Latest frost in Fall, 1937, November 4, 32° Fahrenheit
Earliest frost in Fall, 1970, September 13, 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