Irrigated Crop Research in Oregon's Columbia Basin

1984 Research Report

Special Report 720
August 1984
Agricultural Experiment Station
Oregon State University, Corvallis

COLUMBIA BASIN AGRICULTURAL RESEARCH AND EXTENSION CENTER
HERMISTON, OREGON 97838

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 1984 include potato yield and disease trials, insect studies, alfalfa yield trials, fall grazing crops, grape variety observations, corn and cereal yield trials, wheat, barley, triticale breeding trials, water use patterns, cereal diseases, weather observations, and lawn grass variety trial.

ADVISORY COMMITTEE

In January 1984, an Advisory Committee for the Hermiston Experiment Station was established to increase the station's awareness of agricultural needs of the local area and to encourage research in those areas.

Twelve men were selected to serve two, three, or four-year terms in the areas of potatoes, irrigation, livestock, cereal grains, forage, fruits, vineyards, fertilizer and pesticides.

Those chosen were:

Martin Pitney, Chairman (2)*
P. O. Box 1339
Umatilla, OR 97882

John Hansell, Vice-Chairman (3)
Rt. 1 Box 1710
Hermiston, OR 97838

Richard Betz (3)
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Hermiston, OR 97838

Howard Cushman (4)
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Bob Mueller (2)
Boardman Farms, Inc.
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Rt. 1 Box 1274
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Echo, OR 97826

Don Mills (4)
Rt. 1 Box 58
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John Walchli (2)
Rt. 3 Box 3342
Hermiston, OR 97838

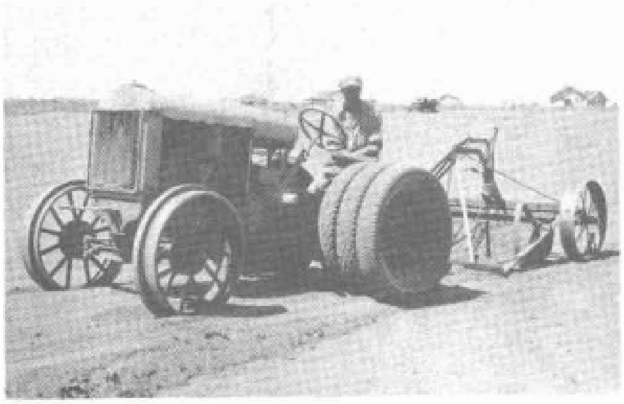
Chestor Prior (4)
Eagle Ranch
Star Route
Echo, OR 97826

Fred Ziari (2)
Umatilla Electric Coop
P. O. Box 1148
Hermiston, OR 97838

Merle Gehrke (3)
Rt. 2 Box 13
Echo, OR 97826

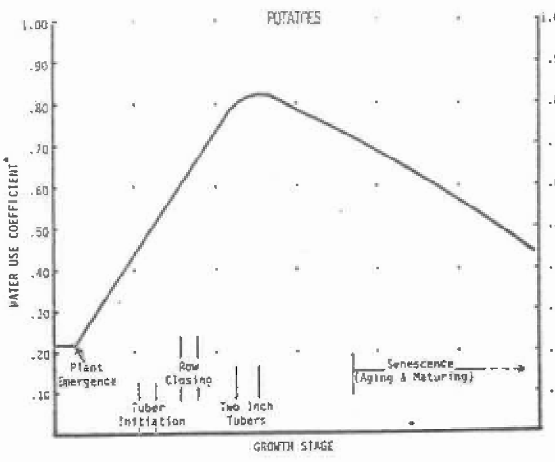
*Indicates number of years per term.

No, this is not Mr. Douglas struggling in the sunshine to make his "greenacres" retreat from the bigtown hustle. Pictured here is some of the preliminary leveling in the early 1930s after the station was relocated to its present site.



Though we may feel the old steel wheeler, changed to rubber tires, was crude and primitive, it represented a more powerful tool than when furrows and leveling meant miles behind the servient horse.

Recent tractors also provide stronger and more comfortable tools for getting the job finished; but ...



*Water use coefficient X pan evaporation = water used by crop.

(Hane & Pumphrey 1982)

now water use curves, cost analysis, and other data worked over by a different tool, the computer, can optimize the works of the "old faithfuls."

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IDENTIFYING DESIRABLE NEW POTATO LINES THROUGH EVALUATION TRIALS CONDUCTED IN NORTH CENTRAL OREGON, 1983

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

Potato (*Solanum tuberosum* L.) evaluation trials are used to identify potato lines with desirable characteristics for processing and/or fresh market use. Information is obtained on yield, quality, disease resistance, storability and frying characteristics.

Hermiston is one of three Oregon locations conducting a statewide trial. Oregon entries are recent selections made at Hermiston and Redmond, Oregon, and Aberdeen, Idaho, that have exhibited good yield potential of blocky to oblong russet tubers, a high grade-out of U.S. No. 1 tubers, good internal qualities and acceptable fry qualities.

The Western Regional trial, which is conducted throughout six western states and Canada, evaluates entries that show possible cultivar status in one or more of the participating locations. Oregon enters lines that have been evaluated in the statewide trials.

To evaluate new cultivars under commercial management conditions in the Hermiston area, tests are conducted at three to four grower locations. These tests include lines from the Western Regional trials that exhibit the best potential for north central Oregon conditions.

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 Captan fungicide and bagged for individual plots. 'Russet Burbank', 'Lemhi' and 'Norgold Russet' are the 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 used for 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 nitrogen per acre is applied through the irrigation system. Generally, three sprinkler irrigations per week are required to supply needed water.

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RESULTS AND DISCUSSION

Table 1 is a summary of the off-station trials conducted at three grower locations near Hermiston. Russet Burbank ranked 5th in total yield. A72685-2 exhibits the most potential for a new variety. It has a good grade-out of U.S. No. 1 tubers that are large as indicated by the more than 10 ounce category. The specific gravity is acceptable and is higher than Russet Burbank. Fry color (Tables 2 and 3) tends to be dark for this entry. Additional storability and fry quality information is needed on this line.

Evaluation for entries in the statewide trial selected for 1984 tests is shown in Table 2. Overall yields and quality are good. A high percent of black spot bruise was measured.

Three lines of particular interest are A69870-3, A72685-2 and A74212-1. Table 3 gives a three-year summary of these lines. As with the off-station results, A72685-2 has the most potential as a processing cultivar. A74212-1, because of its lower gravity and darker fry color, would be considered for fresh market use only. A69870-3 is questionable in our growing area because of a high percent of internal brown spot. Its excellent frying characteristics warrant further consideration.

These three lines, A69870-3, A72685-2, A74212-1, were also entered in the Western Regional trials (Table 4). All three lines yielded better than Russet Burbank. Though these three lines have high yield, high percent of No. 1 tubers, and acceptable gravities, their potential as new cultivars will weigh heavily on storability and internal defects.

Table 1. Total yield, yield of U.S. No. 1 and 2 tubers, specific gravity, and percent internal defects for entries grown at three grower locations near Hermiston, Oregon, in 1983

Entry	Total yield	U.S. No. 1	Ounce classes of U.S. No. 1's 4-6	6-8	8-10	10+	U.S. No. 2	Specific gravity	Hollow heart	Internal brown spot	Black spot
	cwt/acre								percent		
A72685-2	690	555	57	74	91	309	38	1.085	.3	0	1.3
A74212-1	683	538	62	63	84	330	70	1.077	0	.3	0
Lemhi	633	489	61	72	80	233	38	1.082	1.3	0	7.0
A69870-3	632	556	66	82	76	332	14	1.086	2.7	1.7	1.0
RB 80VTSC	615	425	77	119	77	151	68	1.081	1.3	3.0	.3
A7242-3	538	424	107	111	77	128	13	1.079	.3	0	0
Norgold*	384	278	92	50	52	59	7	1.076	.5	0	.3

*Average of two locations.

Table 2. Total yield, yield of U.S. No. 1 and 2 tubers, specific gravity, percent internal defects and fry color for selected entries from the 1983 statewide variety trial at the Columbia Basin Agricultural Research and Extension Center, Hermiston Oregon

Entry	Total yield	U.S. No. 1	Ounce classes of U.S. No. 1's 4-6	6-8	8-10	10+	U.S. No. 2	Specific gravity	Hollow heart	Internal brown spot	Black spot	Fry[1] color
	cwt/acre								percent			
ND415-1	945	848	80	152	120	496	35	1.088	4	0	24	3.8
A71997-8	906	837	97	162	157	411	22	1.080	0	0	9	2.4
Bintje	902	585	145	126	127	186	130	1.072	0	0	0	2.8
A72685-2	874	806	75	61	93	576	18	1.088	0	2	18	3.2
A74212-1	833	704	56	104	131	413	80	1.076	0	0	15	3.8
A7279-12	830	782	72	111	141	458	14	1.099	0	0	0	2.3
A7242-3	776	719	100	144	140	335	22	1.085	0	0	18	4.0
A74123-7	775	711	79	80	85	467	21	1.084	1	0	42	2.5
RB 81VTSC	745	589	72	107	125	286	97	1.082	1	5	27	2.3
A69870-3	712	668	53	74	108	433	10	1.082	0	4	28	1.5
Lemhi	695	649	47	78	88	437	9	1.086	0	0	67	1.6
ND681-3	666	595	56	94	88	357	31	1.083	0	1	9	1.9
A77153-3	635	578	32	58	58	430	37	1.093	0	0	1	3.7
5% LSD	181	167						.004				

[1] 0 = very light. 4 = very dark.

Table 3. 1981, 1982, and 1983 average of total yield, yield of U.S. No. 1 and 2 tubers, specific gravity, percent internal defects and fry color for selected entries grown in the statewide trial at the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon

Entry	Total yield	U.S. No. 1	U.S. No. 2	Specific Gravity	Hollow heart	Internal brown spot	Black spot	Fry[1] color
	-------cwt/acre------				------------percent------------			
RB	771	555	122	1.083	1.3	3.0	9	2.2
A69870-3	726	686	11	1.082	1.3	7.3	9	1.1
A72685-2	840	760	32	1.086	1.3	1.0	6	2.3
A74212-1	833	707	73	1.077	0	1.0	5	2.9

[1] 0 = very light. 4 = very dark.

Table 4. Total yield, yield of U.S. No. 1 and 2 tubers, specific gravity, percent internal defects and fry color for entries grown in the 1983 Western Regional Variety Trials at the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon

Entry	Total yield	U.S. No. 1	Ounce classes of U.S. No. 1's 4-6	6-8	8-10	10+	U.S. No. 2	Specific gravity	Hollow heart	Internal brown spot	Black spot	Fry[1] color
	cwt/acre								percent			
A72685-2	808	762	42	65	96	559	23	1.088	1	0	13	2.7
A75188-3	743	578	49	57	77	395	104	1.080	0	0	1	3.9
A69870-3	741	711	63	89	86	474	11	1.084	0	5	21	1.5
A74212-1	717	630	66	78	95	390	54	1.077	0	0	9	3.4
A7411-2	681	565	27	48	65	426	89	1.093	0	1	19	2.4
RB	644	514	90	123	97	205	87	1.084	1	4	11	1.8
Lemhi	636	575	53	72	101	350	23	1.087	0	1	44	M[2]
A74133-1	594	551	84	80	123	264	1	1.083	0	0	2	4.0
NDD47-1	545	494	50	77	62	306	27	1.081	2	0	8	2.5
NDD277-2	487	440	51	74	65	250	30	1.082	2	0	2	3.7
Norgold	368	318	91	72	64	91	11	1.066	3	0	4	M[2]
5% LSD	147	138						.004				

[1]0 = very light. 4 = very dark.

[2]M = missing data.

CORN GRAIN AND SILAGE VARIETY PERFORMANCE

F. V. Pumphrey[1]

Field corn variety tests for grain and silage yields were conducted on the Columbia Basin Agricultural Research and Extension Center. The varieties in each trial were entered by the companies listed in Table 1. The trials were conducted to determine grain yield, silage yield, and moisture in the grain or the green forage at harvest. Desirable and undesirable characteristics were noted.

PROCEDURE

Minimum tillage practices were used; rows were precision marked preplant using a subsoiling shank. Individual plots were two rows wide and 15 feet long. Rows were 34 inches apart. Each test consisted of five replications. Atrazine was used for weed control.

Fertilizer at the rate of 350 pounds per acre of 10-20-10 was incorpo rated with a narrow rototiller for each row before to planting. A total of 220 pounds per acre of additional nitrogen was applied in three applications after emergence and before pollination.

The tests were planted April 25 and 26. Germination and early growing conditions were reasonably good. Slight loss of stand to pheasants required some "spot" replanting. Plant populations at harvest were 29,000 plants per acre for the grain test and 32,000 plants for the silage test.

Soil in the test area, designated as Adkins fine sand, is relatively uniform in texture to a depth of three or more feet and low in water holding capacity and organic matter. Irrigation water was applied as needed with sprinklers. Water was applied three times weekly during the greater part of the growing season; approximately 1.8 inches of water were applied weekly from early June to mid-August.

Climatic conditions were favorable for corn production. No frosts occurred in the spring after the corn was planted, and no frosts occurred before the silage trial was harvested September 15 and 16. A few frosts occurred before the grain trial was harvested October 20 and 21.

The corn grain test was picked, weighed, and sampled for moisture in the grain. The corn in the silage test was cut, weighed, and subsampled immediately for dry matter. Subsamples for dry matter were oven dried at 70 degrees C.

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RESULTS

Grain test Grain yields at 15.5 percent moisture, moisture content of the grain at harvest, plant height, and relative maturity are presented in Table 2. Yields ranged from 160 to 216 bushels per acre. The higher grain yields, based on 15.5% moisture in the grain, were positively associated with the varieties having later maturity and higher moisture in the grain at harvest. Also, the higher grain yields were positively associated with plant height. Several of the later and very late maturing varieties had an average ear height near six feet. The later maturing varieties appeared to have excellent potential for the production of high moisture corn or silage.

Adversities such as lodging, dropped ears, insects other than corn ear worms, and diseases were minimal and not associated with varieties. Corn ear worm continues to be a serious problem each year.

Silage test Green forage yields, percent dry matter, dry matter yields, silage yields at 70 percent moisture, and percent ears by weight are presented in Table 3. Green forage yields ranged from 27 to 39 tons per acre. Green forage weight and percent dry matter were negatively associated; varieties with the lower green weights were higher in dry matter. Percent ears of the green forage weight was positively associated with percent dry matter of the green forage weight.

Table 1. Companies entering varieties in the 1983 Corn Performance Tests at the Research and Extension Center, Hermiston, Oregon

Company	Brand	Address
Cenex	Cenex	St. Paul, Minnesota 55164
Crookham Company	SS, CX	Caldwell, Idaho 83605
DeKalb	DeKalb	DeKalb, Illinois 60115
Ferry Morse Seed Co.	Ferry Morse	Modesto, California 95352
Germain's Inc.	Funk	Fresno, California 93777
Stauffer Seeds	Stauffer	Phillips, Nebraska 68865

Table 2. Grain yield, moisture in the grain at harvest, plant height, and relative maturity for varieties in the 1983 Grain Corn Test at the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon

Company	Variety	Grain yield 15.5% moisture	Moisture at harvest	Plant height	Relative maturity[1]
		bushels per acre	percent	feet	Hermiston
Cenex	2106	176	18.6	10.4	E
Cenex	2110	173	20.6	9.8	E-M
Cenex	2114	177	22.8	10.3	L
Cenex	2115	191	22.8	11.1	M-L
Cenex	2124	195	26.1	11.4	VL
Cenex	3139	177	19.4	10.7	E-M
Crookham	SS53	161	17.1	11.3	E
Crookham	SS70	199	22.0	11.3	L
Crookham	CX01061	198	19.7	11.4	M
Crookham	CX01064	189	21.1	10.5	M
Crookham	CX02061	193	22.5	10.9	M
DeKalb	XL73	192	22.2	10.9	M
DeKalb	XL74B	210	23.2	11.9	M-L
DeKalb	T1100	188	22.7	10.2	M-L
DeKalb	T1230	200	25.6	11.6	VL
Ferry Morse	GT1822	177	18.4	10.0	E
Ferry Morse	GT2006	182	20.2	9.8	M
Ferry Morse	GT3006	168	21.5	10.2	M
Funk	G4342	203	18.9	9.7	E-M
Stauffer	Super 80	207	20.5	11.0	M
Stauffer	S 7759	216	22.5	11.4	L
5% LSD		15			

[1]E = early, M = medium, L = late, VL = very late.

Table 3. Green forage weight, dry matter, silage, yield at 70 percent moisture, and percent ears for varieties in the 1983 Corn Silage Test at the Columbia Basin Agriculture Research and Extension Center, Hermiston, Oregon

Company	Variety	Green forage	Dry matter		Silage 70% moisture	Ears[1]
		tons per acre	percent	tons per acre	tons per acre	percent
Cenex	2115	37	26.9	10	33	26
Cenex	2124	38	27.0	10	34	28
Cenex	3139	27	33.5	9	30	32
Crookham	SS70	38	26.9	10	34	29
Crookham	SS605	37	30.7	11	38	25
Crookham	02061	33	31.2	10	34	30
Crookham	02062	29	32.5	10	32	31
Crookham	02063	29	35.2	10	34	29
Crookham	02064	29	30.3	9	29	30
DeKalb	XL73	34	29.4	10	34	29
DeKalb	XL74A	35	32.3	11	38	30
Funk	G-4657	39	31.2	12	41	30
Funk	6000X	34	36.0	12	41	30
Ferry Morse	4693	40	27.9	11	37	26
5% LSD		3	----	1	----	2
CV%		8	----	7	----	6

[1]Percent of green forage weight.

FREQUENCY OF IRRIGATION OF SOFT WHITE WINTER WHEAT ON SANDY SOILS IN NORTH CENTRAL OREGON

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

How often should I irrigate? How much water should I apply? Can I irrigate more acres by purposely underwatering and increase my overall yields and profit? Such inquiries have been made for centuries, yet the concern over watering to maximize yield and profit remains.

Frequency of irrigation and the amount of water applied each irrigation have a dominate influence on crop yield which, in turn, affects net return. Optimum yield, which is the yield producing the maximum net return, of intensively managed non-forage crops is often close to the maximum yield. A clear distinction between optimum and maximum yield is often difficult to establish.

Research conducted by Pumphrey, Hane and Bates (6) relating water used by winter wheat to pan evaporation provided information on the amount of water needed to produce optimum yields. This research was expanded to provide information on how often to irrigate. In addition, evapotranspiration yield relationships, optimum and maximum yields, and plant growth characteristics were studied. This research provided data for frequency of irrigation and its relationship to optimum yields.

PROCEDURES

A single sprinkler line was installed for each of four irrigation intervals--three times per week which will be referred to as frequent, weekly, once in two weeks, and once in three weeks. Sprinkler heads and orifices were such that water distribution decreased uniformly from the sprinkler line outward. Intended water application was to vary from 140 percent of estimated water requirement near the sprinkler line to 20 percent at the outer edge of each sprinkled area.

Water requirements were estimated by multiplying pan evaporation by the water use coefficient for the growth stage of the wheat. The two wider application intervals required an estimation of growth stage and water use for a week or more past the application date. Changes in soil water content as determined with a neutron probe provided additional information for deciding application rates.

The water holding capacity of the loamy sand soil at the experimental site was 6.2 inches in the upper four feet. Water application was initiated during late tillering; soil moisture at this time was less than field capacity. Three hundred pounds per acre of 16-20-0 were incorporated into the seedbed before to planting. A total of 180 pounds per acre of

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nitrogen was applied during late tillering and midjointing growth stages. The variety 'Stephens' was grown.

Precipitation and water evaporation from a standard Weather Service Class A evaporation pan were measured daily in a recommended Weather Service climate measuring station. Water applied was measured immediately after each irrigation in catch cans maintained at the height of the growing wheat.

Water use was defined as the water transpired by the wheat, water evaporated from the soil, plus water percolated below the rooting zone. Evapotranspiration was the water transpired by the plant plus water evaporated from the soil. Maximum evapotranspiration was considered to have occurred in each frequency of irrigation where the subsoil moisture at the three to four foot depth was slowly and continuously depleted during the growing season.

Linear regression was used to relate grain yield and dry matter production responses with water used.

RESULTS AND DISCUSSION

Temperatures were favorable each growing season for wheat production (Table 1). No extended periods of hot temperatures occurred during flowering and filling. Rainfall, which was near average (Table 1), did not occur in persistent storms to disrupt the frequency of irrigation influence on plant growth and grain yield.

Table 1. March through June temperature and precipitation for 1982 and 1983 and long time means. Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon

	Mean temperature			Rainfall		
	1982	1983	1932-83	1982	1983	1932-83
		F°			inches	
March	45	46	45	.75	2.23	.72
April	48	51	54	.92	.94	.63
May	58	60	61	. 30	.83	.66
June	69	66	64	.84	1.09	.62

During May and June, wheat irrigated at 100 percent of evapotranspiration used approximately 1.5 inches of water per week. Thus, during this period the frequently irrigated wheat received three one-half inch applications per week; the weekly irrigated wheat received a 1.5 inch application each week; the wheat irrigated once in two weeks received three inches in one application; and the wheat irrigated once in three weeks received 4.5 inches in one application.

Wheat plants at the outer edge of each sprinkler area rapidly depleted the soil moisture in the upper two feet of soil and exhibited moisture stress by the mid-jointing growth stage. As the growing season progressed, visual moisture stress symptoms intensified; more stress was observed in the less frequently than in the more frequently irrigated wheat.

Both the amount of water available to the wheat and the interval between water application affected maturity. Wheat having the least water within an irrigation interval matured eight days earlier than wheat having the most water. Wheat irrigated once in three weeks matured five to seven days earlier than wheat irrigated weekly or frequently. Plant stress was so great in the outer edges of the three week irrigated areas that root extension into the three to four foot soil depth was not sufficient to extract all the soil moisture.

Water used (evaporation from the soil, transpiration, and deep percolation) from spring tillering to grain maturity varied from seven to 33 inches (Figures 1 and 2). Most of the seven inches used by the wheat growing at the outer edge of each sprinkled area came from the soil and precipitation. The subsoil at a depth of four feet was filled to field capacity after each irrigation in those areas frequently or weekly irrigated where more than 23 to 25 inches of water were used. Water in excess of 23 to 25 inches percolated out to the rooting zone.

Wheat frequently or weekly irrigated used 23 to 25 inches of water in evapotranspiration. Wheat irrigated at two or three week intervals used 19 to 23 inches of water in evapotranspiration. Earlier maturity, drier surface soil between irrigations, and greater water stress from inadequate, readily available soil moisture reduced evapotranspiration in the less frequently irrigated wheat.

Two distinctly different grain yield responses to water use were measured (Figure 1). Grain yields increased linearly with increased evapotranspiration until near maximum evapotranspiration. Yield increase per inch of water was over six bushels for the frequent, weekly, and two week application intervals. The maximum yield obtained with this relationship of over six bushels per acre inch of water was the optimum yield for efficient water application.

Application interval had no significant effect on the water-production function when water was less than the maximum used in evapotranspiration (Figure 1). The optimum yields produced by irrigating frequently, weekly, or once in two weeks were statistically the same but were statistically higher than the optimum yield produced by irrigating at three week

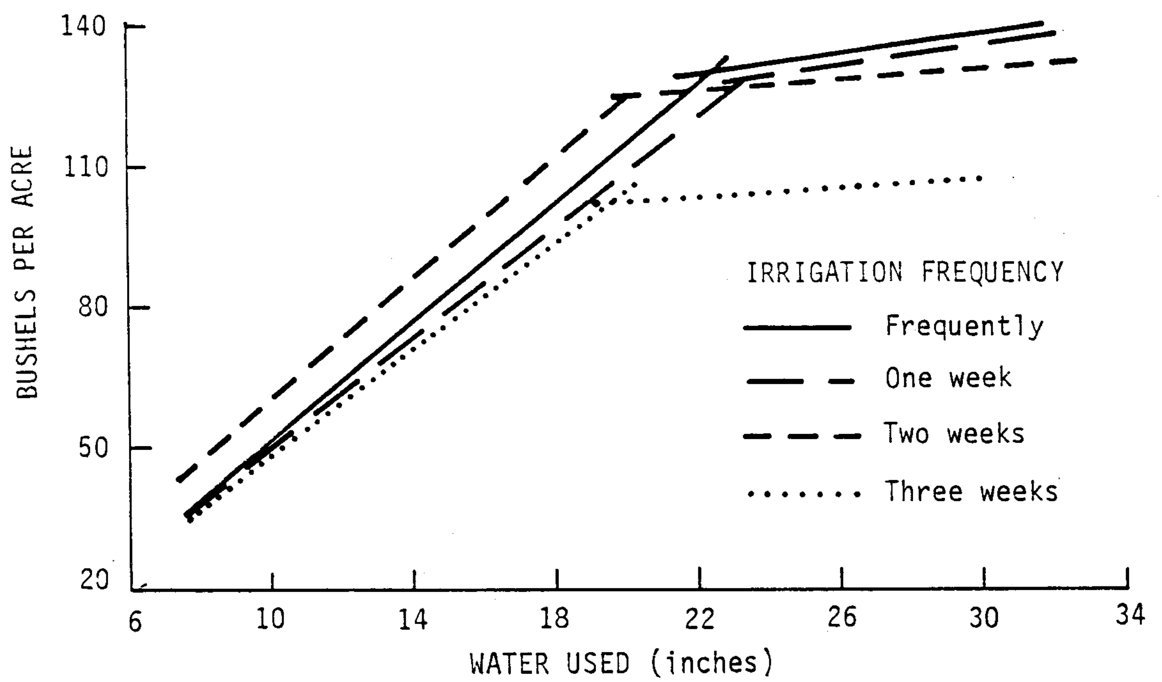

Figure 1. Grain yield-water use relationships of winter wheat sprinkler irrigated with four frequencies of water application

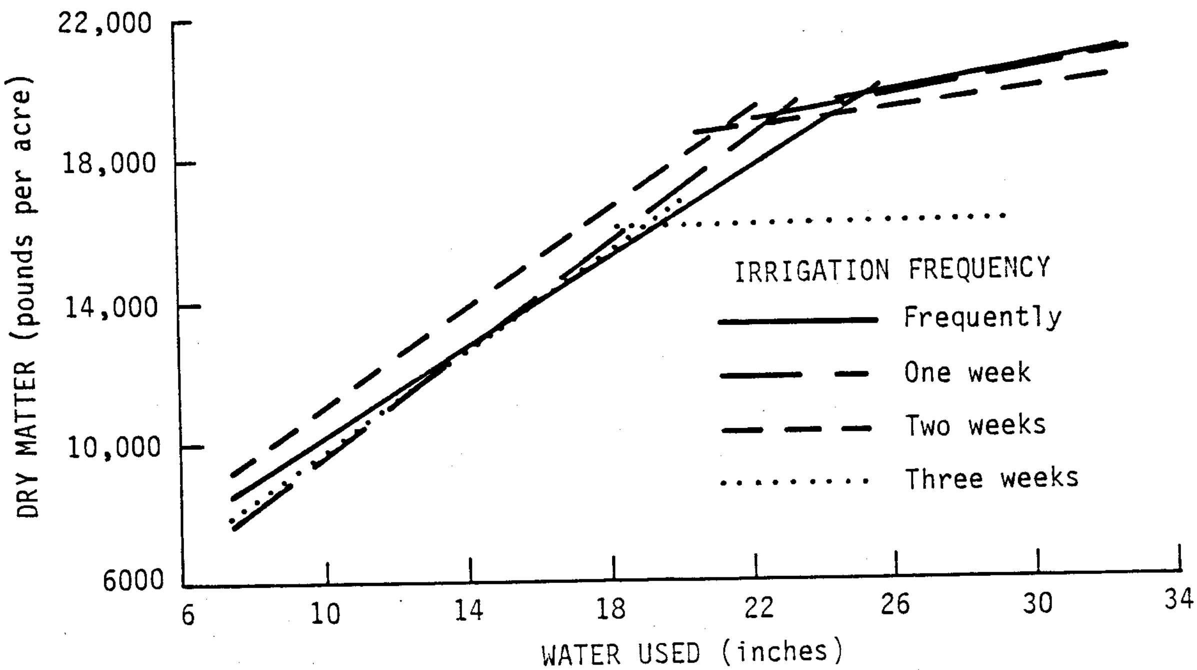

Figure 2. Dry matter (air dry) of straw and grain-water use relationships of winter wheat sprinkler irrigated with four frequencies of water application

intervals. This is of particular interest because (1) it designates what irrigation interval affects optimum yield under these conditions and (2) additional water did not alleviate the plant stress caused by the longer irrigation interval.

These results of linear response of reproductive yield to water used in evapotranspiration agree with results of English and Nakamura (1); Hane and Pumphrey (6); Hanks (3); Kallsen (4); and Pumphrey, Hane and Bates (6). Leggett (5) and workers who have modified his proposal assume a linear grain yield response of dryland wheat to water available during the spring-to-maturity growth period when estimating nitrogen fertilizer needs. This water-production function of six or more bushels of grain per inch of water has proved reliable except when early plant growth is abundant followed by severe drouth during grain filling.

Income from wheat irrigated at three rates of water consumption are presented in Table 2. Gross return per acre where 22 inches of water were consumed was more than twice the return than where 11 inches of water were consumed by the wheat.

Table 2. Dollars gross income per acre from soft white winter wheat irrigated at three rates of water application. Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon

Water consumed	Grain yield	Gross return
inches	bushels per acre	dollars per acre
11	57	194
16.5	89	303
22	122	415

The water-production response where water supply was more than evapotranspiration was distinctly different from the water-production response where water use was less than evapotranspiration. Water in excess of evapotranspiration increased grain yield very little (Figure 1). Apparently some growth factor other than available water or some plant physiological process abruptly limited transpiration which, in turn, limited grain production.

Dry matter (straw plus grain) production increased at the rate of 800 to 900 pounds per acre for each inch of evapotranspiration (Figure 2).

Additional water increased dry matter production at a rate of less than 200 pounds per inch of water. The interval between irrigations had no influence on dry matter production except for the three weeks interval which used less water in evapotranspiration and resulted in less dry matter.

Grain to straw ratio was affected by the quantity of water available to the wheat the same way that dryland wheat is affected. The wider ratios of 120 or more pounds of straw per bushel of grain occurred where available moisture was adequate for early plant growth but inadequate during grain filling. The narrower ratios of 80 to 90 pounds of straw per bushel occurred where the maximum amount of water was used in evapotranspiration. Ratios were slightly wider where more water was available than was used in evapotranspiration; the additional straw did not produce grain at the same rate as where the optimum amount of water was applied.

Grain test weight was normal and unaffected by water quantity or interval of application when 80 percent or more of maximum evapotranspiration water was available. Below this amount test weight decreased with decreasing amounts of water and with extending the intervals between irrigations. Test weights of 55 and 52 pounds per bushel were measured where wheat received the least water and was irrigated at frequent and three week intervals respectively.

The interval between irrigations had little effect on the number of heads where water was the most deficient but did have an effect where water was optimum. Optimumly irrigated wheat had 60 to 64 and 50 to 55 heads per square foot when irrigated frequently or once every three weeks, respectivevly.

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DETERMINING GROWTH PARAMETERS CHARACTERISTIC TO THE COLUMBIA BASIN FOR A COMPUTERIZED POTATO GROWTH MODEL

J. D. Apple and W. S. Overton[1]

A potato growth simulation model (Flexform:POTATOFLEX, 1983) is being developed on the Oregon State University Cyber computer system to be used as a tool to evaluate management strategies. Each management alternative causes many complex reactions to occur in a potato plant. The model will be used to analyze the effect of management strategies on the growth and yield of a potato plant. The model is a set of mathematical equations that represent what is known about how a potato plant reacts to environmental factors, however, it is only as strong as our present knowledge base.

To equate the model parameters to conditions characteristic of the Columbia Basin center-pivot irrigated circles, a pilot study of growth performance was made. Plant growth was monitored at fields of three growers during the 1983 season. The data were compared with model output. This comparison will be used to modify parameters to bring modeled plant growth behavior into agreement with observed field measurements.

PROCEDURE

Tubers of (*Solanum tuberosum* L.), variety 'Russet Burbank' from the foundation seed project were planted at three locations designated WAL, EAG, and LEV (Footnote 2). In each case, test plots were planted the same day as the growers' field. Observations were made and data collected four times during the season for fields WAL and EAG and six times at LEV. At each observation date a set of plants was measured in the field while another set was part of a destructive sample in which stems were returned to the lab for extensive measurements. The variables measured in all samples were plant height, stem girth at 0 cm, number of stems per hill, and number of branches per stem. Symptoms of disease or injury were recorded in the field for those plants not returned to the lab. The variables measured on the sample of plants brought back to the lab include the wet weight of leaves, stems, roots, tubers, and field measurements. Because of the limitations in plant drying facilities, dry weight measurements were made on a single plant taken from each location at each sampling date. The number of tubers and condition of the mother tuber were also recorded for destructively sampled plants, and each stem was assayed for the presence of *Erwinia carotovory* Jones Bergey et al. and *Verticillium dahliae* Kleb.

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[2]Potato seed was provided by John Kelly and the Foundation Seed Project and planted by Dan Hane of the Columbia Basin Experiment Station.

At three dates during the season, a set of plants was inoculated with *Verticillium* by stem injections. These plants were observed and a sample returned to the lab for detailed measurements, at each sampling occasion.

RESULTS AND DISCUSSION

The data obtained from untreated plants in the lab are summarized in Tables 1, 2 and 3. Although the same seed stock was planted at all three locations, the plants grew very differently. Without full consideration of management information, the effects of certain environmental influences can be compared. The effect of naturally occurring, soil-borne *Verticillium* can be seen at the field EAG. At the first sampling date, 62 days after planting, *Verticillium* was isolated from five out of six hills sampled. At the last sampling date many of the plants were dead and of those that were alive, many exhibited symptoms of Early Dying. Although the plants in field EAG did not reach the height of plants in other fields, the yields were comparable.

A vine killer used to dessicate the vines at the field WAL accounts for the decreased size and fresh weight of vegetative plant parts at the last sampling date (Table 2). Otherwise, WAL was characterized by plants of intermediate height and slighly less yield. The field LEV had been fumigated before the season and the plants were grown with high levels of nitrogen. The average plant height and the number of terminal buds per hill give an indication of prolific vegetative growth. Yield at LEV at the last sampling date was only moderately higher than at EAG. The small sample sizes of this preliminary study account for at least some of the variability observed between sampling dates at LEV.

The data collected on *Verticillium* injected plants are summarized in Table 4. Plant height generally appears to be reduced for plants with either by injection or naturally occurring (EAG). The small sample size may explain the lack of consistent yield differences.

The computer model output represented in Figure 1 as the dry weight of plant parts from a single hypothetical plant grown during a 150-day growing season. Due to the small sample of dry weight data obtained during the 1983 season, comparable field data cannot be presented. However, 1983 field data will be used to adjust the model so that it resembles plant growth patterns observed in the field. Specifically, in the model plant there is excessive growth too early in the season, and the amount of vegetative biomass is too high relative to tuber biomass. These adjustments are simple, but should follow a better understanding of the actual field situation. The parameters will be tuned and further detail added to the model so that it will be able to reflect the different types of plant growth and yield observed in each of these three fields.

Additional data regarding management practices at these three locations are being collected to be correlated to plant growth patterns. These relationships will be included in the model and further explored during the 1984 growing season.

Table 1. The means and standard deviations (in parenthesis) of plant height and stem girth at ground level (0 cm)measured in cm averaged per stem of Russet Burbank potato (*Solanum tuberosum* L.), total plant, stem, leaf, root, and tuber fresh weight given in grams averaged per hill, number of tubers, number of stems, and number of terminal buds averaged per hill from field LEV near Hermiston, Oregon, 1983.

Variable[1] Measured	Sampling date June 14	July 7	July 20	August 10	August 29	Sept. 22
Plant height (cm)/plant	30.2 (4.1)	84.0 (14.4)	102.9 (16.7)	164.0 (20.4)	225.7 (13.1)	197.5 (38.9)
Girth at 0 cm (cm)/plant	4.8 (1.1)	4.7 (2.1)	4.6 (1.6)	5.4 (1.6)	5.1 (1.1)	7.3 -
Total plant Fresh weight (gm)/hill	325.0 (82.0)	1052.5 (315.1)	1134.0 (723.1)	1193.8 (582.3)	1754.5 (485.8)	1408.5 (304.8)
Stem fresh Weight (gm)/hill	82.6 (28.3)	496.8 (130.4)	590.5 (380.0)	868.2 (411.8)	1275.5 (263.8)	687.0 (782.1)
Leaf fresh Weight (gm)/hill	195.0 (46.0)	482.3 (188.8)	489.0 (328.0)	275.4 (160.0)	422.5 (201.5)	692.5 (286.4)
Root fresh Weight (gm)/hill	44.0 (15.3)	66.6 (20.4)	49.4 (31.7)	50.2 (22.2)	56.5 (20.5)	29.0 (18.4)
Tuber fresh Weight (gm)/hill	0 0	54.6 (9.6)	222.0 (141.3)	772.4 (393.2)	744.7 (274.1)	1660.0 (648.3)
Number of Tubers/hill	0 0	3.6 (.9)	5.3 (3.9)	9.2 (3.0)	10.0 (5.3)	9.7 (3.2)
Number of Terminal Buds/hill	3.5 (1.4)	9.5 (8.0)	8.3 (5.7)	14.3 (6.9)	19.0 (7.0)	18.0 (7.1)
Number of Stems/hill	1.7 (.8)	2.2 (1.1)	2.0 (.8)	1.6 (.5)	2.7 (1.2)	1.0 0

[1]The number of hills sampled at each date was between 3 and 6.

Table 2. The means and standard deviations (in parenthesis) of plant height and stem girth at ground level (0 cm) measured in cm averaged per stem of Russet Burbank potato (*Solanum tuberosum* L.), total plant, stem, leaf, root, and tuber fresh weight given in grams averaged per hill, number of tubers, number of stems, and number of terminal buds averaged per hill from field WAL near Hermiston, Oregon, 1983.

Variable[1] Measured	Sampling date June 14	July 7	July 20	August 10
Plant Height (cm)/plant	57.0 (4.9)	86.1 (22.0)	119.1 (12.2)	128.3 (18.8)
Girth at 0 cm (cm)/plant	5.2 (1.5)	5.2 (1.6)	5.4 (1.6)	4.2 (1.6)
Total plant Fresh weight (gm)/hill	837.8 (182.5)	897.0 (270.0)	1111.4 (258.4)	469.0 (145.0)
Stem Fresh Weight (gm)/hill	225.0 (19.6)	*443.7 (208.7)	617.4 (151.2)	289.6 (104.1)
Leaf fresh Weight (gm)/hill	545.0 (188.4)	418.0 (109.7)	435.6 (96.8)	148.0 (43.0)
Root fresh Weight (gm)/hill)	64.6 (12.8)	49.2 (11.4)	58.4 (21.4)	31.8 (4.1)
Tuber fresh Weight (gm)/hill	83.8 (32.6)	467.4 (193.1)	683.2 (125.7)	1082.6 (329.6)
Number of Tubers/hill	14.2 (7.0)	8.2 (2.3)	9.4 (3.4)	8.8 (2.2)
Number of Terminal Buds/hill	8.5 (3.4)	11.3 (5.9)	14.0 (4.5)	14.8 (7.6)
Number of Stems/hill	2.8 (1.1)	2.4 (.9)	2.8 (1.6)	2.4 (1.5)

[1]The number of hills sampled at each date was between 3 and 6.

Table 3. The means and standard deviations (in parenthesis) of plant height and stem girth at ground level (0 cm) measured in cm averaged per stem of Russet Burbank potato (*Solanum tuberosum* L.), total plant stem, leaf, root, and tuber fresh weight given in grams averaged per hill, number of tubers, number of stems, and number of terminal buds averaged per hill from field EAG near Hermiston, Oregon, 1983.

Variable[1] Measured	Sampling date June 14	July 7	July 20	August 10
Plant Height (cm)/plant	49.4 (3.6)	79.8 (8.4)	93.9 (16.4)	95.8 (26.9)
Girth at 0 cm (cm)/plant	5.2 (1.2)	4.3 (1.7)	3.9 (.7)	4.8 (1.6)
Total plant Fresh weight (gm)/hill	514.2 (76.1)	728.8 (243.8)	393.8 (162.3)	460.0 (150.0)
Stem fresh Weight (gm)/hill	178.3 (35.3)	360.3 (224.3)	188.8 (82.4)	273.6 (86.7)
Leaf fresh Weight (gm)/hill	309.8 (45.0)	321.8 (107.1)	180.0 (74.8)	162.8 (65.9)
Root fresh Weight (gm)/hill	33.2 (1.9)	38.4 (12.5)	25.0 (7.9)	23.6 (6.7)
Tuber fresh Weight (gm)/hill	22.3 (13.9)	546.8 (246.3)	569.0 (263.1)	1395.0 (628.1)
Number of Tubers/hill	5.7 (1.5)	8.0 (4.1)	8.0 (2.0)	8.0 (2.0)
Number of Terminal Buds/hill	6.2 (1.7)	6.8 (1.7)	5.0 (1.4)	8.3 (1.0)
Number of Stems/hill	2.2 (1.0)	3.0 (1.7)	2.0 (0.0)	1.8 (.8)

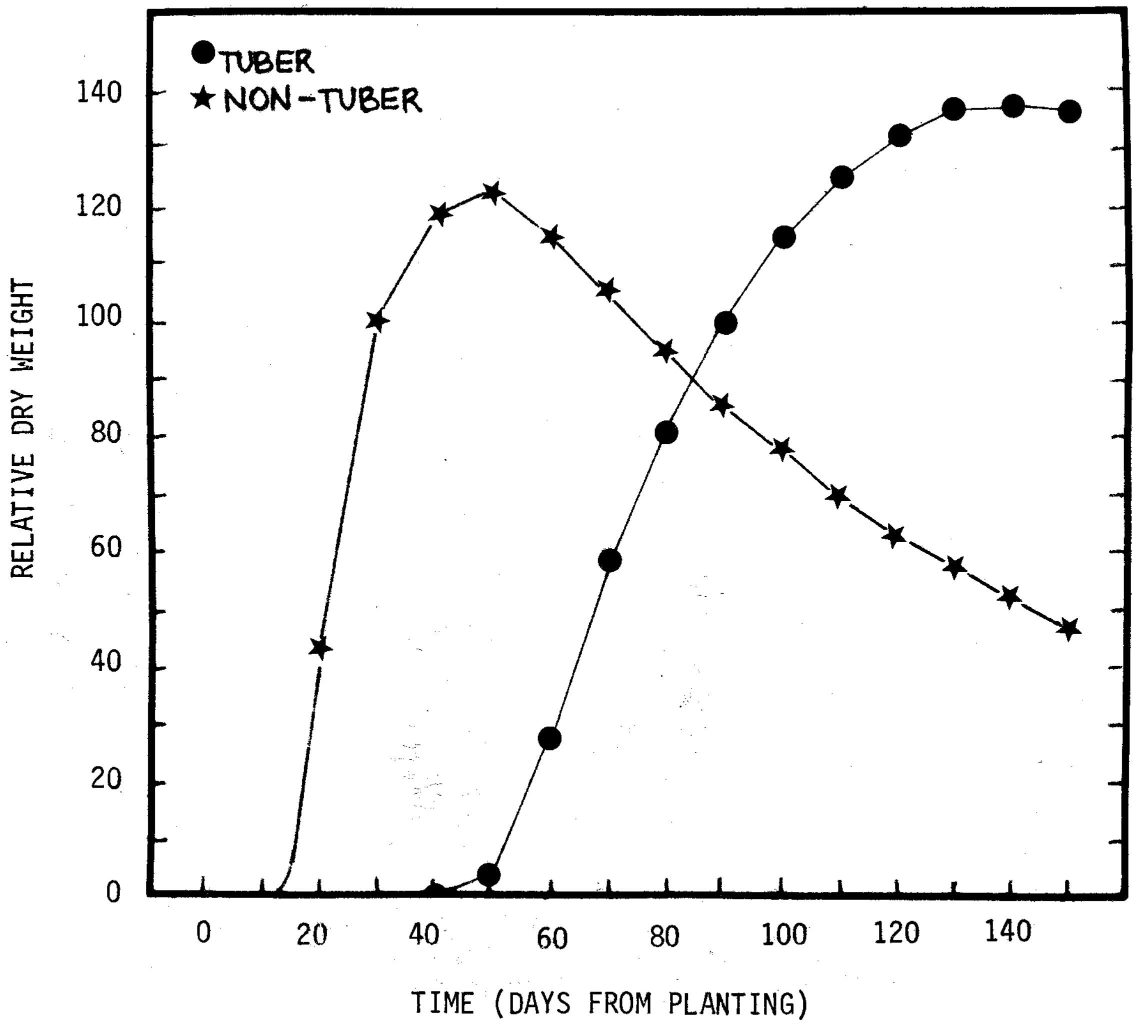
[1]The number of hills sampled at each site was between 3 and 6.

Table 4. Means and standard deviations (in parenthesis) for stem numbers, ground level stem girth, plant height, and branch numbers for 'Russet Burbank' potatoes (*Solanum tuberosum* L.) untreated and treated (by injection) with *Verticillium dahliae* Kleb at three different dates in three fields LEV, WAL, and EAG near Hermiston, Oregon, recorded August 10, 1983.

Treatment[1] date	Number of stems/hill	Variables Stem girth at 0 cm	Average plant height	Number of Branches
		LEV		
Untreated	2.2 (.4)	5.3 (1.3)	171.0 (11.6)	7.1 (3.3)
6-15	2.6 (1.3)	5.5 (.7)	158.5 (14.8)	6.8 (2.7)
7-7	2.0 (0.0)	5.9 (0.4)	161.5 (10.4)	8.0 (3.1)
7-20	1.8 (.8)	5.2 (1.6)	167.9 (24.0)	8.1 (6.5)
		WAL		
Untreated	1.2 (.4)	4.9 (1.3)	131.5 (19.5)	6.2 (5.4)
6-15	1.2 (.4)	5.7 (.8)	113.8 (22.4)	7.7 (2.3)
7-7	1.8 (.8)	5.6 (.6)	133.0 (12.2)	7.5 (2.4)
7-20	2.2 (1.6)	4.7 (1.9)	118.9 (15.4)	4.7 (3.3)
		EAG		
Untreated	2.0 (.6)	4.5 (1.1)	81.3 (19.0)	2.7 (2.1)
6-15	2.3 (.5)	5.3 (1.2)	74.4 (19.5)	3.6 (2.3)
7-7	2.4 (1.3)	4.4 (1.5)	64.8 (6.8)	- -
7-20	2.0 (.7)	3.9 (1.0)	75.3 (7.6)	2.7 (1.6)

[1]Dates indicate time of *Verticillium dahliae* Kleb injection.

Figure 1. Non-tuber and tuber dry weights generated by POTATOFLEX (Flexform,1983) a model on the Cyber computer.



Note: All non-tuber dry weights, (i.e. leaf, stem, and root biomass) follow the same line.

EVALUATION OF TWO HERBICIDES ON CANTALOUPE IN OREGON'S COLUMBIA BASIN

D. C. Hane[1]

Ethalfluralin and fluazifop-butyl were evaluated for weed control in cantaloupe (*Cucumis melo* L.). Ethalfluralin was selected because of excellent results observed with weed control in watermelons (1). Fluazifop-butyl was chosen because of its excellent grass control in numerous crops at the Columbia Basin Agricultural Research and Extension Center. (1)

PROCEDURE

On April 19, 1982, cantaloupe seeds were planted into a well prepared seedbed. Ethalfluralin treatments of 1 and 1.3 pounds of active ingredient (ai) per acre were applied on April 30 in 30 gallons of water per acre followed by a light sprinkler application of water to incorporate the herbicide. Treatments of fluazifop-butyl at .25 and .5 pounds ai per acre were applied on June 2 in 30 gallons of water and 1 quart of crop oil per acre.

In 1983, cantaloupe was planted on April 28. Due to cool damp weather, emergence was extremely poor so the crop was replanted on May 26. On April 29, Ethalfluralin at 1.5 pounds ai per acre was applied in 20 gallons of water per acre followed by a sprinkler application of .4 inch of water. Fluazifop-butyl treatments were applied on June 6 at rates of .187, .25, .375, and .5 pounds (ai) per acre in 30 gallons of water with .25% non-ionic surfactant per acre. Broadleaf weeds were hand cultivated in the fluazifop-butyl plots.

RESULTS AND DISCUSSION

In 1982, weed species were primarily grasses as indicated in Table 1. Lambsquarter and redroot pigweed were a problem in some plot areas. Average weed numbers per square foot were quite variable. The herbicide activity of ethalfluralin, which was applied April 20 was not apparent when weed populations were counted on May 20. Fluazifop-butyl was applied after the May 20 count of weed populations.

On June 9, relative weed control by the various treatments was rated by estimating the percent of plot area covered by weeds (Table 2). Untreated check plots were weedy enough to reduce the relative worth of the melon crop.

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Table 1. Percent of total weed population of weed species present and average number of weeds per square foot in the cantaloupe herbicide trials at the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon, 1982

Treatment	Rate[1]	Watergrass (*Echinochloa crusgalli*)	Witchgrass (*Panicum capillare*)	Redroot Pigweed (*Amaranthus retroflexus*)	Henbit (*Lamium amplexicaule*)	Lambsquarter (*Chenopodium album*)	Hairy Nightshade (*Solanum sarachoides*)	Sheppardspurse (*Capsella bursa-pastoris*)	Yellow Nutsedge (*Cyperus esculentus*)	Average weed population
		percent of total weed population[2]								No. per sq. foot
Check		0	40	3.0	0	16	0	0	40	7.4
Ethalfluralin	1.00	0	27	2.0	0	5	.6	.6	66	15.7
Ethalfluralin	1.30	8	71	.2	0	20	.2	.7	0	40.9
Fluazifop-butyl	.25	14	80	.7	.7	3	.7	.7	0	14.5
Fluazifop-butyl	.50	9	36	4.0	3.0	8	1.0	1.0	40	35.6

[1]Pounds per acre of active ingredient applied.

[2]Rated on May 20.

Ethalfluralin at both rates showed good potential for decreasing weed competition. The main weed species remaining in the ethalfluralin treated plots were yellow nutsedge and witchgrass.

Fluazifop-butyl was an excellent grass herbicide, but ineffective on broadleaf weeds. Observations suggest that an application just as grasses are emerging would eliminate early grassy weed competition with cantaloupe seedlings. The higher rate of fluazifop-butyl was more effective in controlling larger grasses and gave better control further into the season than did the lower rate (Table 2).

Table 2. Weed competition on June 9 in the cantaloupe herbicide trial at the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon, 1982

Treatment	Rate[1]	Ground area controlled by weed populations
		percent
Check		64
Ethalfluralin	1.00	19
Ethalfluralin	1.30	37
Fluazifop-butyl	.25	31
Fluazifop-butyl	.50	19

[1]Pounds per acre of active ingredient applied.

Table 3 indicates grasses were the most prevalent weed competition in the 1983 test. The most dominant broadleaf weed was redroot pigweed. The effectiveness of ethalfluralin, which was applied on April 29 to control early weed competition, was apparent on June 3. Fluazifop-butyl was applied after this weed count.

Weed vigor was rated on June 20 and July 5 as an indication of herbicide effectiveness (Table 4). Fluazifop-butyl treatments were rated for grass control only since broadleaf weeds had been hand cultivated from plot areas. All rates of fluazifop-butyl were quite effective on grasses in the June 20 rating though the weeds observed where the lower rates were applied showed slightly more vigor. Ethalfluralin plots were clean. The rating on July 5 indicates the lack of residual effect from the lower rates of fluazifop-butyl. In fact, some of the grasses that showed little vigor at the earlier date had generated new growth and had become an effective competitor. The .5 lb. rate was showing good residual control. Ethalfluralin plots were not rated on July 5, but weed control was still very effective.

Table 3. Percent of total weed population of weed species present and average number of weeds per square foot in the cantaloupe herbicide trials at the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon, 1983

Treatment	Rate[1]	Watergrass (*Echinochloa crusgalli*)	Large Crabgrass (*Digitaria sanguinalis*)	Redroot Pigweed (*Amarathus retroflexus*)	Russian Thistle (*Salsola Kali*)	Henbit (*Lamium amplexicaule*)	Lambsquarter (*Chenopodium album*)	Average weed population
		percent of total weed population[2]						No. per sq. foot
Check		12	67	18	1	1	1	18
Ethylfluralin	1.5	0	0	0	0	0	0	0
Fluazifop-butyl	.187	16	84	0	0	0	0	15
Fluazifop-butyl	.250	31	69	0	0	0	0	17
Fluazifop-butyl	.375	12	88	0	0	0	0	17
Fluazifop-butyl	.5	20	80	0	0	0	0	9

[1]Pounds per acre of active ingredient applied.

[2]Rated on June 3.

Table 4. Weed vigor ratings as influenced by herbicide and rate in cantaloupe trials at the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon, 1983

Treatment	Rate[1]	Vigor Rating[2] 20 June	5 July
Check		5.0	5.0
Ethalfluralin	1.5	0	*
Fluazifop-butyl	.187	1.0	2.8
Fluazifop-butyl	.250	.9	.7
Fluazifop-butyl	.375	.5	1.3
Fluazifop-butyl	.5	.4	.1

[1]Pounds per acre of active ingredient applied.

[2]0 = weeds dead. 5 = no effect on weeds.

*No rating but notes indicate plots were clean.

Late season weed control from the various treatments is outlined in Table 5. The lower rates of fluazifop-butyl were not effective in controlling grasses throughout the season. Additional applications would be needed to gain full season grass control at rates less than .5 pounds. The .5 pound rate of fluazifop-butyl showed good control of grasses even late into the season. Ethalfluralin plots remained nearly weed free.

Ethalfluralin at 1.5 pounds active ingredient per acre provided excellent season long weed control of broadleaf and grasses. The prevention of early season weed competition gave young cantaloupe seedlings a strong vigorous start.

Fluazifop-butyl at .5 pounds active ingredient per acre did an excellent job in controlling grassy weeds. Early application was essential to eliminate competition with the cantaloupe seedlings. The residual control of grasses late into the season was good. If broadleaf weeds were a problem, additional measures would be needed to control them.

Table 5. Weed competition on August 24 in the cantaloupe herbicide trial at the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon, 1982

Treatment	Rate[1]	Ground area controlled by weed populations
		percent
Check		100
Ethalfluralin	1.5	7
Fluazifop-butyl	1.87	60
Fluazifop-butyl	.250	55
Fluazifop-butyl	.375	25
Fluazifop-butyl	.5	13

[1]Pounds per acre of active ingredient applied.

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EVALUATION OF POTATO VINE DESSICANTS AS TO RATE OF KILL AND RELATIONSHIP TO STEM END BROWNING[1]

D.C. Hane and A. R. Mosley[2]

Chemical dessication of potato (*Solanum tuberosum* L.) vines to hasten tuber maturity is a common practice in Oregon's Columbia Basin since mature tubers have less harvest damage and storage disease problems.

One problem associated with rapid vine death is a vascular discoloration at the stem end of the tuber. A slower rate of vine dessication could reduce the amount of stem end browning.

This test was initiated to evaluate the differences between diquat, diquat plus endothall, and dinoseb as to their rate of vine kill and effect on stem end browning.

PROCEDURES

Traditional north central Oregon potato management practices were used for these 1982 and 1983 tests.

All treatments except for the diquat and endothall combination in 1983, were established at recommended rates.

Treatments in 1982:

1. A single application of diquat at .25 pounds active ingredient with .25% non-ionic surfactant per acre.

2. Diquat as above, then a second application 6 days later.

3. A single application of dinoseb at 2.5 pounds active ingredient with 2 quarts of crop oil per acre.

4. Dinoseb at 1.25 pounds active ingredient and 1 quart of crop oil per acre applied twice. The second application was 6 days after the first.

Treatments in 1983:

1. Dinoseb at 2.5 pounds active ingredient and 5 gallons of diesel oil per acre.

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[1]This study was done in part with a grant from Chevron Chemical Co.

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2. Diquat at .25 pounds active ingredient and .25% non-ionic surfactant per acre.

3. Diquat plus endothall at .25 and .26 pounds active ingredient respectively and .25% non-ionic surfactant per acre.

4. Diquat plus endothall at .25 and .39 pounds active ingredient, respectively and .25% non-ionic surfactant per acre.

Initial application dates, September 15, 1982, and September 16, 1983, were selected to facilitate an October 1 harvest date. Second applications in 1982 of Treatments 2 and 4 were applied on September 21. All treatments were applied with a tractor mounted plot sprayer using 8003 Tee Jet nozzles and 35-40 lbs. psi in 30 gallons of water per acre.

The degree of vine kill was recorded on September 17, 21, and October 1 in 1982 and on September 19, 22, and 26 in 1983. Vascular discoloration was rated at harvest approximately three weeks after treatments were applied.

RESULTS AND DISCUSSION

Potato vines, just before initial applications, though still actively growing, were showing symptoms of senescence. Vines were somewhat more vigorous in 1983.

Tables 1 and 3 show a difference in the vine kill rate between the dessicants studied. In both years diquat killed vines slower than dinoseb when applied in single or split applications. Diquat plus endothall was equivalent to the single application of diquat in killing vines. The split diquat application in 1982 caused somewhat faster vine kill than did the single application. The split application of dinoseb killed vines slower than a single full rate of dinoseb. Two weeks after applications were made, the degree of vine death was the same (Table 1). An early frost in 1983 prevented a two week rating.

Tables 2 and 4 summarize the amount and severity of vascular discoloration resulting from the treatments. There was a difference between years on both the amount and severity of stem end browning in the vascular tissue, 1983 being more severe. There were no ascertainable differences between treatments in 1982 or 1983. In 1982, the Dinoseb treatments had more tubers showing vascular discoloration at the 1/4 to 1/2 inch depth than did the diquat treatments, but the overall numbers of tubers affected were not different.

In this study, the results indicate that the rate of vine kill did not influence the amount of vascular discoloration observed in the stem end of potato tubers at harvest.

One observed advantage of diquat over dinoseb was cleanliness. Dinoseb caused a yellow stain on skin, clothing, spray equipment and exposed tubers whereas diquat was easily cleaned from surfaces.

Table 1. Vine kill ratings as influenced by treatments in the 1982 potato vine dessication trial conducted at the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon

Treatment	Rate[1]	Sept. 17*	Vine kill rating[2] Sept. 21*	Oct. 18*
Diquat	.25	2.7	5.3	9.5
Diquat	.25 + .25	3.3	5.7	9.7
Dinoseb	2.50	6.3	7.7	9.7
Dinoseb	1.25 + 1.25	4.7	6.6	9.9

[1]Pounds per acre of active ingredient applied.

[2]Vine kill rating = 1 to 10 where 1 = 0-10% and 10 = 90-100%.

*Initial applications made on Sept. 15.

Table 2. Vascular discoloration ratings of potato tubers as influenced by treatments in the 1982 potato vine dessication trial at the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon

Treatment	Rate[1]	Vascular discoloration rating[2] 1	2	3	4	5	Total
		percent					
Diquat	.25	56	5				61
Diquat	.25 + .25	44	7			1	52
Dinoseb	2.50	35	11				46
Dinoseb	1.25 + 1.25	38	15			1	54

[1]Pounds per acre of active ingredient applied.

[2]1 = Vascular discoloration extending less than 1/4 inch into tuber from stem end.

5 = Vascular discoloration extending more than 1 inch into tuber from stem end.

Table 3. Vine kill ratings as influenced by treatments in the 1983 potato vine dessication trial at the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon

Treatment	Rate[1]	Sept. 19*	Vine kill rating[2] Sept. 22*	Sept. 26*
Diquat	.25	1.6	5.0	8.9
Diquat + Endothall	.25 + .26	1.4	5.2	9.1
Diquat + Endothall	.25 + .39	1.9	5.1	8.6
Dinoseb	2.50	4.7	6.5	10.0

[1]Pounds per acre of active ingredient applied.

[2]Vine kill rating = 1 to 10 where 1 = 0-10% and 10 = 90-100% death.

*Initial applications made on Sept. 16.

Table 4. Vascular discoloration ratings of potato tubers as influenced by treatments in the 1983 potato vine dessication trial at the Columbia Basin Agricultural Research and Extension Center, Hermiston, Oregon

Treatment	Rate[1]	Vascular discoloration rating[2]					
		1	2	3	4	5	Total
		percent					
Diquat	.25	69	18	4			91
Diquat + Endothall	.25 + .26	53	18	7	1	1	80
Diquat + Endothall	.25 + .39	68	11	5	2		86
Dinoseb	2.50	54	20	6	3		83

[1]Pounds per acre of active ingredient applied.

[2]1 = Vascular discoloration extending less than 1/4 inch into tuber from stem end.
5 = Vascular discoloration extending more than 1 inch into tuber from stem end.

'FLORA', A NEW SEMI-DWARF WINTER TRITICALE (X *Triticosecale*, POACEAE, TRITICALE) OR 8655, Kiss/2/193-803/358

Mathias F. Kolding, Robert J. Metzger, and Warren E. Kronstad[1]

'Flora', OR 8655[2], PI 478305 is a semi-dwarf, winter hexaploid triticale which has a full complement of the donor rye and wheat chromosomes. Its spike is long, lax, nodding, and resistant to shattering. Its rachis might be considered brittle after ripening since the spike breaks into individual florets when threshed instead of having the kernels stripped from the florets as in wheat. It is rough awned. The glumes are light brown, long and narrow. The kernel is brown, shriveled, long, soft, elliptical, with a small germ, and has mid-long brush hairs. The upper portion of the neck is generally short pubescent.

Flora is adapted to the intermountain valleys and plateaus in eastern Oregon, the sandy soils along the Columbia, the Redmond Madras basin, the Treasure Valley, and certain areas in Idaho.

SOURCE OF GERMPLASM

Flora is a selection from the cross Kiss/2/193-803/358 completed by the Center for Maize and Wheat Improvement (CIMMYT) in the triticale program under the direction of Dr. Frank Zillinski.

SELECTION PROCEDURE

Flora was planted as a heterogeneous population in 1976 at the Pendleton site of the Columbia Basin Agricultural Research Center. The following year (1977) it was planted in a long plot near Flora, Oregon. About 60 plant selections were made and planted at the Hermiston site of the Columbia Basin Agricultural Research Center. Several selections from the population growing at Hermiston in the 1977-78 crop year were kept and entered into yield trials. One of these selections, M75-8655-55, was head-rowed (seed from each of 500 heads planted in short rows) in the fall of 1980. Rows containing off types were destroyed before anthesis.

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[2]Partial support of developmental research was supported by:
1. Rockefeller Foundation project GA AS7719, Development and Evaluation of Germplasm and Tests Conducted to Determine Grain Yield Potential of Winter Triticale November 1, 1976 through December, 1979. 2. Annual grants from the Oregon Wheat Commission 1972 through 1983. 3. Pacific Northwest Regional Commission Grant Agreement No. 30-262-9173.

Heads were picked from the remaining rows for the breeders seed planting in 1981. Breeders seed was harvested, designated OR 8655, and given to the Oregon foundation seed project for increase in 1982. Approximately 700 pounds of seed has been produced by the foundation project.

SIGNIFICANT ATTRIBUTES

Flora has an excellent winter survival record at Flora, Oregon, and appears tolerant to the snow molds and the frost heaving in that area. It appears nearly resistant to dwarf smut. Thin stands are compensated for by its tillering ability, an increase in head size, and improved seed set.

Formal yield trials for Flora were not conducted in the Flora area, but a one acre plot yielded 10 to 15% more pounds per acre than the best winter wheat yields on that ranch in 1981. In 1982, a 72-acre plot yielded nearly 4,400 pounds per acre compared to 3,700 pounds per acre for nearby wheats.

Flora is tolerant of high sodium soils. On a farm near Alicel, Flora produced the first acceptable cereal crop on a swamp area having a pH up to 8.0.

Barley Yellow Dwarf Virus (BYDV) symptoms were not observed in Flora in three years of BYDV trials near Hermiston, Oregon. It also appears resistant, or tolerant to other diseases associated with early fall planting on the sandy soils near the Columbia River.

Winter survival ratings during severe winters are higher for Flora near Hermiston than for the commercial wheats.

Flora is stiff-strawed and has not lodged in plots.

The leafy prostrate, but moderate growth of Flora when planted early on the sandy soils, should offer an excellent fall soil cover as well as providing nominal grain yields to producers desiring to protect August harvested potato ground.

We have not observed stripe rust (*Puccinia striiformis* West), leaf rust (*Puccinia recondita* sp. *tritici* Rob ex Desm. f.), stem rust (*Puccinia graminis Pers f. sp tritici* Eriks. & Henn.) septoria (*Septoria* spp.), or dwarf smut (*Tilletia controversa* Kuhn) in Flora in north eastern Oregon, but it is susceptible to bacterial leaf streak (*Xanthomonas translucens* jj. R.).

GENERAL WEAKNESSES

Flora is not adapted to dryland farm practices since both yield and quality drop drastically. Volunteers are found in succeeding crops at about the same rate as other cereal crops, but its large plants are highly visible. Growers relate it to the weedy rye problem and are reluctant to plant any triticale. They are probably wise not to plant triticale if they are in the dryland wheat summer fallow area.

Kernel quality is not as good as wheat, or as good as experimental triticale, however, the Flora grown in the intermountain areas was acceptable to a feed mill near Shedd, Oregon.

PERFORMANCE TRIALS

Flora was included in the Eastern Oregon Winter Triticale performance trials for five years. Table 1 gives bushels per acre yield comparisons for Flora and Stephens during the years they were both tested near Hermiston, Ontario, Pendleton, and Union. Total average yield is five bushels per acre less than Stephens. Much of the lower yield is attributable to Flora's lower yields near Ontario.

Table 1. 1979 to 1983 grain yields of Flora winter triticale and Stephens winter wheat in the Eastern Oregon Winter Triticale trials

Variety	Location	1979	1980	1981	1982	1983	Average
		bushels per acre					
Flora	Hermiston	64	109	136	108	110	105
	Ontario	69	126	124	87	126	106
	Pendleton	28	92	80	--	111	78
	Union	--	--	94	--	--	94
	yearly average	54	109	109	98	116	98
Stephens	Hermiston	33	86	142	114	114	98
	Ontario	100	147	152	132	172	131
	Pendleton	39	66	64	--	121	73
	Union	--	--	59	--	--	--
	yearly average	57	99	104	123	135	103

In the more intensive rate of seeding trial near Hermiston in Table 2, Flora has yielded three to eight percent less than Stephens at all seeding rates for the 1981 through 1983 period. 1983 was the only year when Flora had better yields than Stephens.

Table 2. Grain yields of Stephens winter wheat and Flora winter triticale from rate of seeding trials seeded in the third week of October near Hermiston, Oregon

Variety	Rate of seeding	1981	1982	1983	Average	Percent of Stephens
	Pounds per acre		bushels per acre (60 lbs/bu)			
Stephens	40	95	138	71	101	100
	80	120	151	79	117	100
	120	125	150	90	122	100
	240	142	150	101	131	100
	360	149	130	107	129	100
Flora	40	90	127	78	98	97
	80	107	128	93	109	93
	120	113	127	95	112	92
	240	126	129	113	123	94
	360	131	126	100	119	92

The low bushel weights in Table 3 may explain part of the reason for the lower yields of Flora. The triticale bushel weight is about 75 percent of wheat. Flora also does not have as many heads per square foot (about 80%) as Stephens.

Tables 4 and 5 present grain yields of several prominent wheats compared to Flora. Nugaines and Stephens had equivalent yields to Flora in Table 4 but Flora was the better yielder when seeded early and was equal to Stephens when planted later.

In Mr. Steven James' yield 1982 trial (Table 6) near Madras, Oregon, Flora ranked 14th. The best yielding named wheat variety was 'Hyslop', ranked 16th, at 103.1 bushels per acre.

Dr. Richard E. Ohms conducted a series of trials (Table 7) in Idaho during 1982. Flora ranked first in four locations and second in three locations.

Table 3. Plant height, bushel height, day 50% headed,and heads per square foot of Stephens winter wheat Flora winter triticale from a rate of seeding trial conducted near Hermiston, Oregon, in 1982

Variety	Rate of Seeding	Plant height	Bushel weight	Day 50% headed	Number of Heads
	pounds per acre	inches	pounds		square foot
Stephens	40	39	59.1	May 23	56
	80	38	60.6	May 22	59
	120	39	60.8	May 22	78
	240	39	59.8	May 23	90
	360	38	60.3	May 22	84
Flora	40	36	45.7	May 23	41
	80	37	45.2	May 23	40
	120	37	45.3	May 22	41
	240	37	42.8	May 24	52
	360	37	44.6	May 22	58

Table 4. Barley Yellow Dwarf Virus - Miscellaneous Irrigated Trial, 1983. Yields of Flora compared to the more prominent winter wheat varieties grown in the Pacific Northwest from a trial planted August 31, 1982, at the Columbia Basin Agricultural Research and Extension Center near Hermiston, Oregon

Variety	Bushels per acre
Nugaines	63.7
Flora	61.4
Stephens	58.9
Hill '81'	48.1
Moro	35.5
Crew	34.5
Tyee	33.1
Lewjain	30.1
Faro	27.1

Table 5. Barley Yellow Dwarf Wheat Trial, 1983. Yields of Flora from a trial planted August 31, 1982, and from a trial planted September 28, 1982, compared with winter wheat when planted at the Columbia Basin Agricultural Research and Extension Center near Hermiston, Oregon

Variety	Trial planted August 31, 1982	Trial planted September 28, 1982
	Bushels per acre	
Flora	58.6	97.2
Stephens	42.0	96.7
Hill '81'	36.5	85.8
Lewjain	29.7	84.7

Table 6. Madras Winter Wheat Variety Trial, 1982. Yield, test weight, plant height, heading day and lodging percent concerning Flora from a trial conducted by Mr. Steven James

Variety	Bushels per Yield	Rank in trial	Bushel weight	Plant height	Day 50% headed	Lodging
	60 pounds		pounds	inches		percent
Flora	105	14	41	33	June 21	0
Hyslop	103	16	56	35	June 21	0
Hill '81'	89	31	54	38	June 22	0
Nugaines	86	36	56	34	June 21	15
Daws	85	38	54	36	June 23	0
McDermid	83	44	55	34	June 21	10
Stephens	78	48	55	31	June 21	0

Table 7. 1982 grain yields of Flora and several winter wheats and barleys from trials conducted by Dr. Richard E. Ohms in Idaho

Entry	Flora	Stephens	Daws	Kamiak	Boyer
Location			tons per acre		
Moscow	1.9	2.4	2.5	2.3	2.3
Bonners Ferry	1.8	2.0	1.7	1.1	1.5
Sandpoint	1.3	1.1	1.3	0.9	0.8
Grangeville	1.8	1.5	1.6	1.0	1.2
Rimrock	1.9	2.5	2.1	1.6	1.7
Lewiston	2.6	2.4	2.7	1.8	1.7
Cavendish	1.5	1.4	1.4	1.1	1.3
Reubens	0.9	1.0	0.6	0.7	0.7
Sandpoint	0.5	0.6	0.8	0.3	0.2
Craigmont	2.2	2.0	2.0	1.5	1.5
Average	1.6	1.7	1.7	1.2	1.3

CONCLUSION

Flora is the first semi-dwarf winter triticale released to growers in the Pacific Northwest. Since it is a new crop, it may have very limited market potentials. It can, however, be a useful commodity wherever other cereals are used and offer a flavor variation to diets.

Triticale is used in pancakes, waffles, breads, snack foods and specialty flours. In Oregon it has been fed by researchers to hogs, quail, turkey broilers, turkey toms and turkeys from hatch to slaughter. Its present high bran to endosperm ratio may even attract horse nutritionists' attention.

Low test weights in triticale are being changed gradually by breeders to more satisfactory levels.

The disease resistance and extensive ground cover found in Flora could prove useful if growers would want an early planted crop on sandy soils.

Its apparent tolerance of high pH, winter frost heaving, winter freezes, and snow cover offers a useful fall planted cereal to the higher elevations growers in eastern Oregon.

POPCORN PRODUCTION

F. V. Pumphrey[1]

Popcorn (*Zea mays everta* L.) growth and maturity characteristics are similar to field corn; thus, popcorn is a potential crop wherever field corn is grown. The home gardener can raise popcorn wherever sweetcorn is ready for table use several weeks before frost. Sweetcorn is ready for table use when in the late milk stage of growth; with popcorn, the kernels should mature and start drying before frost.

Popcorn is a specialty crop from the standpoint of marketing and consumption. When marketed, the popcorn should contain about 13.5 percent moisture which is the ideal moisture for maximum expansion when popped. Heating the kernel changes water within the flinty, horny endosperm to steam. When sufficient pressure has developed, the horny endosperm explodes into the soft, starch popped kernel. Expansion should exceed 30 volumes. Most popcorn sold to the consumer is in moisture tight containers to insure a favorable moisture content for popping.

Popcorn was grown at the Columbia Basin Agricultural Research and Extension Center to observe cultural practices needed for production. The yield potential of yellow and white rice popcorn was compared to field corn.

PRODUCTION PRACTICES

Cultural practices used to grow popcorn and field corn are similar.

Traditional plowing and packing, or conservation tillage, are used to prepare a seedbed. Conservation tillage, which leaves considerable plant residue on the soil surface, is preferred wherever wind or water erosion is a hazard.

Previous fertilization of the field and soil test results need to be considered when deciding what and how much fertilizer to apply. Best results are obtained from banding a starter fertilizer containing nitrogen, phosphorus, potassium and possibly zinc two inches to the side and slightly deeper than the seed.

Some of the phosphorus and potassium should be worked into the seedbed if large amounts of these elements are applied. Popcorn production requires over 200 pounds per acre of nitrogen; best results are obtained from applying part of the nitrogen at planting time and the rest when the plants are between six inches tall and tasseling.

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Weed control used for field corn has effectively controlled weeds in popcorn. Consult the current edition of Oregon Weed Control Handbook available at Extension Service offices for herbicide recommendations.

Plant popcorn soon after the soil has warmed to 55°F at the two inch depth. Plant populations between 22,000 and 28,000 plants per acre will produce optimum yields. Seedlings do not have the vigor of field corn. Varieties grown in the trial suckered (tillered) more than field corn. Suckering in corn is of no advantage for producing more grain, or reducing seeding rates.

Popcorn consumes between 1 and 1.5 inches of water per week from early June into late August. Wind, temperature, and precipitation vary between weeks and seasons; therefore soil moisture should be checked regularly to estimate irrigation requirements.

Ear worms, aphids, and mites are common pests on popcorn and may develop enough population that control is economically feasible. Consult the current edition of Pacific Northwest Insect Control Handbook available at Extension Service offices for insect control recommendations for field-corn and sweetcorn. No serious diseases were observed.

YIELD

The yellow popcorn hybrid 'Purdue 410' yielded 70 to 90 bushels per acre. White rice popcorn yielded less than the yellow popcorn. These yields indicate that popcorn would produce approximately one half the yield of field corn.

METEOROLOGICAL DATA
COLUMBIA BASIN AGRICULTURAL 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
1983	39	43	46	50	61	66	69	72	57	51	47	23
1932-83	32	38	45	54	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
1983	47	51	59	64	75	82	82	85	73	65	55	30
1932-83	40	47	56	70	75	82	90	88	80	67	51	44

Temperatures, Monthly Mean Minimum, Fahrenheit

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1983	31	34	39	36	47	47	56	58	45	37	38	16
1932-83	23	29	33	38	47	47	58	58	48	38	31	27

1983 Temperatures, Monthly Maximum and Minimum, Fahrenheit

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Max	60	66	65	77	102	89	95	95	87	73	74	49
Min	20	18	27	25	34	43	44	49	26	29	26	-17

Precipitation, Inches

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1983	1.1	1.8	2.2	.9	.8	1.1	.3	.6	.5	.8	2.0	2.6
1932-83	1.2	.9	.8	.6	.7	.6	.2	.3	.4	.8	1.1	1.3

Total precipitation in 1983, 14.74 inches

Average total precipitation 1932-83, 8.79 inches

Evaporation - Inches

	Mar	Apr	May	June	July	Aug	Sept
1983	2.93	5.48	8.70	9.53	11.77	10.00	6.18
1962-83	3.26	5.30	8.11	9.56	11.20	9.60	6.20

Wind Velocity - Miles Per Hour Average

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1983	2.9	2.5	2.7	2.8	3.4	3.7	3.7	2.5	3.0	2.2	3.0	1.3
1932-83	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 1983

Temperature Extremes - Degree Fahrenheit

	January	February	March	April	May	June
High	1971, 69	1972, 74	1960, 82	1934, 93	1983, 102	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	1983, 26	1935, 7	1955, -12	1983, -17

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	Sep. 1946	Oct. 1957	Nov.1973	Dec. 1973
1.02	1.83	1.99	3.91	3.77	3.45

Most precipitation in a year, 1983, 14.74 inches
Least precipitation in a year, 1967, 4.43 inches

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

Snow records from December 1946 through 1983

December 14, 1948, 7 inches in a 24-hour period
January 10, 1980, 12 inches on ground at 8 AM
December snow record, 1983, 11 inches

Frost-Free Days

1983	April 16	September 29	166 days
1932-83	April 23	October 9	169 days

Latest frost in Fall, 1937, November 4, 32°F.
Earliest frost in Fall, 1970, September 13, 30°F.
Latest frost in Spring, 1964, May 23, 30°F.
Earliest last frost in Spring, 1948, March 27, 19°F.
Longest frost-free period in 1937, 211 days
Shortest frost-free period in 1970, 126 days