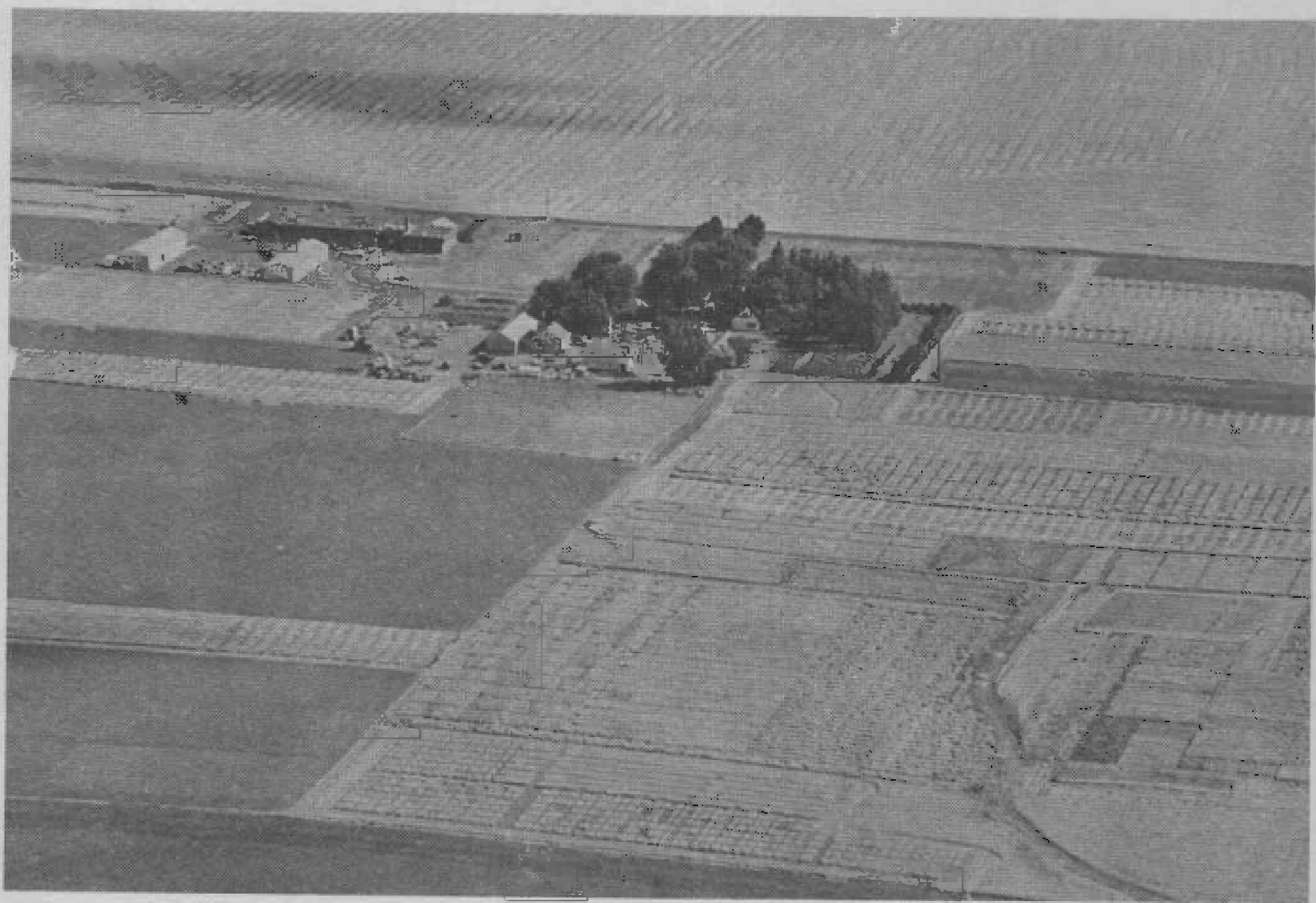
Research Reports

Columbia Basin Agricultural Research



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CONTENTS

CEREAL BREEDING AND TESTING PROJECT

Charles R. Rohde and Wesley B. Locke[1]

The cereal breeding program at Pendleton has the primary objective of developing high yielding, soft, white winter wheat varieties for the lower yielding areas of eastern Oregon. Varieties adapted for lower yielding areas are often taller than semi-dwarf varieties such as 'Hyslop' and 'Nugaines' and include club varieties such as 'Moro' and 'Paha.'

Desired varietal characteristics for lower yielding areas are: (1) production of high yields of grain with excellent milling and baking quality; (2) resistance to smut, stripe rust, and foot and root rots; (3) ability to establish quickly in a high residue seedbed; (4) ability to emerge when seeded deep or when soil moisture in the seeding zone is low; (5) resistance to shattering; (6) medium straw height; (7) resistance to lodging, and (7) moderate winterhardiness.

New varieties of spring and winter wheat, spring and winter barley, and spring oats, developed by public and private breeders, are compared in the variety testing program at the Columbia Basin Agricultural Research Center. Plot sites at Pendleton, Moro, and Hermiston stations and on farmers' fields that are representative of cereal-growing areas of northeastern Oregon provide data on yield, agronomic quality, and disease characteristics for comparison to commonly grown varieties.

Climatic and soil conditions are diverse in northeastern Oregon; consequently, it is necessary to test cereal varieties at many locations and for at least three years to get reliable information as to their adaptability for various areas of northeastern Oregon. Tables 1 through 9 give yield data obtained from these trials for new and old varieties of wheat and barley. Detailed variety descriptions are included in another article in this progress report.

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Table 1. Yield data of winter wheat varieties for the years each has been tested in lower yielding areas of eastern Oregon

Variety	Moro	Pilot Rock	Echo	Heppner	Lexington	Arlington	Condon	Average
				(bushels per acre)				
Stephens	46.3	33.1	35.1	28.2	21.9	29.0	27.8	31.6
Twin (fall seeded)	39.6	30.0	34.3	33.8	20.0	28.9	24.6	30.2
Sprague	40.8	30.4	32.8	31.3	20.2	28.3	23.4	29.6
Faro	44.9	29.1	33.2	29.0	18.6	29.6	21.9	29.5
McDermid	35.9	21.1	32.9	32.1	19.8	26.8	26.7	29.3
Hyslop	38.0	30.0	34.0	32.0	22.4	26.8	21.9	29.3
Daws	41.9	30.6	33.5	28.4	19.2	23.9	24.2	28.8
Luke	37.5	29.8	32.6	28.7	19.4	26.7	25.0	28.5
Nugaines	36.7	24.9	33.7	30.1	19.4	26.9	24.5	28.0
Barbee	37.8	30.2	28.1	25.4	15.1	24.7	25.9	26.7

Table 2. Yield data of winter wheat varieties for the years each has been tested in higher yielding areas of eastern Oregon

Variety	Pendleton	Weston	Holdman	LaGrande	Enterprise	Average
				(bushels per acre)		
Hyslop	71.5	60.8	38.6	61.3	56.3	57.7
Stephens	71.1	58.6	35.0	62.5	58.6	57.2
McDermid	71.6	61.6	35.3	58.2	58.8	57.1
Luke	68.8	62.0	35.5	58.9	56.4	56.3
Nugaines	70.2	59.2	35.0	57.3	52.9	54.9
Sprague	67.5	56.2	36.4	51.0	60.4	54.3
Faro	69.4	55.4	36.6	57.8	52.3	54.3
Daws	67.8	51.8	34.1	58.8	51.4	52.8
Barbee	65.0	45.1	30.3	48.9	58.1	49.5
Twin (fall seeded)	69.9	55.5	32.2	45.8	19.5	44.6

Table 3. Yield data of winter wheat varieties for the years each has been tested under irrigation in eastern Oregon

Variety	Pendleton	Hermiston	Summerville	Average
		(bushels per acre)		
Stephens[1]	99.0	63.2	81.1	81.1
Hyslop	94.4	56.5	84.1	78.3
Nugaines	88.5	52.0	81.7	74.1
McDermid	89.2	55.0	77.8	74.0
Daws[1]	90.4	52.8	77.3	73.5
Yamhill	77.7	49.1	77.3	68.0
Luke	85.1	43.2	74.5	67.6
Twin (fall seeded)[1]	88.4	43.9	64.9	65.7

[1] Tested in 1977 and 1978 only

Table 4. Yield data of spring wheat varieties for the years each has been tested in lower yielding areas of eastern Oregon

Variety	Pendleton	Moro	Rew Farm	Lexington[1]	Heppner	Arlington	Condon	Average
				(bushels per acre)				
Dirkwin	47.2	30.4	23.5	17.1	19.0	25.6	21.8	26.4
Anza	42.8	29.9	23.8	16.0	20.9	24.4	24.5	26.0
Prospur	39.8	26.0	21.2	14.4	35.4	18.6	20.9	25.2
WS-1	45.9	27.5	22.9	14.2	22.9	20.1	20.9	24.9
Fielder	39.9	27.4	22.8	16.8	21.1	23.1	23.1	24.9
Fieldwin	42.9	27.0	22.7	14.8	21.3	21.4	24.0	24.9
Borah	38.9	28.3	22.0	15.6	22.2	22.4	22.6	24.6
Twin	40.2	29.0	23.2	15.0	18.7	22.5	21.7	24.3
Springfield	39.4	28.1	22.6	15.4	19.7	22.0	22.2	24.2
Sawtell	39.1	28.4	19.5	14.6	20.4	22.9	19.1	23.4
Urquie	37.7	27.5	18.1	16.2	18.6	24.1	21.7	23.4
Wared[1]	35.2	28.8	20.9	15.6	20.7	21.6	20.7	23.4
Profit 75	40.0	25.1	18.4	12.4	21.0	17.5	19.8	22.0
WS-6[1]	35.2	24.1	19.1	12.8	20.1	18.4	20.1	21.4
Fortuna	29.9	23.3	19.9	12.9	18.1	19.0	19.6	20.4

[1] Tested in 1977 and 1978 only

Table 5. Yield of spring wheat varieties for the years each has been tested in higher yielding areas of eastern Oregon

Variety	Pendleton	Weston	Hermiston	LaGrande	Wallowa	Baker	Average
			(bushels per acre)				
Dirkwin[1]	67.2	53.4	51.5	55.9	51.0	36.9	52.6
Fieldwin	72.6	43.5	53.7	44.5	49.3	43.5	51.2
Prospur[1]	69.6	53.2	49.4	36.3	48.0	45.5	50.3
Fielder	67.2	44.0	55.2	42.1	44.5	39.9	48.8
WS-1	71.5	47.8	41.1	40.8	43.1	42.3	47.8
Borah	67.4	43.5	53.6	36.5	44.8	38.2	47.3
Twin	64.0	39.4	40.4	40.3	45.8	42.5	45.4
Anza	65.6	43.8	51.2	35.4	36.4	35.8	44.7
Urquie	61.7	37.4	38.4	42.2	46.0	40.9	44.4
Sawtell	55.5	44.8	37.0	45.2	45.1	37.2	44.1
Springfield	62.2	40.3	39.3	38.5	43.2	38.7	43.7
Profit 75	63.3	40.3	42.8	33.8	39.6	38.8	43.1
Wared	53.4	39.8	42.8	31.9	43.4	32.6	40.6
WS-6	44.3	38.0	46.6	30.8	38.2	43.2	40.2

[1] Tested in 1977 and 1978 only

Table 6. Yield data of winter barley varieties for the years each has been tested in lower yielding areas of eastern Oregon

Variety	Moro	Pilot Rock	Echo	Heppner	Lexington	Arlington[1]	Condon	Average
				(pounds per acre)				
Steptoe (fall seeded)	2082	2852	2982	2082	1546	2036	1715	2185
Wintermalt	1956	2269	2789	1950	1524	1794	1617	1986
Kamiak	1888	2173	2568	1752	1314	1685	1533	1845
Hudson	1798	2223	2517	1919	1308	1723	1224	1816

[1] Tested in 1977 and 1978 only

Table 7. Yield data of winter barley varieties for the years each has been tested in higher yielding areas of eastern Oregon

Variety	Pendleton	Weston	Holdman	Hermiston	LaGrande	Summerville	Enterprise	Average
				(pounds per acre)				
Boyer	4948	4387	2633	3489	4315	4061	3022	3836
Schuyler	4694	4152	2760	3170	4462	3999	3372	3801
Wintermalt	5194	3566	2514	4330	3770	3490	2506	3624
Steptoe (fall seeded)	5511	4157	2934	4031	3416	2637	1668	3621
Kamiak	5078	3574	2495	2660	3975	3698	2976	3494
Luther	4134	4112	2423	2967	3851	3604	3048	3448

Table 8. Yield data of spring barley varieties for the years each has been tested in lower yielding areas of eastern Oregon

Variety	Pendleton	Moro	Rew Farm	Lexington[1]	Heppner	Arlington	Condon	Average
				(pounds per acre)				
Steptoe	3929	1872	1954	956	1636	1613	2161	2017
Lud	3746	2027	2171	993	1595	1601	1813	1992
Gem	3484	1928	2047	1088	1617	1601	1974	1963
Flynn 37	3280	1852	2068	1044	1547	1523	1829	1878
Summit[1]	3576	1850	1897	986	1223	1623	1865	1860
Unitan	3180	1850	1954	1100	1404	1424	1824	1819

[1] Tested in 1977 and 1978 only

Table 9. Yield data of spring barley varieties for the years each has been tested in higher yielding areas of eastern Oregon

Variety	Pendleton	Weston	Hermiston	LaGrande	Wallowa	Baker	Average
				(pounds per acre)			
Steptoe	4457	3432	3955	4185	4320	3855	4034
Kombar[1]	5452	3266	3490	3547	3322	2987	3677
Summit[1]	4072	3232	3131	4178	4068	3175	3643
Lud	4203	3414	3208	3941	3900	2926	3599
Klages	3675	2683	2494	3749	3894	3763	3376
Gem	3965	3112	3280	3547	3541	2803	3375
Unitan	3685	2725	3168	3208	3456	3159	3234

[1] Tested in 1977 and 1978 only

CEREAL VARIETY DESCRIPTIONS

Charles R. Rohde[1]

This article describes 46 varieties of cereals available for seeding in eastern Oregon. Varieties are grouped by type and are presented in alphabetical order within each category. Table 1 lists the varieties covered and gives the developer and the name of the organization responsible for foundation seed.

SOFT WHITE CLUB WINTER WHEATS

Barbee

Barbee is a bearded, brown-chaffed semi-dwarf wheat released in 1976. It equals Moro in test weight and winter hardiness. Compared to Paha, Barbee is slower to emerge, about six inches shorter, and very resistant to lodging. Barbee matures about two days later than Paha; therefore, it may be too late for most of the club wheat-growing areas of northeastern Oregon. It is resistant to smut and stripe rust but susceptible to *Cercosporella* foot rot. The baking quality of its flour is very good, but milling quality is similar to that of Nugaines and not as good as that of Paha or Moro.

Faro

Faro is a soft white, beardless, brown-chaffed wheat released in 1976. It is exceptionally well-adapted to the lower rainfall areas of eastern Oregon where club wheats commonly are grown and is recommended as a replacement for Moro and Paha. Compared to Moro, it is equal in test weight, superior in lodging resistance, and four to seven inches shorter. Faro is slightly shorter than Paha which it resembles in growth habit, winterhardiness, seedling emergence, and lodging resistance. Faro is earlier-maturing than Paha so that it often ripens before the heat of summer. Faro is resistant to stripe rust and moderately resistant to smut. It has very good milling and baking quality.

Moro

Moro is a beardless, brown-chaffed, medium tall wheat released in 1965. It is best adapted for growing in the lower rainfall areas of eastern Oregon where its taller straw may be desirable for erosion control. Test weight is medium low and maturity is medium early. Although seedling emergence is very good, plants are somewhat susceptible to lodging. Moro is resistant to smut and stripe rust. Milling and baking quality is very good.

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Paha

Paha is a beardless, brown-chaffed wheat released in 1970. Grain test weight is about 1 lb/bu heavier than Moro. It grows about 4 inches shorter than Moro and is very resistant to lodging. Paha is slightly less winterhardy than Moro. It matures later than Moro and, therefore, is not suitable for areas where earliness is desired. Seedling emergence is poorer than that of Moro. Paha is moderately susceptible to stripe rust but resistant to smut and tolerant to *Cercosporella* foot rot. Milling and baking quality of Paha is very good.

SOFT WHITE COMMON WINTER WHEATS

Daws

Daws is a bearded, white-chaffed semi-dwarf wheat released in 1976. Grain test weight is about 2 lb/bu lower than that of Nugaines. Daws is more winterhardy than any other soft white winter wheat variety grown in the Pacific Northwest. Seedling emergence is poorer than that of Nugaines. Daws is very resistant to lodging. Plant height and maturity date are similar to Nugaines. Daws is resistant to stripe rust and smut but susceptible to *Cercosporella* foot rot. Milling and baking quality is very good (similar to Nugaines).

Hyslop

Hyslop is a bearded, white-chaffed, semi-dwarf wheat released in 1970. Grain test weight is about 3 lb/bu less than that of Nugaines. It is less winterhardy than Nugaines, but no problem of winter killing has occurred in northeastern Oregon. Hyslop is slightly taller and slightly earlier to mature than Nugaines and is very resistant to lodging. Seedling emergence is slightly better than Nugaines. Hyslop is moderately resistant to stripe rust, smut and *Septoria*, but moderately susceptible to *Cercosporella* foot rot. Milling and baking quality is very good.

Luke

Luke is a bearded, white-chaffed, semi-dwarf wheat released in 1970. Grain test weight is about 2 lb/bu lower than Nugaines. It is as tall as Nugaines and is very resistant to lodging. It emerges more quickly and vigorously than either Hyslop or Nugaines. Luke matures about four days later than Nugaines so that it may encounter higher temperatures at the end of filling. It is resistant to stripe rust, common smut, dwarf smut, snow mold and is tolerant to *Cercosporella* foot rot. Because of its rapid emergence and tolerance to foot rot, Luke is well adapted for early seeding and is the best variety to use in areas where dwarf smut is a problem. Luke has very good milling and baking quality.

McDermid

McDermid is a bearded, white-chaffed, semi-dwarf wheat released in 1974. Grain test weight is about 3 lb/bu less than Nugaines. It is about as winterhardy as Nugaines. McDermid is similar in height and seedling emergence to Hyslop but is slightly earlier to mature. McDermid is very resistant to lodging. It is moderately resistant to stripe rust and mildew, resistant to leaf rust, smut, and *Septoria*, but quite susceptible to *Cercosporella* foot rot. Milling and baking quality is very good.

Nugaines

Nugaines is a bearded, white-chaffed, semi-dwarf wheat released in 1965. Grain test weight is very high. Seedling emergence is only fair, especially when it is necessary to seed deep, but plants are quite winterhardy. Nugaines is slightly shorter than Hyslop and is very resistant to lodging. It is medium in maturity date. Nugaines is moderately resistant to stripe rust, resistant to smut, and moderately susceptible to *Cercosporella* foot rot. Milling and baking quality is very good.

Rew

Rew is a bearded, white-chaffed, medium height wheat released in 1974. It is best adapted to areas where the short height of Hyslop, McDermid, and Nugaines causes harvesting problems. Grain test weight is about 2 lb/bu lower than Nugaines. It is about as winterhardy as McDermid. Although it is about seven inches taller than Nugaines, Rew is quite resistant to lodging. Seedling emergence is better than most semi-dwarf varieties but is not as good as that of Moro. Rew matures at about the same time as Nugaines. It is resistant to smut but moderately susceptible to stripe rust. Rew has good milling and baking quality.

Sprague

Sprague is a bearded, white-chaffed, semi-dwarf wheat released in 1973. Grain test weight is only about 1 lb/bu less than Nugaines. It is about two inches taller than Nugaines, does not resist lodging as well as most other semi-dwarf varieties, and thus should not be planted where lodging may cause problems. Sprague is quite winterhardy and emerges well. It matures about the same time as Hyslop and slightly earlier than Nugaines. Sprague is resistant to smut, stripe rust, and snow mold and is the best variety to plant where snow mold is a problem. Sprague has good milling and baking quality.

Stephens

Stephens is a bearded, white-chaffed, semi-dwarf wheat released in autumn of 1977. Heads are distinctly coarse in appearance with beards which tend to flare. Grain test weight is about 3 lb/bu less than Nugaines and equals that of Hyslop and McDermid. Winterhardiness and seedling emergence of Stephens are similar to those of McDermid. Stephens is about one inch taller than Hyslop and is very resistant to lodging. It matures slightly earlier than McDermid. Stephens is very resistant to stripe rust, leaf rust, and smut and appears to have some tolerance to *Cercosporella* foot rot. It has an outstanding yield record as evidenced by its yield superiority across environmentally diverse locations for several years. Milling and baking quality is very good.

HARD RED COMMON WINTER WHEATS

Wanser

Wanser is a bearded, brown-chaffed, medium tall wheat released in 1965. Since it is a hard variety, it is best adapted for growing in lower rainfall areas where conditions may be suitable for production of high protein wheat. Grain test weight is very high, about equal to Nugaines. Wanser is very winter-hardy and emerges very well, nearly as well as Moro. It is about 10 inches taller than Nugaines and is quite resistant to lodging for a tall variety. It matures early, at about the same time as McDermid. Wanser is resistant to smut and moderately resistant to stripe rust. Milling and baking quality is very good.

SOFT WHITE SPRING WHEATS

Dirkwin

Dirkwin is beardless, white-chaffed, semi-dwarf wheat released in 1978. It is a very widely adapted variety, yielding well under both droughty and high-producing conditions. Compared to Twin, Dirkwin is similar in plant height, test weight, and heading date. Dirkwin is resistant to powdery mildew and moderately resistant to leaf rust and stripe rust. The milling and baking quality of Dirkwin is satisfactory.

Fielder

Fielder is a bearded, white-chaffed, semi-dwarf wheat released in 1974. Its grain test weight is about 2 lb/bu greater, maturity about one day earlier, and height about one inch taller than Twin's. Fielder appears better adapted for growing under irrigation than Twin. It is moderately resistant to powdery mildew and leaf rust and moderately susceptible to stripe rust. Fielder has good milling and baking quality.

Fieldwin

Fieldwin is a bearded, white-chaffed, semi-dwarf wheat released in 1977. Fieldwin's grain test weight is nearly 2 lb/bu greater, maturity about 2 days earlier, and height about 1 inch taller than Twin's. Fieldwin is moderately resistant to powdery mildew and leaf rust and moderately susceptible to stripe rust. Milling and baking quality is good.

Springfield

Springfield is a beardless, white-chaffed, semi-dwarf wheat released in 1970. It is similar to Twin in most characteristics but under high yielding situations has yielded slightly less than Twin.

Twin

Twin is a beardless, white-chaffed, semi-dwarf wheat released in 1971. It is a widely adapted variety and yields well under both droughty and high-producing conditions. Compared to Federation, Twin is about 7 inches shorter and matures about one day later. Grain test weight usually is rather low, about 54 to 58 lb/bu. Milling quality is only fair but baking quality is good.

Urquie

Urquie is a bearded, white-chaffed, semi-dwarf, facultative wheat released in 1975. Being facultative means that Urquie can be seeded in either fall or spring. The cold tolerance of this variety makes it suitable for mid-winter to late winter seeding in fields where poor emergence and winter killing have caused poor stands. Urquie's grain test weight is about 2 lb/bu heavier, maturity about 2 days later, and height about 2 inches taller than Twin's. Urquie is moderately resistant to stripe rust, susceptible to leaf rust, and moderately susceptible to powdery mildew and *Cercosporella* foot rot. Urquie has good milling quality and its flour has desirable baking quality for both pastry and bread.

SEMI-HARD WHITE SPRING WHEATS

WS-1

WS-1 is a bearded, white-chaffed, semi-dwarf wheat released in 1972. WS-1's grain test weight is about 1 lb/bu less, maturity about 4 days earlier, and height about 2 inches taller than Twin's. WS-1 is moderately resistant to stripe rust, powdery mildew, and leaf rust. Milling and baking quality is poorer than that of Twin.

HARD RED SPRING WHEATS

Anza

Anza is a bearded, white-chaffed, semi-dwarf wheat released in 1971. It is adapted for growing under a wide range of climatic and soil conditions. Anza's grain test weight is about 4 lb/bu greater, maturity is about 5 days earlier, and height is about 3 inches shorter than Twin's. Anza is resistant to stripe rust, mildew, and leaf rust. The milling quality of Anza is good, but the quality of its flour is debatable.

Borah

Borah is a bearded, white-chaffed, semi-dwarf wheat released in 1974. Its grain test weight is about 3 lb/bu greater, maturity is 5 days earlier, and height is about 1 inch shorter than Twin's. Borah is resistant to leaf and stripe rust and has good milling and baking quality.

Fortuna

Fortuna is a beardless, white-chaffed, medium tall, solid-stemmed wheat released in 1966. Its grain test weight is about 3 lb/bu heavier, maturity is 4 days earlier, and plant height is about 9 inches taller than Twin's. Fortuna is resistant to sawfly, leaf rust, stem rust, and stripe rust. Milling and baking quality is satisfactory.

Profit 75

Profit 75 is a bearded, white-chaffed semi-dwarf wheat released in 1974. Its grain test weight is about 3 lb/bu greater, maturity is six days earlier, and height is about equal to Twin's. Profit 75 is resistant to both stripe and leaf rust. Milling and baking quality is very good.

Prospur

Prospur is a bearded, white-chaffed, semi-dwarf wheat released in 1971. Its grain test weight is about 3 lb/bu greater, maturity about 8 days earlier, and height about 3 inches taller than Twin's. Prospur is susceptible to leaf rust and moderately resistant to stripe rust. It has good milling and baking quality.

Sawtell

Sawtell is a bearded, white-chaffed, semi-dwarf wheat released in 1977. Its grain test weight is about 2 lb/bu heavier, maturity and height are about the same as Twin's. Sawtell is susceptible to mildew and moderately resistant to leaf rust and stripe rust. It has satisfactory milling and baking quality.

Wared

Wared is a bearded, white-chaffed, semi-dwarf wheat released in 1974. Its grain test weight is about 2 lb/bu heavier, maturity is 2 days earlier, and height is about 2 inches taller than Twin's. Wared has shown good resistance to mildew and fair resistance to prevalent races of stripe rust. Milling and baking properties are good.

WS-6

WS-6 is a bearded, white-chaffed, semi-dwarf wheat released in 1973. Its grain test weight is about 1 lb/bu heavier, maturity is 5 days earlier, and height is about equal to Twin's. WS-6 is resistant to leaf rust. It has poor milling quality and fair baking quality.

SIX-ROW WINTER BARLEYS

Boyer

Boyer is a medium short, mid-season, feed grain variety released in 1975. Grain test weight is 2 lb/bu less and height is about 7 inches shorter than Kamiak. Boyer is more resistant to lodging than Kamiak and is about equal in winterhardiness. The spike is mid-dense and kernels are white.

Hudson

Hudson is a medium tall, early maturing feed grain variety released in 1951. Grain test weights are very heavy. Plants are quite winterhardy but only moderately resistant to lodging. The spike is dense and short and kernels are white or occasionally light blue.

Kamiak

Kamiak is a medium tall, early maturing, feed grain variety released in 1971. Its grain test weight is about 1 lb/bu less, maturity date and winterhardiness are about the same, height is about 3 inches shorter, and lodging resistance is greater than Hudson's.

Luther

Luther is a medium height, late maturing feed grain variety released in 1966. Its grain test weight is about 4 lb/bu less, maturity is 12 days later, height is 7 inches shorter, and winterhardiness is about equal to Hudson's. The spike is mid-dense and kernels are light blue.

Schuyler

Schuyler is a medium short, medium early, feed grain variety released in 1968. Its grain test weight is about 1 lb/bu less, maturity is 5 days later, height is 9 inches shorter, and winterhardiness is slightly greater than Hudson's. The spike is mid-dense and medium long; kernels are white.

SIX-ROW SPRING BARLEYS

Blazer

Blazer is a medium tall, medium maturing barley released in 1974. It is acceptable for malting and brewing. Its grain test weight is about the same, maturity is 4 days later, and height is 8 inches taller than Steptoe's. Blazer is moderately resistant to lodging. The spike is moderately dense and medium short; kernels are white.

Flynn 37

Flynn 37 is a medium height, early feed grain variety released in 1941. Its grain test weight is about 1 lb/bu less, height is about 3 inches shorter, and straw is less resistant to lodging than Steptoe's. The spike is lax and short to mid-long. Beards are smooth. Kernels are large and white.

Gem

Gem is a medium height, early, feed grain variety released in 1947. Its grain test weight is similar, maturity is about 5 days earlier, height is slightly shorter, and straw is less resistant to lodging than Steptoe's. The spike is lax and short to mid-long; kernels are large and white.

Steptoe

Steptoe is a medium height, early, feed grain variety released in 1973. Grain test weight is quite heavy and this variety yields especially well in high yielding situations. Steptoe is resistant to lodging. It is tolerant to cold and may be fall-seeded in areas where winter killing is not a serious problem. Spikes are lax and mid-long; kernels are white.

Unitan

Unitan is a medium tall, medium maturing feed grain variety released in 1959. Its grain test weight is slightly greater, maturity is one day later, height is about 2 inches taller, and resistance to lodging is slightly less than Steptoe's. The spike is lax and long; kernels are white.

Vale 70

Vale 70 is a medium tall, late maturing feed grain variety released in 1970. Its grain test weight is about equal, maturity is 8 days later, and height is about 2 inches greater than Steptoe's. Vale 70 is best adapted for growing under irrigation. The spike is dense to semi-club; kernels are white.

TWO-ROW SPRING BARLEYS

Klages

Klages is a medium tall, late maturing barley released in 1973. When grown under irrigation, this variety is acceptable for malting and brewing. Its grain test weight is about 2 lb/bu heavier, maturity is 8 days later, and height is the same as Steptoe's. Klages is quite resistant to lodging. The spike is lax and mid-long to long; kernels are white.

Kombar

Kombar is a short, late maturing feed grain variety released in 1977. Its grain test weight is about 3 lb/bu less, maturity is 7 days later, and height is about 9 inches less than Steptoe's. Kombar is very resistant to lodging and yields well under irrigation but not under dryland conditions. The spike is mid-dense and short.

Lud

Lud is a medium short, late maturing feed grain variety released in 1975. Its grain test weight is about 3 lb/bu heavier, maturity is 9 days later, and height is 4 inches shorter than Steptoe's. Lud is quite resistant to lodging. It yields well under irrigation or when rainfall is plentiful but does not yield well under droughty conditions. The spike is mid-dense and medium short.

Summit

Summit is a medium height, late maturing barley released in 1977. Its grain test weight is about 3 lb/bu greater, maturity is 9 days later, and height is one inch shorter than Steptoe's. Summit is quite resistant to lodging. It yields well under irrigation or high rainfall but not under droughty conditions. The spike is mid-dense and medium short. According to the North American Plant Breeders, grain of Summit is acceptable for malting and brewing.

Vanguard

Vanguard is a medium tall, medium late maturing variety released to growers in 1971. Its grain test weight is about 4 lb/bu greater and plant height, maturity, and lodging resistance are similar to Steptoe's. The spike is medium dense and medium long; kernels are white. Vanguard has been designated a malting barley by the Malting Barley Improvement Association.

SPRING OATS

Cayuse

Cayuse is a short, medium early variety released in 1968. It is quite resistant to lodging. Kernels are light yellow and grain test weight is below average. Cayuse has wide adaptation and yields well under drought as well as under irrigation.

Park

Park is a medium tall, medium maturing variety released about 1953. Kernels are white. Its grain test weight is about 1 lb/bu greater, maturity is 3 days later, and height is about 4 inches greater than Cayuse's. Park is quite resistant to lodging. It has been used to prevent erosion on irrigated sandy soils near Boardman. It is planted in early autumn to provide a ground cover during winter. Park freezes out during winter and does not cause a problem for spring-seeded crops.

Table 1. Cereal grain varietal developers and locations of foundation seed nurseries

Variety	Developer	Foundation seed
	Soft White Club Winter Wheats	
Barbee	C. J. Peterson, Jr. and O. A. Vogel SEA-AR-USDA, WSU, Pullman, WA	Wash. State Crop Impr. Assn., Yakima, WA
Faro	C. R. Rohde, CBARC, OSU, Pendleton, OR	Ore. Foundation Seed Project, OSU, Corvallis, OR
Moro	C. R. Rohde, CBARC, OSU, Pendleton, OR and R. J. Metzger, SEA-AR-USDA, Corvallis, OR	Ore. Foundation Seed Project, OSU, Corvallis, OR
Paha	R. E. Allen and O. A. Vogel, SEA-AR-USDA, WSU, Pullman, WA	Wash. State Crop Impr. Assn., Yakima, WA
	Soft White Common Winter Wheats	
Daws	C. J. Peterson, Jr. and O. A. Vogel, SEA-AR-USDA, WSU, Pullman, WA	Wash. State Crop Impr. Assn., Yakima, WA
Hyslop	W. E. Kronstad, OSU, Corvallis, OR	Ore. Foundation Seed Project, OSU, Corvallis, OR

Variety	Developer	Foundation seed
Luke	C. J. Peterson, Jr. and O. A. Vogel, SEA-AR-USDA, WSU, Pullman, WA	Wash. State Crop Impr. Assn., Yakima, WA
McDermid	W. E. Kronstad, OSU, Corvallis, OR	Ore. Foundation Seed Project, OSU, Corvallis, OR
Nugaines	O. A. Vogel, SEA-AR-USDA, WSU, Pullman, WA	Wash. State Crop Impr. Assn., Yakima, WA
Rew	C. R. Rohde, CBARC, OSU, Pendleton, OR	Ore. Foundation Seed Project, OSU, Corvallis, OR
Sprague	G. W. Bruehl, M. Nagamitsu, and W. L. Nelson, WSU, Pullman, WA	Wash. State Crop Impr. Assn., Yakima, WA
Stephens	W. E. Kronstad, OSU, Corvallis, OR	Ore. Foundation Seed Project, OSU, Corvallis, OR
	Hard Red Common Winter Wheat	
Wanser	W. L. Nelson and M. Nagamitsu, WSU, Lind, WA	Wash. State Crop Impr. Assn., Yakima, WA
	Soft White Spring Wheats	
Dirkwin	D. Sunderman, SEA-AR-USDA, Aberdeen, ID	Idaho Crop Impr. Assn., Aberdeen, ID
Fielder	D. Sunderman, SEA-AR-USDA, Aberdeen, ID	Idaho Crop Impr. Assn., Aberdeen, ID
Fieldwin	D. Sunderman, SEA-AR-USDA, Aberdeen, ID	Idaho Crop Impr. Assn., Aberdeen, ID
Springfield	D. Sunderman, SEA-AR-USDA, Aberdeen, ID	Idaho Crop Impr. Assn., Aberdeen, ID
Twin	D. Sunderman, SEA-AR-USDA, Aberdeen, ID	Idaho Crop Impr. Assn., Aberdeen, ID
Urquie	C. F. Konzak, W. L. Nelson, and M. Nagamitsu, WSU, Pullman, WA	Wash. State Crop Impr. Assn., Yakima, WA

Variety	Developer	Foundation seed
	Semi-Hard White Spring Wheat	
WS-1	World Seeds, Inc., Oceanside, CA	World Seeds, Inc., Oceanside, CA
	Hard Red Spring Wheats	
Anza	Mexican Govt. and International Maize and Wheat Improvement Center, Mexico	Dept. of Agronomy and Range Science, Univ. of Cal. at Davis
Borah	D. Sunderman, SEA-AR-USDA, Aberdeen, ID	Idaho Crop Impr. Assn., Aberdeen, ID
Fortuna	K. L. Lebsock, W. B. Noble, and L. D. Sibbitt, SEA-AR-USDA and No. Dak. State Univ., Fargo, ND	No. Dak. Agr. Expt. Sta., Fargo, ND
Profit 75	World Seeds, Inc., Oceanside, CA	World Seeds, Inc., Oceanside, CA
Prospur	International Maize and Wheat Improvement Center, Mexico	Northrup, King and Co., Woodland, CA
Sawtell	D. Sunderman, SEA-AR-USDA, Aberdeen, ID	Idaho Crop Impr. Assn., Aberdeen, ID
Wared	Developed by SEA-AR-USDA (Minnesota) Released by C. F. Konzak, WSU, Pullman, WA	Wash. State Crop Impr. Assn., Yakima, WA
WS-6	World Seeds, Inc., Oceanside, CA	World Seeds, Inc., Oceanside, CA
	Six-Row Winter Barleys	
Boyer	C. E. Muir, R. A. Nilan, and A. J. Lejeune, WSU, Pullman, WA	Wash. State Crop Impr. Assn., Yakima, WA
Hudson	N. F. Jensen, Cornell Univ., Ithaca, NY	Ore. Foundation Seed Project, OSU, Corvallis, OR
Kamiak	R. A. Nilan and C. E. Muir, WSU, Pullman, WA	Wash. State Crop Impr. Assn., Yakima, WA
Luther	R. A. Nilan and C. E. Muir, WSU, Pullman, WA	Wash. State Crop Impr. Assn., Yakima, WA

Variety	Developer	Foundation seed
Schuyler	N. F. Jensen, Cornell Univ., Ithaca, NY	Cornell Univ., Ithaca, NY
	Six-Row Spring Barleys	
Blazer	R. A. Nilan, C. E. Muir, and A. J. Lejeune, WSU, Pullman, WA	Wash. State Crop Impr. Assn., Yakima, WA
Flynn 37	Minnesota Agr. Expt. Sta. and Moro Sta., CBARC, Moro, OR	Ore. Foundation Seed Project, OSU, Corvallis, OR
Gem	H. K. Schultz and K. H. Klages, Univ. of Idaho, Moscow, ID	Idaho Crop Impr. Assn., Aberdeen, ID
Steptoe	C. E. Muir and R. A. Nilan, WSU, Pullman, WA	Wash. State Crop Impr. Assn., Yakima, WA
Unitan	R. R. Eslick and E. A. Hockett Mont. State Univ., Bozeman, MT	Montana Crop Impr. Assn., Bozeman, MT
Vale 70	Selected from 'Vale' by E. N. Hoffman and L. A. Fitch, Malheur Expt. Sta., OSU, Ontario, OR	Ore. Foundation Seed Project, OSU, Corvallis, OR
	Two-Row Spring Barleys	
Klages	SEA-AR-USDA personnel and Aberdeen Branch Expt. Sta., Aberdeen, ID	Tetonia Branch Expt. Sta., Tetonia, ID
Kombar	Northrup, King and Co., Woodland, CA	Northrup, King and Co., Woodland, CA
Lud	North American Plant Breeders, Berthoud, CO	North American Plant Breeders, Berthoud, CO
Summit	North American Plant Breeders, Berthoud, CO	North American Plant Breeders, Berthoud, CO
Vanguard	R. A. Nilan and C. L. Muir, WSU, Pullman, WA	Wash. State Crop Impr. Assn., Yakima, WA
	Spring Oats	
Cayuse	N. F. Jensen, Cornell Univ., Ithaca, NY, and selected for release by C. F. Konzak, WSU, Pullman, WA	Wash. State Crop Impr. Assn., Yakima, WA

Variety	Developer	Foundation seed
Park	H. Stevens and F. A. Coffman, SEA-AR-USDA and Aberdeen Branch Expt. Sta., Aberdeen, ID	Idaho Crop Impr. Assn., Aberdeen, ID

SILICA MOVEMENT IN WALLA WALLA SOILS

C. L. Douglas Jr. and R. R. Allmaras[1]

Introduction

In dryland farming areas of eastern Oregon and Washington, water infiltration is restricted by a soil layer about 10 inches thick just below the tilled layer. This restricting layer not only decreases soil water storage, but also encourages surface water runoff and erosion. Since the bulk density of the restricting layer is essentially the same as other soil layers, and is not abnormally high, layer formation is probably caused by cementation rather than compaction.

A decreased pH in the plow layer suggests that silica may dissolve in the plow layer and move downward in the soil. When dissolved silica enters the higher pH layers, it may be redeposited and act as a cementing agent. The long term use of ammonium fertilizers and the associated soil acidification in eastern Oregon and Washington soils prompted us to examine whether or not this movement of silica could be occurring.

Experimental Procedures

Soil samples were taken from four treatments of a long term wheat-fallow experiment on Walla Walla soil at the Columbia Basin Agricultural Research Center. Table 1 shows crop residue and nitrogen fertilization treatments applied since 1931. A system of leaching columns in the laboratory was used to simulate natural leaching in four 24-inch soil columns. Water was added to the first column of each treatment, which contained soil from the 0- to 6-inch soil layer. This procedure was continued until leachate had passed a fourth column containing the 18- to 24-inch layer. We measured the amount of leachate and associated silicic acid concentration as it flowed from one column to the next. The amount of water used was equivalent to about 35 inches of rain falling on the soil surface.

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[1]Soil Scientists, USDA-SEA-AR, Columbia Plateau Conservation Research Center, Pendleton, Oregon 97801.

Table 1. Crop residue and fertilizer treatments applied to a Walla Walla soil since 1931

Treatment number	Residue treatment	Fertilizer treatment
1	Wheat straw plowed under in April	80 lb N/A applied before seeding wheat
2	Wheat straw burned in September	None
3	Wheat straw plowed under in April	2.5 tons pea vines applied 0-7 days before plowing
4	Wheat straw plowed under in April	24 tons strawy manure applied 0-7 days before plowing

Results and Discussion

Table 2 gives the soil pH and amount of silicic acid leaving or remaining in each six-inch increment of soil for each treatment. The surface six-inch layer in all treatments released silicic acid into the leaching water. As the pH decreased, more silicic acid was released, except in the manure treatment. The relatively high release of silicic acid by the manure treatment may be caused by a high organic acid content. Organic acids increase silicic acid solubility. As the leachate, laden with silicic acid, entered the soil layers with higher pH, silicic acid was redeposited, as shown by the net gains of silicic acid in Table 2. Silicic acid is still being leached through these layers; however, less is leaving than is entering each layer.

Conclusions

Our research verifies that soil acidification of the plow layer does indeed encourage the leaching of silica from the plow layer and deposition in soil layers that have not yet been acidified. The deposition of silica could cause cementation and slower water movement through the restricting layer of Walla Walla soils.

Further experimentation is needed to provide a direct link between cementation and slower infiltration. More research is planned to determine if liming will decrease the silica leaching.

Table 2. Long term crop residue and nitrogen fertilization effects on soil pH and leachability of silicic acid

Treatment	0 to 6-inch layer		6 to 12-inch layer		12 to 18-inch layer		18 to 24-inch layer	
	pH	Silicic acid change	pH	Silicic acid change	pH	Silicic acid change	pH	Silicic acid change
		lb/A		lb/A		lb/A		lb/A
80 lbs N	4.9[1]	-2535[2]	5.4	-452	6.0	+499	6.4	+930
Stubble fall burned	5.5	-1673	5.7	+229	6.1	+383	6.2	+ 75
Pea vines	5.8	-1663	6.0	+ 27	6.2	+520	6.4	+441
Manure	6.1	-1817	6.2	-431	6.3	+404	6.4	+ 10

[1] Soil pH was measured in 0.01 M $CaCl_2$

[2] A minus sign indicates a net loss; a plus sign indicates a net gain

SURFACE MULCHES AND SOIL NITRATE LOSSES

R. W. Rickman and Betty Klepper[1]

Introduction

Straw mulches on the soil surface help store additional water overwinter, reduce soil erosion, and decrease water loss by evaporation. In most situations, these effects are an advantage to the farmer. In some cases, the extra water conserved by a straw mulch can be a disadvantage. This report describes one of those cases.

The normal soils classified as Ritzville, Walla Walla, or Athena silt loams have a deep (1 to 2 meters), uniform profile that is well drained. Located within these soils in irregular patterns are areas of soil that have a slowly draining subsoil. These "wet spots" occur more frequently in wetter areas (the foothills of the Blue Mountains for example). Compaction from tillage or traffic can cause similar drainage problems and, of course, can occur anywhere.

Plants growing on slowly draining soils usually respond differently to management operations (tillage, fertilization, etc.) than plants on a normal well drained soil. The wet winter of 1978 provided an opportunity to learn why these slowly draining subsoils cause abnormal growth.

Experimental Procedure

Stephens winter wheat was planted in bare and mulched plots on both normal and slowly draining profiles of a Walla Walla silt loam on the Columbia Plateau Research Center land. A well washed burlap strip was used between rows in place of a heavy straw mulch. Two replicates of each treatment were measured for water content, water use rate, rooting, plant nitrogen, and plant growth. Measurements were repeated throughout the season. Soil nitrate supply was measured in early April and soil oxygen was measured in late April after a rainstorm.

Results and Discussion

The mulch caused no yield decrease compared to unmulched soil when applied to the normally draining soils (Table 1). Grain yield on the bare, slowly draining soil was reduced 15 percent. Where the slowly draining soil was mulched, yield decreased by 35 percent. Plant population was not different, but tillering was significantly reduced on the slowly draining soil.

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[1]Soil Scientist and Plant Physiologist, USDA-SEA-AR, Columbia Plateau Conservation Research Center, Pendleton, Oregon

Plant and soil nitrogen measurements showed a lack of nitrogen in the surface horizon of the slowly draining soil. In normal soil, 118 kg/ha nitrogen was taken up by the crop. Only 99 kg/ha was removed from the bare slowly draining soil and 72 kg/ha where it was mulched.

Measurements of soil oxygen supply in late April after a rainstorm revealed a six-day period when the surface horizon of the mulched, slowly draining soil was saturated. Water content of the surface 15 cm of soil was higher throughout the season wherever a mulch was present (Figure 1). This measurement supports the oxygen supply data. Both indicated that the surface mulch helped to accumulate excess water in the surface horizon of the slowly draining profile. During the time that the surface horizon was saturated, enough denitrification occurred that more than 75 percent of the applied fertilizer nitrogen was lost.

In summary, the mulch on the slowly draining profile caused prolonged saturated conditions which, in turn, caused; (1) denitrification, or leaching, or both, (2) inadequate nitrogen supply to the crop, and (3) an extra 20 percent yield reduction.

Practical measures to counteract this problem were not tested, but, if denitrification is causing the nitrogen loss, some management practices could be applied to counteract it. Two separate situations must be considered. The first is where a large percentage of a field has a slowly draining profile. Nitrogen must be applied either in a form that will not be denitrified or leached or must be applied after the period in winter and early spring of heavy rainfall which may saturate the surface soil horizon. In fields where slowly-draining profiles occur only in isolated patches, it may be more practical to apply a localized spring top dressing of urea or ammonium-N fertilizer.

Table 1. Plant growth and yield on bare and mulched areas of a normal and slowly draining Walla Walla soil

Characteristic	Treatment: Normal Draining Bare	Normal Draining Mulch	Slow Draining Bare	Slow Draining Mulch	Standard Deviation
Plants/Meter^2	64.6	64.6	64.6	64.6	4.5
Dry Wt/Plant (g)	20.5	22.8	17.8	12.8	4.2
Tillers/Plant	6.6	5.1	4.3	3.8	1
Grain Yield/Plant (g)	8.9	9.0	7.6	5.6	1.7
Grain Yield (kg/ha)	5750	5810	4910	3620	1100
Grain Yield (bu/ac)	85.3	86.2	72.8	53.7	16.3

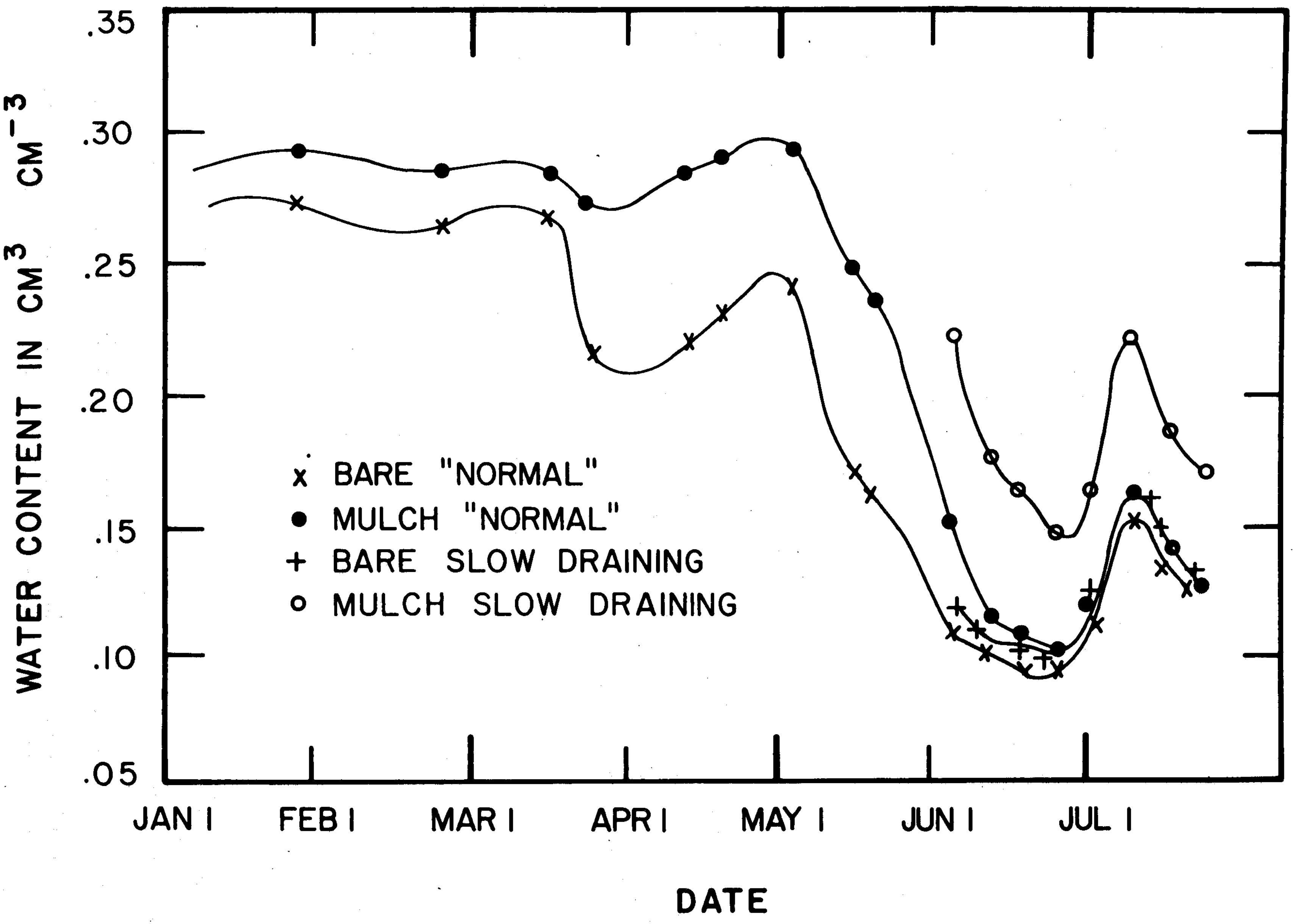

Figure 1. Water content of the surface 15 cm of soil of the 4 soil-mulch treatments.

IDENTIFICATION OF RESISTANCE TO TAKE-ALL ROOT ROT, CERCOSPORELLA FOOT ROT, AND CEPHALOSPORIUM STRIPE

R. L. Powelson[1]

The importance of the various diseases which limit wheat yields varies from year to year and from area to area in Oregon. Before a grower selects a wheat cultivar, he needs to know how resistant the cultivar is to diseases that cause problems in his area. Programs and procedures have been developed for the identification of resistance to stripe rust and smut. However, there has not been adequate evaluation of new cultivars for resistance to take-all (Gaeumannomyces graminis), foot rot (Cercosporella herpotrichoides) and stripe disease (Cephalosporium gramineum).

Disease nurseries were established last fall (1978) with Oregon Wheat Commission support. Each nursery contains 100 entries, replicated four times. The entries were submitted by Oregon plant breeders and represent advanced-line selections.

These disease nurseries should provide criteria for selection of resistance to take-all, foot rot, and stripe disease in the breeding programs. They also will provide wheat growers with information on which variety to grow if one of these diseases is a limiting factor in production.

Take-all This nursery, at the North Willamette Agricultural Experiment station, was inoculated at the time of seeding with inoculum grown on sterilized oats in the laboratory. Paired, inoculated, and uninoculated rows of each entry were planted for direct comparison.

Cultivars highly resistant to take-all are not known, however, there is a wide range of tolerance which may be of practical use.

Cercosporella Root Rot This nursery is at the Columbia Basin Agricultural Research Center at Pendleton. Inoculum grown on sterilized oats was used to inoculate plots last fall. Duplicate entries were planted and one half of each replicate was sprayed with Benlate to compare the relationship between disease severity and yield reduction among entries.

Resistance is related to three characteristics: (1) reduced lodging because of stiffer straw, (2) resistance to lesion development, and (3) tolerance to moisture stress.

Cephalosporium stripe This nursery is on the John Cuthbert farm near LaGrande. Naturally occurring inoculum was supplemented with inoculum grown on sterilized oats. Since there is no way to manage this disease by chemicals or other means, evaluation will be based on relative disease severity among

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the entries. As part of the research project, an attempt will be made to develop an inoculation technique so that direct side-by-side comparisons can be made.

EFFECTS OF TEMPERATURE ON HEADING OF WINTER WHEAT

R. J. Metzger[1]

Winter wheats will not head unless exposed to temperatures in the 33 to 50°F range for a period of time during the vegetative period. Physiological changes that occur during this period trigger spike development and culm elongation. Length of the cold period required to trigger spike development under controlled conditions varies and is dependent on the genotype of the wheat cultivar. Plants which do not receive sufficient exposure to low temperatures do not switch completely from the vegetative to reproductive phase; such plants head late and grain yield usually is reduced.

Numbers of hours of exposure to temperatures in the vernalization range required to assure normal heading of some of our commercial varieties are listed in Table 1. Seedlings of Stephens, Hyslop, Daws, and Yamhill were exposed to 48°F for 5, 6, and 7 weeks. Three of the varieties produced heads after the 5 weeks of treatment and Yamhill headed when exposed to 48°F for 6 weeks. However, to obtain normal heading, stephens, Hyslop, and Daws required 6 weeks exposure to 48°F; Yamhill required 7 weeks.

In the field, because of the range in day-night temperature cycles, time required to accumulate 1,008 to 1,176 hours in the 33 to 50°F range varies within and among growing seasons. Growth chamber data and field observations suggest that Stephens, Hyslop, and Daws should be planted before February 20; otherwise, the exposure to temperatures in the 33 to 50°F range may be too short to uniformly trigger culm elongation and assure normal head development. Yamhill should not be planted after February 10. If planting must be delayed beyond February 20, spring varieties may produce more grain.

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Table 1. Minimum and optimum time required to vernalize winter wheats using an 8-hour day and a constant temperature of 48°F.

Variety	Hours		Weeks	
	Minimum	Optimum	Minimum	Optimum
Stephens	840	1,008	5	6
Hyslop	840	1,008	5	6
Daws	840	1,008	5	6
Yamhill	1,008	1,176	6	7

MANAGEMENT FOR CONTROL OF SOIL EROSION IN NORTHEASTERN OREGON

R. R. Allmaras, J. L. Pikul Jr., and C. E. Johnson[1]

A modified Universal Soil Loss Equation (USLE) has been used since 1974 in the Pacific Northwest as a farm planning guide to control soil erosion by water. The original version of the USLE was developed in 1958 for eastern and central United States. It has been used extensively in their erosion control planning. Detailed information about soils, climate, crop sequences, and farm management is needed for correct prediction of soil erosion using the USLE. Farm management practices for erosion control include tillage and crop residue handling, contour operation, and terracing. These practices can be applied alone or in combination differently on each farm.

Public Law 92-500, section 208, which is concerned with non-point-source pollution, requires that we determine what management practices on the land are needed to control sedimentation. A model like the USLE will help us evaluate and predict effective managements. Nonagricultural demand is increasing for harvested crop residues to produce energy; however, many people fail to realize that crop residues are needed for control of soil erosion. This background of information and current impending policy prompted us to evaluate in detail soil erosion potential and associated crop residue harvest in northeastern Oregon. Only a small portion of the study will be reported here.

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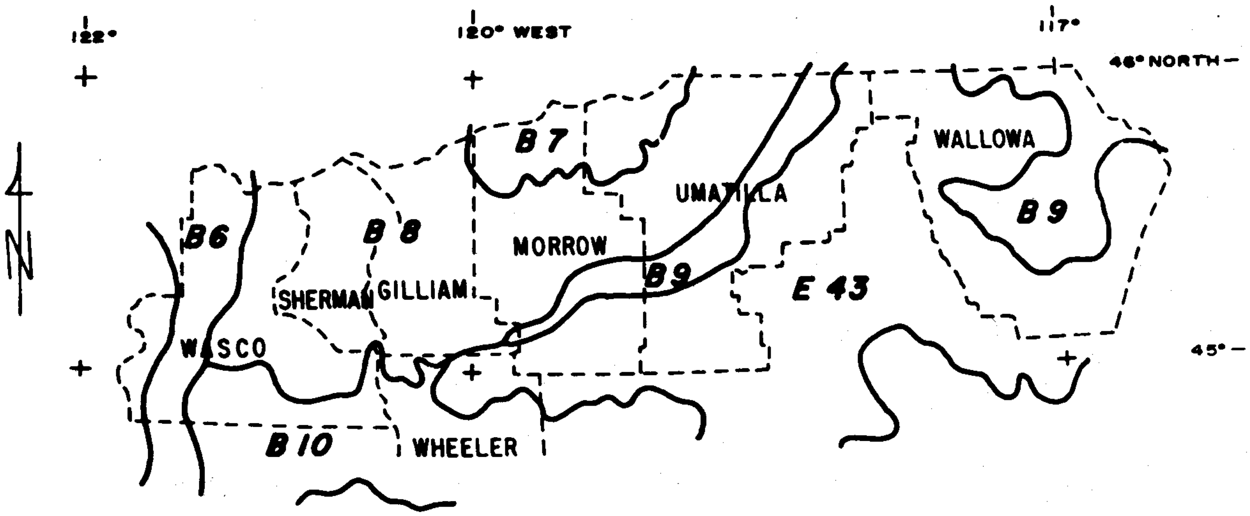

Figure 1. Northeastern Oregon study area showing Major Land Resource Areas B7 (Columbia Basin), B8 (Columbia Plateau), and B9 (Palouse-Nez Perce Prairies).

Detailed information was gathered in the study area (see Figure 1) to calculate soil erosion using the USLE:

$A = R_T\ K\ SL\ C\ P$

where R_T is the rainfall and erosion energy factory,
K is the soil erodibility index,
S is the slope steepness,
L is the slope length manageable by terracing,
C is a cover factor manageable by tillage and residue handling, and
P is the practice factor manageable by contouring.

Each soil mapping unit has an associated R_T, K, and S value. These three factors in the USLE cannot be managed, but, nevertheless they affect soil erosion. The last three factors (L, C, and P) are the manageable factors.

Soil erosion projections were made only for tilled cropland in northeastern Oregon. The area of tilled cropland was determined from soil survey estimates of the fraction of a soil mapping unit that is tilled; the area of nontilled adjacent cropland was obtained from the nontilled fraction in those soil mapping units that had some tilled cropland. Forest and rangeland consisted of those soil mapping units that had no tilled cropland. Table 1 shows the distribution

Table 1. Land type distribution within three Major Land Resource Areas in eastern Oregon

MLRA	Total area (1000 acres)	Fraction of land area in: Tilled cropland	Adjacent nontilled cropland	Range and forest land
B7	536	0.46	0.20	0.34
B8	3,131	0.50	0.11	0.39
B9	509	0.34	0.18	0.45
B9 (Wallowa)	622	0.15	0.28	0.57
Overall	4,798	0.43	0.15	0.42

of these land types in Major Land Resource Areas (MLRA) B7, B8, B9, and B9 (Wallowa). About 43 percent of the land area in northeastern Oregon is tilled cropland.

In this short summary, we will report predicted soil erosion for fallow-wheat in MLRA B8, because this is the most prevalent MLRA and cropping sequence combination in northeastern Oregon. Two tillage and residue handling managements considered were: a) conventional, consisting of moldboard plowing in spring followed by one field cultivator and three rod weeding operations, and b) reduced, consisting of chiseling (or sweeping) in spring followed by one field cultivator and three rod weeding operations. In conventional tillage method at least 100 pounds of residue were left on the surface after wheat planting with a deep furrow drill; in the reduced tillage method, 750 pounds were left on the surface. Respective C values were 0.35 and 0.19. In the detailed report more than two systems of tillage and residue handling management were considered, but the two examples given in this summary contrast moldboard plowing with chiseling as the first spring tillage on fallow. Slope length, L, of an average unterraced field was assumed to be 700 feet. After terracing, the average L was set at 400 feet. Predicted soil erosion for the two slope lengths compared will be used to assess effectiveness of terracing. Operations on the contour reduce the P value (and predicted soil erosion) depending on the slope steepness. For up and down hill operations, P=1.

Table 2 shows that predicted soil losses, on the average for MLRA B8, are below the tolerance value of 3.5 tons/A per year only if reduced tillage, contouring, or both are used. Note that a slope-length reduction to 400 feet is not enough by itself--it must be accompanied by either contouring, reduced tillage, or both. Only 55 percent of the area has soil losses below tolerance when there is no management to reduce erosion. Contouring and reduced tillage together can maintain between 87 and 89 percent of the land with soil losses below tolerance. The relatively greater effectiveness of reduced tillage and contouring as compared with terracing shows why these two types of management should be encouraged in any terraced or unterraced system of wheat-fallow. Alternatively, the combined effectiveness of these types of management in Table 2 suggests considerable farm-to-farm flexibility in controlling soil erosion.

Table 2. Effect of slope length reduction, contouring, or reduced tillage on predicted soil erosion in the wheat-fallow sequence in Major Land Resource Area B8[1]

Length of slope	Contouring practice	Annual erosion (tons/A) with		Percent of land area with predicted erosion losses below tolerance	
		Conventional tillage	Reduced tillage	Conventional tillage	Reduced tillage
700	up-down-hill	4.5	2.5	55	72
700	contour	3.2	1.8	66	87
400	up-down-hill	3.9	2.1	62	81
400	contour	2.7	1.5	68	89

[1]The average tolerance for soil erosion is 3.5 tons/A per year.

Slope steepness is the major factor preventing complete control of soil erosion in wheat-fallow in MLRA B8 (Table 3). Even with terracing, contouring, and reduced tillage, only 60 percent of the tilled cropland in the 10- to 20-percent slope category has predicted soil losses below tolerance. Notice that the 10- to 20-percent slope category makes up 16 percent of the total tilled cropland in MLRA B8.

Following are some conclusions from the detailed study:

1. Even small reductions in tillage along with more surface residue can provide major reductions in soil erosion.

Table 3. Slope steepness effect on maintaining soil erosion below tolerance as affected by tillage practices on the contour in a terraced field of fallow-wheat in MLRA B8

Slope steepness (percent)	Fraction of cropland	Percent of land with predicted erosion losses below tolerance	
		Conventional tillage	Reduced tillage
0-5	0.10	100	100
2-7	.49	98	100
7-12	.21	48	97
10-20	.16	1	60
19-40	.04	3	21

2. Soil erosion can be controlled with a system of management types depending on slope steepness:

   a) On 0- to 5-percent slope, conventional practices suffice.

   b) Contouring and reduced tillage provide adequate control on lands with less than 10 percent slope.

   c) Terracing, contouring, and reduced tillage are all needed on the 10- to 20-percent slope.

   d) On slopes greater than 20 percent, significant reductions of erosion in wheat-fallow are attainable but complete control is not. Drastically reduced and no-till practices will be required.

3. Soil erosion hazard in MLRA B9 was much greater than in B8 because of thinner soils with greater slopes. Nearly all soil mapping units in B9 are problem soils for soil erosion control, whereas only some in B8 present special erosion hazards.

4. In an average year about 75 percent of the harvested acres have straw in excess of that needed for soil erosion control, but only about 60 percent of the straw on each harvested acre can be harvested for offsite use. When projected to a tilled cropland or total area basis, the residue is indeed widely scattered. Crop residue production varies about 25 percent from year to year. The restricted and uncertain supply of crop residues discourages harvest for bioenergy even though residue production per harvested acre in northeastern Oregon ranks among the highest in United States.

CROWN TEMPERATURES OF WINTER WHEAT

Betty Klepper and R. W. Rickman[1]

Introduction

Winter wheats in eastern Oregon overwinter as small dormant seedlings with several green leaves, a fairly deep root system, and a crown about one inch below the soil surface. Sometimes, above-ground tissues are destroyed by cold, by the lashing of wind, or by pests, but the underground crown is protected from these destructive elements.

The crown contains all the bud-type tissues capable of renewing growth in spring. In the crown are found tiny leaves, less than 1/16 inch long, which can grow into new leaves when soils become warm. Here also are dormant tiller buds, one for every leaf on the plant. These tiller buds are found at the base of each leaf. They remain dormant until internal plant factors release them and allow them to grow in spring. Finally, the crown contains the shoot apex, a microscopic dome smaller than the head of a pin and capable of producing new leaves and tiller buds. In March this shoot apex is converted into the spike which eventually produces the kernels. Since crowns contain all the tissues capable of making new plant material in spring, it is essential that they survive the winter.

Crowns survive cold winter temperatures by a hardening process and because they are underground where they are protected from the harsh aerial environment. The work reported here was undertaken to determine how crown temperatures are related to air temperatures during winter.

Materials and Methods

Measurements were made in plots of winter wheat (*Triticum aestivum* L. 'Hyslop' and 'Luke') at the Columbia Plateau Conservation Research Center near Pendleton in early 1977. The wheat was planted with a Bettinson stubble mulch drill in 14-inch row spacings during the first week of October 1976. In February and March, when measurements were made, there were about six tillers per plant, the canopy shaded around 20 percent of the soil surface, and plants were five to eight inches tall.

Crown and canopy air temperatures were measured with fine-wired thermocouples. Thermocouples were installed in crowns by excavating the crown carefully from one side along the row and restoring the excavated soil to as near the original condition as possible. The two thermocouples for measuring canopy air temperatures were each placed in a two-inch-diameter stiff plastic tube to prevent erratic readings caused when wind pressed the measuring point against leaves or soil.

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[1]Plant Physiologist and Soil Scientist, respectively. Columbia Plateau Conservation Research Center, USDA-SEA-AR, Pendleton, Oregon 97801

Values for air temperatures at about 3-foot height were taken from the weather station at the Research Center.

Results and Discussion

Figure 1 shows a period in late January and early February when air temperatures never rose above freezing. During this time, crown temperatures never fell below freezing. Air and crown temperatures differed by as much as 7.8°F and the crown was always warmer than the weather station value. This difference is caused by at least three factors. First, both the plant canopy and the inch of covering soil "mulch" the crown from direct radiant heat loss to the cold night sky. Second, soil heat stored during summer is conducted slowly upward during winter and warms the crown. Finally, when water in these moist soils freezes, the water-ice mixture remains at 32°F and thus delays the decrease of crown temperature below freezing until all the water has frozen.

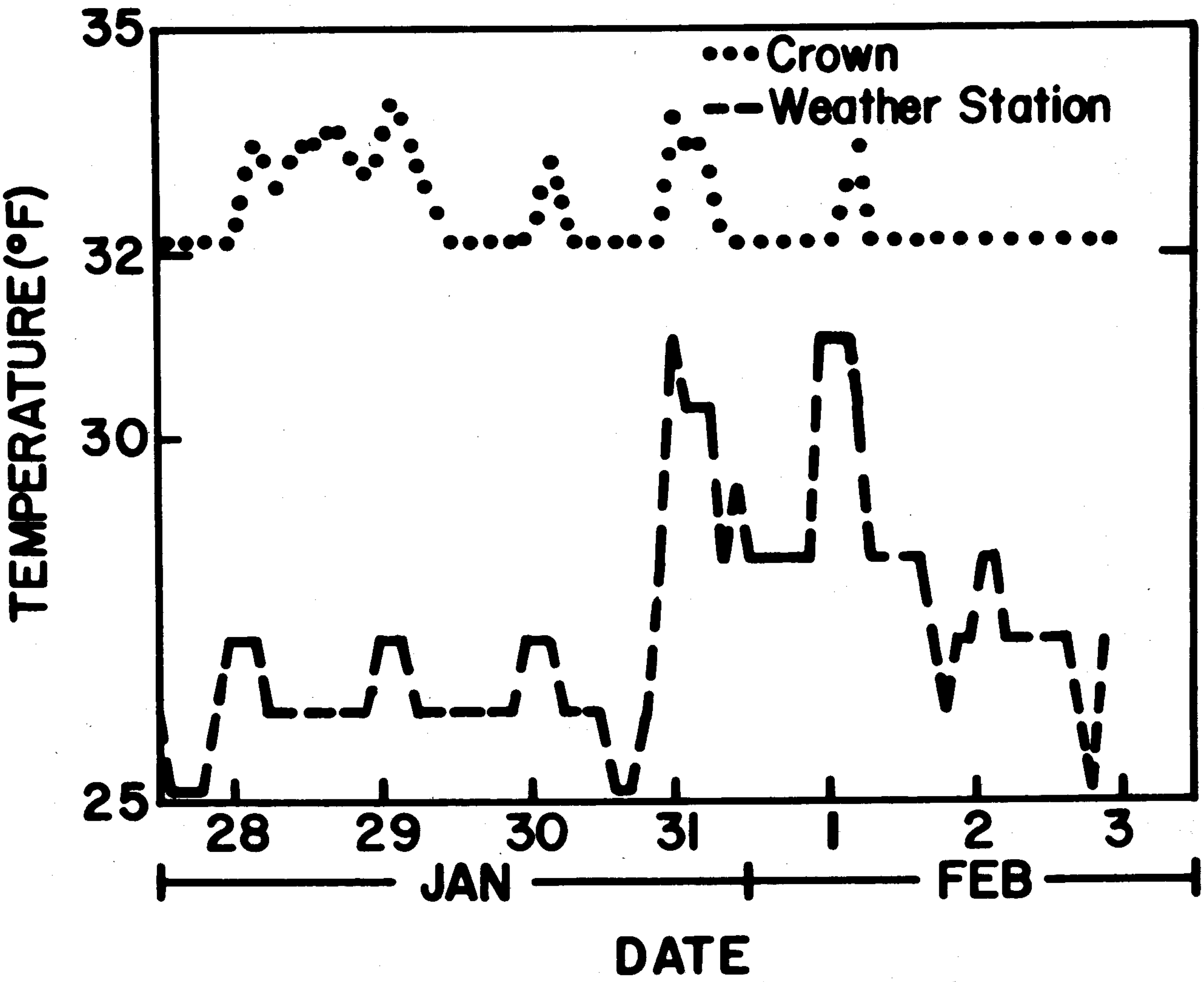

Figure 1. Wheat crown temperature in late January and early February compared to air temperature recorded at a nearby weather station.

Figure 2 shows temperatures in early March for air in the canopy and for crowns. Temperature fluctuates much more in the canopy than in the crown. Wheat leaves receive direct radiation from the sun during the day and, in turn, must radiate directly to the cold sky at night. Thus, they are subjected to much more drastic temperature changes than crowns. During this week-long period, crown temperatures ranged from 34 to 58°F but temperatures in the canopy went from 29 to 69°F.

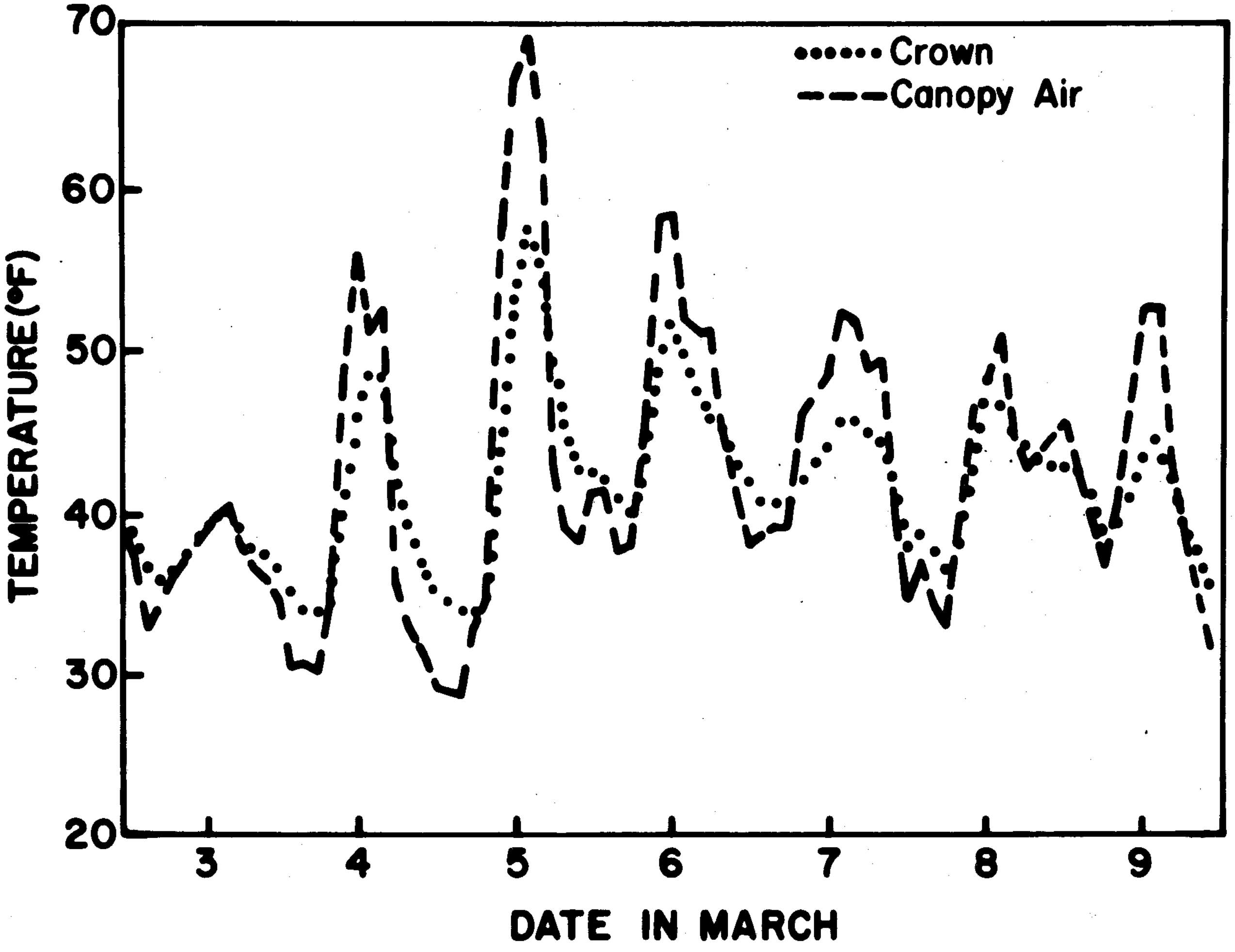

Figure 2. Temperature of wheat crowns and of air at canopy level during early March.

Figure 3 shows temperatures of crowns with and without a straw mulch during early March. The mulched crowns were slightly cooler in the afternoon and were occasionally warmer at night than unmulched crowns, but the differences were small.

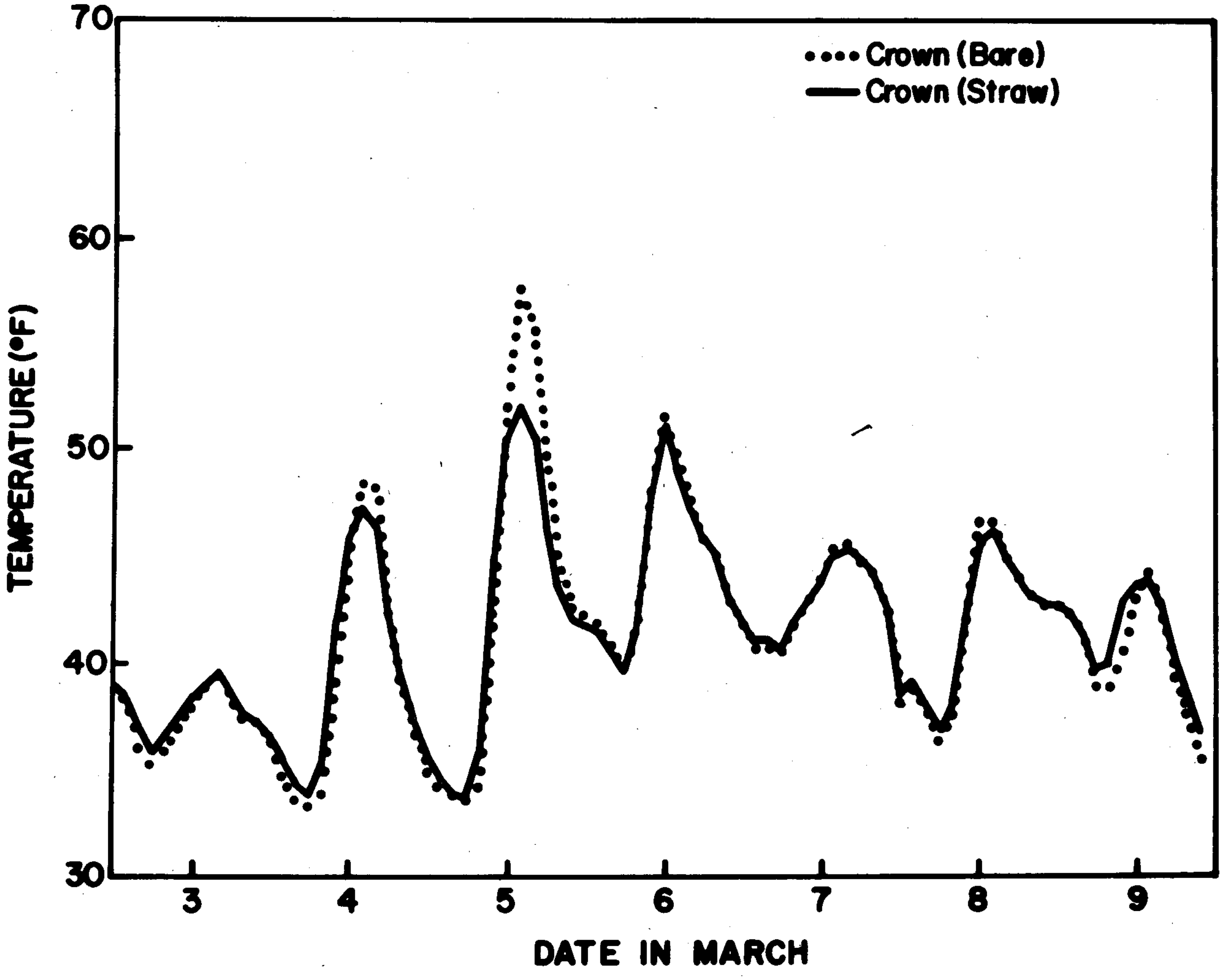

Figure 3. Temperatures of crowns with and without a straw mulch on the ground surface.

Summary

Crowns avoid cold because of their position below the soil and beneath the leafy canopy. During cold weather and at night, crown temperatures are warmer than the air temperatures measured at weather stations. The presence of straw mulch on the soil surface gives small but measurable added protection. Since damage to the crown from cold depends on rates of freezing and thawing and on the ultimate frozen temperature, the protection offered by the canopy, overlying soil, and surface residues allows crowns to overwinter with minimal risk from rapid changes in air temperature.

A WINTER BARLEY FOR NORTH CENTRAL OREGON
FB 73123, Ione/Luther

Mathias F. Kolding[1]

Selection FB 73123, Ione/Luther, is a six-rowed, mid-tall, medium to mid-late, shatter resistant winter feed barley which appears particularly adapted to the deeper dryland soils of north central Oregon. It has yielded 107 percent of Kamiak and 104 percent of Boyer winter barleys in the north central Oregon feed grain trials (Table 1). Though best-fitted to Oregon's deeper dryland soils, it has given superior yields in the Western Regional Winter Barley Nursery[2] (Table 1) conducted at stations throughout the Northwest. FB 73123 is as stiff-strawed and as winter hardy as Boyer; other characteristics are given in Table 2. Selection FB 73123 is in a breeder's seed increase plot at the Columbia Basin Agricultural Research Center.

Table 1. Winter barley grain yields of Kamiak, Boyer, and FB 73123 for north central Oregon nurseries and the Western Regional Winter Barley Nursery

Trial	Years	Test years	Average yields		FB 73123	FB 73123 Percent of	
			Kamiak	Boyer		Kamiak	Boyer
PHEM Winter Barley	1976-77	4	4,000	4,054	4,147	104	102
Moro Dryland Barley	1976	1	3,019	3,105	3,981	132	128
Rugg Winter Barley	1976	1	4,674	4,927	5,215	116	106
Preliminary Winter Barley	1974-78	5	5,466	5,821	5,991	110	103
Advanced Winter Barley	1975-78	4	6,084	6,231	6,300	103	101
Summary	1974-78	15	5,024	5,215	5,396	107	104
Western Region Winter Barley	1976-78	24	4,354	4,546	4,915	113	108

[1]Senior Instructor, respectively, Oregon State University, Columbia Basin Agricultural Research Center, Pendleton, Oregon 97801

[2]Western Regional Winter Barley Nursery, USDA-SEA-AR cooperating with State Experiment Stations in Colorado, Utah, Montana, Washington, Idaho, and Oregon

Table 2. Agronomic observations characterizing Kamiak, Boyer, and FB 73123 winter barleys from the Advanced Winter Barley Trial grown at the Columbia Basin Agricultural Research Center, Pendleton, Oregon, from 1975 through 1978

	Average yield lb/A	Test weight lb/bu	Percent plump over 6/64	Plant height in.	Heading date in May	Relative maturity in July	Leaf[3] scald score	Covered smut
Kamiak	6,084	49.9	81	45	15	Ripe	2	7%
Boyer	6,231	48.0	86	42	20	Hard dough	2	6%
FB 73123	6,300	47.7	83	41	21	Hard dough	3	3%

[3]Leaf scald score, 1 through 9: 1 = resistant, 9 = very susceptible

MONITORING TERRACE EFFECTIVENESS IN CONTROLLING SOIL EROSION AND SEDIMENT IN COLUMBIA BASIN COUNTIES, OREGON

Gerald O. George, Steve Lund, Ray Allmaras, and Gordon Fischbacher[1]

Introduction

Soil erosion and sediment monitoring studies reported in this paper were started in March 1978. Funding by the Oregon Agriculture Experiment Station and the Soil Conservation Service is to provide information for implementing the nonpoint source pollution section of the Clean Water Act, Public Law 92-500, section 208.

Soil and crop management and climatic conditions all affect soil erosion and sedimentation. Tilling, weeding, planting, crop residue, and freezing, thawing, wetting, and drying are some factors that affect soil surface structure, water intake, and soil erosion. Farm management practices that reduce soil erosion and sedimentation are crop residue management, reduced tillage, sediment basins and terraces. Monitoring the direct effects of all practices was impractical. Therefore, the first efforts were directed toward determining the effectiveness of terraces in reducing soil erosion and sediment, and consequently stream pollution.

[1]Agriculture Engineer, Soil Conservation Service and Oregon State University, Superintendent, Oregon State University, Columbia Basin Agricultural Research Center; Soil Scientists and Soil Science Technician, Columbia Plateau Conservation Research Center, USDA-SEA-AR, Pendleton, Oregon 97801.

Field Measurement of Erosion Losses, 1977-78

A survey was made of soil movement in March 1978 after most of the 1977-78 erosion had occurred. A rill meter was constructed to measure rill erosion more rapidly. We contacted landowners with terraced and unterraced fields and obtained permission to measure soil erosion. Fields were selected if they consisted of a dominant soil series that was farmed in a grain-summer fallow sequence, had observable erosion, either cross-slope or up and down hill planting, and had been seeded with either a deep furrow or disk drill. Terraced and unterraced fields were selected. All of the terraces were graded, but both farmed over and non-farmed over terraces were evaluated. Thirteen sites were selected in the five-county area. Measurements were made to determine the effects terracing had on the amount of soil erosion. For comparable slope steepness, terraces did reduce erosion (Table 1).

During the summer of 1978, we examined sediment deposition in two sediment basins constructed in 1977, one field with a sediment basin constructed in 1975, and a sediment deposit area below the site where we had measured 108 tons/acre soil loss. In the two sediment basins constructed in 1977, soil was deposited in six very distinct sediment layers. This sedimentation pattern was similar to that at the USDA-SEA-AR Kirk Erosion Site, Pendleton, where of nine sediment-producing runoff events, six produced more than 0.10 tons/acre soil loss. The basin constructed in 1975 had numerous layers in the top two feet, but distinguishing between years of deposition was impossible. We explored the deposition area where we had measured 108 tons/acre of erosion basing our studies on the identifiable sediment depositions of the 1977-78 winter. The erosion area for the field had a 30% slope and the deposit area had a slope of less than 9%. The erosion and deposit areas were upstream from a 24-inch road culvert which limited the runoff out flow. Sediment measurements indicated that 50% of the eroded soil was deposited because of the flatter slope and the culvert out flow construction.

Field Monitoring and Measuring, 1978-79

During the summer of 1978, one field in each of the five counties in the Columbia Basin dryland was selected for monitoring of runoff, erosion, and sedimentation from October 1, 1978 to May 1, 1979. Recording rain gauges, recording thermometers, and recording flow-depth recorders, measuring flumes, and sediment traps were installed. The monitoring equipment was read twice weekly; associated climatic and soil conditions were observed.

We are measuring rainfall intensity and volume, ground temperature at the time of erosion, and volume of runoff from the field. After erosion had occurred and fields firmed up, the rill meter was used to measure soil losses on the field between terraces. Water samples were collected at the outflow of the flume to determine the amount of sediment being transported. The difference between the rill meter measurements and the sediment outflow measurements will be used to determine terrace effectiveness. The results of these measurements will be available by August 1979.

Table 1. Some measured soil erosion in the 1977-78 winter in eastern Oregon

Soil series	K values	County	% Slope	Slope length (feet)	Seeding method[1] and direction	Terrace type	Measured soil erosion (T/A)	Soil loss predicted by the Universal Soil Loss Equation
Walla Walla	---	Sherman	6	588	Deep furrow Up & down hill	Farmed over graded	5	2
Morrow Silt Loam	.37	Morrow	10	370	Shallow furrow Cross-slope	Non farmed over graded	19	3
Waha	.32	Umatilla	11	225	Fall plowed Cross-slope	Non farmed over graded	18	3
Rhea	.43	Gilliam	12	282	Shallow furrow Cross-slope	None	21	4
Walla Walla	.43	Sherman	14	218	Deep furrow Up & down hill	Farmed over graded	7	5
Walla Walla	.43	Sherman	14	516	Deep furrow Up & down hill	Farmed over graded	10	7
Anderly	.49	Wasco	16	446	Shallow furrow Up & down hill	None	46	9
Valby	.43	Morrow	18	189	Shallow furrow Cross-slope	Farmed over level	18	8
Valby	---	Morrow	20	102	Shallow furrow Cross-slope	Non farmed over graded	26	7
Valby	---	Morrow	22	232	Deep furrow Cross-slope	Non farmed over graded	25	10
Morrow Silt Loam	.37	Morrow	30	193	Shallow furrow Cross-slope	Non farmed over graded	29	13
Dufur	.43	Wasco	30	199	Shallow furrow Modified Cross-slope	None	108	15.7
Duart	.43	Wasco	31	612	Shallow furrow Cross-slope	None	69	28

[1] Shallow furrow less than 1-1/2 inch depth   Deep furrow over 1-1/2 inch depth

Observations in Fall, Winter, and Spring of 1978-79

During the fall and winter of 1978-79 there was a freeze in mid-November followed by a snow and thawing period that produced only minor observable erosion. A similar event occurred in early December followed by a long period of freezing conditions and a snow cover. On February 5, the cold weather broke, but in most instances no observable erosion occurred in a field until after the snow cover disappeared. Serious erosion occurred from February 7 to 10. As the snow disappeared, the soil surface began to thaw and became saturated with water. This fluid soil mass then moved from steep slopes and was deposited on flatter slopes. Terraces, sediment basins, and grassed waterways all decreased the amount of sediment leaving farm fields and thereby reduced stream pollution.

The study has verified that terraces will reduce soil erosion significantly in the Columbia Basin dryland wheat area of Oregon and consequently will reduce stream pollution from sediment. The study also has brought out the need to accelerate investigation of the following previously identified areas in the Columbia Basin dryland wheat counties of Oregon.

1. better and more rapid methods for measuring soil losses related to the first detachment of the soil particle

2. better and more rapid methods for measuring sediment transport and deposition within farm field

3. a better definition on the amount and type of soil surface vegetation during precipitation and runoff periods when major erosion occurs

4. identification of erosion-related forces acting within the plow layer when the soil becomes fluid

5. better information about water movement in the soil, especially in the top 1 inch, and about wheat effects plow pans and well developed "B" horizons have in a sloping topography

6. investigation of the 1 to 3 inch "dust mulch" formed by cultural operations during the summer fallow operation which may significantly affect soil erosion and sedimentation

7. better understanding of the economics of crop rotations for erosion control

8. definition of the water conservation and management potential of level or basin terraces.

EMERGENCE OF WINTER WHEAT AND WINTER BARLEY AS INFLUENCED BY FIELD SOIL TEMPERATURES

M. P. Russelle and F. E. Bolton[1]

Introduction

The potential grain yield of winter wheat and winter barley is affected by the timing of stand establishment. In the fallow-crop rotation area of the Pacific Northwest, adequate, well-developed stands also reduce water erosion during the winter after seeding. In drier areas of this region, it has long been recommended that seeding take place from mid-September to early October. Earlier seeding often results in lower grain yields because of increased water use, winter-kill, and disease. Later seeding can delay emergence and stand establishment because of rapidly dropping soil temperatures.

The objectives of this experiment were to: 1) investigate the effect of average soil temperature on the rate of first emergence and 70 percent potential emergence (70 percent stand) of McDermid wheat and Hudson barley in the field; and, 2) develop a way of predicting the average date after which soil temperature delays the emergence of these crops in the area near Moro, Oregon. The basic approach of the study was taken since it can be used in other locations equally well. We assumed that the seeds could be placed into adequate soil moisture with a deep-furrow drill so availability of water to the seed was not a limiting factor.

Experimental Procedures

Field plots were established on a Walla Walla silt loam soil at the Sherman Unit of Columbia Basin Agricultural Research Center during the fallow-crop periods of 1975-1977 and 1976-1978. Four tillage treatments were used: moldboard plow, shallow rodweeding; moldboard plow, deep rodweeding; sweep plow or disk, shallow rodweeding, and sweep plow or disk, deep rodweeding.

In 1976, McDermid winter wheat and Hudson winter barley were planted on seven dates (Aug. 20, Sept. 4 and 16, Oct. 2, 17, and 30, and Nov. 12) in strips across all tillage treatments. In 1977, McDermid wheat was planted on five dates (Sept. 1, 16, and 30, and Oct. 12 and 27) in the same manner. In both years, the deep-furrow drill was set to reach the depth of adequate soil moisture in the driest plots.

Seed zone temperatures were assumed to be equal to soil temperatures recorded in adjacent fallow plots. Dates of first emergence and 70 percent stand

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were recorded. Relative stand counts were made prior to harvest with a plot combine the following summer.

Results and Discussion

Although the actual depth of seeding from the undisturbed soil surface varied with the depth of moisture on each planting date, the seeds were covered with approximately five centimeters of soil on all dates. The soil water potential at the depth of seeding was not less than -3 bars at planting. There was no consistent difference in temperature extremes or averages from mulch depth. Bare fallow plots had average seed zone temperatures 1 to 2^{o}C higher than stubble fallow plots, but no significant differences in days to first emergence or 70 percent stand because of tillage treatment were observed.

The usefulness of predictive equations based on actual seed zone temperatures is limited by the lack of long-term records. We found a high correlation (r=0.987) between the soil temperature at 10 centimeters in the field and those recorded at the same depth under bare soil at the U.S. Weather Bureau shelter at the Sherman Station. Long-term records of the latter were available, so we used them in regression equations to predict emergence rate (Figure 1).

A useful way of examining emergence data of this kind is in the form:

$$T=S/t + T\ min \qquad \text{Eq. 1}$$

which is the equation for a straight line on a graph of 1/t versus T, where T is the average seed zone temperature, S (the slope) is the degree days needed for emergence, t is the time from planting to emergence in days, and T min (the intercept) is the theoretical minimum temperature at which emergence will occur. When the equations in Figure 1 are converted to the form of Equation 1, one obtains:

$$T = 149/t_{EW} + 0.7 \qquad \text{Eq. 2}$$

$$T = 210/t_{SW} + 0.4 \qquad \text{Eq. 3}$$

$$T = 92/t_{EB} + 6.1 \qquad \text{Eq. 4}$$

$$T = 159/t_{SB} + 3.5 \qquad \text{Eq. 5}$$

where the subscripts E, S, W, and B represent first emergence, 70 percent stand, McDermid wheat, and Hudson barley, respectively.

The theoretical minimum temperature for emergence and stand establishment of McDermid is near 0^{o}C, while it is higher for Hudson. Barley apparently requires higher temperatures to sustain the minimum metabolic rate needed for emergence. However, Hudson requires fewer degree days for emergence and 70 percent stand than McDermid, so it evidently responds more quickly to rising temperatures than the wheat. Barley often emerges sooner than wheat when planted near the optimum dates but develops more slowly than wheat as air temperatures decrease in the fall.

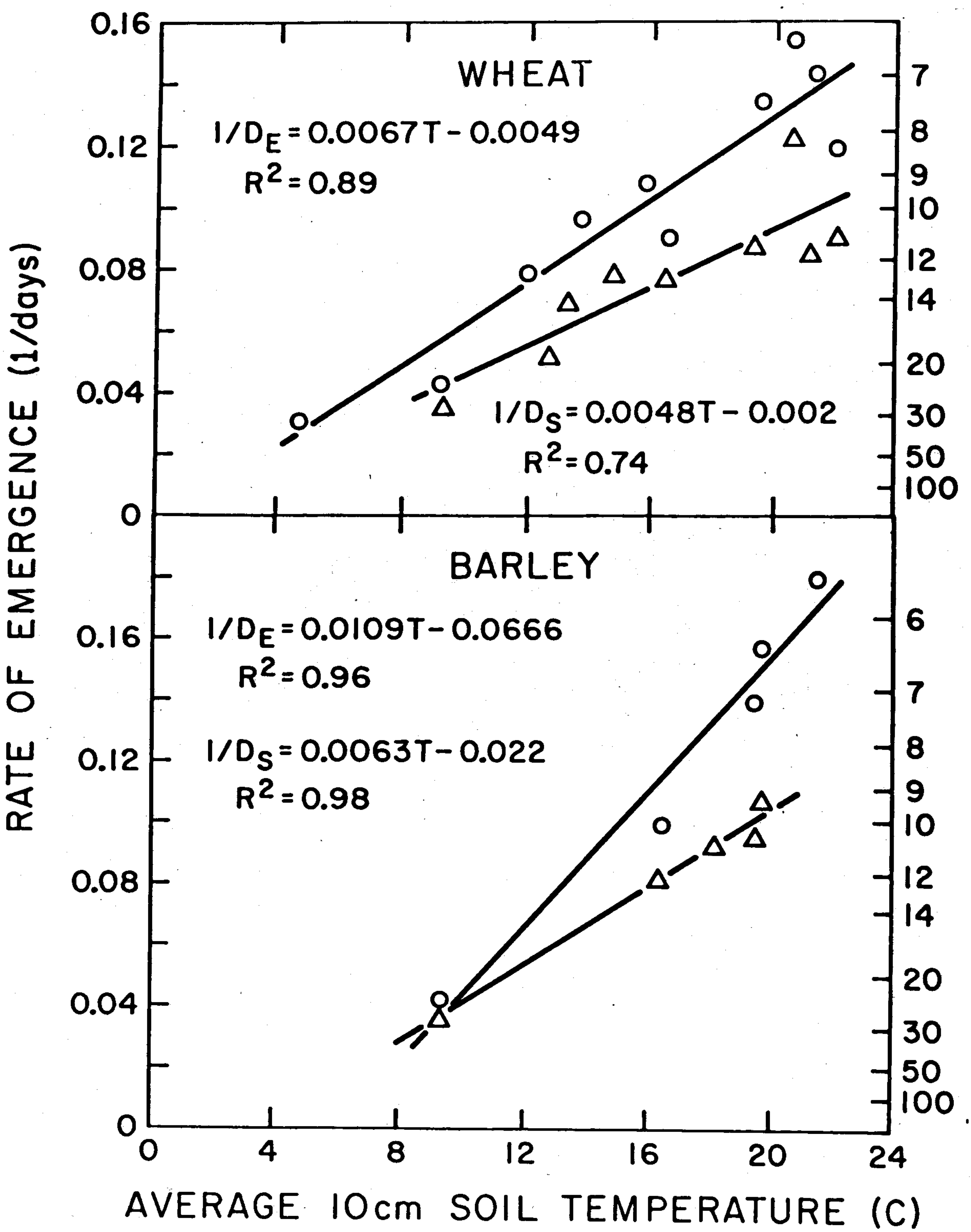

Figure 1. The relationship between the average 10-cm soil temperature from planting to emergence and the rate of emergence (O) and 70% stand (Δ) of McDermid wheat and Hudson barley at Moro, Oregon.

The 15-year (1963-1977) daily averages of 10-centimeter soil temperature at Moro are plotted against date in Figure 2. Information in Figures 1 and 2 can be used to estimate the average last date of planting, given a specific time for emergence, or to estimate the time for emergence, given a date of planting.

For example, if McDermid wheat is to be planted and 70 percent stand is desired within 14 days, the average 10-centimeter temperature needs to be 15.4^{o}C (Equation 3). This temperature corresponds to about October 3. Planting must take place on September 26, seven days earlier, to have an average temperature of 15.4^{o}C over 14 days. It will take Hudson barley an average of 13.4 days to attain 70 percent stand when planted on September 26. However, if planting is delayed until October 20, the average soil temperature will be between 7 and 8^{o}C, and McDermid wheat will require 32 days to reach 70 percent stand. Hudson barley will not generally emerge when planted so late, because the average temperatures are too near the minimum 6.1^{o}C. Other examples are found in Table 1.

Table 1. Average predicted length of time needed for first emergence and 70 percent stand of McDermid wheat and Hudson barley at Moro, Oregon. The 10 centimeter soil temperatures are only an indication of the soil temperature from planting to emergence or stand, since they are averages for the 14-day period following planting. Numbers in parentheses are estimates which extend past the period for which temperature data were collected. Dashes indicate that the average temperature is below that required for emergence or stand

Planting Date	10-cm Soil Temperature (C)	Days to First Emergence		Days to 70% Stand	
		Wheat	Barley	Wheat	Barley
Aug 10	24	6	5	8	7
Aug 20	22	7	5	9	8
Sept 1	21	7	6	10	9
Sept 10	18	8	7	11	10
Sept 20	17	8	8	13	12
Oct 1	14	11	11	16	16
Oct 10	12	14	20	20	24
Oct 20	9	20	--	32	--
Nov 1	6	(35)	--	(45)	--

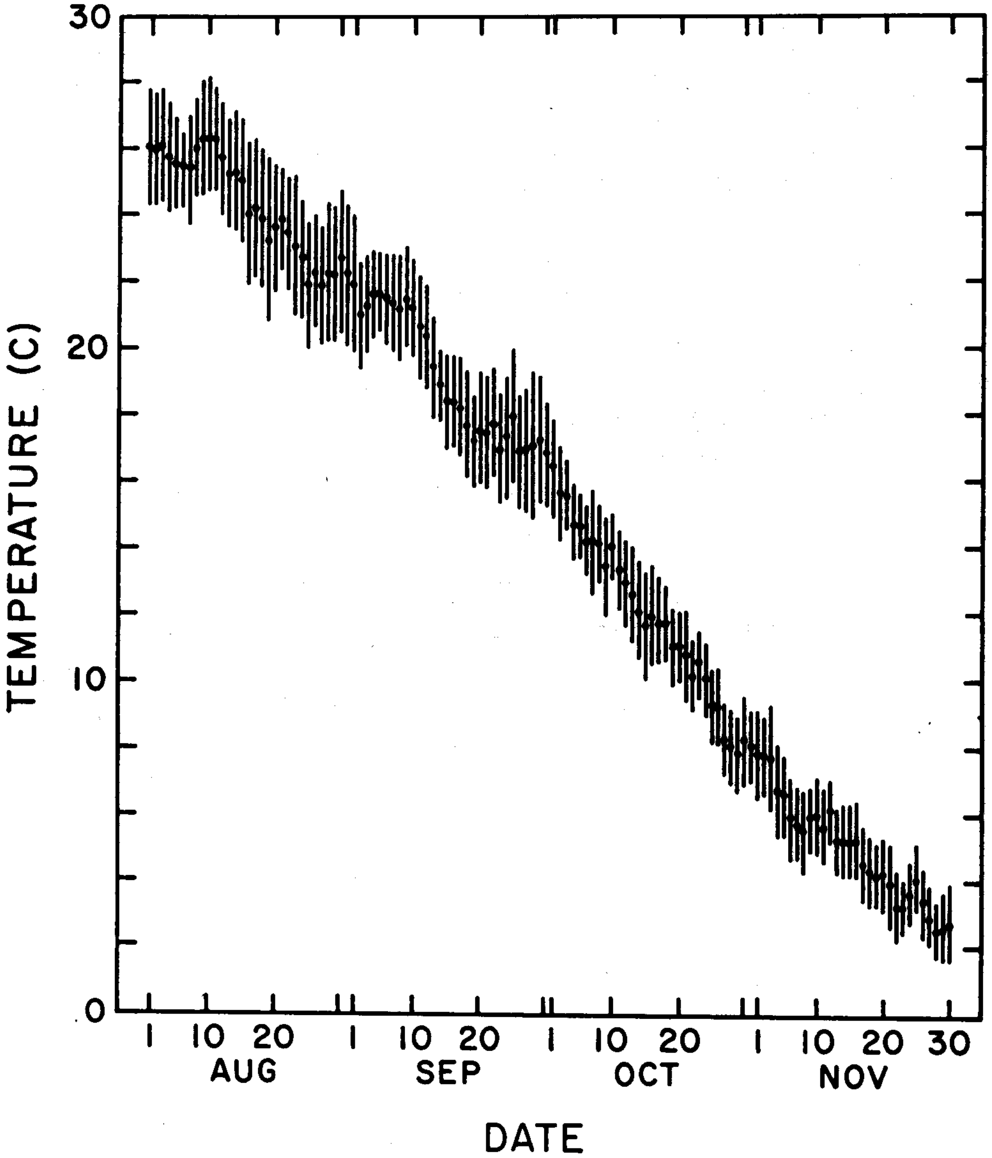

Figure 2. Average daily 10-cm soil temperature and the 95% confidence interval (vertical bar) for August through November, 1963-1977, at Moro, Oregon.

The effect of planting date on relative stand and grain yield of wheat and barley is seen in Table 2. Comparable yields were obtained with wheat and barley in the first year until the October 17 planting, after which the barley yielded significantly less than the wheat. Early and late dates of planting resulted in significantly lower yields than the middle dates. Important factors affecting yields were: increased water use by the early planted grain, an infection of barley yellow dwarf in the early plantings, and higher weed populations in the early and late planted plots. In the second year of the study, McDermid also yielded highest on the middle dates.

Table 2. Relative stand (as percent of the best plots) and grain yield of McDermid wheat and Hudson barley planted on the indicated dates in 1976 and 1977

Planting Date	1976				1977
	Hudson		McDermid		McDermid
	Stand	Yield	Stand	Yield	Yield
	%	g/m^2	%	g/m^2	g/m^2
Aug 20	42	56	81	87	
Sept 1					218
Sept 4	85	191	92	186	
Sept 16	88	346	85	307	328
Sept 30					405
Oct 2	88	369	92	351	
Oct 12					373
Oct 17	43	192	88	279	
Oct 27					347
Oct 30	6	20	77	178	
Nov 12	0	0	58	128	

The relative stand counts in barley were much more affected by date of planting than wheat. This may be caused by lower vigor in vegetative growth and development, whether from differences in the temperature response curve or by other inherent differences. Farmers apparently are aware that the two crops differ, and generally plant barley before wheat when they are growing both species.

Conclusions

Although many other factors enter the decision of when to seed, such as late summer or fall precipitation which germinates weeds, the amount of soil moisture in the seed zone, or the acreage to be planted, the temperature of the seed zone is a factor which is also important. A method for predicting the emergence of two cereals has been presented in this paper. The equations indicate that if 70 percent stand within 14 days of planting is desired, the average last date to seed McDermid wheat and Hudson barley in the Moro area is between September 25 and October 10. This is the time when highest average yields also are obtained. Further experimentation is needed to test the validity of these conclusions to other varieties and cropping systems, but we expect the method presented here to have wide applicability.

DRYLAND VARIETY TRIALS OF PROCESSING PEAS IN NORTHEAST OREGON

Steve Lund and J. M. Kraft[1]

Introduction

Seed companies, processors, and growers initiated a yield trial for canning and freezing peas in northeast Oregon in 1977 to determine the adaptability of new pea strains in the southeast Washington-northeast Oregon production area. The 1977 trial, planted near Weston, Oregon, had 26 entries, but in 1978 the trial was moved to the Pendleton Station of the Columbia Basin Agricultural Research Center and increased to 29 entries.

Experimental Procedure

Trial procedures established in 1977 were essentially followed in 1978. Thirty (lb/A) Ammonia sulfate were applied before planting. One-half lb/A of trifluralin (Treflan) was incorporated into the soil and all plots were planted on April 11, 1978. The plots were 40 feet x 7 feet with the first 10 feet available for tenderometer tests. The remaining 30 feet was divided into two sections so material was available for a second harvest if the first harvest was too immature. Three replicates were used for the Standard Trial; only one replicate was used for the Preliminary Trial. Planting was done with a 10 foot double disc drill with 7-inch spacing. The seeding rate was approximately seven seeds per foot of row based on the number of seed per pound and the manufacturer's suggested setting on the drill.

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One lb/A of MCPA was applied in May to control broadleaf weeds and 1-1/4 lb/A of malathion was applied near harvest to control aphids. Root rot severity readings were made just prior to first harvest.

When the peas were approximately at 100 tenderometer reading (TR), the plants were harvested and shelled with a stationary viner. The peas were then washed, a TR obtained, and an approximately one-pound sample was sized with hand sieves. Yield data were adjusted to a TR of 100.

Results and Discussion

The results of the 1978 Standard and Preliminary Trials are presented in Table 1. The season was well suited to pea production with cool temperatures and adequate rainfall which was well distributed throughout the growing season. Under these conditions, a general increase in yield was closely associated with the number of accumulated heat units (AHU), with the longer-growing strains greatly outyielding the early lines. There also was a higher incident of root rot in the early lines than in the late lines, and some premature ripening may have been caused by this disease.

Stands varied considerably. Stand counts showed a range of 2.7 to 7.3 plants per foot of row. Most stands were in the 4.3 to 5.5 range which appeared adequate. In the case of Camas in the Standard Trial and FR 75108 in the Preliminary Trial, emergence was poor apparently because of defective seed. Yield results probably do not reflect the potential of either of these lines.

Some of the lines were well over the 100 TR at harvest and the sieve size readings may be on the high side. Lines in this category were: LL-1-77, Marlin 602, and SSPA in the Standard Trial, and SSDSP in the Preliminary Trial. No effort was made to determine the exact effect of higher tenderometer readings on sieve size of these lines.

In Table 2 the average results of those lines which were grown both in 1977 and 1978 are presented. Although both years were near normal in temperature, 1977 was very dry, while 1978 had excellent soil moisture.

Rogers Brothers' 72-244 line produced the highest yields both years, indicating a wide range of adaptation. Representatives of the seed company indicated that 72-244 has yielded well in tests in other parts of the world.

Table 1. The results of a dryland, processed pea trial grown at the Columbia Basin Agricultural Research Center, Pendleton, Oregon, in 1978

Variety	Type[1]	Stand plts/ft	Date first flower	Height inches	Maturity to 100 TR: Days	Maturity to 100 TR: AHU's[2]	Yield adjusted to 100 TR: Tons/A	Yield adjusted to 100 TR: % D.S.P.	Root rot & stress	% Sieve size distribution: 1 and below	% Sieve size distribution: 2 & 3	% Sieve size distribution: 4	% Sieve size distribution: 5 and over
STANDARD TRIAL													
M164	Ca	7.3	5-27	21.6	68	990	1.23	47	3	12	32	56[3]	--
Tilma	Ca	5.5	6-2	22.4	72	1090	2.00	77	2+	19	35	45[3]	--
Preperfection (CK)	Ca	5.2	5-30	24.8	73	1110	2.02	77	2-3	11	59	31[3]	--
AG 325 F	Fr	4.6	5-30	20.9	73	1110	2.12	81	3	5	37	58[3]	--
Granada	Fr	4.3	6-2	20.5	75	1150	1.97	75	2	7	43	37	12
CM080F	Fr	5.2	6-3	19.3	75	1150	2.09	80	2+	33	64	2	0
Venus (CK)	Fr	4.6	6-3	19.7	76	1170	2.16	83	2	3	24	37	36
9889	Fr	4.6	6-4	20.9	76	1180	1.79	69	1-2	8	53	33	6
6060 (CK)	Fr	4.3	6-4	26.0	76	1180	1.72	66	1	10	39	32	19
Camas	Fr	2.7	6-4	20.9	77	1190	1.71	66	2-3[4]	12	52	30	5
Swinger	Fr	4.3	6-4	20.9	77	1190	2.25	86	1-2	8	43	35	13
8221C	Ca	4.9	6-5	21.3	77	1190	2.33	89	1-2	13	59	26	2
Nugget A	Ca	4.0	6-7	20.1	80	1260	1.59	61	2	35	61	4	0
Ear. Perf. Str. 11 (CK)	Ca	5.2	6-6	25.6	80	1280	2.12	81	1+	19	66	14	1
Sussex	Ca	6.7	6-8	19.9	81	1290	2.28	87	2+	44	54	2	0
5147 F	Fr	4.3	6-7	24.8	81	1300	1.68	64	1	7	44	26	14
S.S.P.A.	Ca	4.9	6-8	29.9	82	1320	2.38	91	2	6	47	38	9
LL-1-77	Ca	5.2	6-9	20.1	82	1330	2.70	103	-	10	73	17	0
68-273	Ca	4.6	6-7	19.3	82	1330	1.80	69	2	11	52	32	5
Corfu	Ca	5.2	6-8	23.6	82	1330	2.35	90	1	13	71	14	2
Quincy	Fr	4.9	6-8	19.9	82	1330	2.79	107	1-2[4]	4	37	49	9
Puget	Fr	4.0	6-9	22.0	83	1360	3.11	119	2	7	48	34	11
D.S.P. (CK)	Fr	4.3	6-8	25.6	83	1360	2.61	100	1	4	30	34	33
L-3-77	Ca	5.5	6-10	19.3	84	1380	3.08	118	2-3	25	70	5	0
Marlin 602	Fr	6.1	6-10	25.6	86	1420	2.42	93	1-2	16	61	20	2
72-244	Fr	4.6	6-11	19.3	87	1450	3.41	131	1	7	48	35	10
Perf. Str. 15 (CK)	Ca	4.6	6-12	26.8	87	1450	2.63	101	1-2	16	46	29	8
D-5188	Fr	5.5	6-12	26.0	88	1480	2.90	111	1-2	14	50	27	8
Conway	Fr	5.2	6-15	19.3	88	1490	2.64	101	1	17	60	20	4
PRELIMINARY TRIAL													
6060 (CK)	Fr	4.0	6-4	22.5	77	1180	1.92	66	1	10	40	33	17
SSDSP	Fr	4.6	6-7	20.5	81	1300	2.71	94	2-3[4]	1	11	39	50
FR 68178	Fr	4.9	6-7	20.5	82	1330	1.99	69	2-3	4	22	38	36
LL76NP	Ca	5.8	6-9	22.9	83	1350	2.77	96	2-3	10	68	21	1
D.S.P. (CK)	Fr	5.8	6-8	28.0	83	1360	2.88	100	1	5	32	34	29
FR 604	Fr	4.3	6-9	19.7	84	1380	2.92	101	1-2	3	24	43	30
Perf. Str. 15 (CK)	Ca	4.6	6-11	28.8	86	1420	3.49	121	1-2	11	44	37	8
FR 75108	Fr	2.4	6-11	18.1	87	1440	2.31	80	1	10	47	32	11

[1] Ca = Canners Fr = Freezers

[2] Accumulated heat units to the base of 45° F.

[3] Includes all above size 4.

[4] Near Wilt present.

Table 2. Yield, maturity and root rot ratings of 17 pea varieties grown in dryland in northeastern Oregon in 1977 and 1978

Variety	Maturity to 100 TR Days	AHU's[1]	Yield adjusted to 100 TR Ton S/A	% D.S.P.	Root rot and stress[2]
M164	69	980	0.80	42	3
AC352F	73	1085	1.66	87	3+
Preperfection (CK)	74	1100	1.42	74	3
Granada	75	1135	1.51	79	3+
Venus (CK)	76	1145	1.82	95	2+
Camas	77	1170	1.79	94	2+
6060 (CK)	77	1180	1.66	87	1
Swinger	78	1190	1.93	101	2
E. Perf. Str. (CK)	80	1250	1.68	88	2
Sussex	80	1265	1.66	87	3
5147	82	1310	1.65	87	1
D.S.P. (CK)	82	1320	1.91	100	1+
Puget	83	1340	2.28	120	2+
Perf. Str. 15 (CK)	86	1410	1.96	103	1+
Marlin 602	86	1425	2.16	113	2
72-244	87	1440	2.72	142	2
D-5188	88	1460	2.26	118	2

[1] Accumulated heat units to the base of 40° F.

[2] 0 = No root rot   3+ = Root rot extreme

The only other lines that exceeded Dark Skinned Perfection (D.S.P) both years were Puget and D-5188. The variety Camas yielded nearly 2/3 tons/A more than D.S.P. in 1977, but was nearly a ton/A short of it in 1978. With only 2.7 plants per foot of row in 1978, Camas was noticeably sparse in stand. The germination of this lot of Camas apparently was poor and it might have been among the top yielders had we had a better seed lot.

TRITICALE DEVELOPMENT FOR EASTERN OREGON

M. F. Kolding and R. J. Metzger[1]

Winter triticale may find grower acceptance on the sandy irrigated lands along the Columbia River and on some of the higher elevation intermountain valleys and benches in Baker, Union, and Wallowa counties if new breeding lines yield competitively and a reliable market is developed.

Eastern Oregon spring triticale screening trials, started in 1971, have not revealed adapted spring types. Summer heat and moisture stress in the dryland area interferes with seed formation and accentuates heat shattering. At higher elevations, spring triticale does not mature in time for harvest and is susceptible to ergot infections. Fall-planted spring triticale at the Columbia Basin Agricultural Research Center, Pendleton, however, have yielded as well as the wheat checks.

Though some winter habit triticale from other triticale breeding programs are winter hardy, they seldom gave satisfactory yields, were generally too tall, weak-strawed, and shattered in Oregon trials.

Triticale is still a "babe" among cereal crops and is not prepared to walk on its own. Some lines are cold hardy. Others carry various combinations of desirable characteristics, such as high protein, large heads, stiff straw, rapid emergence, tolerance to herbicides, high yield, and resistance to prevailing diseases. Unfortunately, the same lines carry one or more undesirable traits such as sterile florets, weak straw, shriveled kernels, and head shattering.

Oregon triticale breeders are attempting to identify desirable agronomic traits in ready-made triticale lines and in wheat and rye selections that are being used as parents. Through their efforts and those of other breeders, new triticale selections with short stiff straw and resistance to shattering were developed. Though sterile florets and shrunken kernels are still a serious problem, self-fertile, plump-seeded lines are available.

The most promising new winter triticales which may find grower acceptance in Oregon are those originating from wheat x rye crosses of several divergent sources. These sources not only are found in the older winter and spring triticale lines, but also come from newly developed semi-dwarf winter wheat x rye hybrids such as Daws and Stephens crosses with medium tall winter ryes.

When learning about triticale's weaknesses and strengths, one also learns about the environment where it may fit. Tables 1 through 5 report examples of data which give clues to triticale adaptation.

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Table 1. Five-year yield summary for winter seeded triticale and wheat grown at the Columbia Basin Agricultural Research Center at Pendleton, Oregon

Variety	Yield, pounds per acre					
	1974	1975	1976	1977	1978	Average
1. Hyslop, wheat	3,756	5,112	4,530	3,456	4,914	4,354
2. Kiss-6, triticale	4,824	5,166	4,968	3,006	3,396	4,432
3. 6TA476, triticale	4,410	5,742	4,788	3,288	4,092	4,464
4. Nugaines, wheat	4,080	5,118	3,744	3,912	5,495	4,470
5. FT 73643-01, triticale	5,154	5,154	4,488	3,228	5,132	4,631
6. Luke, wheat	5,364	5,232	4,182	3,468	5,111	4,671

Table 2. Three-year yield summary for winter-seeded triticale and wheat grown at Columbia Basin Agricultural Research Center at Pendleton, Oregon

Variety	Yield, pounds per acre			
	1976	1977	1978	Average
1. Kiss-6, triticale	4,968	3,006	3,396	3,790
2. 6TA476, triticale	4,788	3,288	4,092	4,056
3. Luke, wheat	4,182	3,468	5,111	4,254
4. FT 73643-01, triticale	4,488	3,228	5,132	4,283
5. Hyslop, wheat	4,530	3,456	4,914	4,300
6. Nugaines, wheat	3,744	3,912	5,495	4,384
7. M75-8651, triticale	4,416	3,690	5,233	4,446
8. Stephens, wheat	5,790	3,780	6,199	5,256

Table 3. Winter triticale and wheat grain yields from the 1978 winter triticale trial grown at the Columbia Basin Agricultural Research Center at Pendleton and Hermiston, Oregon

	Yield, pounds per acre		
Variety	Pendleton	Hermiston	Average
1. Luke, wheat	5,111	4,425	4,768
2. Nugaines, wheat	5,495	4,332	4,914
3. FT 76219-701, triticale	3,678	6,903	5,290
4. M75-8651, triticale	5,233	5,393	5,313
5. Stephens, wheat	6,199	5,276	5,737
6. M76-6881, triticale	5,779	5,917	5,848
7. M75-8645, triticale	5,752	6,294	6,023
8. M76-6292, triticale	5,996	6,637	6,316

Table 4. Grain yields of two winter wheats and two winter triticale from an irrigated 1978 seeding rate x variety trial grown at the Columbia Basin Agricultural Research Center near Hermiston, Oregon

Seeding rate pounds per acre	20	40	60	80	100	120	Average
Variety	Yield, pounds per acre						
1. Stephens, wheat	4,425	4,725	4,905	4,770	4,740	5,145	4,785
2. FW 74885P01, wheat	4,230	4,845	5,475	4,815	5,145	5,340	4,975
3. FT 75482-603, triticale	3,450	4,140	4,245	4,410	4,440	4,680	4,227
4. M75-8651, triticale	4,740	4,980	5,220	5,265	5,775	5,535	5,252
Average	4,211	4,672	4,961	4,815	5,025	5,175	

The five-year grain yields for three adapted soft white winter wheats (Hyslop, Nugaines, and Luke), 1 winter triticale (Kiss-6), and 2 spring triticale (6TA476 and FT 73643-01) are presented in Table 1. The three triticale have average yields comparable to the winter wheats, but Kiss-6 was dropped from testing because of its tall weak straw, and 1979 will be the last year of testing for 6TA476 and FT 73643-01 since they had extensive freezing damage in November 1978.

Table 2 is a three-year yield summary with the same varieties as in Table 1 plus M75-8651 (a short-strawed cold hardy triticale) and Stephens (a newly released white winter wheat). The three-year yield average in Table 2 shows M75-8651 having some yield advantage over the first six varieties, but the yield advantage is lost to the new variety, Stephens.

Irrigated triticale yield trials were established at the Hermiston site of the Columbia Basin Agricultural Research Center during 1977. The trials were seeded in late September to take advantage of fall aphid flights and consequential barley yellow dwarf virus infections. Table 3 gives the yields of three winter wheats and five winter triticale from a yield trial grown at both the Hermiston and Pendleton sites. Stephens winter wheat was the highest yielder in the Pendleton trial, but not in the Hermiston trial. The winter triticales, though not as well adapted to the dryland area at Pendleton, probably have more tolerance to the barley yellow dwarf virus than the wheats and had a distinct yield advantage over the wheats when irrigated at Hermiston.

Yields from a 1978 seeding rate x variety trial comparing winter wheat and triticale at six seeding rates and grown at Hermiston are given in Table 4. The experimental feed grain line, FW 74885P01, (except at the 20-pound seeding rate) consistently yielded better than Stephens as did the short, winter triticale, M75-8651. The tall triticale, FT 75482-603, did not yield as well as the other three reported in Table 3.

Table 5 demonstrates one other clue to triticale adaptation. During the winter of 1975-76, the combination of frost-heaving and snow mold caused differential losses in the plots at Flora, Oregon. Survival for the different plots ranged from 0 to 100%. M75-8655 was the best of the triticale selections.

During the winter of 1978-79, triticale further substantiated its ability to survive winter hazards. Table 6 lists some typical winter survival ratings of several winter wheats and triticale.

Triticale performs well in specific areas. Spring triticale can compete with wheat in Mexico. Texans use triticale for grazing, forage, and grain. Its promise in one area, which often does not fit in another, points to triticale's narrow or limited geographical area of adaptation. Genes which govern desirable traits are being discovered and are gradually being brought together in desirable plant types.

The triticale yield trial information given in this paper not only demonstrates progress in yielding ability but also points to where and which present triticale will perform best in eastern Oregon.

Table 5. Winter survival of winter wheat and triticale at Flora, Oregon in 1976

Wheat Variety	Percent Survival	Triticale Variety	Percent Survival
Hyslop	10	M75-7206	10
Nugaines	10	M75-8551	70
Luke	40	M75-8064	80
Daws	60	M75-8655	90

Table 6. Winter survival plot ratings of fall-sown wheat and triticale lines at the Columbia Basin Agricultural Research Center at Hermiston, Oregon

Wheat Variety	Survival[1] Rating	Triticale Selection	Survival[1] Rating
Stephens	5	M75-8655	9
Luke	4	M75-8655-35	3
McDermid	5	M75-8655-46	9
Nugaines	6	M75-8655-47	9
Cerco	4	M75-8655-48	8

[1]Survival rating: 0 = plants all dead; 9 = no apparent damage.

A GRAIN DRILL FOR OPERATION IN SURFACE RESIDUES

Clarence E. Johnson[1]

Tillage and seedbed preparation for small grain production in summerfallow cultures often leave an inadequate amount of crop residue on the soil surface. Clean seedbeds with sparse surface residues, particularly on steep slopes, create a serious potential for erosion.

Grain drills that cereal growers use were designed to operate in clean tilled seedbeds. Disk drills have difficulty penetrating strawy surfaces. Hoe drills that can penetrate straw covered surfaces or stubble ground frequently plug. Grain drills are often designed so that fertilizer and seed flow together through the opener. Thus, the seed and fertilizer are placed together. Phosphorous and starter fertilizer can usually be placed with the seed, but the seed should also be separated from the crop residues, because the residues may produce toxins harmful to seedling development.

During the summer of 1978 a prototype seeding device was designed to operate on strawy surfaces, to control seeding depth, and to place fertilizer below the seed level. The new design was a modification of a JOHN DEERE Model HZ grain drill with a 16-inch spacing - a popular drill for seeding on steep hillsides.

The major new features included in the prototype, Figure 1, are a powered rake mechanism (part H, Fig. 2) and a redesigned furrow opener (part A, Fig. 2).

The powered rake mechanism (Fig. 2) rakes residue between the furrow openers. Surface residue in front of the opener is moved to the sides and rear of the furrow opener. The powered rake mechanism is operated mechanically by a chain drive from the packer-wheel shaft, but it can be powered independently with a hydraulic motor. Operation is best when the tips of the teeth move about 3 to 5 times faster than the ground speed.

The furrow opener (part A, Fig. 2) opens a furrow for seed and fertilizer placement. Fertilizer flows down the front tube and is placed below seed level. Soil is gathered from the sides of the opened furrow above the placed fertilizer and firmed over the fertilizer by a soil firming device (part C, Fig. 2). Seed flowing down the rear tube of the furrow opener (part E, Fig. 2) is placed on top of the firmed soil above the fertilizer. Then the press wheels (part I, Fig. 2) gather soil from the sides of the furrow as needed to cover and pack soil around the seed to promote rapid seed germination and emergence.

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Figure 1. Prototype small grain drill

During the summer and fall of 1978, the prototype in Fig. 1 was operated in stubble and stubble mulch conditions with up to 3 tons per acre surface residues. Its functional performance showed the strength and weaknesses of the design concepts and indicated where further development is needed. The precision of seed placement was equivalent to that of a commercial hoe-type seed drill operating in a conventionally tilled seedbed. The seed was positively placed above the fertilizer away from crop residue to obtain crop residue on the soil surface.

Application has been made for a patent on the design concepts in this prototype drill. Since the prototype was developed by employees of the USDA, any firm may obtain a manufacturing license at minimal cost with no royalty if a patent is granted.

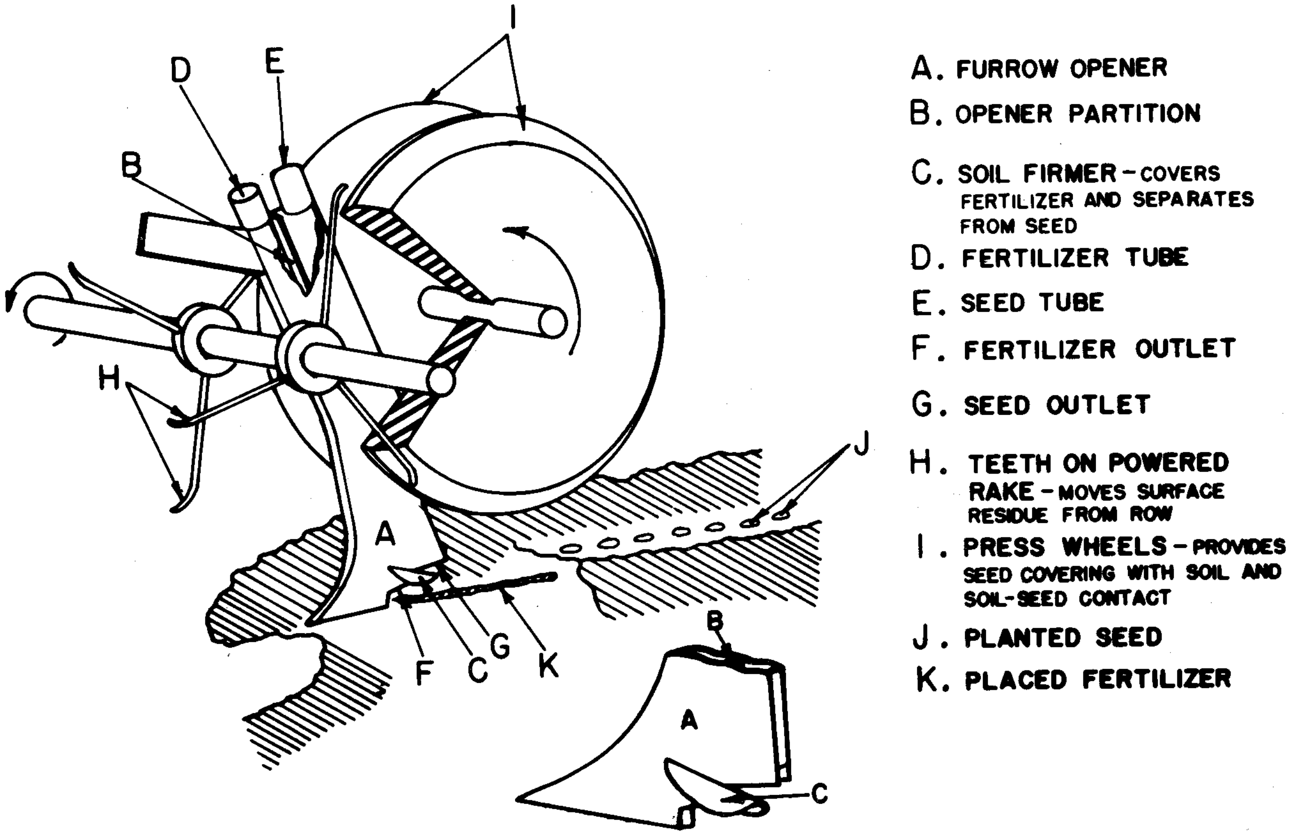

Figure 2. Schematic of seeding device.

SOIL WATER AND NITRATE-N ACCUMULATION AND DISTRIBUTION AS INFLUENCED BY FIVE FALLOW-CROP PRECIPITATION PATTERNS

D. M. Glenn and F. E. Bolton[1]

Introduction

Long-term precipitation data (65 years) from the Sherman Station indicate that both the fallow and crop period can be categorized into dry, normal, and wet seasons. The sequence of precipitation in the fallow-crop periods also affects the yield level of winter wheat (Table 1). Related studies have shown that the fallow moisture level does affect significantly the soil moisture and nitrate-N accumulated in the soil profile at the end of the fallow period. Presumably, the amount of nitrate-N and soil moisture accumulated during the crop year also would be affected by both the fallow and crop season level of precipitation. An understanding of the interactions affecting soil moisture and nitrate-N accumulation and distribution in the soil profile would provide more accurate information in predicting the nitrogen fertilizer needs of a crop. This prediction could insure adequate nitrogen fertilization in relation to the moisture supply and prevent excess application of expensive nitrogen fertilizer materials.

Experimental Procedure

Five, fallow-crop soil moisture treatments simulating a dry fallow-normal crop (DFNC), normal fallow-dry crop (NFDC), normal fallow-normal crop (NFNC), normal fallow-wet crop (NFWC) and wet fallow-normal crop (WFNC) were established on a commercial farm near Moro, Oregon. These treatments were created by covering plots to exclude rain or by adding water as required during the 1978-79 season. Treatment levels were based on the long-term patterns outlined in Table 1. Soil profile nitrate-N was measured at the beginning of the fallow (August), and May, August and September of the fallow period. Crop mineralization of nitrate-N will be estimated indirectly using the fertilizer trials. Soil profile moisture was measured with a neutron probe to depths ranging from 5 to 10 feet at the beginning of the fallow (August), March, August, and September of the fallow and November, March and July of the crop period. Each treatment received six levels of nitrogen fertilizer (0,13,40,54,67,94 #N/A) before Stevens wheat was planted. The first crop will be harvested in July 1979.

The relationship between grain yield and monthly precipitation at the Sherman Station was modeled for the years 1956-1976 using a multiple regression approach. During this period, management and varieties were improved substantially and it was felt that this time span accurately represented the current management level of the lower Columbia Basin.

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Table 1. Fallow-crop patterns at the Sherman Agricultural Experiment Station (Moro, OR) based on 65 years (1912-1976) of monthly precipitation data

Fallow (14 month, Aug-Sept) Cumulative Precipitation (in)	Probability (%)	Crop (10 month, Oct-July)	Cumulative Precipitation (in)	Probability Based on Previous Fallow (%)		Fallow-Crop Cumulative Precipitation (in)	Probability for the Fallow-Crop Sequence (%)	Mean Grain Yield (bu/A)
		Dry crop (DC)	7.03 - 8.58	14.4	DFDC	15.15 - 18.87	3.1	26.0
8.12 - 10.29	21.5	Normal crop (NC)	8.59 - 12.61	64.3	DFNC	16.70 - 22.9	13.9	23.6
dry fallow (DF)		Wet crop (WC)	12.62 - 15.85	21.3	DFWC	20.73 - 26.14	4.6	39.0
				100.0				
		Dry crop (DC)	7.03 - 8.58	28.2	NFDC	17.32 - 23.13	16.9	26.6
10.30 - 14.55	60.0	Normal crop (NC)	8.59 -12.61	56.5	NFNC	18.87 - 27.16	33.9	30.2
normal fallow (NF)		Wet crop (WC)	12.62 -15.85	15.3	NFWC	22.90 - 30.40	9.2	33.7
				100.0				
14.56 - 16.89		Dry crop (DC)	7.03 - 8.58	16.8	WFDC	21.58 - 25.77	3.1	34.6
wet fallow	18.5	Normal crop (NC)	8.59 -12.61	75.1	WFNC	23.13 - 29.50	13.9	37.8
		Wet crop (WC)	12.62 -15.85	8.1	WFWC	27.16 - 32.74	1.5	38.0
				100.0			100.0	

Results and Discussion

The three fallow moisture levels produced significantly different amounts of nitrate-N in the soil profile (Table 2). In May, there were significant differences in the soil nitrate distribution between the dry fallow and the normal and wet fallow treatments. In May, the dry fallow also had accumulated more soil nitrate in the upper six feet. By August, the dry fallow still had accumulated more soil nitrate than the normal fallow. All the treatments increased their total accumulation between May and September. In September, there were differences in both distribution and accumulation of soil nitrate. Both the dry and wet fallow treatments had more nitrate accumulated in the upper foot and in the total profile than did the normal fallow treatment. These results indicate that apparently the rate of mineralization increases with increasing fallow moisture. However, because nitrate is water soluble, there are greater losses of soil nitrate from leaching as the amount of fallow precipitation increases.

Table 2. Nitrate-nitrogen distributions in the soil profile as influenced by three levels of fallow moisture during the 1977-78 fallow season

		NO_3-N in Soil Profile (lbs/A)								
Soil Depth		May			August			September		
(in)	After Harvest	DF	NF	WF	DF	NF	WF	DF	NF	WF
0-12	8.1	6.1	4.0	3.5	21.0	17.0	21.2	31.6	24.0	42.8
12-24	2.3	1.3	1.1	0.7	3.2	2.2	3.0	4.0	4.0	4.0
24-36	1.8	1.1	1.1	0.7	3.0	1.8	2.3	4.0	3.6	3.6
36-48	1.8	2.5	1.4	1.1	4.4	2.9	3.4	6.8	4.0	6.4
48-60	1.4	3.8	1.8	1.0	4.7	2.2	2.4	4.0	2.8	2.8
60-72	1.8	5.7	3.7	2.7	6.5	4.0	3.7	6.4	5.6	6.0
Total	17.2	20.5	13.1	9.7	42.8	30.1	36.0	56.8	44.0	65.6

The three fallow moisture levels resulted in different amounts of total water stored in May (Table 3). However, from May to September there was a substantial loss of moisture from all depths and all treatments. The degree of moisture loss was greatest from the wet fallow and least from the dry fallow. Apparently, water was being lost not only from surface evaporation but also from soil drainage below six feet.

Table 3. Soil moisture distribution in the soil profile as influenced by three levels of fallow moisture during the 1977-78 fallow season

Soil Depth (in)	After Harvest	Soil Water (in)								
		May			August			September		
		DF	NF	WF	DF	NF	WF	DF	NF	WF
0-12	0.8	2.2	2.4	3.0	1.6	1.6	1.9	1.6	1.6	1.7
12-24	1.2	2.6	2.9	2.9	2.3	2.3	2.3	2.0	2.0	2.1
24-36	1.2	2.7	3.0	3.0	2.2	2.4	2.5	2.0	2.1	2.2
36-48	1.2	2.6	3.0	3.0	2.3	2.5	2.5	2.0	2.2	2.2
48-60	1.3	2.5	3.0	3.0	2.3	2.5	2.6	2.0	2.2	2.1
60-72	1.2	2.2	2.8	2.9	2.3	2.5	2.5	2.0	2.3	2.3
Total	6.9	14.8	17.1	18.8	13.0	13.8	14.3	11.6	12.4	12.6

A mathematical estimator of the yearly grain yield for the Sherman Station was developed (Table 4) to predict grain yields for the fallow-wheat areas of the lower Columbia Basin. This model includes both climatic and management effects on wheat yields. Further work and refinement should make this model applicable to each grower on an individual farm basis. This model, in conjunction with an understanding of the effect of fallow-crop precipitation patterns on soil moisture and nitrate accumulation, will be used to develop a nitrogen fertilizer program that would insure adequate nitrogen fertilization in relation to the moisture supply and prevent excess application of expensive nitrogen fertilizers.

Table 4. Wheat yield model for the Sherman Agricultural Experiment Station

Grain yield (bu/A) =	3.07 (fallow November precip)
	+
	9.29 (fallow February precip)
	-
	4.94 (fallow July precip)
	-
	5.68 (fallow August precip)
	+
	2.08 (crop September precip)
	+
	5.48 (crop March precip)
	-
	10.15 (crop May precip)
	-
	0.0047 (days for crop to emerge)^2
	+
	12.16 (WUE) WUE = water use efficiency; WUE = $\frac{\text{grain yield (bu/A)}}{\text{inches of precip to produce that grain yield}}$
	+
	9.67 regression constant

CHEMICAL FALLOW - A MANAGEMENT OPTION

D. J. Rydrych[1]

Chemical fallow was first thought to be merely a hedge on erosion. Chemicals would replace some tillage and thereby reduce the chances of soil erosion by wind and water. However, recent investigations have shown that chemical fallow can produce other benefits.

Chemical fallow applied in fall or early spring can reduce spring tillage by at least two operations. In addition, chemical fallow gives growers the option of delaying tillage when weather conditions prevent good fallow preparations. Timely application of an appropriate general purpose contact herbicide can prevent sod formation by weedy grasses and volunteer cereals. In 1978, sod formulation forced many growers to use three extra spring tillage operations to prepare their fallow land. Chemical fallow also can save valuable soil moisture used by weeds during early fall and late spring months.

Experimental Procedure

Experiment plots were established on the Pendleton Station, Sherman Station (Moro), and a site at Echo, Oregon in 1978. Soil organic matter was 1.96 percent at Pendleton, 1.41 percent at Moro, and 0.95 percent at Echo. Each site contained volunteer stands of cereal grain, downy brome, and numerous broadleaf weeds in a post-harvest stubble. The herbicides IPC (Chem Hoe 135), cyanazine (Bladex), atrazine (Aatrex), dalapon (Dowpon), metribuzin (Sencor or Lexone), paraquat, and glyphosate (Roundup) were applied singly or in combination in wheat stubble on emerged weeds. Treatments were applied in the fall after soil temperatures had cooled to 50°F.

Cyanazine (1 to 3 lb/A), atrazine (0.33 to 1 lb/A), IPC (2 to 3 lb/A), metribuzin (0.50 to 0.75 lb/A), paraquat (0.25 lb/A), and glyphosate (0.25 lb/A) were applied in the stubble when volunteer cereals averaged 2- to 5-tiller, and downy brome averaged 2-leaf to 5-tiller. Broadleaf weeds such as fiddleneck (*Amsinckia intermedia*), purple mustard (*Chorispora tenella*), and chickweed (*Holosteum umbellatum*), averaged 1- to 3-inches in diameter. Applications were made November 2, 1977, at Pendleton, November 11, 1977, at Moro, and November 3, 1977, at Echo.

Results were evaluated the next spring by taking stand counts of all volunteer weeds and cereal in the stubble.

Results and Discussion

Metribuzin, cyanazine, and atrazine have been used extensively in eastern Oregon on a variety of soil types in areas of variable moisture (10 to 16 inches/year), and soil organic matter (0.5 percent - 2 percent). Paraquat and glyphosate

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are used primarily as contact herbicides. All these chemicals are registered for use in Oregon for chemical fallow. IPC and dalapon are two promising materials that do not have label clearance. IPC did have a temporary Section 18 (FIFRA) label for emergency use from November 1978 through April 1, 1979, in Oregon. Weed control data for part of this study are recorded in Table 1.

Table 1. Chemical fallow trial results in wheat stubble at three Eastern Oregon locations. Applications were made in 1977 on November 2 at Pendleton, November 11 at Moro and November 3 at Echo

	Pendleton			Moro			Echo		
Chemicals	V[1]	C	Cost	V	C	Cost	V	C	Cost
atrazine	25	80	2.00	20	100	2.00	0	50	1.50
atrazine-dalapon	100	100	6.90	50	80	6.90	60	70	6.40
atrazine-paraquat	97	99	6.12	99	100	5.50	43	58	5.50
atrazine-glyphosate[2]	94	97	10.00	20	100	9.35	10	40	9.35
cyanazine	25	60	7.50	70	98	7.50	40	40	7.50
cyanazine-dalapon	100	100	7.60	60	96	7.60	60	80	7.60
cyanazine-paraquat	95	98	9.15	60	100	9.15	20	90	9.15
cyanazine-glyphosate[2]	80	70	9.00	70	96	9.00	10	40	9.00
IPC	97	99	8.75	94	100	8.75	90	90	8.75
metribuzin[2]	10	70	8.25	10	93	8.25	0	40	8.25

[1]V = volunteer cereal control in %; C = cheatgrass control in %; costs are for chemicals only in dollars per acre.

[2]Glyphosate = Roundup; Metribuzin = Sencor or Lexone.

Most of the herbicides gave good control of downy brome in fallow stubble but volunteer cereal control was erratic (Table 1). IPC (Chem Hoe 135) gave good grass control and was less erratic on volunteer grain at each site. Herbicides generally were more effective when applied in mixtures such as atrazine with paraquat, glyphosate, dalapon, or with cyanazine (Bladex) with the same combinations. Metribuzin was weak on volunteer cereals. Some of the treatments were less effective at the drier Echo site--an indication that timing is important where moisture is limited. Chemical fallow herbicides are much more effective when applied before volunteer weeds and vegetation get too large. Growth was well advanced when these tests were applied and would explain some of the erratic results at Moro and Echo. Excessive volunteer growth in the fall stubble depletes moisture and causes moisture stress. This moisture stress interferes with translocation of herbicides in the plant.

In general, IPC, atrazine, cyanazine, and metribuzin gave good control of downy brome in stubble but were more effective on volunteer cereals when combined with paraquat, glyphosate, or dalapon. IPC was effective without added herbicide in the mixture. Mixtures compensate for weaknesses of either parent chemical and also allow the use of reduced rates of herbicides--this is important when using atrazine which cannot be applied on low organic soils at rates exceeding 0.33 lb/A.

The chemical costs for various chemical fallow mixtures are recorded in Table 1. Costs generally run less than $10 per acre and are determined by the rainfall and soil organic matter of each location. Higher rates are necessary in areas that receive more than 14 inches of rainfall or where longer term chemical fallow is necessary.

Summary

IPC (Chem Hoe 135) was the most effective grass herbicide in these experiments. Other mixtures such as atrazine-paraquat, atrazine-glyphosate, cyanazine-paraquat, cyanazine-glyphosate, and mixtures with dalapon gave good fallow weed control. Early treatments, while volunteer wheat and weeds are in the seedling stages, are necessary on the drier sites particularly when vegetation in the stubble germinates in September. Costs are determined by the ratio that is safe and effective on a particular soil type and average $6 - $10 per acre. Registrations have been completed for all chemicals used in this study except dalapon and IPC.

STRIP-TILL PLANTING SYSTEM

Floyd E. Bolton[1]

A major problem in the successful use of no-till or chemical fallow in the Pacific Northwest dryland winter cereal area is the timely establishment of a vigorous stand of the cereal crop. For several years, various types of no-till grain drills have been developed with varying success. Most of these no-

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till drills use heavy coulters or chisel points to open a slot in the undisturbed fallow for placement of the seed. This method of planting presents several problems:

1) The surface 7 to 13 centimeters (3 to 5 inches) of soil are often quite hard and dry resulting in poor seed-soil contact and low moisture, which cause delayed and spotty stands.

2) Even when moisture is adequate below the surface 8 centimeters (3 inches), the seed-soil contact is inadequate and the depth of planting too great for rapid, vigorous emergence.

3) Under even moderate amounts of stubble residue and adequate stands, the seedlings often lack vigor probably because of toxic substances from previous crop residues. These toxic substances apparently are eliminated when standard or minimum tillage practices are utilized.

4) Adequate seed-zone moisture from the previous fallow is often deeper than present no-till drills can reach and the seeds are placed in dry soil. Under these conditions, germination and emergence occur only after adequate precipitation, often resulting in delayed emergence.

5) When heavy residues from the previous crop or combine residues are left in concentrated swaths, no-till drills have openers that are pulled through the soil tend to have plugging problems.

A rotary strip-tillage system is being investigated as a method of establishing adequate stands in no-till chemical fallow. This method consists of modifying a heavy-duty rotary tiller to prepare narrow tilled strips 10 to 13 centimeters (4 to 5 inches) wide, spaced 45 to 50 centimeters (18 to 20 inches) apart. The tiller has the capacity to cultivate about 18 centimeters (7 inches) deep. The basic concept is to till to the seed-zone moisture depth and place the seed on the residual moisture from the previous fallow. Excess soil in the tilled strips is pushed out of the furrow by wide shovels or other special attachments to prevent seeds from being covered too deeply.

Previous studies have shown that wider row spacings (45 to 50 centimeters versus 30 to 40 centimeters or 18 to 20 inches versus 12 to 16 inches as normally used) produce comparable yields to the conventional spacings, provided that timely and adequate chemical weed control is practiced during the crop period. Under the strip tillage system, only 25 percent of the surface land area is actually tilled so power requirements are substantially reduced.

Field studies during the last two seasons using the rotary strip-till system have shown that:

1) The tilled strip 10 to 13 centimeters (4 to 5 inches) wide produces excellent seed-bed conditions and good seed-soil contact.

2) When strips are tilled 10 to 13 centimeters (4 to 5 inches) deep, part of the soil in the planting strip is deposited between the rows so that actual planting depth ranges between 5 and 7 centimeters (2 to 3 inches). If deeper strip-tillage (15 to 17 centimeters or 5 to 7 inches) is required to reach the residual moisture, shovels may be required to remove additional soil in the planting strip to maintain proper planting depth.

3) Plantings in relatively heavy stubble residues have shown excellent seedling and plant growth and development. Apparently, the thorough chopping and mixing of stubble in the tilled strip eliminates the problem of toxic substances in stubble residues that generally affect plant development in the slot-seeding method.

4) The rotary strip-tiller can operate in heavy residues without plugging.

5) By using the wide row spacings (45 to 50 centimeters, 18 to 20 inches), the seeding rate may be reduced by about 30 percent.

6) The grain yield level using the strip-till system is about equal to or greater than the standard plow, stubble mulch, or no-till systems (Table 1).

Table 1. Tillage Systems Trials - Harvest 1978 - Sherman County, Oregon

Tillage Systems	Row Spacing	Locations			Average
		Moro-1	Moro-2	Kaseberg Farm	
	cm (inches)	Grain Yield - Kg/Ha (Bu/Acre)			
Bare Fallow (Plow)	35 (14")	3352 (49.8)	4043 (60.0)	3338 (49.6)	3578 (53.1)
Stubble Fallow (Sweep)	35 (14")	3046 (45.2)	3805 (56.5)	2994 (44.5)	3282 (48.7)
Chemical Fallow (No-Till)	35 (14")	3486 (51.8)	- - - - -	2616 (38.8)	3051 (45.3)
Chemical Fallow (Strip-Till-Plant)	50 (20")	3180 (47.2)	3970 (58.9)	3059 (45.4)	3403 (50.5)

FIELD DATA, ALL LOCATIONS:
Date seeded: October 7, 1977
Seeding rate: 65 Seeds/Meter (20 seeds/ft.)
Fertilizers: 50 Units N (30 units at seeding, 20 in spring)
Variety McDermid winter wheat

The rotary tiller used for these trials is a standard heavy-duty machine, 2.45 meters (8 feet) wide. Modifications included reducing the tiller blades to 10 centimeters (4 inches) in cutting width and spacing the blades to the desired row spacing. This particular model and type is manufactured in Yakima, Washington, by the Northwest Equipment Company. Company engineers have indicated that larger machines up to 7.32 meters (24 feet) can be manufactured.

Field trials are underway to further evaluate the strip-till planting system at Moro and Pendleton, Oregon. These trials include studies on nitrogen fertilizer rates, chemical weed control, and seeding rates. The overall objective is to develop an economical planting system that enhances erosion control and combines tillage, planting, fertilizer application, and weed control in a single operation.

DEVELOPMENT OF NEW WINTER VARIETIES OF SOFT WHITE AND HARD RED WHEATS FOR EASTERN OREGON

W. E. Kronstad, W. L. McCuistion, F. A. Cholick, R. Knight and N. S. Scott[1]

A major breakthrough in disease resistance was achieved with the development and release of Stephens wheat. For the first time growers have a variety which has some resistance to foot rot (Cercosporella herpotrichoides). Thus, the advantages of early fall seedings for improved stand establishment and subsequent erosion control are available without the frequent yield losses due to foot rot infection. In addition to superior yielding ability, Stephens wheat has stiff straw and resistance to a broad spectrum of foliar diseases. Its winterhardiness level appears similar to the variety Hyslop and should not be grown in areas where there is prolonged snow cover (snowmold areas) or where in average years a high degree of winterhardiness is required.

In Table 1, eight promising new soft white winter wheat lines are identified for the Rugg-Pendleton site. Selection 67-237-69-53H has been particularly promising having been under test for the past six years with an average yield of 95.8 bu/A, however, this year the high incidence of foot rot severity reduced the yields of this line in comparison to Stephens (68.7 to 90.9 bu/A respectively). Selection 71279-1-2CB had the highest yield (98.0 bu/A)and the highest test weight (59.1) which again reflects resistance to foot rot.

Nine lines surfaced as promising this past year at the Moro site and are noted in Table 2. Of special interest is the large number of these crosses with Yamhill in their parentage. Despite the fact that Yamhill is regarded as adapted to the higher rainfall areas, it has consistently performed well in

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areas of moisture stress. It has been observed in studies conducted in eastern Oregon by Keim and Kronstad involving drought responses that the variety Yamhill maintains a high plant water status during reproductive development in contrast to other varieties including several club wheats which are generally regarded as doing better under limited soil moisture. Many of the experimental lines consistently out-yielded the check varieties (Stephens, Hyslop, Daws and Luke) this year. When averaged over years, however, Stephens has had the highest yield.

A comparison of grain yields for promising Hard Red Winter experimental lines with Wanser (major commercial Hard Red Wheat) and Stephens (Soft White Winter check) for both the Rugg-Pendleton and Moro sites are shown in Table 3. All selections noted yielded more than Wanser at both sites. Four selections yielded more than Stephens at the Rugg-Pendleton site with the cross LFN/VOGAF yielding 98 bu/A compared to 82 bu/A for Stephens. Fifteen lines also yielded more than Stephens at Moro with the cross GNS/LP being the highest yielding at 51 bu/A. It would appear from these results that the yield level of these potential Hard Red Winter cultivars can compete favorably with the Soft White varieties. Currently milling and baking properties are being evaluated at the Western Quality Laboratory at Pullman, Washington. Many of these promising lines were derived from the International Winter X Spring Program.

The advantages of the OSU-International Maize and Wheat Improvement Center (CIMMYT) linkage is very apparent. Through this association the OSU breeding program has access to the very best wheat, barley and triticale germ plasm being developed throughout the world. Since historically wheat production in the Pacific Northwest has relied on the introduction of varieties and germ plasm from other parts of the world (Turkey Red, Federation, Norin 10, etc.), the current program is now in a position to accelerate this aspect of cereal improvement to place the Pacific Northwest wheat producer in the most competitive position possible in the market place.

TABLE 1. PROMISING NEW SOFT WHITE WINTER WHEAT - RUGGS SITE
(Varietal Candidates for the Pendleton Area)

Selection	Yrs. Under Test	1978 Data	Ave yield Bu/A for years grown	Test Weight	Plant Height	Stripe Rust	Cerc.
67-237-69-S3H 1523/DRC-11	6	68.7	95.8	58.1	115	20MR	8
OWW68007-1M6 YMH/HYS	5	75.7	91.5	57.9	125	TMR	5
6720-69-13 CD/P101//DRC	6	82.8	94.0	58.4	105	10MR	3
6720-69-5 CD/P101//DRC	1	87.1	87.1	58.2	105	20MS	2
OWW71279-1-2CB YMH/63-112-66-2//Rouge Prolific/YMH	3	98.0	72.4	59.1	110	30MS	3
OWW71434-2-2W5 Norteno M-67/6720// 6720-69-13	3	80.1	93.3	57.0	115	5MR	3
OWW71612-2-02E4 68-51/YMH//YMH	3	59.0	88.0	57.0	115	TR	6
OWW72399-3-03 1523-DRC DWF/6720-69-13// SPN	3	72.7	67.8	58.8	120	5MR	7
SWH72203-5H-OP GNS/La Porte/3/Art*5/AA// Transfer/Bulg 88	2	82.5	67.3	58.3	120	5MR	7
Stephens	6	90.9	89.3	57.9	115	5MR	2
Hyslop	6	61.0	90.3	57.4	110	20MR	7
Daws	5	87.9	78.2	57.6	115	10MR	4
Luke	6	62.6	84.4	57.5	110	10MR	9

TABLE 2. PROMISING NEW SOFT WHITE WINTER WHEATS - MORO SITE

Selection	Yrs. Under Test	1978 Yield	Ave. yield for for years grown	Hd. Date
72-1577 HYS/YAYLA305//63-112-66-4	3	36.1	37.2	157
OWW71445-1-2W4 Norteno M-67//YMH/HYS	3	37.8	38.3	157
OWW71279-1-1W4 YMH/63-112-66-2//RPR/YMH	2	37.7	43.8	155
SWD69086-2D-2H-OP BEZ/ERA	2	38.1	43.4	154
SWD69282-2D-1H-1H-OH CNO S/INIA//HN7	2	40.8	42.9	155
SWD72773-1H-OH YMH/HN7	2	36.9	39.4	160
SWD70029-6D-1H-1P FN//T/TH/3/3*CLLF/ 4/ANZA	2	35.9	39.4	152
OWW71279-1-6W4 YMH/63-112-66-2// RPR/YMH	2	39.9	34.1	155
OWW71448-3-35W4 Norteno M-67/YMH// 6720-69-13	2	35.6	33.6	156
Maris Hobbit	2	34.7	32.0	161
OWW71623-7-02E4 69-148/YMH//HYS	2	36.5	32.0	156
SW0731149D-OP YMH/NDD/2*P101// Mild/5/KAL/BB/4/KT54A/N10B// KT54B/3/NAR	2	30.2	36.8	157
WWP7147	1	38.1	38.1	156
6720-69-13 CD/P101//DRC	5	32.0	45.2	156
Stephens	6	33.7	47.7	154
Hyslop	6	26.4	40.3	155
Daws	5	27.1	28.9	157
Luke	6	31.1	38.6	150

TABLE 3. YIELD DATA FOR HARD RED WINTER WHEAT LINES GROWN AT PENDLETON AND MORO, OREGON 1/

Pedigree	Pendleton 2/ Bu/A	Moro Bu/A
Wanser	30	30
NBD/DJ	77	41
Bez/Tob//8156	61	43
CD*3/3/MD/MCM//EX	81	35
AN//SN64/SS2	46	38
Aspen	82	32
LFN/VOGAF	98	43
GNS/LP	77	51
Cross Unknown	80	43
ALBA/GNS//FN/SN64	69	37
ALBA/GNS//FN/SN64	59	45
Almond	70	34
65-116/MRS	89	36
65-116/MRS	71	41
GNS/LP/3/ART*5/AA//TF/BULG 88	80	45
ND/WW//LEE/FN/N	66	42
OFN/3/YT54/N10B//IR/MFO/4/DJ/5/PCH	60	39
INIA//SMB/HN4	84	44
CLLF/PCH//P101/VOGAF	77	43
II 58-17//PCH/VG9052	69	45
II62-61/3/14-53/ODIN/CI13431	44	41
LFN/NAD/LFN/BEZ	85	36
Stephens	82	36

1/ Quality evaluations on these lines is presently being conducted at the regional laboratory located at Pullman, WA.

2/ Heavy infection of cercosporella herpotrichoides (eye spot) was observed at this site.

15 Year Precipitation Summary
Sherman Station - Moro, Oregon

(Crop year basis, ie: September 1 through August 31 of following year.)

Crop Yr.	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
68 Yr. Average	.60	.94	1.69	1.69	1.67	1.16	.93	.72	.80	.70	.20	.28	11.38
1963-64	1.63	.50	1.56	1.36	.60	.25	.60	.15	.08	1.30	.04	.18	8.25
1964-65	.16	.60	1.69	6.11	1.65	.16	.63	.72	.32	.59	.17	1.04	13.84
1965-66	.08	.36	2.07	.51	2.45	.54	.78	.06	.02	.13	1.31	0	8.31
1966-67	.47	.74	3.14	1.84	.91	.03	.55	1.47	.39	.32	0	0	9.86
1967-68	.26	.74	.84	.54	.97	1.04	.16	.10	.74	.10	.15	1.52	7.16
1968-69	.33	1.04	2.67	2.09	1.93	.44	.63	.84	.84	1.99	0	0	12.80
1969-70	.52	.76	.53	2.00	3.96	1.27	.88	.38	.33	.22	0	0	10.85
1970-71	.13	.68	2.36	1.21	1.63	.12	1.28	.84	.93	.81	.20	.09	10.28
1971-72	1.36	.45	1.50	1.03	2.25	.26	1.44	.40	.45	1.70	.07	.55	11.46
1972-73	.57	.43	.83	1.62	1.09	.34	.40	.21	.34	.25	0	.07	6.15
1973-74	.90	.85	3.70	3.99	1.29	.97	1.30	1.18	.38	.02	.41	0	14.99
1974-75	0	.37	1.02	1.39	2.01	1.47	1.25	.46	.53	.84	.40	1.26	11.00
1975-76	0	1.17	1.34	1.26	1.25	.93	.95	1.06	.14	.06	.79	1.17	10.12
1976-77	.04	.10	.43	.20	.18	.63	.50	.08	2.70	.28	.37	.90	6.41
1977-78	.88	.22	2.00	3.22	2.80	1.31	.74	1.42	.43	.44	.59	1.32	15.37
1978-79	.33	.01	.79	.69	1.59	1.54	.99						
15 Yr. Average	.49	.60	1.71	1.89	1.66	.65	.81	.62	.57	.60	.30	.54	10.44

15 Year Precipitation Summary
Pendleton Station - Pendleton, Oregon

(Crop year basis, ie: September 1 through August 31 of following year.)

Crop Yr.	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
50 Yr. Average	.69	1.34	1.86	2.17	1.93	1.43	1.58	1.44	1.32	1.29	.32	.41	15.78
1963-64	.68	.42	3.04	1.28	1.74	.41	1.24	.74	.15	1.29	1.12	.23	12.34
1964-65	.61	1.24	1.81	4.43	3.84	.47	.21	1.16	1.03	1.37	.75	1.33	18.25
1965-66	.20	.51	2.28	.45	2.35	.71	1.72	.51	.43	.99	1.14	.17	11.46
1966-67	.46	1.10	2.30	2.86	2.80	.32	1.51	1.60	.95	.55	.04	0	14.49
1967-68	.56	1.17	1.30	.76	.74	2.39	1.04	.21	.65	1.11	.34	.77	11.04
1968-69	.83	1.36	2.71	2.65	2.62	.78	.43	2.31	1.26	.75	.06	0	15.76
1969-70	.65	1.41	.44	2.39	5.23	1.50	1.87	1.05	.62	.85	.11	.05	16.17
1970-71	1.02	1.40	2.22	1.02	1.44	.77	1.28	1.65	1.66	3.14	.63	.33	16.56
1971-72	1.42	1.72	3.14	3.93	1.15	1.70	2.11	1.35	1.50	.91	.76	.35	20.04
1972-73	.49	.66	1.14	2.47	.89	.89	1.27	.58	1.03	.12	0	.09	9.63
1973-74	1.77	1.24	5.86	4.40	1.29	2.00	1.50	3.64	.38	.33	1.30	0	23.71
1974-75	.02	.35	1.56	1.76	3.73	1.68	.97	1.72	.68	.69	.05	1.38	14.59
1975-76	0	2.16	1.47	3.40	2.13	1.09	1.69	1.65	1.21	.58	.04	2.58	18.00
1976-77	.44	.53	.47	.59	.90	.57	1.72	.46	1.70	.31	.12	2.21	10.02
1977-78	1.54	.69	1.79	3.19	2.27	1.71	1.40	3.50	.81	1.27	.59	1.37	20.13
15 Yr. Average	.71	1.06	2.10	2.37	2.21	1.13	1.33	1.48	.94	.95	.47	.72	15.47