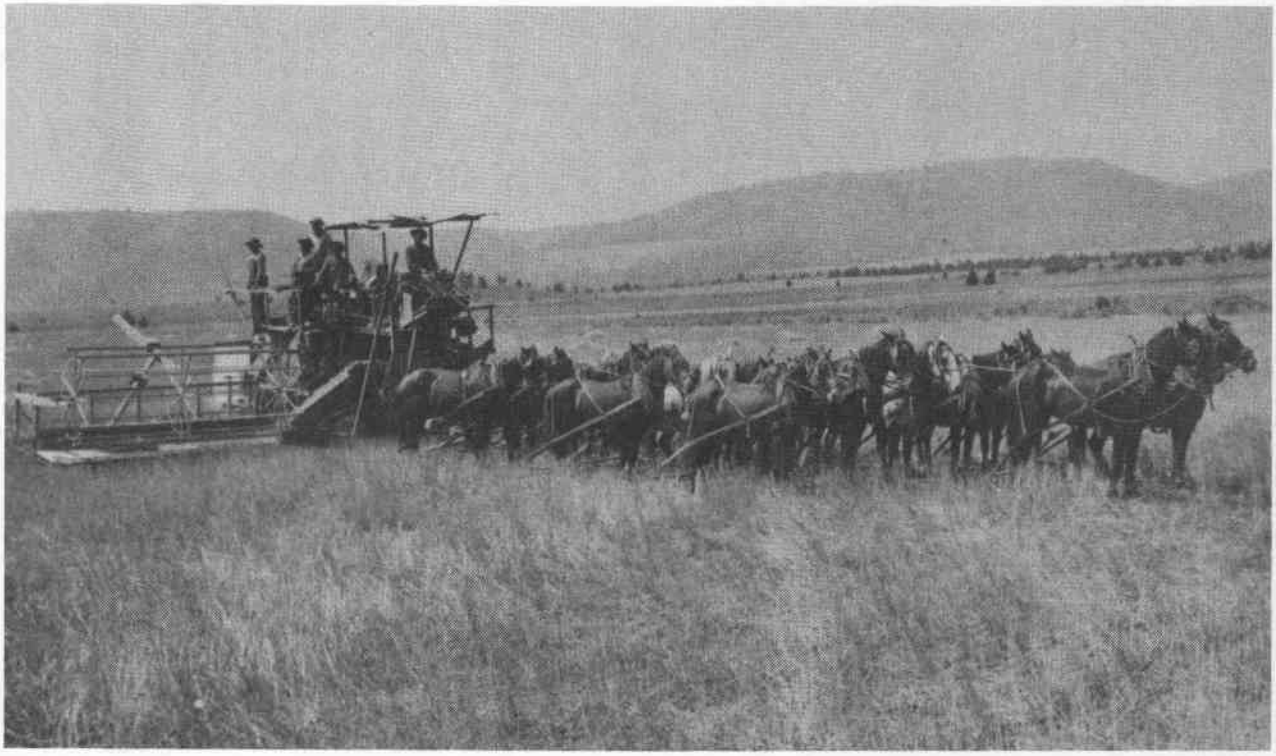
Central Oregon Crop Research 1987-1988



Special Report 847
October 1989

Agricultural Experiment Station
Oregon State University

COVER:

Grimes Flat, circa 1908. Combine with 16-horse team on dry land. Courtesy of the Crook County Historical Society, Bowman Museum, Prineville, OR.

Contents

100TH ANNIVERSARY COMMEMORATIVE PUBLICATION

The Agricultural Experiment Station at Oregon State University was created in 1888. In commemoration of the 100th anniversary of providing research information for improvement of Oregon agriculture, the Central Oregon Experiment Station will publish a history of agriculture and agricultural research in central Oregon. This brief history will feature the development of the first experiment stations by the Oregon Agricultural College in Metolius and Redmond in 1911-12 as a result of railroad and early emigrant lobbying; the demise of these early experiment stations in 1913 as a result of a lack of coordinated support among various interests in central Oregon [such divided interests soon resulted in the division of Crook County into Crook, Jefferson and Deschutes Counties]; the creation and early involvement of the Extension Service in 1912-14; and the re-development of the current Central Oregon Experiment Station since 1948. This history should be available later in 1989 or in 1990.

UPDATE 1987-89

THE CENTRAL OREGON EXPERIMENT STATION

Frederick J. Crowe, Superintendent

The Central Oregon Experiment Station (COES) is an off-campus branch of the Agricultural Experiment Station of Oregon State University. The COES provides for a local focus for both applied and basic research on irrigated crops of the central Oregon region. As with other branch stations, it functions administratively as a department within the College of Agricultural Sciences at O.S.U.

Station personnel, 1989

Frederick Crowe,	Superintendent and Associate Professor of Botany & Plant Pathology
[vacant]	Assistant Professor [department affiliation to be determined]
Malcolm Johnson,	Professor Emeritus, retired
Jeanne Debons,	Research Associate
Steven James,	Senior Research Assistant
Kay Moore,	Clerical Specialist
Pat Foltz,	Supervising Biology Technician
Dale Coats,	Biology Technician
Sylvia McCallum,	Bioaide
Peter Tomseth,	Bioaide

Current facilities include:

Redmond (main office). State-owned offices, laboratory, storage and shop facilities, on land leased from the City of Redmond. Address is 1556 SE 1st St. (P.O. Box 246, Redmond, OR 97756). Phone 503-548-3340.

Madras. Office, storage and shop facilities on 0.6 acres of state-owned land, plus 67 acres of cropland leased from the City of Madras, Jefferson County and the U.S. Bureau of Reclamation. Address is 1778 NW Mill St., Madras, OR 97741. Phone 503-475-7107.

Powell Butte. Offices, shop, laboratory, and potato storage on 80 acres of cropland leased from the OSU Foundation. Location is 12 miles east of Redmond and 6 miles west of Prineville on Highway 22. Address is Rt. 1, Box 320, Powell Butte, OR 97753. Phone 503-447-5138.

Recent changes include construction of the office and shop at Powell Butte, and initial landscaping efforts at that site. The City of Madras gave notice of lease termination at the Mill Street site, but provided for a 50 year lease, renewable at 5-year intervals, at a (currently) dryland 82-acre site just north of Dogwood Lane and bordering Hiway 26. This new site will provide for increased permanence and visibility within Jefferson County, plus serve as the location for the Station's main offices. Irrigation water may be relocated from the old to the new site. The COES staff has been developing the site during 1989, including rock removal, land leveling and planning for an irrigation system and facilities. The COES main offices will be relocated from Redmond to the new Madras site during 1990, with other facilities to be completed over the following few years. Facilities at Madras eventually may include offices, shop, equipment storage, greenhouses and storage buildings. The new Madras field may be able to be planted to experiments by 1991 or 1992. After relocation of offices to Madras, the Redmond site will be returned to the City of Redmond. Construction at Powell Butte and part of the construction planned at Madras will be funded by the Oregon Lottery Commission, from $500,000 dedicated to improving the COES's potato-handling facilities. All development and planning have required extensive negotiation and cooperation among the University, the City of Madras, Jefferson County, a Site Selection and Facilities Development Committee of interested Jefferson County growers and business people, the COES Advisory Board, and the Oregon Potato Commission. Numerous agencies and individuals have assisted in the efforts accomplished so far.

1987

RESEARCH

RESULTS

METEOROLOGICAL DATA - 1987
Redmond, Oregon*

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	1987 TOTAL
AIR TEMP. (°F)													
AVE. MAX. TEMP.	42	48	53	66	70	79	77	80	78	71	52	39	
AVE. MIN. TEMP.	21	26	29	33	40	45	47	45	39	32	29	24	
MEAN TEMP.	32	37	41	49	55	62	62	63	59	52	41	32	
AIR TEMPERATURE (No. of Days)													
MAX. 90 OR ABOVE	0	0	0	0	0	5	3	3	2	0	0	0	
MAX. 32 OR BELOW	1	1	0	0	0	0	0	0	0	0	1	9	
MIN. 32 OR BELOW	24	24	20	15	8	1	0	0	5	18	20	22	
MIN. 0 OR BELOW	2	0	0	0	0	0	0	0	0	0	0	0	
GROUND TEMP. (°F at 4")													
AVE. MAXIMUM	27	31	36	49	58	66	67	68	62	52	39	31	
AVE. MINIMUM	25	30	35	42	50	57	59	59	54	45	36	29	
MEAN TEMP.	26	31	36	46	54	62	63	64	58	49	38	30	
PRECIPITATION (inches)													
MONTHLY TOTAL	.96	.88	1.37	.54	1.25	.27	3.82	.08	T	.00	.47	2.17	11.81
EVAPORATION (Ave. Inches Per Day)	--	--	--	.19	.22	.31	.27	.25	.17	--	--	--	
WINDAGE (Ave. Miles Per Day)	65	64	78	64	66	100	57	41	37	35	46	68	

Growing Season:	**Last Date Before July 15**	**First Date After July 15**	**Total Number of Days Between Temp. Minimums**
Air Temp. Min. 32° or below	6/1	9/4	94
Air Temp. Min. 28° or below	5/21	9/27	128

Madras, Oregon*

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	1987 TOTAL
AIR TEMP. (°F)													
AVE. MAX. TEMP.	40	45	53	69	73	82	82	85	81	69	50	39	
AVE. MIN. TEMP.	23	29	31	36	43	46	50	48	45	36	30	25	
MEAN TEMP.	32	37	42	53	58	64	66	67	63	53	40	32	
AIR TEMPERATURE (No. of Days)													
MAX. 90 OR ABOVE	0	0	0	0	2	9	5	10	2	0	0	0	
MAX. 32 OR BELOW	4	0	0	0	0	0	0	0	0	0	0	8	
MIN. 32 OR BELOW	25	19	19	11	2	1	0	0	0	12	25	21	
MIN. 0 OR BELOW	2	0	0	0	0	0	0	0	0	0	0	0	
GROUND TEMP. (°F at 4")													
AVE. MAXIMUM	--	--	--	64**	72	81	82	84	78	67**	--	--	
AVE. MINIMUM	--	--	--	53**	59	66	69	69	65	57**	--	--	
MEAN TEMP.	--	--	--	59**	66	74	76	77	72	62**	--	--	
PRECIPITATION (inches)													
MONTHLY TOTAL	1.76	1.34	1.35	.20	1.66	.27	3.06	.17	.22	T	.85	3.19	14.07
EVAPORATION (Ave. Inches Per Day)	--	--	--	.22**	.24	.31	.27	.32	.22	.17**	--	--	
WINDAGE (Ave. Miles Per Day)	--	--	--	64**	72	57	65	55	48	38**	--	--	

Growing Season:	**Last Date Before July 15**	**First Date After July 15**	**Total Number of Days Between Temp. Minimums**
Air Temp. Min. 32° or below	6/1	10/11	131
Air Temp. Min. 28° or below	4/20	10/20	182
Air Temp Min. 24° or below	4/19	11/25	219

METEOROLOGICAL DATA - 1987
Prineville, Oregon*

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	1987 TOTAL
AIR TEMP. (°F)													
AVE. MAX. TEMP.	44	51	**	70	73	83	**	87	**	**	52	40	
AVE. MIN. TEMP.	21	25	**	31	38	42	**	39	**	**	26	24	
MEAN TEMP.	32	38	**	51	56	63	**	63	**	**	39	32	
AIR TEMPERATURE (No. of Days)													
MAX. 90 OR ABOVE	0	0	**	1	3	11	**	11	**	**	0	0	
MAX. 32 OR BELOW	1	0	**	0	0	0	**	0	**	**	1	7	
MIN. 32 OR BELOW	27	23	**	16	7	2	**	3	**	**	23	24	
MIN. 0 OR BELOW	1	0	**	0	0	0	**	0	**	**	0	0	
PRECIPITATION (inches)													
MONTHLY TOTAL	.89	1.17	**	.22	.94	.27	**	.21	**	**	.60	1.90	6.20**

Growing Season:	**Last Date Before July 15**	**First Date After July 15**	**Total Number of Days Between Temp. Minimums**
Air Temp. Min. 32° or below	6/2	8/16**	74**
Air Temp. Min. 28° or below	5/21	11/3**	165**
Air Temp Min. 24° or below	4/20	11/4**	197**

* No meteorological data are recorded at the COES Powell Butte field. Redmond data are recorded at COES facilities. Prineville data are from KRCO, four miles NW of Prineville. Madras data are recorded at the North Unit Irrigation District offices, adjacent to the COES field.
** Missing data.
NA = Not available.
T = Trace precipitation, not affecting total.

EFFECT OF PREPLANT N AND SOIL TEMPERATURE ON N2 FIXATION, LEAF N, AND YIELD OF ALFALFA

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ABSTRACT

A randomized block experiment was conducted to determine the effect of preplant N and soil temperature on nitrogen fixation, leaf N, and yield of 1st cut Vernema alfalfa in a low N soil. Ammonium nitrate was applied to 2/3 of each plot the day before planting (6/17/87) at rates of either 0, 10, 20, 40, or 60 kg N/ha (0, 9, 18, 36, or 54 lbs/acre). The remaining third of each plot was treated with ammonium nitrate fertilizer depleted in the natural abundance of ^{15}N. Leaf samples collected from these plots will be used to determine the portion of N the plants derive from N_2 fixation versus applied nitrogen. A separate area of each plot was used to make observations on how N_2 affected the development of the plants and leaf N levels. After emergence, it was clear that plants with added preplant N had more rapid early development. This effect was observed over most of the vegetative stage of growth, about 9 weeks. However, by the time of the first cutting, 12 weeks after planting, visual differences were less apparent. The addition of pre-plant N did not result in significant increase in yield, in fact the yield was slightly less in plots where starter N was used. Likewise, the addition of preplant N did not result in increased level of leaf N. Soil tests showed the presence of higher NO_3 levels in plots with preplant N. NH_4 levels were also higher in N treated plots but the effect appears to have diminished over about 2 weeks. Preliminary results suggest that under conditions of cool, wet, and low N soils, starter N does not provide significant benefits to either yield or quality of alfalfa. The experiment will be duplicated in 1988.

ACKNOWLEDGEMENTS: Seed for this research was donated by Bob Clark, Round Butte Seed Growers, Inc., P.O. Box 117, Culver, Oregon 97734.

INTRODUCTION

Practical experience and grower observations have suggested that under some circumstances the use of preplant or "starter" N in establishment of alfalfa may be a desirable practice. However, questions remain under what conditions this may be a prudent management practice and under what conditions the addition of N actually inhibits the proper development of root nodules for nitrogen fixation.

Previous research suggests that in many cases alfalfa growers are using preplant or "starter" N unnecessarily. Results indicate that, in general, using starter N on alfalfa inhibits proper nodulation and gives no significant increase in yield or quality. Nevertheless, practical experience and other research suggests that there may be conditions where starter N could be economically beneficial: 1) at establishment where soils have low soil nitrogen levels, and 2) under cold soil conditions where dinitrogen fixation is not adequate to provide plant N needs. At present there is no firm scientific basis for making recommendations for starter N in colder production areas. There is a need for research to develop fact-based recommendations for these situations.

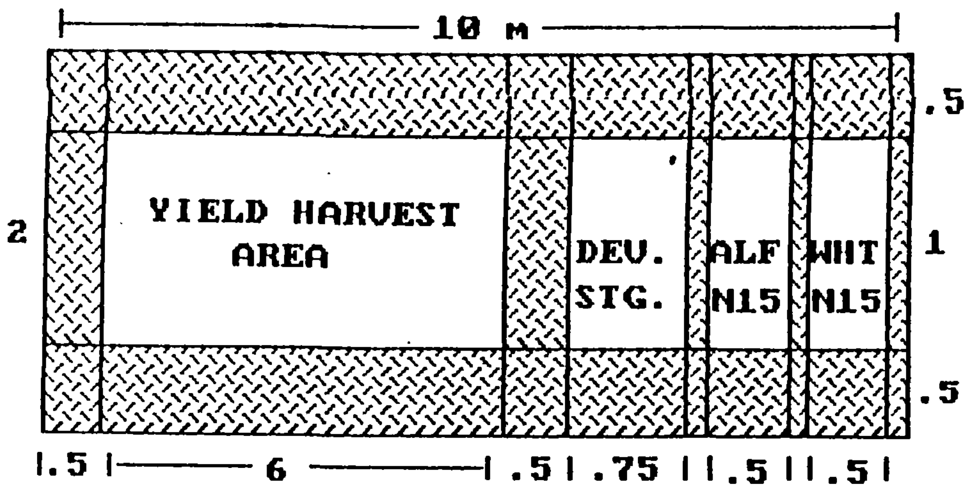
The purpose of this research project is to further define conditions under which starter N provides the grower with an economic advantage. This will make it possible to make appropriate recommendations to alfalfa producers in colder production areas.

MATERIALS AND METHODS

A randomized block experiment with 5 N levels and 4 blocks was established at the Powell Butte experiment farm in June, 1987. Plots were 10 m x 2 m (33 ft x 6 1/2 ft.) and were subdivided into 4 areas as indicated in figure 1. Plots were fertilized according to soil tests by broadcasting and incorporating 800 kg/ha of 0-10-0-14(Sulfur) into the seedbed on June 17.

Pre-plant nitrogen was added to appropriate plots in 2 ways. In the plot area reserved for yield determination and collection of plant samples, nitrogen was added as a liquid solution of ammonium nitrate at rates of 0, 10, 20, 40, or 60 kg N/ha (0, 9, 18, 36, or 54 lbs/acre) the day before planting. On the end portion of each plot were reserved 2 areas of 1 x 2 m to which a specially formulated ammonium nitrate fertilizer was applied. This material was processed to contain less than the normal amount of one isotope of nitrogen, ^{15}N. The use of this fertilizer will allow determination of the effect of preplant N on the development of nitrogen fixation in alfalfa. The ^{15}N depleted fertilizer was sprayed on these small areas at the same rates as above, several hours before planting.

Figure 1. Diagram of plot layout for Powell Butte field experiment, June, 1987.



'Vernema' alfalfa seed was inoculated and seeded into the plots at 20 lbs/acre on June 18. Daily air and soil temperatures were recorded at the plot site by an electronic datalogger. Weeds began to be a problem in early July and on July 31 a tank mix of bromoxynil and 2,4-DB (0.187 and 0.5 lbs active ingredient/acre, respectively) was applied to all plots. This was supplemented with hand weeding as necessary. Plots were irrigated as needed by a solid-set irrigation system.

Plant and/or soil samples were collected on July 2, July 16, July 30, August 13, and August 27. Leaf N is being determined by the Plant and Soil Analysis lab at Oregon State University in Corvallis. Soil samples are being analyzed for content of nitrate, ammonium, and total N by the soil analysis lab in the OSU soil science department. The content of leaf nitrogen that is the ^{15}N isotope will be determined by Isotope Services in Los Alamos, New Mexico.

On September 10, a forage harvester with sickle cutter bar was used to cut a 1 m x 6 m (3 ft. x 20 ft.) swath in each plot. The cuttings were weighed in the field and subsamples collected for moisture determination. Dry matter yield was computed and statistical analysis was conducted on the results.

PRELIMINARY RESULTS AND DISCUSSION

Since analysis is still being conducted on soil and plant samples, and since this is the first year of a 2-year study, it should be noted that these results are incomplete and preliminary. Table 1 shows the effect of pre-plant nitrogen on the yield and leaf N of alfalfa. Table 2 summarizes the effect of preplant N on soil levels of NO3 and NH4.

Visual Observations

After emergence, it was clear that plants with added pre-plant N had more rapid early development. This effect was observed over most of the vegetative stage of growth, about 9 weeks. However, by the time of the first cutting, 12 weeks after planting, visual differences were less apparent.

The addition of pre-plant N did not result in significant increase in yield, in fact the yield was slightly less in plots where starter N was used. Likewise, the addition of preplant N did not result in increased level of leaf N. This is despite the fact that weather conditions were unusually cool and wet during the early part of the growing season. Under these conditions we might have expected more benefit from starter N.

Table 1. Effect of pre-plant N on dry matter yield, leaf % N, and total N uptake of Vernema alfalfa at Powell Butte, Oregon, 1987.

N Level --lbs N/acre--	Dry matter yield -----tons/acre----	Leaf N ---%N---
0	4.25	3.76
10	3.57	3.96
20	3.90	3.60
40	3.93	3.66
60	3.94	3.60

Soil tests showed the presence of higher NO_3 levels in plots with preplant N. NH4 levels were also higher in N treated plots but the effect appears to have diminished over about 2 weeks.

Table 2. Effect of pre-plant N on seasonal soil nitrate, ammonium, and total N levels in alfalfa plots at Powell Butte, Oregon, 1987.

N Level	Soil NO3		Soil NH4	
--lbs N/acre--	----ppm----		----ppm----	
	7/2	7/16	7/2	7/16
0	44.4	39.3	7.2	2.1
10	44.3	54.4	5.9	2.6
20	51.6	51.4	5.8	3.0
40	76.3	59.1	11.5	1.4
60	70.9	53.6	26.9	0.6

The effect of starter N on nitrogen fixation is being determined presently. Results will be included in the 1988 report.

Preliminary results suggest that under conditions of cool, wet, and low N soils, starter N does not provide significant benefits to either yield or quality of alfalfa. The experiment will be duplicated in 1988.

REFERENCE

1. Burghardi, S. 1987. Lack of fertilizer stymies alfalfa yields. Hay and forage grower. 2:12-14.

WINTER BEARDLESS BARLEY FOR HAY IN CENTRAL OREGON

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Department of Crop Science, O.S.U.
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ABSTRACT

Four winter beardless barley varieties (Henry, Maury, Sussex, and Wysor) were compared in replicated single row plots with Stephens soft white winter wheat for winter survival in 1986-87. The test was conducted at the Central Oregon Experiment Station Madras research site. The winter was too mild to evaluate winter hardiness but other useful information was collected. Field emergence of Henry and Maury were similar but significantly better than Sussex, Wysor, and Stephens. At harvest Henry and Maury were taller than Sussex and Stephens. The barley varieties were about three weeks earlier than Stephens wheat. No difference in dry matter yield existed among the four barley varieties. Stephens was not harvested.

INTRODUCTION

Varieties of barley, oats, rye, and wheat have been used for hay in Central Oregon for many years. However, with the current farm program there has been increased interest in the use of cereals for forage, including beardless barleys. To date very few varieties of beardless barley are available. Belford, a six-row hooded spring barley, has been most frequently used (1). Only recently have other winter type forage barleys been identified but their adaptability under various winter climates has not been fully evaluated. Therefore, the Station joined the Oregon program to assist in data collection for a determination of adaptability range. The information could also be useful to local forage producers.

MATERIALS AND METHODS

A single row of Henry, Maury, Sussex, and Wysor winter beardless barley, and Stephens soft white winter wheat were planted November 3, 1986 at the Station's Madras site. The four winter barley cultivars were developed by breeders at the Virginia Polytech Institute. All are early maturing, lodging resistant and susceptible to scald. Sussex is the earliest heading of the four.

Each variety was replicated four times in a randomized complete block design. Each plot was three feet wide by 12.5 feet long with the row in the center. One hundred and fifty seeds of each variety were sown 1.5 inches deep and one inch apart in the row. Stephens winter wheat was included as a check for winter hardiness.

A top dressing of 16-20-0 NPK at a rate of 500 lbs/A was applied April 8, 1987. The trial was irrigated as needed. No herbicides, fungicides, or insecticides were applied.

Data were collected on field emergence (number of plants April 8 divided by 150 seeds sown per plot x 100) relative maturity, plant height on June 12, and yield on June 12 for the barley varieties. About 500 grams of green forage was taken from each plot at harvest and dried at 155^{o} F from which dry matter yields were calculated. Data were analyzed statistically.

RESULTS AND DISCUSSION

Due to the late planting date and fall/winter environmental conditions complete emergence of seedlings did not occur until spring. However, on December 18, 1986 each variety was ranked from most to least for number and height of seedlings as follows: Stephens, Henry, Sussex, Wysor, and Maury. The seedlings were approximately two inches tall. On April 8, 1987 field emergence was 91.3 and 96.2 % for Henry and Maury, respectively (Table 1). They were similar for this trait but Maury had significantly more plants than Sussex, Wysor, and Stephens wheat. At this time the tillers of the barley cultivars were more prostrate and occupied a larger diameter than Stephens wheat. According to Feekes growth stage scale the barley was in stage three compared to a four for the wheat. The average tiller length from tiller base to the tip of the longest leaf was five inches for Maury, Henry, and Wysor; 7.5 for Sussex, and 8.5 inches for Stephens. These measurements were made on replication one only and the data were not analyzed statistically. There also appeared to be more tillers on the wheat plants than on the barley plants. By May 5th height differences were clearly visible. Cultivar rankings were Sussex, Wysor, Henry, Maury, and Stephens from tallest to shortest. Barleys were in growth stage 8 compared to only a 5-6 for Stephens wheat.

Maturity differences could be readily observed between barley and wheat. All barley cultivars had reached anthesis by May 18 but Maury appeared to be 2-3 days later since fewer anthers were visible. Anthesis did not occur on Stephens until June 10. Therefore it appears that the barleys are about three weeks earlier than Stephens wheat.

The barley varieties reached soft dough stage on June 12. Henry and Maury were significantly taller than Sussex and Stephens at this time (Table 1).

Dry matter yield was similar for all barley varieties. The average yield was 4.2 tons/A. Murphy (1) found that the two year average hay yield of Belford barley at Redmond in mass seeded plots was 4.3 tons/acre. One might expect a higher yield from the winter beardless barleys at Madras if they were sown in 6-8 inch rows. However the question still exists, do these winter barleys possess sufficient winter hardiness for production in Central Oregon? If they do, then additional evaluations are needed to compare their value to spring oats which are traditionally grown for hay in the area. The highest oat hay yields from tests at Redmond ranged from 6.5 - 7.9 tons of dry hay per acre (1,2). Perhaps winter barley could also be grazed. The early harvest of winter barley may allow for double cropping.

Additional research is suggested for winter barley and other cereals for Central Oregon forage-livestock systems. Producers may benefit from planting certain species/cultivar mixtures or sowing cereals in established pastures by no-till methods as summarized by Horn (3). Interseeding of cereals and legumes or mixtures of each in which winter beardless barley could be a component may provide forage of improved nutritive value as well as yield.

REFERENCES

1. Murphy, W.M. and M.J. Johnson. 1979. Cereals for hay in Central Oregon. Agric. Exp. Stn., Oregon State University, Corvallis. Special Report 538.

2. James,S.R. and Rod Brevig. 1984. Varietal evaluation of cereal grains in Central Oregon. In Irrigated Crops Research in Central Oregon 1984. Oregon Agricultural Experiment Station. Special Report 717. pp. 4-10.

3. Horn, F.P. 1985. Cereals and Brassicas for forage. In M.E. Heath, R.F. Barnes, and D.S. Metcalfe (eds.) Forages. Iowa State University Press, Ames. p. 271-277.

Table 1. Winter beardless barley test at Madras, Oregon 1986-87

Variety	Field emergence[1]	Ht.	Dry Matter yield
	(%)	(in)	(T/A)
Henry	91.3	43	4.3
Maury	96.2	43	4.0
Sussex	87.8	39	4.3
Wysor	88.2	41	4.3
Stephens[2]	83.5	40	---[3]
Mean	89.4	41	4.2
LSD (5%)	7.2	2	0.3
CV (%)	5.2	4	4.6

1 Percent field emergence =

$$\frac{\text{no. of plants April 8, 1987}}{\text{no. of seeds planted Nov. 3, 1986}} \times 100$$

2 Stephens winter wheat as a check for winter survival.

3 Stephens was not harvested.

THE EFFECT OF pH AND POTASSIUM ON THE YIELD AND QUALITY OF ALFALFA HAY

FINAL REPORT

Steven R. James
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ABSTRACT

An experiment to study the effects of soil pH and potassium (K) on potatoes, winter wheat, and alfalfa was begun in 1979 at Powell Butte, Oregon. A wide range of soil pH levels was created by the addition of lime or elemental sulphur; five K levels were created by the addition of potassium chloride. The trial area was seeded with Pioneer 532 alfalfa in 1984. One cutting was taken in 1984, three cuttings were taken each year in 1985 and 1986, and 1987.

In each of the four years of the study, hay yields increased as the soil pH increased. When the pH level dropped below 6.5 (the highest pH observed in the study), yields decreased. Also, in each year, as the soil pH level dropped below 6.5, the percent crude protein dropped. Higher pH levels were also advantageous in stand establishment and nodule formation.

The soil K level had less effect on yield and quality of alfalfa hay than soil pH levels. As soil K increased, hay yields trended slightly higher.

INTRODUCTION

Hay is one of Oregon's principal farm commodities, ranking third in total value of production, behind cattle/calves, and greenhouse/nursery products in 1987 (1). Approximately 52,000 acres of hay are grown annually in Deschutes, Crook, Jefferson, and northern Klamath counties. A soil fertility survey conducted in 1980 on central Oregon alfalfa fields indicated 42 percent of the fields were below a pH critical level of 6.5, and five percent of the fields were below the soil K critical level of 150 ppm (2). Fertilizing alfalfa

ACKNOWLEDGEMENT: This study was supported in part by grants from the Northwest Plant Food Association and the Oregon Agricultural Research Foundation.

with K was not practiced in central Oregon for many years because soil K levels were very high (800-1200 ppm) when lands were converted from rangeland to cropland. In 1980, surveyed fields averaged 367 ppm of K and many were lower, hence a downward trend in K fertility has developed in central Oregon alfalfa fields.

An experiment to study the effects of soil pH and K on potatoes was begun in 1979 at Powell Butte, Oregon. A wide range of soil pH and K levels was created by the addition of lime or elemental sulphur and potassium chloride. After completion of the potato studies in 1983, the trial was seeded to alfalfa in 1984. The alfalfa experiment was designed to determine critical pH and soil K levels and aid in the fertilizer recommendations of lime and K.

MATERIALS AND METHODS

A relatively uniform Deschutes sandy loam site with a pH of 5.5 and soil K level of 168 ppm at the Powell Butte site of Central Oregon Experiment Station was chosen for the experiment in 1979. The experiment consisted of 20 treatments arranged in a completely random design replicated four times. Plots were sized 20 feet x 30 feet to facilitate tillage and reduce edge effects. Four different pH levels were artificially created on March 19, 1979, by four application levels of: four tons/acre of lime, two tons/acre of lime, no amendment, and one and one-half tons/acre of elemental sulphur. These treatments were allowed to stabilize for one year with a crop of potatoes.

Five K levels were created within each pH level in May, 1980, by the application of 0, 100, 200, 400, and 800 pounds/acre of K as muriate of potash. The K treatments were repeated in April 1982, and May 1986.

The trial area was cropped as follows:

1979:	Potatoes
1980:	Potatoes
1981:	Winter Wheat
1982:	Potatoes
1983:	Winter Wheat
1984:	Alfalfa
1985:	Alfalfa
1986:	Alfalfa
1987:	Alfalfa

The trial was seeded June 6, 1984, with 17 pounds/acre of Pioneer 532 alfalfa. The plots were treated with three pints/acre of Eptam 7-E before planting and two quarts/acre of 2,4-DB was applied July 5, 1984, after the plants had three trifoliate leaves. The trial was fertilized with 650 pounds/acre of 0-10-0-13 in 1984 and 1985; 455 pounds/acre of 0-10-0-13 was applied in 1986, and 490 pounds/acre of 0-10-0-13 was broadcast in 1987.

One cutting of hay was taken in 1984 on August 30. A 20-foot x 44-inch swath was harvested from each plot and a one-pound sample was taken from each plot for moisture determination and plant analysis. Three cuttings of hay were taken in 1985, 1986, and 1987. Protein and plant nutrients were determined from the first cutting in 1984 (only cutting), the second cutting in 1985, the third cutting in 1986, and the second cutting in 1987.

The soil was sampled August 30, 1984, May 2, 1985, and September 11, 1986, and July 17, 1987. Eight cores at a sampling depth of 0-8 inches were taken from each plot and analyzed for pH, phosphorus, potassium, calcium, and magnesium.

Ten plants with their entire root systems were removed from the center of each plot immediately after the first cutting was taken in 1984. The samples were refrigerated overnight and carefully washed the following day. The number of pink or presumably functioning nodules was recorded for each plant. Nodulation samples were not taken in 1985 and 1986.

RESULTS

Yield, soil analyses, plant analyses, and hay quality results are shown in Table 1, Table 2, Table 3, and Table 4 for 1984, 1985, and 1986, and 1987, respectively.

1984. Soil pH levels ranged from 5.2 to 6.5 in 1984. Hay yields from the first cutting of the new stand significantly increased for each increase in soil pH. Soil K had no effect on hay yield.

Soil pH also affected hay quality; pH levels over 6.0 increased percent crude protein significantly over pH levels under 6.0. Higher soil pH levels increased acid detergent fiber and total digestible nutrients, but decreased relative feed value. Soil K levels had little effect on hay quality in 1984.

Nodulation was increased nearly threefold when the pH level was greater than 6.0 as compared with pH levels less than 6.0. A soil K level of 321 ppm also significantly increased nodulation over a soil K level of 116.

1985. Soil pH levels were lower in 1985 than the other years tested. Generally, the soil pH is lower in the spring after fertilizer application than later in the year. The soil was sampled May 2, 1985; soil samples were taken later in the year in each of the three additional years of the study. Hay yields increased as soil pH and K levels increased. At a pH less than 5.4, hay yields were significantly lower than treatments with a pH of 5.4 or higher. As soil K levels increased, yields corresponding increased.

Crude protein increased as soil pH increased except the 18.3 percent crude protein observed at the lowest pH level was surprisingly high and equal to the percent protein at the two higher pH levels. Soil K levels of 160 and 162 ppm produced the highest protein levels in 1985.

1986. As soil pH increased, total hay yields, percent crude protein, and percent acid detergent fiber (ADF) increased. Increasing soil K levels also increased yields except for the highest level of K (336 ppm). Percent crude protein decreased as soil K levels increased.

1987. As soil pH levels increased, hay yield, and percent crude protein increased. At a pH of 6.4, hay yields averaged nearly one half a ton per acre higher and tested two percent higher in crude protein than hay yields and percent crude protein harvested from plots with a pH of 5.3. Hay yields also trended higher as soil K levels increased; soil K had no effect on percent crude protein.

Plant Analysis. In each year of the study, as pH levels increased, plant K, Mg, Zn, and Mn decreased. The soil pH had no effect on plant P and Ca, except in 1987 when plant Ca levels increased as soil pH increased. Also, in each year higher soil K levels increased the uptake of K and decreased plant Mg. Soil K had no effect on plant Zn and Mn except in 1986 when high K levels decreased the amount of Zn in the plant. Higher soil K levels tended to decrease plant P and Ca.

SUMMARY

In each of the four years of the study, hay yields increased as the soil pH increased. When the pH level dropped below 6.5 (the highest pH observed in the study), yields decreased. Also, in each year, as the soil pH level dropped below 6.5, the percent crude protein dropped. Higher pH levels were also advantageous in stand establishment and nodule formation.

The soil K level had less effect on yield and quality of alfalfa hay than soil pH levels. As soil K increased, hay yields trended slightly higher.

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Table 1. The effect of four pH treatments and five potassium treatments on the yield, quality, nodulation, and soil and plant nutrient levels of establishment year (1984) alfalfa grown at Powell Butte, OR

Treatment	Yield	Nodules /plant	Crude protein	ADF	TDN	RFV	Soil pH	Soil P	Soil K	Soil Ca	Soil Mg	Plant P	Plant K	Plant Ca	Plant Mg	Plant Zn	Plant Mn
	ton/A	no.	%	%				ppm	ppm	meq	meq	%	%	%	%	ppm	ppm
pH-1	1.43	1.38	13.0	31.5	54.7	140	5.2	41.6	196	8.1	3.2	.27	2.3	1.4	.37	27.9	168
pH-2	1.69	1.38	13.3	32.3	54.7	137	5.8	35.1	184	8.5	4.1	.27	2.0	1.4	.33	23.0	69
pH-3	2.00	3.38	15.4	33.5	56.0	133	6.2	31.1	185	10.7	3.8	.27	2.1	1.4	.31	21.1	53
pH-4	2.22	3.96	15.4	33.9	55.8	132	6.5	32.2	168	12.0	3.6	.27	2.0	1.4	.27	18.5	45
LSD 5%	0.14	1.05	0.9	1.2	.8	4	0.1	3.0	21	0.3	.2	NS	.1	NS	.02	1.9	13
K-0	1.86	1.88	14.2	33.1	55.2	135	6.0	32.5	116	9.8	3.6	.27	1.7	1.4	.37	21.7	73
K-100	1.94	2.50	14.3	33.3	55.2	134	6.0	34.1	131	9.9	3.5	.27	1.9	1.4	.34	23.6	89
K-200	1.77	2.11	14.3	32.9	55.3	136	5.9	34.3	166	10.3	3.9	.27	2.1	1.4	.33	23.1	88
K-400	1.89	2.56	13.9	32.9	55.0	135	5.9	34.8	182	9.9	3.6	.27	2.2	1.4	.29	21.3	79
K-800	1.71	3.57	14.7	31.9	55.9	139	5.9	39.3	321	10.4	3.8	.27	2.6	1.3	.28	23.3	89
LSD 5%	NS	1.18	NS	1.3	NS	4	NS	3.4	24	0.4	.3	NS	.1	NS	.03	NS	14

Table 2. The effect of four pH treatments and five Potassium treatments on the yield, quality, and soil and plant nutrient levels of second year (1985) alfalfa grown at Powell Butte, OR

						Soil					Plant						
Treatment	Yield*	Crude protein	ADF	TDN	RFV	pH	P	K	Ca	Mg	P	K	Ca	Mg	Zn	Mn
	ton/A	%	%				ppm	ppm	meq	meq	%	%	%	%	ppm	ppm
pH-1	5.7	18.3	36.0	57.3	125	4.78	39.3	169	8.9	4.1	0.37	2.5	0.9	0.41	11.6	92
pH-2	6.0	17.1	37.9	55.9	118	5.43	31.9	176	10.9	4.0	0.36	2.4	1.0	0.39	13.9	52
pH-3	6.0	18.4	37.6	56.9	119	5.73	25.0	183	12.2	3.2	0.34	2.2	1.0	0.38	12.7	41
pH-4	6.1	18.5	39.1	56.6	113	6.11	28.8	164	13.0	3.5	0.34	2.0	1.0	0.36	12.3	34
LSD 5%	0.3	1.0	1.1	.9	4	0.12	5.8	19	0.8	0.7	NS	0.2	NS	0.02	NS	13
K-0	5.7	17.6	37.7	56.3	119	5.65	29.2	147	11.1	3.9	0.35	2.0	1.0	0.42	13.7	55
K-100	5.9	18.9	36.7	57.5	122	5.57	32.0	160	11.0	3.8	0.34	1.9	1.0	0.42	13.2	48
K-200	5.9	19.0	37.9	57.3	118	5.44	28.1	162	10.9	4.0	0.36	2.2	1.0	0.40	12.2	59
K-400	6.1	17.4	38.2	56.1	117	5.41	31.8	168	11.4	3.3	0.36	2.4	0.9	0.38	11.6	51
K-800	6.2	17.4	37.8	56.1	118	5.50	35.1	229	11.8	3.3	0.34	3.0	0.9	0.31	12.5	62
LSD 5%	0.3	1.1	1.2	1.0	4	0.14	6.5	21	0.9	NS	NS	0.2	NS	0.03	NS	NS

* Total of three cuttings

Table 3. The effect of four pH treatments and five Potassium treatments on the yield, quality, and soil and plant nutrient levels of third year (1986) alfalfa grown at Powell Butte, OR

						Soil					Plant					
Treatment	Yield*	Crude protein	ADF	TDN	RFV	pH	P	K	Ca	Mg	P	K	Ca	Mg	Zn	Mn
	ton/A	%	%				ppm	ppm	meq	meq	%	%	%	%	ppm	ppm
pH-1	4.2	21.2	28.7	61.6	150	5.35	44.1	187	8.2	3.1	0.34	2.5	1.3	0.37	22.8	104
pH-2	4.7	21.4	31.2	61.1	141	5.85	33.3	177	9.6	3.8	0.35	2.6	1.3	0.35	21.7	58
pH-3	5.0	21.8	30.8	61.4	142	6.14	31.4	190	10.4	3.5	0.34	2.4	1.4	0.33	19.6	41
pH-4	5.2	22.2	30.7	61.8	143	6.41	30.8	186	11.8	3.3	0.34	2.2	1.5	0.33	21.8	35
LSD 5%	0.3	0.7	1.2	NS	4	0.08	3.6	NS	.5	.2	NS	0.2	NS	0.02	2.2	13
K-0	4.7	22.2	29.2	62.2	149	6.01	34.6	96	9.9	3.4	0.37	1.7	1.5	0.42	23.4	56
K-100	4.8	22.0	30.5	61.7	143	5.93	33.6	124	9.8	3.3	0.35	2.0	1.4	0.38	21.3	54
K-200	4.6	22.3	29.2	62.3	148	5.91	36.0	172	10.2	3.6	0.33	2.4	1.4	0.35	22.1	68
K-400	5.0	21.2	31.1	60.9	141	5.93	33.2	197	9.8	3.3	0.34	2.8	1.3	0.33	19.8	55
K-800	4.7	20.5	31.8	60.2	138	5.89	37.0	336	10.3	3.5	0.32	3.2	1.2	0.27	20.7	64
LSD 5%	0.3	0.8	1.3	0.9	5	0.09	NS	29	NS	NS	0.02	0.2	NS	0.02	2.5	NS

* Total of three cuttings

Table 4. The effect of four pH treatments and five Potassium treatments on the yield, quality, and soil and plant nutrient levels of fourth year (1987) alfalfa grown at Powell Butte, OR

Treatment	Yield*	Crude protein	ADF	TDN	RFV	Soil					Plant					
						pH	P	K	Ca	Mg	P	K	Ca	Mg	Zn	Mn
	ton/A	%	%				ppm	ppm	meq	meq	%	%	%	%	ppm	ppm
pH-1	6.2	15.9	32.4	56.6	137	5.25	43.0	157	8.5	3.1	0.29	1.8	1.4	0.38	19.0	103
pH-2	6.3	16.1	33.8	56.4	131	5.87	34.1	162	10.0	3.7	0.29	1.7	1.5	0.37	18.8	65
pH-3	6.3	16.8	34.3	56.7	130	6.14	30.3	171	10.9	3.5	0.29	1.7	1.5	0.34	17.7	52
pH-4	6.6	17.7	33.6	57.5	132	6.36	28.6	145	12.2	3.3	0.29	1.5	1.7	0.33	17.1	43
LSD 5%	0.3	0.8	1.2	.9	5	0.10	3.3	NS	0.5	0.2	NS	0.2	0.1	0.02	1.0	6
K-0	6.2	16.5	32.9	56.9	135	6.06	32.8	94	10.5	3.5	0.31	1.2	1.7	0.42	18.3	71
K-100	6.4	17.0	32.6	57.4	136	5.91	32.8	106	10.1	3.3	0.30	1.4	1.6	0.39	18.4	67
K-200	6.4	16.4	34.9	56.1	127	5.83	33.4	127	10.4	3.5	0.29	1.6	1.5	0.36	18.1	62
K-400	6.4	16.5	33.8	56.7	131	5.88	34.6	165	10.1	3.3	0.28	1.8	1.5	0.33	17.6	62
K-800	6.5	16.7	33.4	56.9	133	5.84	36.3	303	10.8	3.5	0.28	2.4	1.4	0.29	18.1	67
LSD 5%	0.3	NS	1.4	1.0	5	0.11	NS	36	0.6	NS	0.01	0.2	0.1	0.03	NS	7

* Total of three cuttings

HERBICIDES FOR WEED CONTROL IN SEEDLING ALFALFA IN CENTRAL OREGON

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ABSTRACT

Seven herbicides (Balan, Eptam, Butyrac, Buctril, Basagran, Pursuit, and Poast) at two rates each and 11 combinations were compared with a non-treated control for weed control in seedling alfalfa on the Bill Sigman Ranch and Dennis Gant Farm near Prineville, Oregon in 1987. Eptam + Balan combination gave good control of major broadleaf weeds (lambsquarters, pigweed, and shepherd's purse) at each location. Each herbicide alone was weak on shepherd's purse. Balan and Eptam each in combination with Butyrac, Buctril, and Basagran gave acceptable control of the broadleaf weeds. Buctril + Butyrac also gave good broadleaf control.

Poast, a newly registered herbicide for use on alfalfa, gave control of volunteer grain and quackgrass.

INTRODUCTION

Growers have the option to use herbicides in the establishment phase of an alfalfa field. Several herbicides are registered but few growers actually use them. Herbicides are effective when used properly and few weeds remain uncontrollable. However, possible reasons for low usage in central Oregon may be the lack of consistent results with present herbicides, resistant weeds, cost of chemical, economic health of the grower, and lack of understanding about available herbicides. Therefore, two tests in grower fields were established in 1987 to compare the effectiveness of some new chemicals and/or combinations to those presently available or being used.

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MATERIALS AND METHODS

Identical experiments were conducted at two sites in Crook County -- one on the Bill Sigman Ranch on the lower Crooked River and the other on the Dennis Gant farm north of Prineville. Seven herbicides with two rates each and 11 combinations of these herbicides (Tables 1 and 2) were compared to a non-treated control in a randomized complete block design. Each treatment was replicated three times. Each plot was six feet wide and 20 feet long. Herbicides were applied in 38.4 gallons of water per acre with a CO_2 backpack sprayer with Delavan flat fan 8003 nozzles placed 19 inches apart on the boom. Poast treatments were also applied with one quart crop oil per acre. All preplant incorporated (PPI) treatments were done within three hours after application with a roto-tiller adjusted to till 3-4 inches deep.

The percent weed control was based on a visual evaluation of reduction in number of weeds in each plot. All check plots received a zero rating.

Bill Sigman Ranch

The PPI treatments were made May 15, 1987. The alfalfa was planted on May 16 and sprinkler irrigated as needed by the grower. The postemergence treatments were applied between 12 noon and 3 p.m. on June 22. The air temperature was 64^{o} F with clear skies and a northwest wind at about three miles per hour. The alfalfa was about four inches tall with four trifoliate leaves. The prominent weed species were shepherd's purse, lambsquarters, redroot pigweed, and common mallow. They were from one to three inches tall. Weed control was visually rated on July 17, 1987.

Dennis Gant Farm

The grower treated the quackgrass infested field with glyphosate prior to seedbed preparation. The PPI treatments were made June 10, 1987. Postemergence herbicides were applied July 17. The air temperature was about 55^{o} F. Plots were rated for percent weed control on August 31.

RESULTS AND DISCUSSION

Vigorous alfalfa stands were obtained at both locations. Weed populations were not uniform throughout each test area. Therefore, weed control was difficult to evaluate. Data presented should not be construed as recommendations for application of any chemical or treatment combination. Additional tests need to be conducted. Herbicides currently labeled and recommended for use in seedling alfalfa are listed in the Weed Control Handbook (1). These include Balan (benefin) at 1.12 to 1.5 ai/A, Eptam (EPTC) at 2 to 4 lbs ai/A, and Butyrac (2,4-DB) at 0.5 to 1.5 lbs ai/A. In addition, Poast has been registered for use on alfalfa since publication of the 1987 handbook. From this list of available herbicides central Oregon growers have used Eptam and Butyrac primarily; if they chose to control weeds with chemicals.

Weed control from the herbicides used in the two tests reported here can be compared to the above recommended chemicals and rates. However the results reported should be understood to represent trends rather than absolute values since considerable variation existed among replications for treatments.

Balan at 1.5 lbs ai/A was necessary to give satisfactory control of lambsquarters and pigweed, however, neither rate of Balan gave adequate control of shepherd's purse (Table 1). The results from both rates of Eptam were rather disappointing since better weed control was anticipated because of past grower results with Eptam. Control of lambsquarters and pigweed was poorer with Eptam than from Balan except for pigweed control at Gant's Farm. Eptam was better on shepherd's purse at both locations. The Eptam + Balan mixture was more effective in controlling all three broadleaf weeds than either material used singly. Stanger reported a similar result from applications of the same tank-mix combinations in eastern Oregon (2). Both herbicides need to be applied before planting and soil incorporated mechanically two to three inches deep within a few hours of application.

The postemergence application of Butyrac at one lb ae/A gave good control of lambsquarters, pigweed, and shepherd's purse at both test sites. Buctril at .25 lb ai/A gave results similar to one lb Butyrac on lambsquarters and shepherd's purse but not on pigweed. Buctril + Butyrac improved pigweed control at Sigman Ranch but not at Gant's Farm. This tank-mix combination may be more effective on a wider spectrum of broadleaf weeds than either herbicide alone. Stanger found in his experimental trials that Buctril + Butyrac was quite effective (2).

Basagran at one lb ai/A gave excellent control for shepherd's purse only. Pursuit was strong on pigweed and shepherd's purse but not consistent on lambsquarters. Poor control was obtained on lambsquarters on the Sigman Ranch.

Broadleaf weed control was poor with Poast as expected.

Combinations of Balan with either Butyrac or Buctril gave good control of lambsquarters, pigweed, and shepherd's purse except Balan + Butyrac on shepherd's purse. Basagran with

Balan was somewhat less effective than either Butyrac or Buctril with Balan. Balan + Buctril was more effective on broadleaf weeds in these two tests than either herbicide alone.

Approximately 20-30% stunting of the alfalfa occurred in two replications from the .25 lb. ae/A application of Buctril. There was also about 10% alfalfa stunting in one replication from Basagran (1 lb. ai/A), Eptam + Buctril (2 + .187), and Eptam + Balan (2 + 1).

All postemergence combinations with Eptam gave fairly good weed control. Poast combinations were poor on all the broadleaf weeds present except on shepherd's purse.

Volunteer grain, quackgrass, nightshade, filaree, and common mallow were present throughout the test area on the Gant Farm but unevenly distributed. Therefore these evaluations were difficult.

The grasses were effectively controlled with Eptam at 3 lbs ai/A, Poast at both rates, Balan + Buctril, Balan + Basagran, Poast + Butyrac, and Poast + Buctril (Table 2). Eptam alone and in combination also appeared to reduce the amount of quackgrass. A similar situation existed for Poast at .5 lb ai/A and Poast + Buctril.

No significant differences in control of nightshade, filaree and common mallow were observed.

Additional research is needed to determine best herbicide rates and/or combinations for weed control in seedling alfalfa in central Oregon. New chemicals should also be evaluated. Future plans exist for continued research/demonstration work.

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Table 1. Percent weed control from herbicides applied during alfalfa establishment. Bill Sigman Ranch and Dennis Gant Farm, Prineville, Oregon - 1987

Herbicide	Rate lbs ai/ac	Growth stage	Percent weed control[1] Lambsquarters		Pigweed		Shepherd's Purse	
			[2]	[3]	[2]	[3]	[2]	[3]
Balan (benefin)	1.0	PPI	63	80	80	73	10	27
Balan	1.5	PPI	88	95	90	100	17	30
Eptam (EPTC)	2.0	PPI	57	62	68	77	90	50
Eptam	3.0	PPI	78	65	73	93	82	72
Butyrac (2,4-DB)	0.5	Post	96	32	100	42	67	90
Butyrac	1.0	Post	99	93	100	67	88	93
Buctril (bromoxynil)	0.187	Post	77	100	53	27	93	97
Buctril	0.25	Post	90	100	50	35	90	93
Basagran (bentazon)	0.50	Post	30	0	43	0	64	83
Basagran	1.0	Post	60	43	58	30	98	97
Pursuit (AC 263, 499)	0.05	Post	10	47	95	77	87	100
Pursuit	0.1	Post	43	97	97	100	97	100
Poast (sethoxydim)	0.25	Post	10	0	7	0	7	43
Poast	0.5	Post	10	10	7	10	7	30
Balan + Butyrac	1.0 + 0.5	PPI + Post	99	98	100	100	50	63
Balan + Buctril	1.0 + 0.187	PPI + Post	92	98	99	90	95	97
Balan + Basagran	1.0 + 0.5	PPI + Post	78	70	98	67	97	80
Eptam + Balan	2.0 + 1.0	PPI	83	93	81	93	65	57
Eptam + Butyrac	2.0 + 0.5	PPI + Post	98	85	95	87	87	43
Eptam + Buctril	2.0 + 0.187	PPI + Post	92	100	83	70	93	98
Eptam + Basagran	2.0 + 0.5	PPI + Post	85	93	48	63	99	100
Poast + Butyrac	0.25 + 0.5	Post	99	60	99	53	83	98
Poast + Buctril	0.25 + 0.187	Post	63	87	37	13	93	98
Poast + Basagran	0.25 + 0.5	Post	23	47	33	23	95	85
Buctril + Butyrac	0.187 + 0.5	Post	99	83	87	20	91	97
CHECK	---	----	0	0	0	0	0	0
LSD (5%)			16	35	37	40	26	41
LSD (1%)			21	46	49	54	35	54
CV (%)			15	32	33	45	23	34

1 Percent weed control: 0 = No control, 100 = All plants killed. Results shown are averages of three replications.
2 Bill Sigman Ranch
3 Dennis Gant Farm

Table 2. Percent weed control from herbicides applied during alfalfa establishment. Dennis Gant Farm, Prineville, Oregon - 1987

Herbicide	Rate lbs ai/ac	Growth stage	Percent weed control[1] Volunteer Grain	Quack-grass	Night-shade	Filaree	Common Mallow
Balan (benefin)	1.0	PPI	20	47	0	0	3
Balan	1.5	PPI	33	33	0	0	0
Eptam (EPTC)	2.0	PPI	60	63	0	0	0
Eptam	3.0	PPI	93	70	0	0	0
Butyrac (2,4-DB)	0.5	Post	0	0	0	0	0
Butyrac	1.0	Post	27	0	0	30	33
Buctril (bromoxynil)	0.187	Post	40	0	0	0	33
Buctril	0.25	Post	20	0	0	0	0
Basagran (bentazon)	0.50	Post	33	0	0	0	0
Basagran	1.0	Post	0	0	33	33	33
Pursuit (AC 263, 499)	0.05	Post	63	0	0	0	0
Pursuit	0.1	Post	47	0	0	0	0
Poast (sethoxydim)	0.25	Post	100	33	0	0	0
Poast	0.5	Post	93	67	0	30	0
Balan + Butyrac	1.0 + 0.5	PPI + Post	67	50	0	33	0
Balan + Buctril	1.0 + 0.187	PPI + Post	98	33	3	0	0
Balan + Basagran	1.0 + 0.5	PPI + Post	87	50	0	0	0
Eptam + Balan	2.0 + 1.0	PPI	67	77	0	0	0
Eptam + Butyrac	2.0 + 0.5	PPI + Post	50	63	33	30	0
Eptam + Buctril	2.0 + 0.187	PPI + Post	53	60	33	0	0
Eptam + Basagran	2.0 + 0.5	PPI + Post	67	95	33	0	0
Poast + Butyrac	0.25 + 0.5	Post	87	30	0	0	0
Poast + Buctril	0.25 + 0.187	Post	83	90	0	0	0
Poast + Basagran	0.25 + 0.5	Post	50	37	3	0	0
Buctril + Butyrac	0.187 + 0.5	Post	33	0	0	0	33
CHECK	---	----	0	0	0	0	0
LSD (5%)			68	57	35	39	38
LSD (1%)			91	76	46	52	51
CV (%)			79	100	395	323	354

1 Percent weed control: 0 = No control, 100 = All plants killed. Results shown are averages of three replications.

VARIETAL EVALUATION OF IRRIGATED CEREAL GRAINS
IN CENTRAL OREGON IN 1987

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ABSTRACT

Irrigated cereal evaluations were conducted at Powell Butte and Madras, Oregon in 1987. Six replicated yield trials were established at the two sites. Varieties and advanced lines are continued to be looked at for up to date data on cereal production for central Oregon growers. Several soft white winter and spring wheat lines out-performed the standards including "Malcolm" and "Stephens". In Powell Butte "Dusty" continued to be a top performer. Hard red winter wheat had some improvements, but most material is not acceptable for central Oregon. The Western Regional Barley trial had many advance lines that had good test weights and yields compared to the standards. "Scio" is still a good choice for central Oregon growers.

INTRODUCTION

The primary objective of the cereals project in central Oregon is to evaluate potentially new varieties as well as up-to-date data of released varieties under local conditions. Cereals are evaluated for yield, test weight, maturity, height, lodging, winter hardiness and disease resistance. Central Oregon also serves as a cooperative site in statewide and regional cereal testing programs. In 1987, regional hard red spring wheat and spring barley nurseries were maintained on the Central Oregon Experiment Station within the set of spring trials planted by the OSU cereal breeding program. Results will not be reported here.

Six replicated yield trials were established in 1987 at two sites of Central Oregon Experiment Station. Table 1 indicates the various trials grown, their location, and the number of lines investigated in each trial.

METHODS

Cereal plots (5 feet wide by 20 feet long) were seeded at a rate of 100 pounds/acre using a Oyjord plot planter. Fertilizing was accomplished either by a Barber metered feed fertilizer spreader or by hand as the need arose. Overhead irrigation was used on either 40 x 40' spacing (Powell

Butte) or 30 x 40' spacing (Madras). Harvest was accomplished with a Hege plot combine. Cultural data for the different experiments are listed in Table 2.

Table 1. Cereal grains variety trials planted in central Oregon in 1987

Cereal type	Location	No. of lines
Soft white spring western regional	Madras	36
Soft white winter wheat elite	P. Butte	44
Soft white winter wheat elite	Madras	58
Hard red winter wheat elite	Madras	30
Winter barley western regional	Madras	36

Table 2. Cultural data for 1987 variety trials at Madras and Powell Butte, Oregon

Trial	Location	Lbs. N/ac	Date of planting	Date first irrig.	Date last irrig.	Date of harvest
WRSWR	Madras	162	4/02/87	5/08/87	7/06/87	8/12/87
SWWWE	P. Butte	188	10/23/86	5/07/87	8/05/87	8/28/87
SWWWE	Madras	212	10/31/86	4/20/87	7/14/87	8/06/87
HRWWE	Madras	212	10/31/86	4/20/87	7/14/87	8/06/87
WRWBN	Madras	80	10/31/86	4/20/87	6/23/87	8/05/87

RESULTS AND DISCUSSION

Diseases were absent in 1987, so are not noted. Abnormally high lodging followed a severe rain storm at Madras in July, 1987. Little or no insect damage was noticed throughout the 1987 season.

Resident geese reduced cereal stands in some plots at Powell Butte during the mild 1986-87 winter, but variety trials were less affected than certain other cereal trials.

Soft White Winter Wheat

Soft white winter wheats have been the best performing wheats in central Oregon. Tables 3, 4, 5, and 6 show the results of the 1987 trials, and some long-term agronomic data for established soft white winter wheats in Madras and Powell Butte.

Most test lines and standard varieties were moderately to severely lodged following record July rains, although "B82-3319" notably withstood this lodging pressure (Table 3).

Yields among standard varieties were notably low, probably due to lodging, and this was probably true to several test lines. Nevertheless, ORCW8632, OR830211, OR833649 and ORCW8617 yielded well in spite of moderate lodging (Table 3). Long term performance of standard varieties (Table 4) in Madras test plots is reduced from previous years because of the 1987 lodging affect. This is especially true for Dusty, which has only been evaluated for 2 years.

Performance of standard varieties at Powell Butte was more typical of most years (Tables 5 and 6), although Malcolm yielded somewhat less. Dusty yielded very highly (133.6 bu/ac) for the second consecutive year. Yields for ORCW8519, Nugaines, Gaines, and Daws were above 120 bu/ac and ORCW8619 was above 119 bu/ac.

Table 3. Agronomic data for select soft white winter wheat lines grown at Madras, Oregon, in 1987

Treatment	Yield	Test wt	Height	Hd date	Lodging
	bu/a	lbs/bu	in	days	%
Stephens	102.1	56.43	39	155	48
Hill 81	85.0	56.16	41	161	50
Dusty	71.5	55.43	37	163	95
Malcolm	99.8	55.07	37	155	65
OR CW8314	99.4	55.70	39	154	63
OR CW8522	100.9	58.75	37	152	80
OR CW8627	106.6	60.31	40	156	43
OR CW8629	100.8	56.70	38	159	43
OR CW8632	111.8	57.58	38	153	30
OR CW8633	96.6	59.13	37	160	78
OR 830166	99.2	58.87	38	153	58
OR 830211	128.3	62.12	38	152	48
OR 830801	99.3	56.61	35	151	35
OR 833649	108.5	60.45	39	157	43
Hyslop	81.0	55.84	40	159	58
Nugaines	96.8	58.33	37	159	53
Daws	94.8	57.75	38	158	30
McDermid	89.3	56.76	37	158	95
FW 75336-103	98.0	54.51	40	156	25
FW 81454-301	99.1	56.15	38	155	65
FW 82167-307	95.3	56.25	39	156	58
B82-3319	102.1	46.64	37	158	0
OR CW8617	112.8	56.20	37	153	55
OR CW8323	103.2	58.81	38	154	58
LSD(5%)	14.2	2.03	3	2	32

Table 4. Soft White Winter Wheat varieties grown at Madras, Oregon, 1979-1987 (1983 trials destroyed by hail)

Variety	Yield	Test Wt[4]	Headdate[3]	Lodging	Height[2]
	bu/a	lbs/bu	days	%	in
Hyslop	103.3	56.5	167	16	36
Daws	106.1	57.3	168	14	36
Dusty[1]	95.2	58.5	162	48	36
Hill 81	103.0	57.0	168	9	38
Malcolm	118.2	56.6	165	13	35
McDermid[5]	95.4	59.2	158	48	36
Nugaines	103.6	58.6	167	21	34
Stephens	110.8	56.3	165	11	36

1. 1986-1987 data only (2 yr. average is low due to unusual lodging conditions in 1987).
2. 1980,1981 data missing.
3. 1979,1980 data missing.
4. 1980 data missing.
5. 1981 data missing.

Table 5. Agronomic data for selected soft white winter wheat lines grown at Powell Butte, Oregon, in 1987

Treatment	Yield	Test wt	Height	Hd date	Lodging
	bu/a	lbs/bu	in	days	%
Stephens	103.7	53.64	34	176	4
Hill 81	115.7	57.10	36	175	1
Dusty	133.6	54.26	33	178	0
Malcolm	100.6	52.85	32	177	1
OR CW8323	103.8	56.91	32	174	1
OR CW8417	102.8	59.88	36	176	1
OR CW8519	123.6	56.27	38	173	1
OR CW8619	119.2	58.07	37	176	1
OR CW8622	111.6	58.73	34	171	8
OR CW8625	104.9	54.34	33	174	0
OR CW8627	109.6	58.62	33	173	0
OR CW8629	105.2	56.12	34	176	3
OR CW8631	107.1	56.55	34	177	6
OR CW8633	106.8	57.15	33	180	1
Hyslop	91.0	53.57	34	178	4
Nugaines	128.6	57.71	31	171	6
Daws	123.2	56.74	33	171	3
McDermid	107.8	54.71	25	176	0
Crew	105.6	56.63	33	175	0
Lewjain	97.2	54.52	31	178	15
OR 7996	108.2	55.89	36	176	4
Gaines	126.6	57.48	30	171	9
Tres	115.1	59.47	33	174	4
LSD(5%)	17.8	10.68	4	3	12

Table 6. Soft White Winter Wheat varieties grown at Powell Butte, Oregon, 1979-1987

Variety	Yield	Test wt	Headdate[3]	Lodging	Height[2]
	bu/a	lbs/bu	days	%	in
Hyslop	107.6	56.2	177	18	35
Daws	111.9	57.2	179	9	35
Dusty[1]	139.1	58.0	176	0	35
Hill 81	115.2	57.8	181	9	37
Malcolm	121.2	55.8	179	5	34
McDermid	107.8	54.7	176	0	25
Nugaines	108.4	58.0	179	15	33
Stephens	110.6	55.1	179	7	34

1. 1986-1987 data only.
2. 1980 data missing.
3. 1982,1983 data missing.

Soft White Spring Wheat

Emphasis for several years has been placed on identifying an alternative to winter wheat in central Oregon. 1987 varietal trials for soft white spring wheat show several lines with promise for high yield and short straw (Table 7). All test lines yielded above 120 bu/ac, with ORS08509, ID000312, and ORS08512 above 130 bu/ac. Nevertheless, based on the exceptional yield performance by McKay, Edwall and Owens in 1987 (Table 7) compared to their five year average (Table 8), 1987 yields generally may have been higher than average.

Table 7. Select soft white spring wheat lines from the western regional nursery grown at Madras, Oregon, in 1987

Treatment	Yield	Test wt	Height	Hd date	Lodging
	bu/a	lbs/bu	in	days	%
McKay	130.0	60.39	36	171	65
Edwall	104.0	58.12	36	169	78
Owens	114.5	59.66	36	170	100
Penawawa	127.4	61.13	34	169	33
WA 007075	120.6	59.24	37	170	58
WA 007183	123.3	59.45	34	170	85
ORS 08418	125.8	62.18	34	167	75
WA 007492	122.1	58.97	35	170	95
ID 000303	121.3	60.45	38	168	88
ID 000312	131.8	61.24	33	167	53
ID 000319	128.3	59.73	36	168	78
UT 461941	121.2	59.73	38	174	45
ORS 08509	133.2	61.85	33	168	18
ORS 08512	130.4	62.54	32	168	10
WA 007496	128.9	58.69	32	170	70
ID 000348	129.5	61.82	34	168	58
ID 000373	132.4	61.94	35	169	53
LSD(5%)	13.0	3.82	3	2	44

Table 8. Soft White Spring Wheat varieties grown at Madras, Oregon, 1982-1987

Variety	Yield	Test Wt	Headdate	Lodging	Height
	bu/a	lbs/bu	days	%	in
Dirkwin[3]	79.5	56.5	176	10	37
Owens	93.2	59.7	174	37	38
Twin[3]	85.7	57.3	175	8	37
Edwall[1]	89.2	58.5	173	45	36
Waverly[3]	86.9	58.0	176	19	37
McKay	100.0	59.8	169	30	36
Wampum[3]	75.2	58.1	175	41	40
Fielder[2]	81.3	57.8	177	1	38
Walladay[2]	77.8	56.6	183	0	37

1. 1982,1983 data missing.
2. 1986,1987 data missing.
3. 1987 data missing.

Winter Barley

The Western Regional Winter Barley nursery was grown at Madras in 1987 for only the second year in central Oregon. No stand losses resulted in the mild 1986-87 winter, which is a risk with winter barley in central Oregon. With the greater exposure to winter barley varieties through a regional trial, this helps in the search for greater flexibility for the growers in the area. "Scio" has been recommended for the central Oregon region. High yield and superior disease resistance have been the basis for the recommendation. Advanced line 79AB812 has been put forward for release in the 1988 season.

Table 9. Agronomic data for selected varieties grown in the western regional winter barley nursery at Madras, Oregon, in 1987

Treatment	Yield	Test wt	Height	Hd date	Lodging
	bu/a	lbs/bu	in	days	%
Kamiak	82.6	46.41	42	136	95
Schuyler	99.9	47.75	39	149	29
Boyer	105.3	47.86	40	149	23
Wintermalt	84.5	47.30	42	136	71
Hesk	103.8	46.33	39	147	49
Mal	97.4	47.43	42	153	20
Scio	123.2	47.40	38	145	25
79AB812	120.5	48.84	36	145	24
Showin	117.8	46.62	33	144	3
OR FB75075	126.9	46.04	36	139	64
OK 82850	101.1	46.29	37	138	45
OR WF8328	118.9	46.06	37	139	70
OR WF8411	114.0	47.60	35	138	41
OR WF8410	136.3	48.05	27	139	0
WA 2607-80	109.8	46.84	39	149	13
WA 2808-83	107.1	48.21	37	139	59
NK 592	106.4	45.94	38	142	43
OR FB763167	128.0	47.56	37	147	0
OR FB77796	108.0	49.13	40	138	46
Steptoe	106.8	47.32	42	140	70
OR WM8515	112.5	48.80	32	139	23
OR WF8417	126.5	45.00	36	139	51
OR WF8527	111.3	46.71	30	138	16
LSD(5%)	20.0	1.14	3	4	47

Hard Red Winter Wheat

Table 10 shows the agronomic data for the hard red winter wheat elite trial grown at Madras in 1987. Yield levels are improving on the advanced lines compared to the standards. Studies are being done to evaluate alternate fertility regimes to increase protein levels.

Table 10. Agronomic data for several hard red winter wheat lines grown at Madras, Oregon, in the 1987 elite trial

Treatment	Yield	Test wt	Height	Hd date	Lodging
	bu/a	lbs/bu	in	days	%
Wanser	62.5	60.93	47	152	70
Stephens	112.6	60.25	37	155	25
Centura	61.2	60.14	44	147	98
Hatton	74.3	63.18	47	158	88
Bantum	80.2	58.41	39	160	95
OR CR8619	95.0	61.36	35	148	30
OR CR8622	95.7	62.48	35	153	45
OR 831455	108.0	60.20	36	154	28
OR 832038	100.8	60.72	37	148	45
OR CR8617	101.3	62.64	35	155	3
OR CR8620	97.2	61.73	39	146	3
LSD(5%)	11.0	0.94	2	2	37

SUMMARY

With the overproduction of soft white wheat, there has been and still is emphasis on alternative cereals, such as hard red wheat, and on cereal quality. As shown in trials at the Central Oregon Experiment Station in 1986 and 1987, hard red spring wheats, if fertilized for optimum protein levels, are competitive with other cereals in central Oregon. The acreage of hard red spring wheat in central Oregon has increased from only a few acres prior to 1985, to between 6-8,000 acres in 1987, a significant proportion of the regional cereal acreage. At this time there are still better alternatives to hard red winter wheat in the central Oregon area. Soft white spring wheat and spring barleys yield well. With increased emphasis on the OSU barley breeding program, improved barleys should be forthcoming.

NEW POTATO VARIETY DEVELOPMENT AT CENTRAL OREGON EXPERIMENT STATION-1987

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ABSTRACT

Seed increases, selection, and variety trials were conducted in 1987 at Central Oregon Experiment Station as a part of statewide, tri-state (Oregon, Washington, and Idaho), and western regional variety development programs. Seed of 864 clones was produced for 1988 statewide, tri-state, and regional trials. Also, 25,634 single-hill selections were grown; 348 were selected for further evaluation. Virus levels were very low in all 1987 seed production.

Advanced and preliminary statewide variety trials were grown at Redmond in 1987. ND01496-1 was advanced to the regional chip trial. AO81216-1, AO82260-8, AO82283-1, AO82611-7, and AO82616-18 (all oblong russets) were advanced to tri-state trials. In 1987 statewide trials these five selections had good internal quality, excellent yields, and promising processing quality.

Seed of fresh market selection A74212-1 (oblong, medium-light russet) was increased and evaluated commercially in on-farm trials in major Oregon and Washington potato growing areas. Some of the growers experienced problems with seed rotting in the ground prior to emergence; no other serious problems were encountered in production, handling, or marketing. A74212-1 will likely be named and released in the fall of 1988.

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INTRODUCTION

A small program to develop new potato varieties for the Oregon potato industry was begun in the early 1970's at Central Oregon Experiment Station and Klamath Experiment Station. The program has evolved over the years in both the number ofselections evaluated and the number of sites used for evaluation. Over 80,000 varieties and clones were evaluated in 1987 at five Oregon sites and one Washington site.

The primary emphasis of the potato variety development program has been placed on developing new processing varieties, but chipping and fresh market selections are also being developed. The current effort arose from a need for high-yielding, disease resistant varieties which will process well and maintain their quality in long term storage. The overall objectives of the current program are as follows:

1) Develop and release superior new potato varieties for the Oregon potato industry through a cooperative program involving four branch experiment stations, two campus departments, O.S.U. Seed Certification, and O.S.U. Foundation Seed and Plant Materials Project.

2) Cooperate with neighboring states in evaluating advanced selections.

3) Develop optimized field production, storage, and use recommendations for selections nearing release.

4) Supply seed of promising Oregon selections to cooperating scientists in neighboring states.

Central Oregon Experiment Station is ideally located and equipped to accomplish these objectives in cooperation with other state and regional experiment stations. The station has the capacity to screen thousands of new clones and produce high quality, disease-free seed of promising selections. The station also has the facilities and equipment necessary to free clones which have become contaminated with viruses and maintain and increase disease-free seedstocks of these clones. This report discusses 1987 activities at Central Oregon Experiment Station in these areas.

METHODS

Seed Increases. The Powell Butte field of Central Oregon Experiment Station was the major site producing seed for cooperative regional, tri-state, and statewide potato variety trials. In 1987, 13 lines were increased for regional trials and 197 lines were increased for statewide trials.

Prior to planting, five and one-half pints/acre of Eptam 7-E were incorporated into the soil on May 18, 1987. An Iron Age assisted feed potato planter was used to band 800 pounds/acre of 10-20-20-5 (NPKS) fertilizer prior to planting. The potato planter was used to open the rows and all seed was hand planted in tuber units.

On May 21 and 22, 1987, 30 tuber units (six seedpieces each) of each regional and statewide clone, and 15 tuber units of each preliminary clone were planted. Individual seedpieces were planted 10 inches apart within the row and tuber units were separated by 18 inches. Two rows were planted 36 inches apart and were bordered on either side by a blank row or a 10 foot alley for tractor access. The blank rows/tractor alleys provided space for sprinkler laterals, roguing, and spraying with minimal vine contact.

The seed increase blocks were rogued for potato virus Y (PVY), potato virus X (PVX), potato leaf roll virus (PLRV), and other bacterial and viral diseases each week during the growing season. In addition to weekly roguing, one pound per acre of Orthene 75S and a one percent solution of a paraffin based mineral oil were applied each week by ground sprayer at 250 psi.

Eight leaves from each of three tuber units from each regional and statewide clone were collected immediately prior to vine kill and tested for PVX, PVY, and PLRV using ELISA. The tubers were hand dug from tuber units which tested free of any viruses. These tubers will be winter eye-indexed and become planting stock for 1988 seed increases.

The seed increase block was dessicated on September 15, 1987, using one pint/acre of Diquat H/A. The ELISA tested tuber units were dug by hand September 30 and October 1, 1987; the remaining seed was harvested by machine and sacked October 13-15, 1987. All seed was shipped to Klamath Experiment Station in Klamath Falls for storage.

Selection Trials/Increases. First and second field generation material for which less than five total tubers existed were planted in a combination selection/increase trial.

Five hundred ninety-two clones selected from seedling tubers planted at Powell Butte in 1986 and 62 clones selected from seedling tubers planted at Ontario in 1986 were planted at Powell Butte on May 20, 1987. Approximately 18 seedpieces (three tuber units of six pieces each) of each clone were planted in the same spatial arrangement as the regional and statewide seed increases. Each clone was separated by "All Blue" potatoes, which were planted to reduce variety mixing at harvest. Fertilizer and weed control were the same as used for regional and statewide increases.

The selection trials/increases were harvested on October 16, 1987, by lifting with a level bed potato digger. Selection was based on appearance, shape, malformities, skin color and type, and size and shape uniformity. Clones selected were bagged and all non-selected clones were left in the field.

Approximately 25,630 seedling tubers (small tubers produced in greenhouses from true potato seed) were planted. These tubers were produced from genetic crosses made in Idaho, Colorado, and North Dakota. Individual tubers were planted 27 inches apart in 36 inch rows on May 27 and 28, 1987. Fertility, herbicides, and management practices were identical to the seed increases above.

Variety Trials. Two variety trials were grown at Redmond in 1987. Forty varieties/clones were entered in the statewide variety trial and 160 varieties/clones were evaluated in a statewide preliminary variety trial (PYT2).

Five and one-half pints/acre of Eptam 7-E were incorporated into the soil on May 11, 1987. The plots were planted May 13, 1987, and 1,100 lbs/acre of 19-14-15-6 (NPKS) fertilizer was banded to the sides and slightly below the seedpieces at planting time. On July 7, 1987, 0.25 lbs. ai/acre of metribuzin was applied when plants were four to five inches high. The field was irrigated with one-half inch of water after the metribuzin application.

The variety trials were arranged in randomized block designs; the statewide trial had four replications, the PYT2 trial two replications. Seedpieces were placed nine inches apart in rows spaced 36 inches apart and each plot was separated by two hills of "All Blue" potatoes. The individual plots in the statewide trial were 25 feet long (27 seedpieces) and the PYT2 plots were 15 feet long (16 seedpieces). The trials were sprinkler irrigated twice weekly according to demand. Nearly three and one-half inches of rainfall occurred between July 20 and July 25, 1987. The unusual amount of rainfall flooded completely one replicate of the PYT2 trial and moderately damaged the remaining replicate. The statewide trial was not adversely affected by the rains.

Potato vines were dessicated naturally by frost on September 16 and 17, 1987, and the vines were removed with a flail mower prior to harvest. The statewide trial was harvested on October 19, 1987 and graded the following day. One replicate only of the PYT2 trial was harvested on October 21, 1987; the PYT2 plots were graded October 22, 1987. For each plot the total number of tubers was recorded and the total weight was recorded for each of six categories: under four ounces, culls, twos, four to six ounce US number ones, six to twelve ounce ones, and over twelve ounce ones. A 10 pound sample from each plot was taken for french frying, specific gravity determination, and internal defect grading.

Specific gravities were determined by weighing approximately 10 pounds of tubers in air and water. Sixteen tubers from each plot were sliced longitudinally and internal defects were recorded as percent of tubers with a given defect. Four tubers from each plot were stored for two months at 50^{o}F for french frying. Four one-quarter inch square strips from each of four tubers were fried for four minutes at 350^{o}F. Each strip was evaluated for color and dark ends. Color was scored from 0-4 based on the "USDA Standard Color Chart for Frozen French-fried Potatoes".

RESULTS AND DISCUSSION

Seed Increases. Seed of 864 clones/varieties was produced for statewide, tri-state, and regional testing. Only 0.05% of all plants were rogued due to PVX or PVY infection. Leaves from 206 clones were sampled and ELISA tested for PVX, PVY, and PLRV prior to vine kill. Among the regional and statewide regional clones ELISA tested, 0.16% tested positive for leafroll, 0.16% tested positive for PVY, and 1.78% tested positive for PVX. Over one-half of the positive PVX samples were collected from two clones, HiLite and CO083021-4. HiLite will be grown in the 1988 trials only and C0083021-4 was dropped from further evaluation and seed production.

Because of the large numbers of clones and the importation of material from other programs, it has been difficult to totally eliminate viral infection. Winter eye-indexing, ELISA testing during the growing season and prior to vine kill, intensive roguing, and high pressure aphicide/oil spraying have kept viral infection relatively low as compared with the early days of the variety development program.

Selection Trials/Increases. Over 25,600 seedling tubers from 277 genetic crosses were planted in 1987. These single-hill selections were dug on October 6, 1987, and evaluated by a team of potato researchers, breeders, and processors from several western states. The evaluation team selected 348 clones to be advanced to 1988 second field generation selection trials. The selections were based on visual criteria, such as relative yield, tuber size, shape, uniformity and overall appearance.

The 629 clones selected from 1986 Powell Butte single-hills plus 62 clones selected from single-hills grown at Ontario were planted at Powell Butte. Also, 25 blue-skinned clones were included in this trial. This trial was dug October 16, 1987, and 87 clones were advanced to the 1988 PYT2 trial.

The clones were field selected using the same criteria as for the single-hills, but were also evaluated for internal and processing quality. Eight blue-skinned clones were retained for further fresh market evaluation. A small but increasing market for specialty clones has sprung up and blue-skinned varieties commanded premium prices in 1987-88 specialty markets.

Statewide Variety Trial. Yield and quality data for the 1987 statewide advanced yield trial are shown in Table 1. Russet Burbank produced 65% US No. 1 potatoes; every other clone in the trial produced a larger percentage of US No. 1 tubers than Russet Burbank. Also, 22% of the Russet Burbank tubers had either hollow heart or brown center. Black spot was found in 35% of the Lemhi tubers sliced. The majority of the clones evaluated had higher marketable yields and better internal quality than Russet Burbank and Lemhi, respectively. Russet Norkotah was added as an internal quality check variety in the 1987 trial and will also be included as a check variety in future trials.

Eleven clones were retained for further evaluation in 1988 regional, tri-state, and statewide trials. ND01496-1, a round, white chipping clone, was advanced to the 1988 regional chipping trial. This clone produces well, has a high specific gravity, and makes excellent chips. It will also be evaluated for storage quality in 1988. A081216-1, an oblong russet, will be evaluated for a second year in the tri-state trials. Clones A082260-8, A082283-1, A082611-7, and A082616-18 were selected for tri-state evaluation in 1988. These clones are oblong russets with excellent processing potential and high specific gravities. The clones that were retained but not entered into regional or tri-state trials in 1988 have fresh market potential. HiLite, a privately owned variety, was included in the trial for comparison purposes only.

Fresh market selection A74212-1 was evaluated for the seventh year. A74212-1, an oblong, medium-light russet, has excellent potential for the fresh market. It produces a high percentage of US No. 1 potatoes and has excellent internal quality. Large commercial trials were conducted in the central Columbia basin, the Hermiston area, and also in the Klamath basin. Some growers experienced a problem with seed rotting prior to emergence; research to explore this problem is planned for 1988. No other serious problems were encountered in production, handling, or marketing. A74212-1 will likely be named and released in the fall of 1988.

Clone A082260-4 will be held out of 1988 trials because of a variety mixture. The two clones will be separated and seed produced of each clone in 1988.

Table 1. Yield, grade, fry color, and internal defects of statewide potato variety trial entries grown at Redmond, Oregon 1987

Variety	Yield-cwt/a Total	Yield-cwt/a No. 1	%[1] RB	Spec[2] grav	Fry[3] color	%[4] HH	%[4] BS	%[4] BC	Disposition
R. BURBANK	608	398	100	1.089	1.50	9	6	13	CHECK
LEMHI	730	559	120	1.093	1.50	7	35	0	CHECK
NORGOLD	496	411	82	1.072	2.05	5	2	2	CHECK
NORKOTAH	582	483	96	1.069	2.25	0	0	0	CHECK
A74212-1	634	490	104	1.081	3.44	0	5	0	KEEP
AO81178-11	642	488	106	1.079	1.75	5	2	0	DROP
AO81178-12	698	598	115	1.086	2.94	2	4	0	DROP
AO81216-1	539	409	89	1.088	3.13	9	18	2	KEEP
AO81394-7	541	400	89	1.100	1.88	2	2	0	DROP
COO80152-1	613	476	101	1.085	1.69	0	6	2	DROP
COO8177-2	513	426	84	1.089	0.75	9	2	0	DROP
A81362-3	706	546	116	1.085	2.00	0	4	0	KEEP
A81727-9	462	394	76	1.078	1.00	0	9	0	DROP
AO81084-2	458	351	75	1.080	2.63	0	4	0	DROP
AO81509-1	643	511	106	1.083	2.06	9	2	0	DROP
AO81512-1	499	369	82	1.092	2.31	25	5	2	DROP
AO81522-1	590	535	97	1.082	1.94	0	2	0	DROP
AO81783-7	451	342	74	1.081	0.01	11	5	0	DROP
AO81794-9	528	427	87	1.081	1.06	11	0	2	DROP
AO82023-1	501	420	82	1.077	1.75	0	5	0	DROP
AO82254-24	695	582	114	1.078	2.94	0	10	0	KEEP
AO82260-4	600	509	99	1.077	1.50	0	3	0	HOLD
AO82260-7	279	212	46	1.073	0.50	9	0	0	DROP
AO82260-8	624	526	103	1.086	1.50	18	4	0	KEEP
AO82281-1	686	624	113	1.077	1.94	4	0	0	KEEP
AO82283-1	559	468	92	1.085	0.19	2	13	0	KEEP
AO82283-5	549	397	90	1.097	1.19	4	12	0	DROP
AO82283-9	479	408	79	1.088	1.38	2	23	0	DROP
AO82606-13	626	500	103	1.084	2.88	0	9	0	DROP
AO82611-7	677	466	111	1.090	1.50	0	7	0	KEEP
AO82616-12	543	423	89	1.094	1.69	0	23	0	DROP
AO82616-18	724	559	119	1.090	0.69	11	20	0	KEEP
COO82136-2	410	352	67	1.085	0.25	9	2	0	DROP
COO82063-3	591	537	97	1.077	1.81	0	2	0	DROP
NDO1062-1	553	447	91	1.091	1.00	2	2	0	DROP
NDO1496-1	594	426	98	1.095	0.01	0	0	0	KEEP
NDO1567-2	642	520	106	1.075	1.94	0	4	0	DROP
NDO2061-2	501	436	82	1.070	1.75	0	0	0	DROP
HILITE	648	579	107	1.075	2.00	0	2	0	KEEP
A7411-2	694	486	114	0.000	0.88	0	14	0	DROP
LSD 5%	146	148	---	0.006	0.81	12	11	2	----

1 % RB = total yield/total yield of Russet Burbank x 100
2 Air/water method
3 O = Lightest; 4 = darkest
4 HH = hollow heart; BS = black spot; BC = brown center

Preliminary Yield Trial (PYT2). Of 160 clones grown in the 1987 PYT2, the 40 clones retained for further evaluation are shown in Table 2. CO83098-1 and ND02382-4 are chipping clones and will be tested in the 1988 statewide chip trial, the remaining clones will be advanced to the 1988 statewide variety trial. CO82177-3, A083019-10, A083088-2, A083093-2, and A083196-15 are fresh market selections; the remaining clones all produced acceptable french fries.

The decision to retain or discard individual clones was based largely on data from Klamath Falls, Ontario, and Hermiston, as the Powell Butte trial was flooded as a result of heavy July rains.

Table 2. Yield, grade, fry color, and internal defects of clones retained from the preliminary variety trial, Redmond, Oregon 1987

Variety	Yield-cwt/a Total	No. 1	%[1] RB	Spec[2] grav	Fry[3] color	%[4] HH	BS	BC
R. BURBANK	596	405	100	1.088	1.00	7	0	29
LEMHI	645	540	108	1.087	1.50	0	36	0
NORGOLD	666	522	112	1.072	1.25	0	0	0
CO083008-1	640	550	107	1.089	1.00	0	0	0
CO083020-5	489	302	82	1.088	2.75	7	0	0
CO083021-1	645	526	108	1.096	2.00	0	7	0
CO083021-5	621	576	104	1.092	3.00	7	7	0
CO083023-9	639	518	107	1.082	1.25	0	0	0
CO083066-1	636	505	107	1.095	2.50	14	7	0
CO083067-3	626	525	105	1.080	1.56	0	0	0
CO083085-5	712	626	119	1.079	4.00	0	7	0
CO083098-1	598	501	100	1.085	1.00	0	0	0
CO083120-5	622	491	104	1.089	2.00	0	14	0
CO082177-3	620	434	104	1.070	4.00	36	0	7
AO83005-1	598	537	100	1.093	1.00	0	0	0
AO83010-7	554	485	93	1.076	0.01	14	0	0
AO83019-10	588	548	99	1.079	4.00	0	43	0
AO83026-3	701	595	118	1.089	2.00	0	0	0
AO83029-8	633	566	106	1.077	3.00	0	7	0
AO83037-6	535	443	90	1.087	3.00	0	7	0
AO83037-10	730	633	122	1.079	2.00	0	0	0
AO83065-2	488	378	82	1.082	1.00	7	0	0
AO83088-2	777	584	130	1.076	4.00	7	14	0
AO83093-2	618	483	104	1.072	3.00	0	0	0
AO83110-3	584	397	98	1.084	1.00	0	0	0
AO83119-2	590	379	99	1.087	2.00	0	7	0
AO83119-3	452	195	76	1.081	2.00	0	0	0
AO83148-1	426	300	71	1.090	1.00	0	0	0
AO83177-5	520	359	87	1.080	0.01	0	14	0
AO83177-6	620	431	104	1.081	1.00	0	0	0
AO83196-12	543	397	91	1.087	2.25	0	0	0
AO83196-15	502	374	84	1.074	2.00	0	0	0
AO83206-2	592	415	99	1.079	3.25	0	0	0
AO83218-10	586	388	98	1.084	1.00	0	0	0
AO83222-6	417	210	70	1.077	0.01	0	0	0
AO83222-7	446	267	75	1.081	2.00	0	0	0
AO81323-4	154	59	26	1.073	2.50	0	0	0
AO81323-20	28	4	5	1.080	2.00	0	0	0
AO82098-3	171	40	29	1.080	1.00	0	0	0
NDO2382-4	638	223	107	1.073	0.01	0	0	0

1 % RB = total yield/total yield of Russet Burbank x 100
2 Air/water method
3 O = Lightest; 4 = darkest
4 HH = hollow heart; BS = black spot; BC = brown center

EFFECT OF DIQUAT APPLICATION DATE AND RATE ON VINE DESSICATION AND STEM END DISCOLORATION IN RUSSET BURBANK POTATOES

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ABSTRACT

An experiment was established at Powell Butte, Oregon in 1987 to evaluate the efficacy of Diquat H/A applied at a total of .50 or .75 pounds ai/acre in one, two, or three applications on Russet Burbank potatoes. Because of relatively high soil moisture, warm weather, and actively growing plants, all Diquat treatments dessicated 75% of vines within three days and nearly 100% of the vines were dessicated within seven days. There were no statistical differences in tuber stem end discoloration between the untreated check and Diquat treatments after 120 days in storage. There was no measurable residual diquat detected in the tubers seven days after application at the .75 pounds ai/acre rate.

INTRODUCTION

Dessication of potato vines is often necessary to mature tubers before harvest in central Oregon. Prior to 1987, dinoseb was commonly used in central Oregon, but is no longer available for potato vine dessication. Diquat dibromide (Diquat, Valent, U.S.A. Corporation) was utilized very little by growers prior to the ban of dinoseb because it was more costly than dinoseb and they were largely unfamiliar with it. Experimental trials and some grower experimentation with Diquat revealed it was somewhat slower acting than dinoseb, was effective in cool weather, required good soil moisture for optimal dessication, and required more care in application than dinoseb. The current label specifies up to 0.50 pounds ai/acre of Diquat could be applied for potato vine dessication. This study was part of a national study conducted in major potato growing areas of the United States

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to evaluate the effect of Diquat on potato vine dessication at a total of 0.75 pounds ai/acre applied in two or three applications. Residual Diquat in the tubers was monitored as well as the effect of Diquat on stem end discoloration in stored tubers.

METHODS

A randomized, complete block experiment with four replications was established in late August on the Tom Evans farm in Powell Butte, Oregon in a Russet Burbank field with a good stand and virtually no natural vine senescence. The plots were 6 rows wide (18 feet) by 40 feet in length. Rows were spaced 36 inches apart and plants were spaced at 10 inches in the rows. The trial area was sprinkler irrigated throughout the growing season and a final irrigation was applied three days prior to the first application of Diquat. The field in which the trial was located was fertilized and managed by practices common in central Oregon.

Table 1 summarizes the Diquat application dates and rates evaluated in the trial. Table 2 summarizes the application data for each of the three spray dates.

Table 1. Diquat application rates and dates, Powell Butte, Oregon, 1987

Diquat treatment	1987 dates of application 9/4	9/9	9/14	Total application
	--------------lbs ai/acre			--------------
0+.25+.25	0	.25	.25	.50
0+.25+.50	0	.25	.50	.75
.25+.25+.25	.25	.25	.25	.75
0+0+.50	0	0	.50	.50
Untreated Check	0	0	0	0

Approximately ten pounds of whole, mature tubers were collected seven days after the last Diquat application for residue analysis from the untreated check, 0 + .25 + .50, and .25 + .25 + .25 pounds ai/acre Diquat treatments. The samples were washed, frozen and shipped to the Chevron laboratory in Richmond, California for residue analysis.

The trial was harvested on October 12, 1987, and the following day 50 pounds of tubers were collected from each plot, and placed in poly-mesh bags for stem end discoloration evaluation after 120 days in storage. The samples were placed into storage at 50°F and 95% relative humidity on October 13, 1987. The temperature was lowered to 45°F on December 11, 1987. The samples were removed from storage on

February 10, 1988 and 25 tubers were randomly selected from each plot for stem end discoloration evaluation. The tubers were sliced longitudinally and scored for depth of discoloration.

Table 2. Application data of Diquat, Powell Butte, Oregon, 1987

	1987 Dates of application		
	9/4	9/9	9/14
Time of day	10:30 am	10:30 am	10:45 am
Sky	Clear	Clear	Clear
Wind	None	0-1 mph	0-1 mph
Dew	None	None	None
Air temperature	65°F	71°F	70°F
Soil type	<--Deschutes Sandy Loam-->		
Soil pH	5.2	5.1	5.4
Soil moisture (% of field cap.)	79%	65%	70%
Soil temperature (4 inch)	51°F	58°F	55°F
Surfactant rate (x-77)	<------16 oz/100 gal----->		
Defoamer rate	<-----1/4 oz/100 gal----->		
Sprayer type	<200 gal 3 point Pak-Tank>		
Nozzle	<------8003 flat fan----->		
Nozzle spacing	<---------20 inches------->		
Boom height above canopy	<---------20 inches------->		
Spray pressure	35 psi	35 psi	36 psi
Spray gallonage	24 gal/a	24 gal/a	24 gal/a
Spray water source	<-----City of Redmond---->		
Spray water pH	7.6	7.6	7.6

RESULTS

The effect of Diquat application date and rate on the vine dessication of Russet Burbank potatoes is shown in Table 3. Diquat effectively dessicated potato vines for all treatments under the ideal conditions prevalent in 1987. Nearly 75% dessication was achieved within three days after the initial application for each treatment, and all Diquat treatments were nearly 100% dessicated within one week of the initial application. Vine killing frosts of 29°F were recorded on both September 16 and 17, 1987. The data tabulated for the untreated check in Table 3 quantifies the frost effect.

The effect of Diquat application date and rate on stem end discoloration of Russet Burbank potatoes after 120 days in storage is shown in Table 4. There were no statistically significant differences among the untreated check and Diquat treatments. All tubers cut would be acceptable for either fresh market or processing uses.

Residual Diquat in the tubers seven days after treatment is shown in Table 5. The analytical test procedure can detect Diquat levels above .01 ppm; no measurable diquat was found in the tubers. The treatments where a total of .50 lbs ai/acre was applied were not analyzed for residual Diquat.

Table 3. Effect of Diquat application date and rate on the vine dessication of Russet Burbank potatoes, Powell Butte, Oregon

Diquat treatment[1]	1987 Evaluation date					
	9/7	9/9	9/11	9/14	9/17	9/21
lbs ai/acre	----------% vine kill-----------					
0+.25+.25	0	0	75	85	98	100
0+.25+.50	0	0	76	86	98	100
.25+.25+.25	80	89	94	95	100	100
0+0+.50	0	0	9	10	74	100
Untreated check	0	0	1	5	53	88
LSD 5%	6	4	5	8	11	3
CV (%)	23	16	7	10	9	2

1 Treatments were applied Sept. 4, Sept. 9, and Sept. 14, 1987

Table 4. Effect of Diquat application date and rate on stem end discoloration of Russet Burbank potatoes after 120 days in storage, 1987

Diquat treatment[1]	Stem end discoloration rating[2]				Average rating
	1	2	3	4	
lbs ai/acre	-------number of tubers-------				
0+.25+.25	54	36	10	0	1.56
0+.25+.50	53	40	7	0	1.54
.25+.25+.25	65	32	3	0	1.38
0+0+.50	41	54	5	0	1.64
Untreated check	43	48	9	0	1.66
LSD 5%	NS	NS	NS	NS	NS
CV (%)	25	28	95	0	10.4

1 Treatments were applied Sept. 4, Sept. 9, and Sept. 14, 1987

2 Rating scale: 1 = none, 2 = < 1/4", 3 = 1/4-1/2", 4 = > 1/2"

Table 5. Residual diquat in the tubers seven days after application, 1987

Diquat Treatment	Diquat residue in tubers
lbs ai/acre	ppm
0 + .25 + .50	< .01
.25 + .25 + .25	< .01
Untreated check	< .01

THE OCCURRENCE OF POTATO VIRUSES IN OTHER CROPS, WEEDS, RANGE PLANTS

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ABSTRACT

Potato leafroll virus (PLRV) and Potato Virus Y (PVY) are transmitted by aphids, which themselves feed on diverse plant species within and away from potato fields. A preliminary survey was conducted of numerous overwintering and perennial plant species which (theoretically) could serve as overwintering reservoirs of aphid-vectored potato viruses. All surveyed plants were within a few miles of potato fields in Central Oregon and the Columbia Basin. Serological evidence was gathered which suggested that PVY was present in numerous plant species, including common crops, weeds, and range plants. The incidence of suspected infection was highly variable within plant type, ranging from 0-60%. PLRV can be difficult to distinguish serologically from related viruses such as Beet Western Yellows Virus (BWYV), which is known to be very cosmopolitan among plant species. Initial survey results indicated the presence of these types of viruses in numerous plants. Follow-up tests with distinct monoclonal antisera produced specifically for a strain of PLRV and a strain of BWYV indicated that both viruses were present in the surveyed areas in plants other than potatoes.

INTRODUCTION

Preliminary data were gathered in 1987 to determine how widespread Potato Leafroll Virus (PLRV) and Potato Virus Y (PVY) might be in central Oregon and in the Columbia Basin, specifically in plants other than potatoes. It is known that PVY can infect some other plants, but potatoes are believed to be the primary source for aphid acquisition. PLRV is believed to be restricted to movement by the Green Peach Aphid, but PVY can be less effectively transmitted by a few other known aphids, such as the Potato Aphid. Control of PLRV has been greatly improved by modern methods of elimina-

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tion of virus from potato nuclear stock and by focusing field control on the Green Peach Aphid, but PVY has proven difficult to control with these procedures. We hypothesized that other aphids and other infected plants might be common sources of PVY. For both viruses, most virus acquisition by aphids initially is from infected plants (potatoes or others) early in the season, specifically plants which overwinter. Thus, we focused our investigation on potential overwintering plants other than potato tubers.

PLRV has been presumed to be restricted to potatoes. Recently, Beet Western Yellows Virus has been shown to cause leafroll-like symptoms in potatoes, when BWYV-infected aphids were fed on potatoes. BWYV is very cosmopolitan, infecting many plant species. BWYV and PLRV are closely-related and can react to the same antisera. Furthermore, both PLRV and BWYV, and several other related viruses, produce diverse strains which may vary from typical strains, further confusing identification and interpretation of some published investigations. Like PLRV, BWYV also is commonly vectored by the Green Peach Aphid. These findings have caused researchers to ask if some proportion of potato leafroll symptoms in the field might be due to BWYV, and whether the host range for PLRV might be greater than just potatoes. Recently, antisera to a specific strain of PLRV and a specific strain of BWYV were produced. These two monoclonal antisera clearly distinguish between specific test strains. We assayed plants in our survey with polyclonal antisera to PLRV, which could not distinguish between PLRV and BWYV. We then further tested some of them with the monoclonal antisera of each virus.

MATERIALS AND METHODS

Foliage samples from overwintering annual and perennial plant species were collected from Crook, Jefferson and Deschutes Counties in central Oregon, and from Morrow, Umatilla, and Wasco Counties in the Columbia Basin. Samples were assayed serologically (ELISA) for viruses. Aphids were collected from these and additional plants. Samples were collected at two-four week intervals from May through October, 1987. Sample numbers for many plant species were between 20 and 120 for the season. The serological test included grinding of plant tissue, and treating with serologically-specific antisera from known viruses. The antisera had been tagged with indicator-dye reactants. Positive serological controls included purified viruses and virus-infected potato tissue. Negative controls included potato sap from plants know to be free of viruses. Dye reactions were evaluated conservatively: using a Dynatech Minireader, a "positive" was recorded if the test wells were greater than the mean + 4s (n=6 control wells), with two test wells required to be positive. Samples were re-tested for each antiserum if first tests gave mixed results, and some samples were processed in two different laboratories.

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RESULTS

Data are summarized in Tables 1 through 4 for all spring-through-fall sampling dates and for all sites and regions, as there was only slight variation among times, regions and areas. No universally-high non-specific absorbent values were found for any plant species.

PVY was commonly detected in the Compositae (6-60% positive in 9 of 20 species), the Umbelliferae (7-26% in 2 of 2 species), the Leguminosae (6-11% in 2 of 11 species), the Polygonaceae (8-20% in 2 of 5 species) and also in the Chenopodiaceae, Boraginiaceae, the Malvaceae, and the Rosaceae (Tables 1 and 2). Positive reactions were found in 5-46% of samples from 15 species (6 from Compositae, 4 for Cruciferae, and 1 each from the Polygonaceae, Chenopodiaceae, Boraginiaceae, Malvaceae and Geraniaceae) for two different polyclonal PLRV antisera (PLRV/BWYV serogroup) (Table 1). Later in the season, the list of surveyed plants was narrowed to a few species which had frequently reacted positively with polyclonal PLRV antisera. When monoclonal antisera then was utilized, PLRV was found in 85 and 83% of dandelion (*Taraxicum officinale*) and green rabbitbrush (*Chrysothamnus viscidiflorus*), respectively. BWYV was found in 39% of the dandelions. It seems likely that these, and probably other species commonly harbor PLRV, BWYV and PVY in our region. Our preliminary survey was not designed to monitor aphids adequately. Nevertheless, aphids were identified when found (Table 4). Green peach aphid was not among those aphids discovered on the surveyed plants, even though they were commonly present in the area.

DISCUSSION

We recognize the uncertainty of interpreting serological data without the use of known infected survey plants and known non-infected survey plants as comparisons with unknown surveyed plants. Until we can do follow-up surveys and controlled transmission studies in which we clearly move PVY and/or PLRV from potatoes (or other plants) into suspected host plant types, and move these back onto virus-free potatoes, our preliminary data should be interpreted with caution. Although confirmation from our findings could influ ence virus/aphid/weed control practices near potato seed or commercial fields, it is too early to develop firm conclusions and guidelines.

Nevertheless, we tentatively conclude that there maybe extremely abundant PVY on a very wide range of overwintering plants near potato fields. Additionally, PLRV may be present in at least several of our most common plants, if not in many different plant types. With the use of several polyclonal antisera and the use of follow-up monoclonal antisera for distinguishing PLRV from BWYV, we find our data compelling. The level of BWYV in our areas is not clear. Notably, many of our positive findings were from perennial plants, so inoculum reservoirs may be permanent or semipermanent, and virus incidence might be expected to increase in perennials if the virus is not debilitating. We hypothesize that abundant transfer of virus from those reservoirs is very possible.

Plant samples were few enough for some plant species that detectable infection levels would have to be somewhat high. Negative data for low plant numbers also should be interpreted with caution. Our 1987 data do not tell us if, or when, viruses are being transmitted into potatoes from other plants, nor which aphids specifically may be involved. With continued funding, these questions may be addressed.

Table 1. Positive serological determination of PVY and PLRV/BWYV serogroup* in overwintering weeds, crop, desert and range plants in and near potato-production regions of Oregon in 1987**

Family / Scientific name	Common name	Perennial (p), biennial (b), overwintering annual (oa)	Total n	+ve for PVY n***	+ve for PVY %	+ve for PLRV/BWYV serogroup n	+ve for PLRV/BWYV serogroup %	+ve for PVY & PLRV/BWYV serogroup n	+ve for PVY & PLRV/BWYV serogroup %
COMPOSITAE									
Taraxicum officinale	dandelion	p	79	46	58.2	36	45.6	31	39.2
Lactuca serriola	prickly lettuce	oa,b	72	11	15.3	11	15.3	--	--
Lactuca pulchella	blue lettuce	p	5	3	60.0	--	--	--	--
Achillea millefolium	yarrow	p	23	2	8.7	--	--	--	--
Centaurea repens	Russian knapweed	p	7	1	14.3	--	--	--	--
Chrysothamnus viscidiflorus	green rabbitbrush	p	65	35	53.8	5	7.7	4	6.2
Chrysothamnus nauseosus	grey rabbitbrush	p	74	8	10.8	4	5.4	--	--
Artemisia tridentata	sagebrush	p	79	5	6.3	3	3.8	--	--
Undetermined Compositae	?	?	13	2	15.4	--	--	--	--
CRUCIFERAE									
Brassica campestris	turnip (volunteer)	oa,b	114	--	--	4	3.5	--	--
Brassica napus	rapeseed (cultivated)	oa,b	62	1	1.6	1	1.6	--	--
Sisymbrium altissimum	tumble mustard	oa	99	1	1.0	--	--	--	--
Lepidium latifolium	perennial pepperweed	op	3	--	--	1	33.3	--	--
Lepidium perfoliatum	clasping leaf pepperweed (yellow flower pepperweed)	oa	19	--	--	1	5.3	--	--
LEGUMINOSAE									
Lupinus sp.	lupine	p(?)	9	1	11.1	--	--	--	--

TABLE 1 (continued)

Plant species: Family / Scientific name	Common name	Perennial (p), biennial (b), overwintering annual (oa)	Total n	+ve for PVY n***	+ve for PVY %	+ve for PLRV/BWYV serogroup n	+ve for PLRV/BWYV serogroup %	+ve for PVY & PLRV/BWYV serogroup n	+ve for PVY & PLRV/BWYV serogroup %
POLYGONACEAE									
Polygonium convolvulus	field bindweed	p	5	1	20.0	--	--	--	--
Rumex venosus	veiny dock	p	12	--	--	1	8.3	--	--
Rumex crispus	curly dock	p	13	1	7.7	--	--	--	--
UMBELLIFERAE									
Daucus carota	carrot (cultivated)	oa	115	30	26.1	--	--	--	--
Cicuta douglasii	poison hemlock	b	55	4	7.2	--	--	--	--
CHENOPODIACEAE									
Salsola kali	Russian thistle	oa	24	2	8.3	1	4.2	--	--
BORAGINIACEAE									
Amsinckia sp.	fiddleneck	oa	19	3	15.8	2	10.5	2	10.5
MALVACEAE									
Malva neglecta	mallow	oa,b	25	1	4.0	1	4.0	--	--
GERANIACEAE									
Erodium cicutarium	red-stem filaree	oa,b	32	--	--	3	9.4	--	--
ROSACEAE									
Purshia sp.	bitterbrush	p	18	2	11.1	--	--	--	--

* Two different polyclonal PLRV antisera were utilized; neither polyclonal PLRV antiseram was considered able to distinguish between PLRV or BWYV, and possibly other serologically-related luteoviruses. Plant species in which no positive responses were found to either virus are listed in Table 2. Data from monoclonal antisera to PLRV and BWYV are in Table 3.

** Total of all specimens between April 21 and October 15 in three potato production regions.

*** n = Number of specimens per category, mixed infections in last column are included in the totals of other columns.

Table 2. Plant species (by family) of overwintering weeds, crop, desert and range plants in Oregon in 1987 in which ELISA reactions to PVY or PLRV/BWYV serogroup were determined negative or were unconfirmed.*

SOLANACEAE: Solanum tuberosum (volunteer and cull pile potatoes) [35].

COMPOSITAE: Tanacetum vulgare (tansy) [1], Senecio vulgaris (groundsel) [6], Cirsium vulgare (bull thistle) [6] Cirsium arvense (canadian thistle) [15], Centaurea cyanus (bachelor button) [2], Tragopogon sp. (salsify) [8], Onopordum acanthium (Scotch thistle) [9] Matricaria matricariodies (pineapple weed) [3], Sonchus oleraceus (sow thistle) [3] Centaurea sp. (undetermined knapweed) [2], Cirsium sp. (undetermined thistle) [2], Balsamorhiza sagittata (arrowleaf balsamroot) [25], undetermined composite [13].

CRUCIFERAE: Brassica spp. (undetermined mustard) [5], Brassica nigra (black mustard) [1], Capsella bursa-pastoris (shepherd's purse) [33], Descurainia sophia (tansy mustard) [26], Descurainia pinnata (flixweed) [14], Chlorispora tenella (purple mustard) [3], Thlaspi arvense (field penny-cress) [2], Camelina spp. (undetermined species) [7], Raphanus sativus (cultivated radish) [2].

LEGUMINOSAE: Vicia villosa (hairy vetch) [3], Medicago sativum (cultivated alfalfa) [12], Medicago lupulina (black medic) [2], Trifolium album (white clover) [3], Psoralea lanceolata [17], Vicia sp. (undetermined species) [9], Astragalus sp. (undetermined vetch) [1], Astragalus succumbens (Columbia milkvetch) [6], Robinia pseudo-acacia (black locust) [1].

POLYGONACEAE: Polygonum aviculare (prostrate knotweed) [3], Rumex acetosella (red sorrel) [1].

AMARANTHACEAE: Amaranthus retroflexus (redroot pigweed) [24], Amaranthus blitoides (prostrate amaranth) [2].

CHENOPODIACEAE: Chenopodium album (lambsquarters) [17], Eriogonum sp. (undetermined buckwheat) [12].

SCROPHULARIACEAE: Verbascum thapsus (flannel mullen) [8], Linaria vulgaris (yellow toadflax) [1].

LABIATAE: Lamium amplexicaule (henbit) [4], Marrubium vulgare (hoarhound) [2].

RANUNCULACEAE: Ranunculus testiculatus (testiculate buttercup) [2].

TABLE 2 (continued)

CONVOLVULACEAE: Convolvulus arvensis (field bindweed) [2].

LYTHRACEAE: Lythrum salicaria (loosestrife) [2].

PLANTAGINACEAE: Plantago sp. (undetermined plantain) [2].

HYDROPHYLLACEAE: Phacelia sp. (undetermined species) [3].

EUPHORBIACEAE: Euphorbia spp. (undetermined species) [1].

URTICACEAE: Urtica dioica (stinging nettle) [1].

POLENOMIACEAE: Phlox spp. (undetermined species) [4].

RUBIACEAE: Galium spp. (undetermined species) [1].

CARYOPHYLLACEAE: Cerastium vulgatum (chickweed) [1].

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* ELISA reactions either distinctly absent, not strong enough, or inconsistently positive on retesting. Number in brackets is the number of specimens tested between April 21 and October 15, 1987.

Table 3. ELISA reactions (polyclonal and selected monoclonal antisera) for PVY, PLRV and BWYV for specific dandelion (<u>Taraxacum officinale</u>) and green rabbitbrush (<u>Chrysothamnus nauseosus</u>) plants for three 1987 sampling dates in the Hermiston and central Oregon regions of Oregon.

			ELISA reaction																	
			PVY antisera[b]						Polyclonal PLRV/BWYV serogroup antisera[b]						Monoclonal antisera[b]					
	Specimen		#1			#2			#1			#2			PLRV			BWYV		
Species	no.	Location[a]	D1	D2	D3[c]	D1	D2	D3	D1	D2	D3	D1	D2	D3	D1	D2	D3	D1	D2	D3
Dandelion[d]	1	H	+	+		+	+	+	+	+		+	+	+	-	-	-	+	+	+
	2	H	+	+		+	+	+	-	-		-	-	-	+	+	+	-	-	-
	3	H	+	+		+	+	+	+	+		-	-	-	-	-	-	-	-	-
	4	H	+	+		+	+	+	-	-		+	+	+	-	-	-	+	+	+
	5	H	+	+		+	+	+	-	-		-	-	-	+	+	+	-	-	-
	6	H	+	+		+	+	+	-	-		+	+	+	-	-	-	-	-	-
	7	H	+	+		+	+	+	-	-		+	+	+	+	+	+	-	-	-
	8	H	+	+		+	+	+	-	-		+	+	+	+	+	+	-	-	-
	9	H	+	+		+	+	+	-	-		+	+	+	+	+	+	-	-	-
	10	H	+	+		+	+	+	+	+		+	+	+	+	+	+	-	-	-
Green Rabbitbrush																				
	1	CO	+	+		+	+	+	-	-		-	-		-	-	-	-	-	
	2	CO	+	+		+	+	+	-	-		-	-		-	-	-	-	-	
	3	CO	-	-		-	-	-	-	-		-	-	-	+	+	+	-	-	
	4	CO	-	-		-	-	-	-	-		-	-	-	+	-	-	-	-	
	5	CO	-	-		-	-	-	+	-		-	-	-	+	+	+	-	-	
	6	CO	-	-		-	-	-	+	+		-	-	-	+	+	+	-	-	
	7	CO	-	-		-	-	-	+	+		-	-	-	+	+	+	-	-	
	8	CO	-	-		-	-	-	+	+		-	-	-	+	+	+	-	-	
	9	CO	-	-		-	-	-	-	-		-	-		-	-	-	-	-	
	10	CO	+	-		+	-	-	-	-		-	-		-	-	-	-	-	

a H = Hermiston, CO = central Oregon.

b See text for sources of antisera.

c D1, D2, D3 = Aug. 12, Sept. 14 and Oct. 15, 1987. Not every specimen was sampled for each date.

d For 30 additional dandelions sampled from central Oregon for these dates, nearly all were positive for PVY and PLRV (both monoclonal and polyclonal), and all were negative for BWYV monoclonal antiserum.

Table 4. Aphids found on surveyed winter annual and perennial plants in central Oregon and Hermiston, Oregon, 1987

Aphids found	Plants species found on
Acyrthosiphum lactuca (Passerini)	*Lactuca serriola* (prickly lettuce)* *Sisymbrium altissimum* (tumble mustard)
Acyrthosiphum purshiae (Palmer)	*Purshia tridentata* (bitterbrush)
Braggia eriogoni Cowen)	*Eriogonum* sp. (buckwheat)
Capitophorus eleagoni (del Guercio)	*Circium arvense* (Canadian thistle)
Lipaphis erysimi (Davis)	*Brassica napus* (rapeseed)* *Raphanus sativus* radish)
Macrosiphum euphorbiae (Thomas)	*Taraxacum officinale* (dandelion) *Lactuca serriola* (prickly lettuce) *Brassica napus* (rapeseed) *Raphanus sativus* (radish)
Macrosiphum sp.	*Amaranthus retroflexus* (red root pigweed)
Obtusicauda artemesicola (Williams)	*Artemesia tridentata* (sagebrush)*
Acyrthosiphum lactucae (Passerini)	*Lactuca putchella* (blue lettuce)
Uroleucon (Morduilko) sp.	*Chrysothamnus viscidiflorus* (green rabbitbrush)
Unknown #3	*Brassica napus* (rapeseed)*
Cavaiella aegopodii (Scopoli)	*Daucus carota* (carrot)
Brachycaudus helichrysi (Kaltenbach)	*Amsinckia* sp. (fiddleneck)

* Indicates frequent occurrence on this plant type.

EFFECT OF FLOATING ROW COVERS ON RUSSET BURBANK POTATOES AT REDMOND, OREGON IN 1987

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ABSTRACT

Number and size of tubers/plot, and yield of Russet Burbank potatoes were evaluated from replicated plots covered the full season with Agronet and Agryl P 17 at Redmond, Oregon in 1987. Response of non-covered (control) and Agronet covered potatoes were similar. However total tuber yield, yield of No. 1 tubers, yield of 6-12, and > 12 oz. tubers, and average tuber size was significantly lower from Agryl P 17 covered plants compared to the other two treatments. The covers were not evaluated for control of insects or diseases. Agryl P 17 developed holes by mid-season compared to none for Agronet. Cover durability is necessary to exclude insects.

INTRODUCTION

Many different kinds of plastic materials have come into widespread use in world agriculture to improve yield and/or quality of vegetables (1). Materials used to cover plants may be either supported, for example, with metal hoops, or laid directly on the plants in which case the plants push or raise the cover during growth. These later covers, called floating row covers, are very light but some cause high temperatures deleterious to plant growth. Covers have also controlled insects and diseases. Covers reduce virus transmission in potatoes but Agryl, Reemay, and Agronet covers reduced number of tubers per plot and total yield on 'Norgold' potatoes grown at the North Willamette Experiment Station in 1986, however, the reverse occurred in 1987 (2, 3). Reed found that Agronet substantially depressed tuber numbers and total weight per acre of 'Butte' potatoes at Hermiston in 1987. Additional data are needed to define the effects floating row covers have on potato varieties in Oregon. There is no information from the central Oregon region. Therefore a small study was initiated at Redmond, a

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cool, short growing season area, to begin data collection of cover effects on potato growth.

MATERIALS AND METHODS

The study was conducted at Redmond, Oregon on Oregon State University nuclear VT-SC Russet Burbank potatoes planted May 14, 1987, in rows 36 inches apart. A 19-14-15-06 fertilizer at 1100 lbs/A was banded at planting. Agronet, a UV stabilized extruded film/net of polypropylene and polyamide, and Agryl P 17, a nonwoven spunbonded polypropylene material, were placed on 9 x 30 foot plots on June 2 for comparison to a non-covered control treatment. The potato plants were beginning to emerge. The three treatments were replicated four times in a randomized complete block design. Each cover was 21 feet wide by 40 feet long which allowed for full potato vine growth without restriction. The covers were removed for hilling on June 19. Covers on the center row of plots were removed July 8 and 27 when Metribuzen (.25 lb ai/A) was applied for weed control. No Temik was applied for insect control except by accident on Agryl P 17 covered plot in replicate four. Potato plants were dusted with Sevin for Colorado potato beetle control when needed. The experiment was irrigated as needed. However from July 20-25 nearly 3.5 inches of rain occurred with water standing for sometime on the plots. Plants in replicate four may have been adversely affected because this was the low part of the field and water remained on these plots for a longer time.

Covers were left on plots until shortly before harvest on October 14. Twenty-five feet of the center row of each plot was dug for yield, number, and tuber size determinations. Data were analyzed statistically. Neither plants nor tubers were tested for virus infection.

RESULTS AND DISCUSSION

Total yield and yield of No. 1 potatoes were similar from Agronet covered potatoes and non-covered plants but Agryl P 17 significantly depressed these yield components (Table 1). There was also less yield of 6-12 oz. tubers under Agryl P 17. The yield of 12 oz. and larger tubers from plants covered with Agryl P 17 were significantly less than non-covered plants but similar to plants under Agronet. Data show no significant differences among covered and non-covered plants for number of tubers although there may be a slight trend toward fewer tubers when plants are covered. The average tuber weight from Agryl P 17 covered plants was significantly lower than Agronet and non-covered plants.

The adverse affect from Agryl P 17 is probably due to heat stress since temperatures are higher under Agryl P 17 than

Agronet according to Hemphill (2) and Reed (3). No temperature data were collected in this experiment. However, there was burning on the margin of many potato leaves two to three weeks after shoot emergence under Agryl P 17 but none was observed on leaves under Agronet. Hemphill found that row covers reduced the number of tubers and total yield for 'Norgold' potatoes but only Agryl reduced the mean tuber weight. Reed found substantial reductions for the later maturing cultivar 'Butte'. He also reports that Hemphill obtained a slight increase in tuber numbers and total weight per acre in 1987. Reed hypothesis that covers could be a positive factor in the cooler portions of Oregon devoted to seed production. However one year (1987) results on Russet Burbank potatoes at Redmond did not show this. The suggestion by Hemphill that row covers might be more effectively utilized on very early plantings with covers removed at the onset of hot weather appears to be more plausible. Future research should be conducted to define the benefits of row covers for the production of disease free potato seed in the cool central Oregon region.

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Table 1. Effect of floating row covers on tuber number, size, and yield of Russet Burbank potatoes at Redmond, Oregon, 1987

Treatment	Tuber yield								Tuber no.[c]	Avg. tuber wt.[d]
	Total[a]	<4 oz.	4-6 oz.	6-12 oz.	>12 oz.	No. 1[b]	No. 2	Culls >4 oz.		
	ctw/a									oz.
No cover	560	108	93	240	96	429	9	13	248	6.3
Agronet	540	104	104	237	68	409	7	20	245	6.1
Agryl P 17	330	113	79	110	12	201	4	13	225	4.1
Mean	477	108	92	196	59	346	7	15	239	5.5
LSD 5%	127	32	40	72	69	153	12	19	44	1.6
LSD 1%	192	48	61	109	104	232	19	29	66	2.4
CV %	15	17	25	21	68	26	106	73	11	16.7

a Total yield = < 4 oz. + 4-6 oz. + 6-12 oz. + 12 oz. + No. 2 + > 4 oz.
b No. 1 = 4-6 oz. + 6-12 oz. + >12 oz.
c Tuber number = average number of tubers in four single 25 foot long rows.
d Avg. tuber size = total yield per plot/no. of tubers per plot.

RESPONSES OF GARLIC TO NEMATODE SEED TREATMENT, NEMATICIDE AND TIME OF PLANTING

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ABSTRACT

Planting date effects likely are far greater than single or interactive effects from (these particular) seedlots, hot water-formaldehyde seed treatment, or Nemacur in-furrow treatments. With late planting and with no nematode disease pressure, hot water-formaldehyde seed treatment favored slightly better spring emergence and yield over Nemacur in-furrow treatment, but these differences were small and did not occur with early planting. In fact, with early planting, there was evidence that Nemacur aided early establishment in the fall, but this affect did not carry over into measurable spring emergence or harvest responses, and no such affect was seen with later planting.

INTRODUCTION

Garlic (<u>Allium sativum</u>) is grown using cloves as seedstock. Production continually is threatened by the clove-borne nematode <u>Ditylenchus dipsaci</u>, which proliferates in the storage leaves and, in high populations, degrades the developing bulb. This nematode pest persists only a few years in soil in the absence of garlic or other <u>Allium</u> species. Hot water treatment of cloves prior to planting eradicates the nematodes from planting stock, or supresses populations to sub-damaging levels. However, such treatment reduces clove vigor, especially if planting is delayed. If improperly done, hot water treatment may kill the cloves. Formaldehyde has been incorporated into hot water treatments for additional nametode control, but formaldehyde increasingly is under regulatory restriction. Nematicides applied at seeding might substitute for hot water-formaldehyde treatments, but there is some suspicion that the most available nematicide. Nemacur might be phytotoxic. This study was designed to evaluate this possibility compared to standard seed treatments. In the absence of nematode disease pressure, will nematicide effect garlic performance (emergence,

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winter survival, yield) as much or more than hot water/formaldehyde seed treatment? Will this response vary with delayed planting?

MATERIALS AND METHODS

Except where indicated, all handling of seed and plants was as per standard industry practices, and is not specified here. Two seedlots of 'California Early' garlic, harvested from Oregon in 1987, were obtained as #32134 and #31338, provided by Gilroy Foods. Based on seedlot history and prior seed testing, these seedlots, were considered to be as free as possible of Ditylenchus dipsaci, the garlic stem and bulb nematode. Seedlots were cracked and part of each seedlot was treated with hot water and formaldehyde on September 14, 1987; all seed was shipped by truck to Madras, Oregon and all seed was stored prior to planting. The Madras Field of the Central Oregon Experiment Station was utilized. No Allium species had ever been grown in the field selected, and no Ditylenchus dipsaci was found in the soil based on soil analyses prior to planting. Planting dates 1 and 2 were on September 18 and October 2, 1987, respectively. For each date, cloves were sized and planted 200 per plot in two adjacent 5-ft bed sections (20 cloves/bed-ft). Seed was dropped with uniform spacing into planting slices opened by hand with hoes, and hoes were used to cover seed 2 1/2 inches deep. Prior to planting, granules of Nemacur 15 G (15% active ingredient, fenamphos, Mobay Chem. Corp.) were spread into planting slices which were to receive seed that had not been seed treated, in an attempt to simulate a commercial granular application. The labeled rate is 9.2-18.4 oz/1,000 ft of row (15-30 lbs/ac on 40-inch beds, 2 rows/bed). The highest rate was utilized.

The test was arranged as two separate experiments: experiment one was on Planting Date 1, and experiment two was on Planting Date 2. Planting dates were not replicated treatment variables, and therefore were not directly statistically compared. Within each planting date each seedlot was combined with either hot water-formaldehyde seed treatment or with Nemacur in-furrow application. Each combination was replicated four times in a complete, randomized block experimental design. Data were evaluated by analysis of variance. Each experiment was in four beds; the two experiments were located side by side, with no separating alleys between them; and commercial garlic was planted adjacent to the outside beds of the experiments. All garlic was irrigated within 1/2 day of planting, and all irrigation and fertilization was as per normal commercial practices. All weeds were removed by hand every two wks during the season. Both fall and spring stand counts were made, as were other observations on general growth during the season. On July 7, 1988, all plants in each plot were lifted by shovel slightly prior to complete drydown, roots and tops were trimmed, and bulbs were weighed.

RESULTS

Unless otherwise indicated, all statements of statistical significance, or lack of, refer to a 5% level ($P \leq 0.05$). Table 1 shows summarized treatment means for stand and yield data for the first planting date. Each treatment combination is not shown. Stand counts were the number of plants present as a percentage of the number of cloves planted. Garlic in the first planting date partially emerged in the fall of 1987, averaging about 17% emergence. At that time, there was 1) a significant difference between nematode control treatments, 2) no significant seedlot effect, and no significant interaction between seedlot and nematode control treatments. In the fall, Nemacur treatments seemed to be emerging faster than the hot water/formaldehyde treatments. The final emergence data (May 13, 1988) for the first planting showed no statistically significant differences among any factors, except for an interaction which was not considered meaningful. Harvest weights were expressed as lbs per plot. Harvest weights were not statistically different among seedlots or among nematode control treatments, or for interactions. Harvest weight differences shown in Table 1 were consistent with differences found for planting date 2, shown in Table 2, and are discussed further below. Growth observations during the 1988 growing season showed plants among all plots to appear identical. Table shows summarized treatment means for stand and yield data for planting date 2. Again, each treatment combination is not shown. No emergence occurred in 1987 for any plots. Time of emergence in 1988 was about the same as for planting date 2. For stands counts evaluated on May 13, 1988, there were highly-significant differences between seedlots ($P \leq 0.004$) and between nematode control treatments ($P \leq 0.002$), but not for interaction between seedlot and nematode treatments. Seedlot #32134 averaged 84.4% and seedlot #31338 averaged 80.8% emergence. Hot water-formaldehyde treated seed averaged 84.6% and in-furrow Nemacur averaged 80.6%. Harvest weights showed no statistically significant differences among any factors, nor among interactions. The following trends were noted, however, for both planting dates: seedlot #32134 averaged slightly higher harvest weight than seedlot #31338, and garlic treated with hot water-formaldehyde averaged slightly higher harvest weight than garlic treated only with in-furrow Nemacur. As within planting date 1, plants in plots from planting date 2 grew uniformly and no growth differences were discerned during the season among plots. Plants in planting date 2 were noticeably smaller than those in the earlier planting for approximately half the season, at which time this difference could not be discerned visually.

DISCUSSION

Differences between planting dates were not statistically evaluated, due to experimental design considerations. Clearly, however, garlic planted earlier emerged faster (beginning in the fall), were larger for much of the 1988 season, and yielded about 20% above garlic planted later.

Within the earlier planting date, although non-seed treated garlic planted into Nemacur-treated soil began to emerge slightly faster in the fall than did seed-treated garlic, this effect did not persist. No other significant differences were observed in the early planting date experiment with respect to spring stand, growth or yield. Within the later planting date, spring emergence favored one seedlot over the other, and hot water-formaldehyde treated garlic performed better than garlic in Nemacur treatments. None of the emergence data was reflected in statistically significant harvest weight differences, so the commercial significance of these differences is not clear. There was a trend with both planting dates for higher yield with one seedlot over the other, and for hot water-formaldehyde treatment over Nemacur treatment, but the importance of this trend is not further evaluated here.

Table 1. Mean values for plant stand and harvest weight from planting date 1 (September 18, 1987).

Stand on 11/2/87

Treatment	lbs/plot	Statistical Significance[a]
Seedlot #1 32134	14.7	N.S.
Seedlot #2 31338	18.5	
Hot water-formaldehyde	11.3	
Nemacur in-furrow	21.9	*

Stand on 5/13/87

Treatment	% Stand	Statistical Significance
Seedlot #1 32134	93.1	N.S.
Seedlot #2 31338	93.3	
Hot water-formaldehyde	93.1	N.S.
Nemacur in-furrow	93.2	

Harvest weight on 7/20/88

Treatment	lbs/plot	Statistical Significance
Seedlot #1 32134	12.8	N.S.
Seedlot #2 31338	11.6	
Hot water-formaldehyde	12.6	N.S.
Nemacur in-furrow	11.8	

a. N.S. = no significance, $P \leq 0.05$; * indicates significance $P \leq 0.05$. No interactions were significant $[P \leq 0.05]$ except for stand 11/2/87.

Table 2. Mean values for plant stand and harvest weight from planting date 2 (October 2, 1987).

Stand on 5/13/88

Treatment	lbs/plot	Statistical Significance[a]
Seedlot #1 32134	84.4	**
Seedlot #2 31338	80.8	
Hot water-formaldehyde	84.6	
Nemacur in-furrow	80.6	**

Harvest weight 7/20/88

Treatment	lbs/plot	Statistical Significance
Seedlot #1 32134	11.0	N.S.
Seedlot #2 31338	9.5	
Hot water-formaldehyde	10.4	N.S.
Nemacur in-furrow	10.1	

a. N.S. = no significance, $P \leq 0.05$; ** indicates significance $P \leq 0.01$ (see text). No interactions were significant.

1986-87 WINTER RAPESEED VARIETY TRIAL AT MADRAS, OREGON

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ABSTRACT

Ten varieties of edible oil type winter rapeseed (Brassica napus L.) were evaluated at the Central Oregon Experiment Station Madras site in 1986-87.

All cultivars were vigorous and survived the mild winter. Flowering began the end of March. Cascade flowered earliest followed by Santana, Lindora, and Liradonna. The average plant height was 47 inches - rather short compared to previous years. The tallest variety was Glacier at 50.5 inches. No variety lodged. Most varieties were similar in yield (ave. of 3680 lbs/A). Cascade had the lowest yield, shortest height, and smallest seed.

INTRODUCTION

Export market opportunities exist for edible oil rapeseed (1). Canada has developed a rapeseed industry based on the marketing of oil low in erucic acid (2% or less) and a meal low in glucosinolates (30 u moles/g or less). Canola is the Canadian term coined for varieties with these specifications (2). Canada has little competition in world export markets; however, the Pacific Northwest and other areas in the U.S. may be able to successfully produce Canola type rapeseed and provide competition. There is also a growing domestic use of rapeseed oils which could eventually surpass the export in volume.

The Central Oregon Experiment Station has been involved in the evaluation of both winter and spring type rapeseed varieties for about a decade in the search for alternative crops (3). A new Oregon winter rapeseed variety evaluation program was initiated in 1986 because of interest by Mitsubishi Corporation, a Japanese oil handler and processor.

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The 1986-87 winter rapeseed variety test at Madras was part of a four-site Oregon testing program.

MATERIALS AND METHODS

Ten winter rapeseed varieties from as many sources (Table 1) were planted August 22, 1986 at Madras. Each entry was replicated four times in a randomized complete block design. Fertilizer was preplant incorporated - 400 lbs/A of 16-20-0-15(S) impregnated with Treflan (1.0 lb ai/A). Seed was sown at a rate of six lbs/A (14 seeds/sq. ft.) in rows eight inches apart. Plots were five feet wide by 20 feet long.

Malathion 5E (1.25 lb ai/A) was applied September 8, 1986 for aphid control.

The trial was irrigated as needed. No post emergence herbicides or fungicides were applied.

Outside rows of each plot and three feet from each end were removed prior to swathing by hand on June 24, 1987. Swathed material was threshed with a Hege combine on July 7. The seed was cleaned with an M-2B Clipper air screen machine. Seed was weighed and yields were calculated. Data were also collected on maturity, plant height, and 1,000 seed weight.

RESULTS AND DISCUSSION

All varieties were vigorous and showed good winter survival - the winter weather was mild. The fall aphid infestation was the only insect problem observed. Cascade began flowering the end of March. It reached 50% bloom on April 10, 1987. Estimated dates of 50% bloom for Santana, Lindora and Liradonna were April 15 with the remaining cultivars reaching this stage on April 20-21. Tandem was the latest variety as evidenced by green pods later in the season. All cultivars matured rather rapidly due to hot weather.

Plant height at maturity was much shorter than observed in previous years for both winter and spring type rapeseed varieties. In this trial Cascade was significantly shorter than other cultivars except Tandem (Table 1). The tallest variety, Glacier, was only 50.5 inches. Lodging did not occur for any variety.

The average seed yield (3680 lbs/A) for all varieties in the trial was the highest observed in the history of rapeseed variety testing at the Central Oregon Experiment Station (3).

Seed yield was similar for all cultivars except Cascade and Viking which were lower. Cascade has yielded 5469 lbs. of seed per acre in Idaho where it was developed (4). This and other research indicates that rapeseed may not be an economically competitive crop in Central Oregon. The 1,000 seed weight for Cascade was similar to Santana and Viking but significantly lower than the other varieties. Generally, the seed weights were less than those of the seed lots used to plant the test.

There may be several winter rapeseed varieties that could be grown in Central Oregon; however, many factors must be considered before attempts are made to introduce rapeseed as an alternative crop. Some of these include its economic competitiveness with other crops in the area and other production areas and its compatibility with other crops in the area. These and other factors must be thoroughly investigated before rapeseed production is undertaken in Central Oregon.

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Table 1. Source, erucic acid and glucosinolate level, height, 1,000 seed weight, and seed yield of ten winter rapeseed varieties at Madras, Oregon, 1986-87

Variety	Source[1]	EA/GLUC level[2]	Height	1000 seed weight	Seed yield
			in	g	lb/A
Cascade	U. of Idaho	Low/Low	42.8	4.38	2721
Ceres	Alan Hick & Assoc.	Low/Low	47.3	5.02	3624
Glacier	Normarc Seeds	Low/Low	50.5	5.28	3842
Lindora	Canola, Inc.	Low/?	48.0	5.11	3694
Lirabon	Burlingham & Sons	Low/Low	45.5	4.84	4322
Liradonna	Alan Hick & Assoc.	Low/Low	48.0	4.86	4282
Mitre	Nickerson RPB LTD	Low/Int.	46.0	5.07	3738
Santana	Agrimax-Hilsenkopf	Low/Low	47.8	4.48	3836
Tandem	Various	Low/Int.	43.8	5.18	4015
Viking	Daehnfeldt, Inc.	Low/Low-Int.	47.8	4.64	2721
		Mean	46.7	4.89	3680
		LSD (5%)	2.5	0.40[3]	896[3]
		CV (%)	4	6	17

1 Source = Originator or distributor.
2 EA = erucic acid in the oil; GLUC = glucosinolate in the defatted seed meal; EA Level: low = <2%; GLUC Level: low = <30 u moles/g of glucosinolate.
3 This value is the PLSD (5%).

1988

RESEARCH

RESULTS

METEOROLOGICAL DATA - 1988
Redmond, Oregon*

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	1988 TOTAL
AIR TEMP. (°F)													
AVE. MAX. TEMP.	40	52	54	62	64	72	84	84	76	73	48	45	
AVE. MIN. TEMP.	23	25	26	34	35	44	47	43	38	37	32	23	
MEAN TEMP.	32	39	40	48	50	58	65	63	57	55	40	34	
AIR TEMPERATURE (No. of Days)													
MAX. 90 OR ABOVE	0	0	0	0	0	0	9	5	4	0	0	0	
MAX. 32 OR BELOW	8	1	0	0	0	0	0	0	0	0	0	4	
MIN. 32 OR BELOW	28	24	24	11	12	2	1	0	10	5	20	24	
MIN. 0 OR BELOW	0	0	0	0	0	0	0	0	0	0	0	1	
GROUND TEMP. (°F at 4")													
AVE. MAXIMUM	26	30	37	46	53	61	71	71	61**	56	38	30	
AVE. MINIMUM	24	27	32	40	46	53	61	61	53**	49	35	27	
MEAN TEMP.	25	29	35	43	50	57	66	66	57**	53	37	29	
PRECIPITATION (inches)													
MONTHLY TOTAL	.99	.32	.49	1.43	.39	1.30	.00	.34	.14	.00	2.26	.35	8.01
EVAPORATION (Ave. Inches Per Day)	--	--	--	.11**	.20	.22	.34	.31	.21	--	--	--	
WINDAGE (Ave. Miles Per Day)	62	57	77	79	67	53	54	51	59	46	82	66	

Growing Season:	**Last Date Before July 15**	**First Date After July 15**	**Total Number of Days Between Temp. Minimums**
Air Temp. Min. 32° or below	7/6	9/10	65
Air Temp. Min. 28° or below	5/30	9/18	110
Air Temp Min. 24° or below	5/17	11/14	180

METEOROLOGICAL DATA - 1988
Madras, Oregon*

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	1988 TOTAL
AIR TEMP. (^{o}F)													
AVE. MAX. TEMP.	38	50	55	63	67	75	86	86	77	71	49	42	
AVE. MIN. TEMP.	24	26	29	36	38	46	50	47	43	42	33	23	
MEAN TEMP.	31	38	42	49	53	61	68	67	60	56	41	33	
AIR TEMPERATURE (No. of Days)													
MAX. 90 OR ABOVE	0	0	0	0	0	4	13	7	5	0	0	0	
MAX. 32 OR BELOW	9	0	0	0	0	0	0	0	0	0	0	6	
MIN. 32 OR BELOW	28	25	21	11	8	0	0	0	2	4	13	27	
MIN. 0 OR BELOW	0	0	0	0	0	0	0	0	0	0	0	0	
GROUND TEMP. (^{o}F at 4")													
AVE. MAXIMUM	--	--	--	61**	66	76	87	84	72	67**	--	--	
AVE. MINIMUM	--	--	--	49**	56	64	74	73	64	61**	--	--	
MEAN TEMP.	--	--	--	55**	61	70	81	79	68	64**	--	--	
PRECIPITATION (inches)													
MONTHLY TOTAL	1.72	.07*	.67	1.65	.25	1.47	T	T	.29	T	2.79	.44	9.35
EVAPORATION (Ave. Inches Per Day)	--	--	--	.13**	.21	.24	.34	.32	.22	.15**	--	--	
WINDAGE (Ave. Miles Per Day)	--	--	--	55**	67	52	59	51	56	34**	--	--	

Growing Season:	**Last Date Before July 15**	**First Date After July 15**	**Total Number of Days Between Temp. Minimums**
Air Temp. Min. 32^{o} or below	5/30	9/17	109
Air Temp. Min. 28^{o} or below	5/26	10/27	153
Air Temp Min. 24^{o} or below	3/28	11/30	246

METEOROLOGICAL DATA - 1988
Prineville, Oregon*

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	1988 TOTAL
AIR TEMP. (°F)													
AVE. MAX. TEMP.	40	55	57	64	70	78	90	87	79	77	48	45	
AVE. MIN. TEMP.	24	23	24	34	35	42	44	39	34	32	29	21	
MEAN TEMP.	32	39	40	49	52	60	67	63	56	55	39	33	
AIR TEMPERATURE (No. of Days)													
MAX. 90 OR ABOVE	0	0	0	0	2	8	17	11	5	2	0	0	
MAX. 32 OR BELOW	8	1	0	0	0	0	0	0	0	0	0	5	
MIN. 32 OR BELOW	25	25	26	11	12	3	1	1	15	13	21	29	
MIN. 0 OR BELOW	0	0	0	0	0	0	0	0	0	0	0	1	
PRECIPITATION (inches)													
MONTHLY TOTAL	1.33	.38	.61	1.34	.70	.67	.00	.11	.06	T	2.54	.18	7.92

Growing Season:	**Last Date Before July 15**	**First Date After July 15**	**Total Number of Days Between Temp. Minimums**
Air Temp. Min. 32° or below	7/6	8/21	45
Air Temp. Min. 28° or below	5/30	8/12	104
Air Temp Min. 24° or below	5/4	9/18	136

* No meteorological data are recorded at the COES Powell Butte field. Redmond data are recorded at COES facilities. Prineville data are from KRCO, four miles NW of Prineville. Madras data are recorded at the North Unit Irrigation District offices, adjacent to the COES field.

** Missing data.

NA = Not available.

T = Trace precipitation, not affecting total.

EFFECT OF ELECTRICAL FIELDS, IONS AND NOISE ASSOCIATED WITH HIGH VOLTAGE DC TRANSMISSION LINES ON NEARBY CATTLE AND CROPS

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ABSTRACT

A three-year study was conducted in central Oregon to determine the possible effects of a ±500-kV direct-current (d-c) transmission line on cattle and crops. Two herds totalling 100 beef cows and six bulls were confined in pens beneath the d-c line. The cows were paired and the other members of the pairs were maintained in two herds in control pens 2,000 ft west of the line. The management facilities under the power line were duplicated in the control area. There were no significant differences in consumption of feed, minerals or water between the line and control herds. Also, no effects were found on breeding, conception, calving, calf birth date, calving interval, average daily gain, adjusted mwaning weight, cow weight, condition, carcass weight, and mortality. Differences were found between years for calf birth date, average daily gain, adjusted weaning weight, and cow weight. These differences were attributed to condition and age of the cows entering the study and their adjustment to pen confinement.

Alfalfa hay and winter wheat were produced for two years near two span midpoints of the d-c line. Crops were raised in strips extending in both directions beneath and perpendicular to the line. An identical set of control plots were placed 2,000 ft from the line. Analysis of data from line vs control plots showed no consistent statistical differences for production, seasonal growth stages or heights, hay or grain quality, or infectious disease. Wheat heights were slightly shorter among line plots than among control plots, although this was not clearly a response to the d-c

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line. There was limited evidence of slightly increased but biologically insignificant tipburn on wheat directly beneath the d-c line. Wheat plants were exposed to a d-c electric field in a laboratory test to establish corona onset levels. Based on this lab test, plants beneath the line experienced frequent daytime corona, but this could not be visualized in the field.

Data from four separate efforts were integrated to provide exposure estimates for cattle and crops. The Bonneville Power Administration provided measurements of d-c electric fields and air ions at ten fixed and one mobile station. The mobile station measured electric field, ion current, and space charge density at 25 locations in the cattle pens and crop area for 1 to 2-week periods.

The electrical measurements provided the data base for modeling the electrical environment in the entire study area. Monthly average levels of electric field, ion current density and ion density were estimated for locations within the cattle pens and along the crop plantings. Estimates of variation for the electrical parameters were also included in the models developed by T. Dan Bracken, Inc.

Observations of cattle location in study pens were used to develop estimates of time spent by the cattle at various distances from the d-c line. Location data for calves were also collected to permit estimates of their distribution. The estimated levels for electrical parameters were combined with the location data to yield a monthly time-integrated exposure for the average cow.

To translate the electrical environment measurements to a dose-related quantity, ion currents were collected with a full-scale cow model under the d-c line. Measurements were made at several locations in unshielded and shielded situations. These measurements were related to laboratory measurements using the simple geometric model. The exposure model measurements and dosimetry analyses were performed by Battelle Pacific Northwest Laboratories.

The following is a summary of a 450 page report, which contains details of the research site, experimental methods and results, plus a literature review. The full final report may be ordered as follows: "Joint HVDC Agricultural Study: Final Report", U.S. Department of Energy, Bonneville Power Administration, Portland, Oregon.

INTRODUCTION

Background. There are various phenomena associated with high voltage (hv) direct-current (d-c) transmission lines which theoretically could affect plants or animals. These include 1. electric fields, 2. the quantity, electrical features and chemical nature of ions produced by corona at the surface of line conductors, and 3. noise. The chemical nature of ions produced in this study was not determined. With d-c power transmission, ozone and magnetic fields are infinitesimal, and limited data collected in this study confirmed their insignificance.

In contrast to alternating current (a-c) lines, d-c line conductors generate many charged ions that get into the environment. Ion movement is influenced by the wind, so the electrical environment around the transmission lines frequently changes.

The following terms may be helpful in reading this summary:

a) Voltage on the transmission line is expressed as kV = thousands of volts. A plus sign (+) indicates voltage traveling in one direction, a minus sign (-) indicates voltage traveling in the opposite direction. For paired transmission line conductors, each carrying 500 kV, this is described as ±500 kV for the line.

b) Corona is electrical discharge which occurs when molecules of air, water, dust, insect and other objects ionize on the surface of line conductors. It is accompanied by noise and light. The intensity of corona varies with the line voltage and environmental conditions. The light usually is too faint to see.

c) Electrical fields are expressed as kV/m, which is thousands of volts per meter. There may be contributions from both the static electric field around line conductors and electric field contributed by charged ions.

d) The amount of current carried by ions is expressed as nA/m^2, or billionths of amperes per square meter.

e) The numbers of ions found at different locations is expressed as ion density = $k\text{-ions}/cm^3$, which is thousands of ions per square centimeter.

Interest in the possible environmental effects of high voltage d-c (HVDC) transmission lines developed as a result of public controversy over the need for a ±400-kV d-c line in Minnesota. Surveys conducted after the line was energized in 1978 indicated that some people believed the line had adversely affected people, wildlife, and livestock.

However, a scientific committee formed by the State of Minnesota concluded that the survey was inadequate and inconclusive.

A majority of the Minnesota committee also concluded that there was no scientific evidence to indicate that short-term exposure to the d-c line posed a risk to human health. One committee member, however, concluded that the air ions produced by the line represented a potentially significant hazard. All of the committee concluded there was virtually no information on the possible long-term effects of exposure to elevated air ion concentrations. Among their recommendations was that there was need for studies of crops and livestock raised near a d-c line.

A study of dairy cattle in Minnesota was subsequently conducted (1). Dairy cattle production was assessed by examining Dairy Herd Improvement Association records from before and after the d-c line was energized. Other than general estimates of distances of herds from the d-c line, no information on electric field or air ion exposures were developed. The study found no chronic or acute effects attributable to the line on milk production, reproductive problems, or incidence of abortions. The researchers added, however, "If, in fact, substantial exposure to air ions and electric fields is present on a few farms, then this study could not have observed power line effects".

No studies of crop growth near the d-c line in Minnesota have been reported. Wheat growing at various distances from the D-C Intertie in Oregon was studied when the intertie was operated at ±400-kV. At harvest time, no significant differences were found in plant height, or in quantity, number, or germination of seeds that were related to the d-c line.

The studies discussed above are the only previously published field studies on the possible effects of commercial HVDC lines on animals and plants. There is a large and controversial body of literature involving laboratory studies of people, animals, and plants exposed to d-c electric fields and air ions. Most of this research, however, was not specifically done to assess the possible effects of d-c power lines.

Other reviews of the literature on effects of air ions on people and animals was published in 1987 (2, 3). This review concluded that reported effects of air ions are generally small in magnitude, and transient (effects were no longer present after exposure to air ions was stopped).

The reviews monitored above generally concluded that short-term adverse effects of air ions or d-c fields are unlikely. Research on possible long-term effects, however, is limited. Only three previous studies of animals and plants living near an HVDC line have been published and both involved ±400-kV d-c lines (4, 5, 6). For these reasons, the present study was developed to examine possible long-term effects of air ions and d-c fields produced by the first commercial ±500-kV d-c transmission line in North America. Beef cattle, wheat, and alfalfa were selected for study because they are commonly raised along the D-C Intertie Line in Oregon.

Objectives and Design. The Bonneville Power Administration (BPA) determined that both environmental and electrical monitoring studies would be done when the Pacific DC Intertie was upgraded from ±400-kV to ±500-kV in 1985. Nine other utility organizations from the United States and Canada joined with BPA in sponsoring an agricultural study involving the line. The project was conducted from 1985 to 1988 by researchers from Oregon State University and the Agricultural Research Service, USDA.

Research objectives were to determine the potential effects of a ±500-kV d-c transmission line on production and reproduction of beef cattle and on crop growth, health, and reproduction.

Overall, the study assessed whether operation of the ±500-kV d-c transmission line resulted in any detectable effects (beneficial or detrimental) on livestock or crops, under controlled simulated ranching and farming conditions. Livestock and crops were located on the transmission line right-of-way and received long-term exposure to maximum electric field and air ion concentrations. The study was designed to provide data on end points and parameters of primary interest in commercial ranching and farming operations.

This study simulated a "worst case" condition in terms of exposure to the d-c line. In farming, crops are grown directly under the power line, whereas, in livestock operations, the animals generally are managed on various size pastures with the power line transecting them. In this study, 100 cows and six bulls were confined in pens directly under and extending 200-ft on either side of the transmission line center. One hundred cows and six bulls in identical control pens were located 2,000-ft from the d-c line.

The study area was typical, with respect to climate, topography, and vegetation of most of the land under the Celilo-Sylmar d-c line across Oregon and much of California. The site was in central Oregon near Madras on the Crooked River National Grassland.

METHODS

One hundred cows with their calves were managed directly under the line with a corresponding group in the control area for three production and reproduction cycles. Parameters compared between line and control groups were conception, calving difficulties, calving interval, calf and cow weights, nutrient intake, health, behavior, and slaughter characteristics.

For the plant study 60 wheat and 60 alfalfa plots were established in 400-ft strips transecting the power line with corresponding plots in the control area for two growth and production cycles. Parameters compared between the line and control areas included: phenology and other growth characteristics, yield on both crops, the quality measures of protein and fiber for the alfalfa, and protein and germination of the wheat.

The electrical study conducted by BPA, while not directly part of the OSU contract, was an integral part of the combined Grizzly Mountain HVDC Research Facility. The electrical study was designed and in place before the agricultural study began. A coordinated program was developed to minimize potential areas of conflict between the two studies.

Measurements of electrical parameters were taken at fixed locations at distances of 26, 75, 500 and 1,000-ft from the center of the line on both positive and negative sides of the line. In addition, a portable monitor was used to measure electrical parameters at selected locations within the pens. Meteorological variables were recorded on a continuous basis.

In a field study which investigated the possible effects of an operating transmission line on biological systems, there was a need to identify and quantify the exposure of the study subjects to the electrical environment. Documentation of exposures can provide information for dose-response analyses and on thresholds for effects. Exposure quantification can also provide the basis for comparison of exposures in this study to exposures in laboratory studies and to actual exposures received from this and other d-c transmission lines.

The principal electrical exposure parameters in this study were the d-c electric field, the ion current density and the ion density. Because these parameters are dependent on transmission line and meteorological factors, they are highly variable and are best characterized by measured levels whether in the short term or the long term.

The principal electrical exposure parameters at the Grizzly site were measured almost continuously at five locations within the treatment area near the line and at one location in the control area. In addition, measurements were made at various locations within the study area using a portable measurement system. From the measurements at the five permanent locations in the treatment area, the electrical environment over the entire treatment area encompassing four cattle pens under two spans was modeled to produce a quantitative description of the fields, ion currents and ion density to which the cattle and crops were exposed.

Average cattle exposures were estimated based on the field (or other parameter) levels at a location and the time the cattle spent at that specific location. Cattle location distributions were estimated from monthly observations. Thus, in an analogous fashion to exposure models for air pollution and 60-Hz electric fields, time, location and level data were combined to produce an estimate of monthly and total time-integrated exposure for the average cow. Monthly means of electrical parameters provided a direct estimate of exposure levels for the plants; since the crops are stationary, averaging over different locations is not required.

There is no identified mechanism of interaction which produces effects on biological systems for any of the three principal electrical parameters. Therefore, a meaningful exposure metric to characterize interactions between electrical quantities and biological systems cannot be established. For this study time-integrated average exposures over a month or longer were selected as the exposure metric, because they were considered indicative of long-term exposures. In the event that a more biologically significant or appropriate method of expressing exposure is identified in the future, the collected data are available in a form that can probably accommodate any particular metric.

The average monthly levels of electrical parameters which were used to express exposure levels say nothing about dosimetry (i.e., what dose of field or ions an animal actually receives). Questions of dosimetry such as the effects of animal shape, size, and posture were addressed in a study by Battelle Pacific Northwest Laboratories, performed under a subcontract to Oregon State University.

RESULTS

Livestock Parameters. The livestock study included three production and reproduction cycles (1985, 1986, and 1987). No statistically significant differences occurred between line and control groups for any of the production or reproduction parameters. Conception rates for line and control herds were 86 and 82, 100 and 100, and 98 and 100 percent, respectively, for the three breeding seasons. Average daily weight gains for calves in each year were 1.64 and 1.56, 2.15 and 2.08, and 1.94 and 2.04 lb for line and control groups, respectively. There were ten deaths in the line group and ten in the control group during the entire study. The animals went on feed readily and at no time in the study period was there any significant difference in nutrient intake between line and control animals. The live animal condition scores, carcass condition ratings and antemortem examinations showed no significant differences between line and control animals.

Behavior of cattle was quantified by monitoring their locations at feed bunks and their distribution and activity in 16 subdivisions of the pens during afternoon loafing periods, night bedding periods, and 24-hr watches. No disparities of biological significance were detected in cattle activities or in their selection of feeding locations. Statistically significant relationships were detected in the distribution data. These suggested one to four percent fewer cattle remained in areas under the d-c line conductors than in corresponding areas of control pens. This finding did not appear to be correlated with either the electric field or the audible noise produced by the d-c line.

Plant Parameters. No line vs control differences were found for the primary production parameters of wheat and alfalfa fields, and quality of wheat grain and alfalfa hay. Similarly, few if any differences were found for the primary production parameters when side of the line or distance treatments away from the line were considered. A difference in wheat height might be related to the electrical environment, but plot-to-plot variation and effects from factors other than the transmission line were equally likely to have been responsible for these differences.

Control area plots were intended to provide relatively uniform data away from the d-c line. However, control plots varied as much or more than line plots. This reduced our ability to determine significant differences between line and control area plots. Influences other than presence of the transmission line may have resulted in occasional patterns of crop response in both line and control plots. This was most apparent with occasional exceptional center plot responses in comparison to all other plots, but there were several measurements in which significant trends were seen with distance from the midpoint of blocks. It is also possible that the elongated block design caused a differential plant growth away from the midpoint of the blocks. However, we do not believe that these negate the importance of our findings. Within the limits of design and management capabilities, no commercially important differences were detected above normal variation.

Leaf tip and awn damage on wheat growing beneath the d-c line was not easily detected by plant specialists. These effects appeared to be no greater than natural tip burn that occurs in the region. Theoretical crop losses from such tip burn would be so small that no detectable production responses would result. Laboratory data for corona on wheat leaves and awns, in conjunction with measured and calculated field and ion levels near the transmission line, support the contention that corona probably does occur at times on sharp plant parts protruding above the ground plane beneath the conductors. However, no corona was observed on crops using an image intensifier due to several possible factors. These include the fact that most intense corona would occur during daylight hours when it would be impossible to visualize. At night, corona might occur, but would be faint enough to be obscured by high ambient star light levels.

Dust did not accumulate differently on crop foliage near or away from the transmission line. No infectious disease problems occurred during the two-year study. Measurable animal damage was limited to rodents. Where this damage was abundant, crop yields were corrected for rodent damage.

Exposure Estimates. Exposures of the cattle and crops to electrical fields were quantified, using data from the electrical measurements program and the cattle location observations. The principal electrical parameters in this study were the d-c electric field, the ion current density, and the ion density.

Electrical parameters at the study site were measured almost continuously at five locations near the line and at one location in the control area. In addition, measurements were made at various locations within the study area, using a portable measurement system. From these measurements, the electrical environment over the entire line and control areas was modeled to produce a quantitative description of exposure. Cattle exposures were estimated based on the field (or other parameter) levels at a location and on the time the cattle spent at that specific location. Since the crops were stationary, averaging over different locations was not required.

The total accumulated electric field exposure was approximately 5,000 (kV/m) days for an average cow in the line group. This corresponded to exposure to an average electrical field of 5.5 kV/m over the duration of the project. The total accumulated ion current exposure in the line group was about 3,700 (nA/m^2) days for an average cow. This corresponds to exposure at an average ion current of about 4.1 nA/m^2 for the entire project. The total accumulated ion density exposure was about 12,000 ($k\text{-ions}/cm^3$) days for an average cow in the line group. This level corresponds to exposure at an average of about 13 $k\text{-ions}/cm^3$ over the duration of the project. Depending on the parameter under consideration, exposures in the line area were five to 30 times greater than exposures in the control area.

The exposure levels experienced by the study cattle were related to that received by rodents in other recent laboratory studies. A series of measurements at the study site of the ion current collected by various animal models was compared to the exposure levels in the study and to those of the three EPRI-sponsored air ion research projects. Relative dose for an animal was expressed as the product of the collected ion current and the duration of exposure divided by the weight of the animal. Using this exposure metric, the relative exposures ranged from 21 to 0.25 for the laboratory studies and 1.8 for the study of cattle.

Maximum exposures for the crops occurred directly under the d-c line. The maximum average electric field exposures were approximately +9 and -16 kV/m. The maximum levels in line plots exceeded minimum levels by four to 30 times, depending on the parameter. The maximum exposures in the line plots exceeded exposures in the control plots by a factor of 30 to 100 depending on the parameter. Similar differences were seen for ion current density and ion density.

CONCLUSIONS

This experimental study found no evidence that continuous exposure to a ±500-kV d-c transmission line affected the production of beef cattle, wheat, or alfalfa. Extensive electrical monitoring indicated that electric field and air ion exposures received by cattle and crops raised near the line, were substantially greater than exposures in the control area. For cattle, these exposures were greater than would typically occur because the animals were confined beneath the line. This further decreases the likelihood that effects would occur to livestock normally exposed to a d-c transmission line.

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ALFALFA VARIETY TRIALS IN CENTRAL OREGON

PRELIMINARY REPORT

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ABSTRACT

Two alfalfa variety trials were established in June, 1987; one each at the Madras and Powell Butte research sites of the Central Oregon Experiment Station. Twelve seed companies and/or originating agencies cooperated in this study of 24 cultivars. At both Madras and Powell Butte, there were no statistically significant differences in total yield among the varieties tested. However, Vernal was the poorest yielding variety at Powell Butte, and among the poorer yielding varieties at Madras.

INTRODUCTION

Forage crop production is a significant part of the central Oregon economy. Alfalfa hay and other types of hay are produced on about 49,500 and 34,500 acres, respectively. An additional 55,000 acres are devoted to cropland pastures. The value of production exceeds $23 million. Alfalfa is a major cash crop produced for sale, primarily to western Oregon dairies. There is also much local use of alfalfa for hay or in mixture with grasses and other legumes for hay or pasture.

Alfalfa variety trials have been conducted for many years in central Oregon. Two test locations are currently used. The Powell Butte site (3,180 feet elevation) provides information on winter hardiness and performance under a short growing season (80 to 90 days). The Madras site (2,440 feet elevation) has a longer growing season (120 days) and milder winters than Powell Butte.

ACKNOWLEDGEMENT: These trials are partially supported by fees collected from Agri Pro, Andrew Seed Co., Asgrow Seed Co., Cargill, Inc., DeKalb-Pfizer Genetics, Garst Seed Co., Keller Seed, Northrup King Co., Pioneer Hi-bred International, Inc., Seed Tec., and W-L Research, Inc.

MATERIALS AND METHODS

Non-coated inoculated seed of each cultivar was sown in rows 8 inches apart on June 29, 1987 at 18 pounds per acre. Each plot was five feet wide by 20 feet long. Varieties were replicated four times in a randomized complete block design. The cultivar name, source (entering or originating agency), and test site for each entry are shown in Table 1. No fertilizer was incorporated into the seedbed prior to planting. The spring soil test values were pH 7.9, 42 ppm P, 390 ppm K, and 23 ppm nitrate N at Madras and pH 6.3, 20 ppm P, 179 ppm K, and 10.6 ppm nitrate N at Powell Butte. Ninety-three pounds of sulphur per acre as gypsum were top dressed on each nursery in March, 1988.

Broadleaf weeds were controlled with a tank-mix of buctril and 2,4 DB (.187 + .5 lb ae/A) when the alfalfa had 2-3 trifoliate leaves on July 20 and July 31 at Madras and Powell Butte, respectively.

Both trials were sprinkler irrigated as needed throughout the growing season.

The Madras and Powell Butte plots were harvested September 22, 1987, and September 15, 1987, respectively. Although excellent stands were established, seeding year yield data is not reported because of variation due to uneven soil moisture.

During 1988, the Madras trial was harvested on May 25, July 5, August 19, and September 5. A 3.3 feet by 15 feet strip was harvested from the center of each plot. A total of three cuttings were taken from Powell Butte in 1988. Cuttings were taken on June 16, July 27, and September 14, 1988. After each plot was cut and the green weight recorded, a sample of approximately one pound was taken and oven-dried for use in dry matter yield calculations.

RESULTS

Madras. There were no statistically significant differences in total yield among the 19 varieties grown at Madras in 1988. Total yields of Arrow, Apollo II, Garst 636, Fortress, Ultra, Max 85, USDA W12, and WL225 were all 110% greater than those of Vernal. Vernal was among the poorer yielding varieties (Table 2).

Powell Butte. The results of the alfalfa variety trial grown at Powell Butte in 1988 are shown in Table 3. There were no statistically significant differences among total yields. However, Vernal was the poorest yielding variety. Many of the new improved, proprietary varieties yielded more than 110% of Vernal.

Table 1. Variety name, source, and test site(s) of alfalfa cultivars in tests in Central Oregon.

Variety	Sources*	Madras	Powell Butte
Arrow	Agri Pro	X	X
Apollo II	Agri Pro	X	X
Vernema	Andrew Seed Co.	X	X
Wrangler	Andrew Seed Co.	X	X
629	Garst Seed Co.	X	X
636	Garst Seed Co.	X	X
KS 101	Keller Seed	X	X
Commander	Northrup King	X	
Fortress	Northrup King	X	X
Meteor	Northrup King	X	
Trumpeter	Northrup King		X
5432	Pioneer	X	X
XAR53	Pioneer	X	X
Ultra	Seed Tec	X	X
Max 85	Seed Tec	X	X
W 12	WA-USDA	X	X
W 45	WA-USDA	X	X
Vernal	Andrew Seed Co.	X	X
WL 225	W-L Research	X	X
WL 320	W-L Research	X	X
120	DeKalb		X
135	DeKalb		X
Eagle	Asgrow		X
Endure	Cargill		X

* Source: entering or originating agency

Table 2. Alfalfa Variety Trial, Madras, Oregon, 1988

Variety	Yield 1st Cut	2nd Cut	3rd Cut	4th Cut	Total	% Vernal
	tons/acre					
Arrow	3.36	2.43	2.26	3.01	11.05	117
Apollo II	3.61	2.10	1.95	2.86	10.52	111
Vernema	3.49	2.22	1.52	2.01	9.23	97
Wrangler	3.49	2.08	1.93	2.34	9.84	104
629	3.50	2.14	1.89	2.40	9.92	105
636	3.31	2.30	2.20	2.73	10.54	111
KS 101	3.55	2.22	1.75	2.21	9.75	103
Commander	3.30	2.25	2.05	2.65	10.24	108
Fortress	3.32	2.31	1.94	2.91	10.49	111
Meteor	3.20	1.97	1.94	2.57	9.69	102
5432	3.20	2.15	1.96	2.81	10.13	107
XAR53	3.36	2.22	2.19	2.19	10.37	109
Ultra	3.49	2.41	1.95	2.69	10.54	111
Max 85	3.60	2.19	1.94	2.82	10.55	111
W12	3.50	2.40	2.05	2.68	10.63	112
W45	3.20	2.10	1.79	2.20	9.30	98
Vernal	3.17	2.18	1.84	2.28	9.47	100
WL225	3.37	2.32	2.06	2.79	10.54	111
WL320	2.83	1.81	2.11	2.73	9.48	100
MEAN	3.36	2.20	1.96	2.59	10.12	106
PLSD, 5%	NS	0.29	NS	0.56	NS	---
CV%	8.78	9.30	13.82	15.13	7.86	---

Table 3. Alfalfa Trial, Powell Butte, Oregon, 1988

Variety	Yield				%
	1st Cut	2nd Cut	3rd Cut	Total	Vernal
	tons/acre				
Arrow	2.66	2.04	2.17	6.87	109
Apollo II	2.80	2.06	2.16	7.02	111
Vernema	2.39	2.45	2.11	6.95	110
Wrangler	2.47	2.49	2.35	7.31	115
Eagle	2.53	2.39	2.40	7.31	116
Endure	2.64	2.08	2.20	6.92	109
120	2.26	2.45	2.09	6.80	107
135	2.52	2.56	2.15	7.23	114
629	2.76	1.88	2.03	6.67	105
636	2.57	2.08	2.24	6.89	109
KS 101	2.67	2.40	1.98	7.05	111
Trumpeter	1.95	2.37	2.16	7.48	118
Fortress	2.62	2.18	2.11	6.91	109
5432	2.21	2.42	2.36	6.99	110
XAR53	2.72	2.49	2.30	7.50	118
Ultra	3.13	2.52	2.20	7.84	124
Max 85	2.43	2.30	2.22	6.94	110
W 12	2.70	2.28	2.10	7.08	112
W 45	2.22	2.12	2.38	6.71	106
Vernal	1.88	2.46	2.00	6.33	100
WL 225	2.76	2.48	2.17	7.40	117
WL 320	2.15	2.52	2.39	7.05	111
MEAN	2.55	2.32	2.19	7.06	111
PLSD, 5%	0.47	NS	NS	NS	---
CV%	12.98	15.66	12.57	8.29	---

FORAGE GRASS VARIETY TRIALS

PRELIMINARY REPORT

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ABSTRACT

One test each of 13 orchardgrass, eight tall fescue, and four timothy cultivars was established in August, 1987 at the Powell Butte research site of the Central Oregon Experiment Station. Seven seed companies cooperated on these tests. Orion, Napier, and Potomac were the top yielding orchard grass varieties; Latar was the least productive. Tandem and Mozark varieties of tall fescue were the leading forage producers; Fawn tall fescue was among the poorer forage producers. Clair was the top yielding variety of timothy.

INTRODUCTION

In central Oregon, grass is an important component in many alfalfa fields that are used for hay. There are also many acres of different grass species and varieties used for pasture. The last grass variety trial at this station was conducted from 1968-72 in Redmond (1). Varieties of orchardgrass, timothy, bromegrass, meadow foxtail, intermediate wheatgrass, tall fescue, and Kentucky bluegrass were included. Productivity was greatest for orchardgrass and decreased in order listed with Kentucky bluegrass producing the least forage. Since this trial several new varieties have been developed by public and private plant breeders which have shown improved performance in other areas of the U.S. and Canada. Therefore new grass variety trials were planted in August, 1987 at Powell Butte.

ACKNOWLEDGEMENT: These trials are partially supported by fees collected from Cargill, Cenex/Land O'Lakes, Daehnfeldt, Inc., International Seeds, Inc., Northrup King Co., Turf Seed, Inc., and Willamette Seed & Grain.

MATERIALS AND METHODS

Non-coated, non-treated seed was hand broadcast on August 21 and 22, 1987. The orchardgrass and tall fescue cultivarswere sown at 18 lbs/A in plots six feet wide x 20 feet long. The timothy plots were only five feet wide but the same length. Timothy was planted at eight pounds per acre. Seed was raked-in and firmed with a corrugated roller. Each cultivar was replicated four times in a randomized complete block design. Table 1 shows the variety name and source of each entry.

Soil test values from a sample taken June 1, 1987 were pH 6.5, 13 ppm P, 281 ppm K, and 6.2 ppm nitrate N in the 0-12 inch depth. A broadcast application of 16-20-0-15(s) at 410 pounds per acre was incorporated into the seedbed on August 17, 1987. Another application of 16-20-0-15(s) at 500 pounds per acre was top-dressed on all plots April 4, 1988.

The trials were sprinkler irrigated as needed throughout the growing season.

The first cutting was harvested June 20, 1988. Plot size harvested was 3.3 feet wide by 14 feet long. A sample of approximately one pound was taken from each plot, placed in a forage dryer, and dried to determine percent dry matter. All harvested green weights were then converted to tons per acre of dry matter. The second cutting was taken August 9, 1988, except for the Timothy trial, which was harvested August 8, 1988.

RESULTS

ORCHARDGRASS. The height, maturity, and yields of 13 orchardgrass varieties grown at Powell Butte in 1988 are shown in Table 2. Growers have utilized Latar for many years, but it was the lowest yielding variety in this trial. Orion, Napier, and Potomac were the three highest yielding varieties.

There was a wide range in maturity among the varieties. Napier, Potomac, Sterling, and Ambassador were among the earlier maturing varieties, while Orion, Syn 8 SM, Rancho, Phyllox, and Latar were among the later maturing varieties.

TALL FESCUE. The first year production data for eight tall fescue varieties is shown in Table 3. The check variety Fawn was among the lowest yielding varieties; Tandem and Mozark produced nearly 1 1/2 tons per acre more forage than Fawn. Mozark was the earliest maturing variety, Fawn the latest.

TIMOTHY. The height, maturity and yield of four timothy varieties grown at Powell Butte in 1988 are shown in Table 4. Clair was the earliest maturing variety and also the top yielding variety. By contrast, Climax was the latest maturing variety and the least productive.

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Table 1. Forage grass varieties and sources of each in Powell Butte, Oregon, tests, 1987

Type of Grass	Variety	Source*
ORCHARDGRASS	Rancho	Cenex/Land O'Lakes
	Phyllox	Daehnfeldt, Inc.
	Ambassador	International Seeds, Inc.
	Comet	Northrup King Co.
	Orion	Northrup King Co.
	Syn 8SM	Turf Seed, Inc.
	Syn 885	Turf Seed, Inc.
	Syn 887	Turf Seed, Inc.
	Napier	Willamette Seed & Grain
	Paiute	USDA
	Latar	CHECK
	Potomac	CHECK
	Sterling	CHECK
TALL FESCUE	Forager	Cenex/Land O'Lakes
	Syn W	Cenex/Land O'Lakes
	Mozark	International Seeds, Inc.
	Martin	International Seeds, Inc.
	FA-293-86	Turf Seed, Inc.
	Tandem	Turf Seed, Inc.
	Johnstone	Willamette Seed & Grain
	Fawn	CHECK
TIMOTHY	Timfor	Northrup King Co.
	Mor-Tim	Cargill
	Climax	CHECK
	Clair	CHECK

* Source: Entering or originating agency; CHECK varieties were supplied by Gooding Seed Co., Northrup King Co., and Round Butte Seed Growers.

Table 2. Height, maturity, and yield of 13 orchardgrass varieties grown at the Powell Butte site of the Central Oregon Experiment Station, 1988

Variety	Height[1]	Maturity[2] score	Yield[3] 1st Cut	2nd cut	Total
	in		------tons/acre------		
Orion	33.3	1.3	3.27	2.23	5.50
Syn 8 SM	29.0	1.0	2.97	2.12	5.09
Napier	28.0	5.3	2.94	2.51	5.45
Potomac	27.8	6.0	2.90	2.41	5.31
Syn 887	27.0	2.3	2.83	2.14	4.97
Sterling	27.8	5.3	2.81	2.30	5.11
Rancho	25.3	1.8	2.76	2.15	4.91
885	26.5	3.3	2.68	2.29	4.97
Paiute	28.5	4.8	2.68	2.17	4.85
Comet	27.3	3.8	2.51	2.28	4.79
Ambassador	27.3	5.8	2.47	2.15	4.62
Phyllox	27.0	1.8	2.45	2.38	4.83
Latar	24.5	2.0	2.21	2.08	4.29
Average	27.6	3.4	2.73	2.25	4.98
LSD (5%)	3.5	2.0	0.45	0.30	----
CV (%)	8.8	42.0	11.37	9.35	----

1 Ht. = height taken June 16, 1988.
2 Maturity Score: 1 = panicles starting to emerge, 5 = 50% of panicles shedding pollen, 10 = 100% of panicles shedding pollen. Taken June 16, 1988.
3 Yield is on a dry matter basis determined from an oven-dried sample from each plot. Plots cut June 20, 1988, and August 8, 1988.

Table 3. Height, maturity, and yield of eight tall fescue varieties grown at the Powell Butte site of the Central Oregon Experiment Station, 1988

Variety	Height[1]	Panicle[2] score	Yield[3] 1st Cut	2nd Cut	Total
	(in)		--------tons/acre------		
Tandem	33.0	3.5	4.27	2.48	6.75
Mozark	34.5	10.0	4.24	2.73	6.97
Syn W	25.8	5.0	3.58	2.44	6.02
Johnstone	23.8	6.5	3.42	2.22	5.64
FA 293	25.0	7.5	3.32	2.39	5.71
Forager	24.3	2.3	2.92	2.34	5.26
Fawn	22.5	1.0	2.89	2.45	5.34
Martin	23.3	2.3	2.72	2.63	5.35
Average	26.5	4.8	3.42	2.46	5.88
LSD (5%)	2.8	2.0	0.67	0.54	----
CV (%)	7.3	29.1	13.27	14.82	----

1 Ht. = height to end of tallest leaf taken June 16, 1988.
2 Panicle density score: 1 = least number of panicles and 10 = most dense.
3 Yield is on a dry matter basis determined from an oven-dried sample from each plot. Plots cut June 20, 1988, and August 8, 1988.

Table 4. Height, maturity, and yield of four timothy varieties grown at the Powell Butte site of the Central Oregon Experiment Station, 1988

Variety	Height[1]	Maturity[2] score	Yield[3] 1st Cut	2nd Cut	Total
	in		--------tons/acre------		
Clair	32.0	10.0	4.00	2.28	6.28
Timfor	26.5	2.6	3.85	2.12	5.97
Mor-Tim	27.3	3.5	3.82	2.04	5.86
Climax	25.5	1.8	3.52	1.82	5.34
Average	27.8	4.5	3.80	2.07	5.86
LSD (5%)	2.7	0.8	0.45	0.32	----
CV (%)	6.0	11.2	7.44	9.77	----

1 Ht. = height taken June 16, 1988.
2 Maturity Score: 1 = mid-boot stage, 3 = late boot stage, 5 = 50% headed, 10 = 100% headed.
3 Yield is on a dry matter basis determined from an oven-dried sample from each plot. Plots cut June 20, 1988, and August 8, 1988.

VARIETAL EVALUATION OF IRRIGATED CEREAL GRAINS IN CENTRAL OREGON IN 1988

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ABSTRACT

Six replicated yield trials were conducted at two sites of the Central Oregon Experiment Station in 1988. Two new releases of soft white winter wheat, 'Hyak' and 'Madsen', and several other advance lines performed better than the standard varieties, including 'Stephens' and 'Malcolm'. 'ORCR8313' has continued to outperform the standard and looks very promising for release as a new hard red winter wheat. Winter barleys had good yields in 1988 with 'Showin' and 'Boyer' having the greatest yields. 'Scio', however is still the best choice for central Oregon and has had the best performance and quality over a number of years.

Central Oregon is currently and will continue to be a major cooperator with the OSU breeding programs for wheat (Dr. Warren Kronstad) and barley (Dr. Pat Hayes). The spring and duram wheats originate in Mexico and are initially planted and evaluated in Madras. The spring barley program also uses Madras as a major site for initial evaluation. Results from these programs will not be reported here.

Winter Cereals are evaluated for yield, test weight, maturity, height, lodging, winter hardiness and disease resistance. Six replicated yield trials were established in 1988 at two sites in central Oregon. A summary of the trials grown, location, and number of lines investigated in each trial can be seen in Table 1.

METHODS

Cereal plots (5 feet wide by 20 feet long) were seeded at a rate of 100 pounds/acre using an Oyjord plot planter. Fertilizing was accomplished by a Barber metered feed fertilizer spreader. Overhead irrigation was used on either 40 x 40' spacing (Powell Butte) or 40 x 30' spacing (Madras). Harvest was accomplished with a Hege plot combine. Cultural data for the different experiments are summarized in Table 2.

Table 1. Cereal grain variety trials planted in central Oregon in 1987

Location	Trial	No. Entries
Madras	Hard Red Winter Wheat Elite	26
Madras	Western Reg. H.R. Winter Wheat	38
Madras	S.W. Winter Wheat Elite	44
Madras	Western Reg. S.W. Winter Wheat	36
Madras	Western Reg. Winter Barley	30
Powell Butte	S.W. Winter Wheat Elite	44

Table 2. Cultural data for 1988 variety trials at Madras and Powell Butte, Oregon

Trial	Location	Lbs. N/Ac	Date of planting	Date of first irrig.	Date of last irrig.	Date of harvest
HRWWE	Madras	162	10-27-87	4-14-88	7-19-88	8-10-88
WRHRWW	Madras	162	10-27-87	4-14-88	7-19-88	8-10-88
SWWWE	Madras	162	10-27-87	4-14-88	7-19-88	8-9-88
WRSWWW	Madras	162	10-27-87	4-14-88	7-19-88	8-9-88
WRWB	Madras	80	10-28-87	4-14-88	7-4-88	8-8-88
SWWWE	P. Butte	162	10-28-87	4-13-88	8-1-88	8-26-88

HRWWE - Hard Red Winter Wheat Elite
WRHRWW - Western Regional Hard Red Winter Wheat
SWWWE - Soft White Winter Wheat Elite
WRSWWW - Western Regional Soft White Winter Wheat
WRWB - Western Regional Winter Barley
SWWWE - Soft White Winter Wheat Elite

RESULTS AND DISCUSSION

Unusually low yields were observed in Powell Butte, mainly due to abnormal frost pockets in the critical stages of growth early in the summer. The 1987-1988 winter was mild and abnormally dry.

Diseases were absent in 1988, therefore none will be noted. Little or no insect damage was observed throughout the season.

Soft White Winter Wheat

Cereal evaluations have been done for a number of years in central Oregon. Results from the 1988 trials are shown in Tables 3 and 6. Table 4 and 5 shows some of the most common varieties of soft white winter wheats averaged since 1979 for comparison.

Performance of soft white wheats at Madras was especially good compared to years past. Refer to Table 3. Although Lodging was more than average, it did not seem to lower the yields. ORCW8632 and OR830211 both out performed the standards. Long term performance data is shown in Table 4 for the Madras plots. Long term performance data for Powell Butte is shown in table 5 where Dusty still out performs the other standards.

Table 3. Agronomic data for select soft white winter wheat lines grown at Madras, OR in 1988

Treatment	Yield	Test wt	Height	Hd date	Lodging
	bu/a	lbs/bu	in	days	%
STEPHENS	134.8	59.57	33	167	45
HILL	120.4	59.50	38	169	14
MALCOLM	139.5	57.82	35	170	29
OVESON	127.7	60.90	35	169	63
DUSTY	120.0	59.78	35	172	53
TRES	107.8	61.74	37	170	100
FLORA	123.7	45.15	37	165	0
OR 855	128.4	62.72	37	167	66
BASIN	125.2	62.16	29	168	0
CASHUP	132.8	61.81	35	171	46
OSU-21	113.0	58.87	37	166	78
OSU-28	118.2	60.48	35	169	0
OR CW8314	131.2	60.34	36	165	28
OR CW8519	120.4	60.69	40	168	41
OR CW8627	127.9	61.25	39	168	3
OR CW8632	141.8	58.59	36	165	6
OR CW8635	127.5	60.34	41	167	80
OR CW8724	131.0	57.96	38	165	41
OR CW8725	132.5	57.96	36	166	29
OR 830211	143.8	63.28	37	164	3
OR 830801	128.1	58.10	35	165	5
OR 833765	129.1	60.20	37	165	3
OR 834686	138.9	59.92	36	167	29
OR 840813H	137.6	62.23	37	167	0
OR 840814H	134.8	61.11	37	165	0
OR 840815H	137.0	62.37	38	165	13
OR 840836S	134.4	59.64	41	166	6
OR 841073H	135.0	58.03	41	167	4
OR 833649	132.6	60.34	39	167	5
LSD(5%)	12.2	7.60	3	3	40

Table 4. Soft white winter wheat varieties grown at Madras, 1979-1988 (1983 trials destroyed by hail)

Variety	Yield	Test Wt.[4]	Head Date[3]	Lodging	Height[2]
Hyslop[6]	103.3	56.5	167	16	37
Daws[6]	106.1	57.3	168	14	36
Dusty[1]	103.4	58.9	165	49	36
Hill 81	105.0	57.3	168	10	38
Malcolm	120.6	56.7	166	15	35
McDermid[5]	95.4	59.2	158	48	36
Nugaines	107.4	59.3	167	19	34
Stephens	110.8	56.3	165	11	36

1 1986-1988 data only
2 1980, 1981 data missing
3 1979,1980 data missing
4 1980 data missing
5 1981 and 1988 data missing
6 1988 data missing

Table 5. Soft white winter wheat varieties grown at Powell Butte, OR 1979-1988

Variety	Yield	Test Wt.	Head Date[3]	Lodging	Height[2]
Hyslop[4]	107.6	56.2	177	18	35
Daws[4]	111.9	57.2	179	9	35
Dusty[1]	118.9	58.8	175	8	35
Hill 81	112.1	58.0	180	9	37
Malcolm	116.7	56.1	178	4	35
McDermid[4]	107.8	54.7	176	0	25
Nugaines[4]	108.4	58.0	179	15	33
Stephens	108.6	55.3	178	6	34

1 1986-1988 data only
2 1980 data missing
3 1982, 1983 data missing
4 1988 data missing

Soft white winter wheat grown at Powell Butte had a much lower yield in 1988 than in the past. Refer to Table 5. This is due to abnormal frost early in the season. Advance line ORCW8632 performed much better than the standards despite the extreme conditions.

Table 6. Agronomic data for soft white winter wheat lines grown at Powell Butte, OR in the 1988 elite trial

Treatment	Yield	Test wt	Height	Hd date	Lodging
	bu/a	lbs/bu	in	days	%
STEPHENS	90.3	57.81	35	173	0
HILL	84.5	60.27	37	175	13
MALCOLM	76.4	59.28	36	174	0
OVESON	50.9	61.54	33	169	15
DUSTY	78.7	60.60	36	173	23
TRES	50.5	59.57	35	174	69
CREW	63.0	58.01	35	173	68
FLORA	67.6	45.49	35	170	25
OR 855	55.3	61.55	33	177	48
BASIN	55.9	60.27	29	169	9
CASHUP	73.2	61.11	32	168	3
TRES+TYEE	54.6	59.02	33	171	64
OSU-21	50.4	58.75	35	170	18
OSU-28	69.9	59.10	34	171	0
OR CW8314	58.6	59.00	36	175	10
OR CW8519	93.5	58.45	39	167	8
OR CW8626	71.4	59.33	36	171	11
OR CW8627	87.6	61.27	36	172	8
OR CW8631	67.1	59.71	36	177	59
OR CW8632	104.5	58.46	35	174	23
OR CW8635	86.1	60.24	37	174	11
OR CW8724	70.5	59.80	30	170	10
OR CW8725	59.1	59.28	35	176	0
OR 830211	89.9	60.53	33	172	10
OR 830801	69.6	57.00	31	171	0
OR 833725	91.9	60.22	36	169	9
OR 833765	65.6	59.59	38	171	16
OR 834686	81.9	60.82	37	170	33
OR 840813H	92.6	61.45	35	170	0
OR 840814H	89.9	60.33	36	172	3
OR 840815H	83.6	60.98	36	170	4
OR 840836S	100.7	58.86	37	170	0
OR 841073H	95.5	59.49	39	170	0
OR 841386P	93.6	59.32	33	176	6
OR 841438P	94.0	60.64	38	173	0
OR 833649	77.6	58.03	36	172	0
LSD(5%)	23.0	6.69	5	1	28

The Western Regional trials are set up in cooperation with other experiment stations in the Pacific Northwest to give an overall performance of advance lines before release as a variety. In the soft white winter wheat trial two new releases are available to the farmer, WA7163 as Madsen and WA7166 as Hyak. Stephens and Nugaines performed very well this year of the standard however advance line ID0329 was better than the standards in yield and test weight. Refer to Table 7.

Table 7. Select Soft white wheat lines from the western regional nursery grown at Madras, OR in 1988

Treatment	Yield	Test wt	Height	Hd date	Lodging
	bu/a	lbs/bu	in	days	%
KHARKOF	60.9	63.42	42	166	98
ELGIN	74.7	61.95	41	170	75
MORO	91.5	59.50	40	173	98
NUGAINES	134.4	63.00	34	167	0
STEPHENS	131.5	60.83	35	168	4
TRES	109.0	62.58	39	170	69
WA 7163	118.5	60.55	37	171	13
WA 7166	103.9	61.88	38	165	96
OR CW8416	111.7	61.95	37	166	50
OR CW8517	100.3	61.18	40	168	25
ID 0329	138.4	61.18	38	165	29
ID 0330	123.6	60.34	37	170	19
OR 0843	121.0	61.81	41	169	0
OR 0842	120.9	60.97	32	169	0
OR 0845	125.1	60.69	37	164	38
ORF 75336	129.4	60.48	37	167	28
WA 7529	125.9	57.19	36	170	41
OR 855	107.8	57.33	39	169	99
OR CW8632	133.5	60.27	38	165	28
OR CW8633	112.2	60.48	36	170	3
OR CW8635	114.7	57.12	39	168	58
OR CW8724	130.0	59.57	39	169	45
OR 8300801	120.6	57.82	35	165	35
WA 7621	118.9	59.99	37	170	66
WA 7623	127.2	58.80	38	166	0
WA 7625	126.9	58.38	38	171	3
WA 7627	113.3	56.98	37	172	41
LSD(5%)	20.1	5.85	4	4	50

Hard Red Winter Wheat

Different wheat classes are continually being tested to give the farmer the most possible options for crop selections. Hard red winter wheats are improving every year for agronomic qualities. Several advanced lines are performing better than the standards promising several future for the upcoming releases of new lines as varieties. Refer to Tables 8 and 9.

Table 8. Agronomic data for select hard red winter wheat lines grown in the 1988 elite trial, Madras, OR

Treatment	Yield	Test wt	Height	Hd date	Lodging
	bu/a	lbs/bu	in	days	%
WASNER	87.6	63.35	44	165	43
STEPHENS	109.3	59.43	36	165	63
FEDERATION	100.3	60.83	45	162	78
HATTON	97.6	64.47	44	167	74
BANTUM	99.9	58.59	36	169	90
ANDREWS	111.5	62.09	35	163	100
SURVIVOR	59.6	61.04	40	170	100
OR CR8313	119.9	62.58	39	162	100
OR CR8414	106.7	61.25	40	163	76
TSN-B2	101.4	61.74	39	167	78
OR CR8601	108.6	61.74	39	165	45
OR CR8602	125.4	60.90	34	163	69
OR CR8603	113.0	59.99	37	163	20
OR CR8604	108.5	61.18	36	165	74
OR CR8608	119.4	62.65	38	168	68
OR CR8718	122.6	61.11	40	166	53
OR 830027	100.0	61.60	43	165	74
OR 830282	137.6	61.46	40	165	25
OR 831134	108.0	63.35	39	167	24
OR 831455	111.8	59.01	34	170	23
OR 832306	110.5	58.59	38	165	95
OR 840027P	103.9	58.59	36	160	98
OR 840157P	121.7	60.48	43	170	66
OR 840214H	106.5	63.98	38	163	15
OR 841708P	116.7	56.42	41	169	20
OR CR8617	123.2	60.69	34	168	56
LSD(5%)	17.7	5.23	3	4	49

Table 9. Select hard red winter wheat lines grown in Madras, OR for the 1988 Western Regional trial

Treatment	Yield	Test wt	Height	Hd date	Lodging
	bu/ac	lbs/bu	in	days	%
KHARKOF	60.2	60.6	43	168	93
WANSER	86.8	62.7	44	173	95
OR CR8313	121.8	62.2	40	169	83
ID 0331	75.1	62.5	37	163	58
SURVIVOR	70.4	61.4	41	170	93
ID 0333	74.8	60.6	45	172	93
ID 0335	74.4	62.0	37	168	60
ID 0336	98.7	62.9	39	170	90
OR CR8414	106.9	63.0	38	169	98
WA 7522	101.3	62.9	41	169	93
OR CR8601	117.1	63.5	38	166	98
UT 156751	118.7	63.2	41	166	90
UT 156775	117.6	62.8	37	165	65
UT 156516	126.5	63.9	39	164	80
ID 0353	98.7	62.2	42	168	95
ID 0354	99.5	61.9	42	166	78
MT 8039	113.1	60.9	37	167	68
UT 157140	121.4	60.6	36	166	50
OR CR8602	117.9	60.7	40	165	70
OR CR8603	116.5	61.7	44	169	83
OR CR8608	120.1	63.7	44	167	65
OR 830282	119.1	62.6	47	171	88
OR 832306	117.4	59.8	43	167	95
WA 7626	96.9	62.7	36	169	80
OR 8522	118.6	56.8	39	167	63
ID 0323	104.3	59.8	36	166	50
ID 0356	112.6	60.0	39	166	83
LSD(5%)	14.7	4.1	6	4	39

Winter Barley

The yields and test weights for the Western Regional Barley Nursery were much higher in 1988 than 1987. The variety Showin out performed all the standards and the advanced lines for yield, however, the test weight of Showin was low. Scio was not the top performer this year, however its consistency over a number of years shows it to be the variety of choice for central Oregon. Table 10 shows the agronomic data for the 1988 winter barley nursery.

Table 10. Agronomic data for select varieties grown in the Western Regional winter barley nursery at Madras, OR in 1988

Treatment	Yield	Test wt	Height	Hd date	Lodging
	bu/a	lbs/bu	in	days	%
KAMIAK	97.8	51.59	67	134	70
SCHUYLER	110.5	53.06	42	152	36
BOYER	139.3	52.36	42	149	0
WINTERMALT	108.1	51.38	41	150	76
HESK	137.3	51.52	40	150	18
MAL	126.6	50.54	44	152	43
SCIO	123.0	51.87	40	150	23
79AB812	133.3	53.48	44	149	38
SHOWIN	143.3	49.14	35	151	19
OR FB75075	124.7	50.82	38	149	46
OR WF8328	121.5	50.75	36	150	36
OR WF8411	119.2	52.08	41	149	5
OR WM8406	133.1	52.78	41	147	30
OR WF8422	119.2	50.96	42	149	36
OR WF8410	137.8	53.06	35	150	38
OR WM8407	132.3	52.71	40	151	45
WA 2607-80	141.5	49.77	41	150	20
WA 2554-81	119.4	51.17	39	150	76
OR FB763167	127.3	51.66	40	149	3
OR FB77796	115.8	52.22	43	147	31
86AB445	125.9	52.15	39	150	34
WA 3035-84	141.8	50.54	33	149	28
LSD(5%)	26.0	4.74	15	6	46

SUMMARY

With cereals being an important crop for the region, one of Central Oregon Experiment Station's objectives is to give the farmer up-to-date information on released varieties as well as advanced lines. Yield, test weights, plant height, lodging, winter hardiness, head date and disease/insect resistance are checked for all the cereals grown.

WHEAT BREEDING
AT THE CENTRAL OREGON EXPERIMENT STATION

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ABSTRACT

A brief summary of spring wheat breeding trials is presented below, highlighting performance of some commercial varieties and several advanced breeding lines.

INTRODUCTION

The Central Oregon Experiment Station continues to be a vital link in the total Oregon State University wheat breeding and genetics program. During the past 25 years, the station has evaluated advanced selection of wheat for their adaptation to Central Oregon. In doing so, they have provided information to the growers in the area regarding the potential of new varieties. Madras is the initial site for planting and evaluating of the spring Durum lines from Mexico.

METHODS

In 1988, at the Madras experimental site, approximately 9.5 acres were planted with spring wheat and spring durum experimental lines. Two hundred and seventeen hard red spring wheat lines were yield tested with their appropriate check varieties. There were 178 soft and hard white spring lines in yield test. The number of spring durums in yield test at Madras equaled 200.

In addition to the lines tested for yield, there were nine observation nurseries (2 row plots). These nurseries originated at The International Maize and Wheat Improvement Center in Mexico (CIMMYT) and at The International Center for Agricultural Research in the Dry Areas in Syria (ICARDA). They constitute the major source of the spring wheat and spring durum program at OSU.

DISCUSSION

In Tables 1 and 2 yield and quality data for two advanced soft white lines are presented. These soft white lines are compared to Twin, Dirkwin, and Owens. The experimental lines are superior in yield and equal in quality to the checks.

Table 1. 1988 crop yield data for two advanced soft white spring lines, Central Oregon Experiment Station, Madras, Oregon

Madras	Yield
	bu/a
ORS8501	90
4870442	94
Twin	87
Dirkwin	87
Owens	82
Location average	88

Table 2. Quality data for two advanced soft white spring lines, Central Oregon Experiment Station, Madras, Oregon

	Test wt.	Flour yield	Flour protein	Cookie diameter	Cake volume	Sponge cake score	No. of years
ORS8501	6402	70.6	9.0	9.0	1230**	69*	6
4870442	62.3	69.7	9.2	8.9	1205*	73*	2
Twin	60.5	69.0	9.5	9.1	1183**	63**	8
Dirkwin	59.9	69.3	9.5	8.8	1203**	66**	6
Owens	62.7	69.0	9.5	9.1	1260**	73**	7
Average	61.9	69.5	9.3	9.0	1216	69	

* One year of data
** Two years of data

Seven hard red spring cultivars are noted in Table 3. All were equal or superior to McKay in yield in 1988. The quality data are found in Table 4.

Table 3. Yield and agronomic data of seven advanced hard red spring lines, Central Oregon Experiment Station, Madras, Oregon

Madras	Yield
	bu/a
McKay	89
ORS8510	90
4870355	94
4870456	95
4870475	99
4870293	91
4870396	96
4870400	98
4870401	96
Location average	94

Table 4. Quality data averaged over years for eight hard red spring lines and with check variety McKay, Central Oregon Experiment Station, Madras, Oregon

	Test Wt.	Flour Yield	Flour Protein	Mixing Time	Loaf Volume	Crumb Score	No. of Year
ORS8510	62.5	69.8	11.5	4.0	964	3	9
4870355	64.6	69.2	13.1	2.7	1006	2	2
4870456	64.6	70.9	10.6	3.2	989	2	2
4870475	61.8	69.9	11.5	2.7	983	3	2
4870293	65.2	70.9	10.5	2.6	844	5	1
4870396	64.0	71.5	10.2	4.3	873	2	1
4870400	66.0	71.3	9.9	3.1	826	2	1
4870401	63.2	70.0	10.0	3.6	850	3	1
McKay	62.6	71.6	10.9	4.3	995	3	34
Average	63.8	70.0	10.9	3.4	925	3	

Tables 5 and 6 list three hard white selections and compare their yield and quality with McKay. Though their yields are equivalent or better than McKay, their flour yield and loaf volumes appear to be somewhat lower. The yield of ORS8413 is more statistically significant than McKay.

Table 5. Yield data for three advanced hard red spring lines, Central Oregon Experiment Station, Madras, Oregon

Madras	Yield
	bu/a
ORS8413	102
4870235	86
4870279	92
McKay	90
Location average	92

Table 6. Quality data for three hard white spring advanced lines, Central Oregon Experiment Station, Madras, Oregon

	Test Wt.	Flour Yield	Flour Protein	Mixing Time	Loaf Volume	Crumb Score	No. of Years
4870235	65.0	69.8	12.3	3.9	915	2	2
4870279	63.7	68.9	12.8	4.4	981	3	2
ORS8413	63.4	69.9	11.3	4.7	931	4	11
McKay	62.6	71.6	10.9	4.3	995	3	34
Average	63.7	70.1	11.7	4.5	969	3	

The spring durum lines were very impressive in yield (Table 7) compared with WPB881, the check variety. The quality of these lines is being evaluated by the Pendleton Flour Mills and by the quality lab at OSU cereal project.

Table 7. 1988 yield data for five advanced spring durum lines grown in Madras and Pendleton, Oregon compared with WPB881

Madras	Yield
	bu/a
WPB881	69
4880139	91
4880142	100
4880081	106
4880092	109
4880121	117
Location average	99

BARLEY BREEDING AT THE CENTRAL OREGON EXPERIMENT STATION

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ABSTRACT

A brief summary of spring barley breeding trials is presented below, highlighting performance of some commercial varieties and several advanced breeding lines.

The Madras branch of the Central Oregon Experiment Station is a key site for evaluating spring habit barley lines. The site allows the OSU Barley Breeding program to realize its objective of developing spring habit barley lines of both feed and malting type. Currently, the emphasis is on developing malting quality two-row lines adapted to irrigated environments. In view of industry demands, the breeding emphasis will shift to developing six-row materials. The yield standard by which advanced lines are gauged is 'Steptoe'. For malting quality, two-row lines are compared with 'Klages' and six-row lines with 'Mores'.

In 1988, five advanced line nurseries, one screening nursery, and one thesis project were grown in Madras. Most promising of the advanced line materials are ORSM 8408, a two row line approved for plant scale testing by the American Malting Barley Association (AMBA), and ORSM 8623, a semi-dwarf two row approved for a second year of pilot scale malting by the AMBA. Yield and quality data for these lines, including the 1988 Madras season, are presented in the attached tables.

In Tables 1 and 2 the yield and quality data are shown as well as malting data for advanced line ORSM 8408 and BA 8529. These advance lines are compared with standards for these traits at six and five different locations respectfully.

Table 1. Selected agronomic traits from six locations of the WSBN 1988 throughout Oregon

Variety	Yield mg/ha	Tst.WT. kg/hl	Plt.Ht. cm	Hd.Dt. Frm.1/1	Plump 2.38mm	Thin 2.18mm	Lodging %
Steptoe	7.08	64.1	84.2	163.8	88.4	7.9	46.2
Morex	5.91	67.5	92.5	165.2	90.1	6.7	33.2
Klages	5.73	69.0	86.8	172.3	77.1	13.9	51.8
ORSM 8408	6.44	68.2	88.5	170.2	80.8	12.8	44.2
BA 8529	6.43	70.4	87.8	169.5	86.1	9.8	31.6

Tulelake, CA; Bertoud, CO; Aberdeen, ID; Ontario, OR; Madras, OR; Hermiston, OR.

Table 2. Malting quality of ORSM 8408, BA 8529, Klages, and Morex for five locations of the 1988 WSBN throughout Oregon

	Barley protein %	Plump barley on 6/64	Barley color agtron	Malt extract %	Ext Diff F-C %	Beta glucan %	Wort protein %	Protein ratio S/T	Dia-static power	Alpha amylase	Over-all rank value
Klages	14.0	79.8	73	78.9	3.4	1.0	4.90	34.3	150	41.1	12
Morex	14.0	89.2	75	78.8	3.1	0.8	4.86	34.7	179	38.6	10
BA 8529	13.5	89.5	69	80.1	2.3	0.5	5.24	39.1	161	48.1	2
ORSM 8408	14.0	86.4	71	79.6	3.7	0.6	5.05	29.5	171	40.1	5

Aberdeen, ID; Berthoud, CO; Madras, OR; Pullman, WA; Tulelake, CA.

In Table 3 and 4, advance line 2862023, a two row semi-dwarf malting barley, is compared with the standards for agronomic data at Madras and Klamath Falls, Oregon.

Table 3. Agronomic comparisons of 2862023, Morex, Klages, and Steptoe, Madras data only

Variety	Yield lbs/ac	Height cm	Lodging %
Morex	4437	111	95
Klages	5602	90	90
2862023	7212	70	0
Steptoe	5585	95	50

Table 4. Agronomic comparisons of 2862023, Marex, Klages, and Steptoe, Klamath Falls data only

Variety	Yield lbs/ac	Height cm	Lodging %
Morex	5462	103	28
Klages	5665	98	43
2862023	5710	58	0
Steptoe	6883	98	13

USING DIQUAT AS A POTATO VINE DESSICANT

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ABSTRACT

An experiment was established at Powell Butte, Oregon in 1988 to evaluate the effect of Diquat application rates on vine dessication, yield, grade, skin set, specific gravity, stem end discoloration, and fry color of Russet Burbank potatoes. An initial Diquat application of 0.50 lbs a.i. per acre hastened vine dessication as compared with an application of 0.25 lbs a.i. per acre. After ten days, all Diquat treatments resulted in equal dessication. Dessication slowed tuber bulking. Tubers in dessicated plots continued to size for approximately one week after dessication, but at a reduced rate when compared with undessicated plots. All dessicated treatments tended to reduce specific gravities initially, but after three weeks there were no significant differences in specific gravity among all treatments. Dessication improved tuber skin set as compared with the untreated check. There were no significant differences in french fry color or stem end discoloration among all treatments.

INTRODUCTION

Prior to the 1987 EPA ban on the use of dinoseb as a potato vine dessicant, Diquat was used very little by potato growers because it was more expensive than dinoseb and growers were largely unfamiliar with it. Since 1987, the use of Diquat has increased extensively. Research has been needed to identify application timing, rates, techniques, and efficacy. Growers have also fielded questions about tuber skin set, yield, stem end discoloration, and other quality factors. This study was undertaken not only to determine optimum application rates and dessication efficacy, but also to identify the effect of Diquat on skin set, yield, grade, specific gravity, stem end discoloration, and fry color of Russet Burbank potatoes.

ACKNOWLEDGEMENT: This study was supported in part by a grant from Valent U.S.A. Corporation.

METHODS

The experiment was established in August, 1988 at the Powell Butte site of Central Oregon Experiment Station in a field of Russet Burbank potatoes. Six treatments were arranged in a randomized block experimental design and replicated four times. Individual plots were eight rows wide (24 ft.) by 50 feet in length. Rows were spaced 36 inches apart and plants were spaced at nine inches in the rows. The trial area was sprinkler irrigated throughout the growing season and a final irrigation was applied two days prior to the first application of Diquat. The field in which the trial was located was fertilized and managed by practices common in central Oregon.

The experimental treatments, application rates, and application dates are shown in Table 1. The potato vines were green with minimal natural senescence on September 2, 1988 when the first Diquat treatments were applied. Table 2 summarizes the application procedures and conditions for each of the three spray dates. Vine, weather, and soil moisture conditions were all ideal for potato vine dessication with Diquat.

Table 1. Diquat application rates and dates, 1988, Powell Butte, Oregon

Diquat treatment	Dates of application 9/2	9/7	9/12	Total application
	--------------lbs ai/acre			---------------
.25 + .25	.25	.25	0	.50
.25 + .50	.25	.50	0	.75
.25 + .25 + .25	.25	.25	.25	.75
.50	.50	0	0	.50
.50 + .25	.50	.25	0	.75
Untreated Check	0	0	0	0

Stem and leaf dessication were rated visually three, seven, 10, and 14 days after the initial Diquat treatment.

On September 1, 1988, six 40 foot plots were harvested within a single two-row strip through the trial area to determine yield, tuber size, grade, specific gravity, and fry color prior to the first Diquat application. A two-row, 40 foot strip was harvested from each plot on September 6, September 9, September 16, and September 23, 1988. Plots were graded and weighed immediately after harvest for each of the five harvest dates. A ten pound sample of six to ten ounce USDA No. 1 potatoes was taken from each plot to determine specific gravity, skin set, and french fry color. Specific gravity was determined by the air-water method. Skin set was rated as the percent of area without skin on each tuber. The individual tuber scores were averaged to obtain the percent skinning per plot. Four tubers from each ten pound sample were sliced, fried for four minutes at 350 ^{O}F, and scored from 0-4 based on the USDA Standard Color Chart for frozen french-fried potatoes.

Table 2. Application data for Diquat, 1988, Powell Butte, Oregon

	1988 Dates of application		
	9/2	9/7	9/12
Time of day (am)	10:00	10:00	10:00
Sky	Clear	Clear	Clear
Wind (mph)	None	1-2	0-2
Dew	None	None	None
Air temperature (^{O}F)	78	64	69
Soil type	Deschutes Sandy Loam		
Soil pH	5.6	5.7	5.6
Soil water potential (MPa)	.02	.23	.36
Soil temperature (4 inch) (^{O}F)	52	55	53
Surfactant rate (X-77)	16 oz/100 gal		
Defoamer rate	1/4 oz/100 gal		
Sprayer type	200 gal 3 point Pak-Tank		
Nozzle	8003 flat fan		
Nozzle spacing	20 inches		
Boom height above canopy	20 inches		
Spray pressure (psi)	32	32	32
Spray gallonage (gal/acre)	20	20	20

A 30 tuber sample of six to ten ounce US No. 1 potatoes was taken on the September 23, 1988 harvest date for stem end discoloration evaluation. The tubers were placed in poly-mesh bags and placed into storage on September 23, 1988. The storage temperature was lowered approximately two degrees Fahrenheit each week until it reached 39 ^{O}F in late November. The samples were removed from storage on February 15, 1989 and evaluated for stem end discoloration. The tubers were sliced longitudinally and scored for depth of discoloration.

RESULTS

The effect of Diquat on the leaf dessication of Russet Burbank potatoes is shown in Table 3. Leaf dessication was significantly greater three days after the initial treatment when 0.50 lbs. a.i. per acre was applied on Sept. 2, 1988 as compared with 0.25 lbs. a.i. per acre applied on Sept. 2, 1988. Seven days after the initial treatment, there were fewer differences among the treatments, and after ten days all Diquat treatments had dessicated 100% of the leaves.

Vines were frosted on Sept. 10, 1988 (29°F) and Sept. 11, 1988 (31°F). The effect of these light freezes accounted for the dessication noted for the untreated check treatment.

Table 3. Effect of Diquat application date and rate on the leaf dessication of Russet Burbank potatoes 1988, Powell Butte, Oregon

Diquat treatment[1]	Days after initial treatment			
	3	7	10	14
lbs ai/acre	-----% leaf dessication-----			
.25 + .25	43	81	100	100
.25 + .50	43	84	100	100
.25 + .25 + .25	40	78	100	100
.50	58	86	100	100
.50 + .25	63	94	100	100
Untreated check	0	3	53	93
LSD 5%	12	8	3	2
CV (%)	20	7	2	1

1 Treatments applied 9/2/88, 9/7/88, and 9/12/88.

Diquat's effect on stem dessication is shown in Table 4. At both three and seven days after the initial Diquat treatment, the 0.50 lbs. a.i. per acre treatments applied on Sept. 2, 1988, resulted in significantly greater stem dessication than the 0.25 lbs. a.i. per acre Diquat treatments applied on Sept. 2, 1988. Stem dessication was equal after ten days, and all stems were 100% dessicated after two weeks.

Table 4. Effect of Diquat application date and rate on the stem dessication of Russet Burbank potatoes, 1988, Powell Butte, Oregon

Diquat treatment[1]	Days after initial treatment			
	3	7	10	14
lbs ai/acre	-----% stem dessication-----			
.25 + .25	14	50	88	100
.25 + .50	14	50	86	100
.25 + .25 + .25	11	43	83	100
.50	25	64	88	100
.50 + .25	23	75	98	100
Untreated check	0	0	31	56
LSD 5%	4	12	8	7
CV (%)	20	17	7	5

1 Treatments applied 9/2/88, 9/7/88, and 9/12/88.

Although the higher application rates hastened vine dessication, there was no advantage in their use. After ten days all Diquat treatments resulted in equal dessication. Weather, plant, and soil conditions in 1988 were ideal for potato vine dessication. In years where cool, rainy or moist conditions exist, higher rates and follow-up applications may prove beneficial.

Tables 5, 6, and 7 show the effect of Diquat vine dessication on total yield, yield of No. 1 potatoes, and yield of undersize (less than four ounces), respectively. Yield is expressed as percent of the untreated check treatment for clarity. Also, the data is tabulated based on the initial Diquat application only because the second and third applications had little effect on dessication.

Table 5. Total yield of Russet Burbank potatoes at five harvest dates after vine dessication with Diquat, 1988, Powell Butte, Oregon

Diquat treatment[1]	Days after initial treatment				
	0	4	7	14	21
lbs ai/acre	yield as percent of check				
.25	100	96	98	99	94
.50	100	95	95	96	96
Untreated check	100	100	100	100	100
LSD 5%	-	NS	NS	NS	NS
CV (%)	-	5	6	7	8

1 Treatments applied 9/2/88.

Table 6. Yield of No. 1 Russet Burbank potatoes at five harvest dates after vine dessication with Diquat, 1988, Powell Butte, Oregon

Diquat treatment[1]	Days after initial treatment				
	0	4	7	14	21
lbs ai/acre	yield as percent of check				
.25	100	96	96	93	89
.50	100	95	93	89	88
Untreated check	100	100	100	100	100
LSD 5%	-	NS	NS	NS	NS
CV (%)	-	14	13	11	15

1 Treatments applied 9/2/88.

Vine dessication slowed tuber bulking as soon as four days after initial treatment. Total yields decreased five percent when compared with untreated plots. Yield of No. 1 grade potatoes dessicated with Diquat decreased over 10% when compared with the untreated check treatment. Nearly five percent of that yield loss occurred during the first week. The higher rate of Diquat accentuated the total yield and No. 1 yield loss slightly.

Table 7 indicates that there was an increase in the yield of undersized tubers when the vines were dessicated as compared with no dessication. Tubers in the untreated check treatments had opportunity to continue to grow to marketable sizes, thus yields of No. 1 potatoes increased.

Table 7. Yield of undersize (< 4 oz.) Russet Burbank potatoes at five harvest dates after vine dessication with Diquat, 1988, Powell Butte, Oregon

Diquat treatment[1]	Days after initial treatment				
	0	4	7	14	21
lbs ai/acre	yield as percent of check				
.25	100	95	103	103	107
.50	100	92	99	103	109
Untreated check	100	100	100	100	100
LSD 5%	-	NS	NS	NS	NS
CV (%)	-	14	7	12	12

1 Treatments applied 9/2/88.

Dessication slowed tuber bulking. Tubers in dessicated plots continued to size for approximately one week after dessication, but at a reduced rate when compared with undessicated plots.

The effect of dessication on specific gravity of Russet Burbank potatoes is shown in Table 8. All dessicated treatments tended to reduce specific gravities initially, but after three weeks there were no significant differences among all treatments.

Dessication improved tuber skin set as compared with the untreated check treatment. Table 9 indicates dessicated plots had manageable levels of tuber skinning three weeks after initial treatment with Diquat. Tuber skinning was still at unacceptably high levels in untreated plots harvested three weeks after treatments were applied.

Vine dessication had no effect on the color of Russet Burbank potatoes fried fresh from the field (Table 10). The french fry color of all treatments was commercially acceptable.

The effect of Diquat on stem end discoloration of Russet Burbank potatoes after 145 days in storage is shown in Table 11. There were no significant differences among the treatments. Approximately 88% of the tubers from each treatment, whether dessicated by Diquat or not, had no stem end discoloration. The remaining tubers contained slight stem end discoloration less than 1/4 inch deep.

Table 8. Specific gravity of Russet Burbank potatoes at five harvest dates after vine dessication with Diquat, 1988, Powell Butte, Oregon

Diquat treatment[1]	Days after initial treatment				
	0	4	7	14	21
lbs ai/acre					
.25 + .25	-	1.078	1.082	1.079	1.077
.25 + .50	-	1.078	1.083	1.080	1.079
.25 + .25 + .25	-	1.078	1.081	1.080	1.076
	.50	-	1.078	1.081	1.078
1.077					
.50 + .25	-	1.078	1.079	1.077	1.076
Untreated check	1.080	1.081	1.083	1.082	1.080
LSD 5%	-	NS	0.002	0.003	NS
CV (%)	-	0.198	0.144	0.165	0.204

1 Treatments applied 9/2/88, 9/7/88, and 9/12/88.

Table 9. Percent tuber skinning of Russet Burbank potatoes at five harvest dates after vine dessication with Diquat, 1988, Powell Butte, Oregon

Diquat treatment[1]	Days after initial treatment				
	0	4	7	14	21
lbs ai/acre	----------% skinning---------				
.25 + .25	-	43	43	18	6
.25 + .50	-	41	38	18	5
.25 + .25 + .25	-	49	36	19	6
.50	-	54	41	14	5
.50 + .25	-	46	45	15	4
Untreated check	62	53	50	29	14
LSD 5%	-	NS	NS	8	3
CV (%)	-	17	15	28	28

1 Treatments applied 9/2/88, 9/7/88, and 9/12/88.

Table 10. French fry color of Russet Burbank potatoes at five harvest dates after vine dessication with Diquat, 1988, Powell Butte, Oregon

Diquat treatment[1]	Days after initial treatment				
	0	4	7	14	21
lbs ai/acre	USDA color rating (0-4 scale)[2]				
.25 + .25	-	0.3	0.0	0.1	0.2
.25 + .50	-	0.1	0.1	0.1	0.1
.25 + .25 + .25	-	0.3	0.2	0.1	0.1
.50	-	0.2	0.2	0.1	0.2
.50 + .25	-	0.2	0.2	0.1	0.2
Untreated check	0.2	0.2	0.2	0.2	0.2
LSD 5%	-	NS	NS	NS	NS
CV (%)	-	62.9	78.7	94.0	72.3

1 Treatments applied 9/2/88, 9/7/88, and 9/12/88.
2 Color scale: 0=light, 4=dark.

Table 11. Effect of Diquat application date and rate on stem end discoloration of Russet Burbank potatoes after 145 days in storage, 1988, Powell Butte, Oregon

Diquat treatment[1]	Stem end discoloration rating[2]				Average rating
	1	2	3	4	
lbs ai/acre	number of tubers				
.25 + .25	26	4	0	0	1.13
.25 + .50	26	4	0	0	1.13
.25 + .25 + .25	26	4	0	0	1.14
.50	27	3	0	0	1.09
.50 + .25	27	4	0	0	1.12
Untreated check	26	4	0	0	1.14
LSD 5%	NS	NS	NS	NS	NS
CV (%)	8	4	0	0	6

1 Treatments applied 9/2/88, 9/7/88, and 9/12/88.
2 Rating scale: 1=none, 2= < 1/4", 3= 1/4-1/2"
4= > 1/2"

SEASONAL INFLUX OF POTATO VIRUSES INTO POTATOES, AND DETERMINATION OF APHID VECTORS AND NON-POTATO VIRUS RESERVOIRS

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ABSTRACT

In 1988, green rabbitbrush (C. viscidiflorus) and grey rabbitbrush (C. nauseosus) from 12 sites in Central Oregon (see map, Fig. 1) were tagged and serologically tested for PVY, PLRV and PVS. The ELISA results are summarized in Table 1. ELISA tests indicated that 38% of the 373 green rabbitbrush tested and 7% of the 200 grey rabbitbrush were infected with PVY. PLRV (or perhaps a serologically related virus) was found in 14 and 2% of the same plants, respectively. PVS was found in native plants at only one location during the 1988 tests. These data confirm similar results gathered during a broader survey of weeds, crops and range plants in 1987.

During 1988, potato plots at Madras, Hermiston and Aurora were exposed at weekly intervals to feral populations of aphids to allow transmission of PLRV and PVY and to determine seasonal distribution of virus transmission. Row covers were used to protect plants from aphids and selected plots were exposed for different weeks during the season. Plots were harvested during October and potato samples were evaluated for virus infection in March. Aphids were collected weekly from the plots to establish presence of aphids and identify which species were potential vectors.

ACKNOWLEDGEMENT: This research was supported in part by grants from The Oregon Potato Commission and the United States Department of Agriculture.

INTRODUCTION

In all regions of Oregon, as in much of the world, potato leafroll disease and PVY-related mosaic diseases are among the most important virus diseases of potatoes. The potential loss or restriction of aldicarb (Temik) and other aphid control chemicals due to real and/or perceived environmental hazards or to insect tolerance has made us aware of the need to understand the biological basis of this aphid:native plant:potato:virus system. The following objectives were designed toward that understanding.

Objectives:

1. Monitor virus infections and aphid presence in potato research plots through the growing season.

2. Determine the incidence of PLRV, PVY and PVS, on selected overwintering range plants.

3. Determine occurrence and identification of aphids on selected range plants suspected of serving as virus reservoirs.

MATERIALS AND METHODS

Virus Testing Procedures

Foliage samples from green rabbitbrush and grey rabbit brush were collected throughout central Oregon (Crook, Jefferson, and Deschutes Counties) and assayed (ELISA) for PLRV, PVY and PVS. These plant species were selected as possible model systems for alternate reservoirs of potato virus based on a broad survey of many plant species in 1987. The sample sizes and sample area can be seen in Table 1 and Figure 1. No universally-high non-specific absorbent values were found for any plant species. Positive serological controls included purified viruses and virus-infected potato tissue. Dye reactions were evaluated conservatively: Using a Dynatech Minireader, a "positive" was recorded if the test wells were greater than the mean + 4sd (n=6 control wells), with two contol test wells required to be positive. Samples were retested for each antiserum if first tests gave mixed results.

Row Cover Procedures

During the 1988 season a series of experiments using floating row covers to prevent aphid vectored transmission of viruses were completed in several potato production regions in Oregon. Included were Central Oregon (Madras), the Columbia Basin (Hermiston) and the Willamette Valley (Aurora). The experiment involved covering potato plants, grown from nuclear virus-tested 'Russet Burbank', at the time of emergence and removing the plastic covering for one week periods during the season. In Central Oregon plots were located at the COES, Madras field. Planting was on May 18, emergence was during the week June 6, and the vines were killed with Diquat on September 15. The period from emergence to harvest was approximately 17 weeks. At the other locations the seasons were slightly longer. Treatments also included plots which were never covered and other plots which were covered for the entire season. To help ensure that the transmission might be monitered, rows of potatoes known to be infected with the subject viruses were interplanted at intervals between test rows.

Aphid Monitoring Procedures
Yellow water pan traps were used to monitor the seasonal distribution of aphids near plots at Madras and Hermiston. Alate (winged) aphids from traps were collected weekly and stored in 70% alcohol. Aphids were identified, when possible, at Oregon State University, Corvallis, and at the Hermiston Experiment Station.

RESULTS & DISCUSSION

As summarized earlier and in Table 1, we suspect PVY and possibly PLRV are present in the native plant population. Nevertheless, with PLRV other related viruses may confuse accurate identification, and false positives are a problem associated with the ELISA test. For example, recent studies have found non-PLRV infected mature dandelion plants to give a positive ELISA reaction for PLRV (Lee Fox, Yakima ARS, personal communication). Also, the cosmopolitan Beet Western Yellows Virus has proven difficult to serologically distinguish from PLRV. This necessitates that we follow-up future native plant ELISA testing with indicator plant transmission studies.

Aphid populations during the season can be seen for Madras and Hermiston in Figures 2 and 3, respectively. Aphid populations are higher at Hermiston than at Madras. This is not surprizing as Hermiston, the Columbia Basin is the site where commercial potato production is abundant. Madras on the other hand, has smaller populations of aphids and smaller more isolated areas of seed potato production. Also noteworthy here is the abundance of aphid species other than green peach early in the season, namely U44 in Madras and the Potato and Pea aphids in Hermiston.

Visual virus incidence was taken from eye-indexed plants from 20 tubers collected from each plot from each location. The results can be seen in Figures 4, 5 and 6. At all threee locations the incidence of both viruses were lower in the plots covered for the entire season compared to those left open for the entire season, this can be seen in the 'C' (covered) and 'O' (open) treatments. This would indicate that row covering is an effective method of eliminating aphids and associated transmission of viruses.

PVY at all threee locations and PLRV at both Hermiston and Aurora show higher virus incidence among plants that were uncovered during weeks at the beginning of the season. This might indicate the importance of preventing aphid transmission of viruses early in the season, at emergence rather than at lay-by. PLRV and PVY incidence was lowest at Madras and highest at Hermiston. This corresponds with the greater aphid populations and commercial production at Hermiston.

CONCLUSION

Our data strongly suggest other plants may be involved in harboring potato viruses. Nevertheless, until confirmed with other techniques, our results must be considered tentative. At this time we need to verify the identity of the viruses found in the native plants and the ability of green peach aphid and others aphids to transfer these viruses (a) into potatoes from range plants and (b) into range plants from potato. Upon such verification, additional field investigations into the role of other plants may continue.

Our row cover testing on timing of aphid:virus influx appears to suggest that other aphid species (in addition to Green Peach Aphid) be monitored. More efficient utilization of pesticides may be accomplished by protecting plants earlier in the season, from emergence, rather than the current practice of protecting at lay-by.

Figure 1: Location of range plant samples and potato seed fields in Central Oregon in 1988.

Table 1: Percent virus detection of PVY, PLRV and PVS using ELISA on native range plants sampled from 12 sites in Central Oregon in 1988.

Figure 2: Seasonal aphid distributions, Madras, OR, 1988.

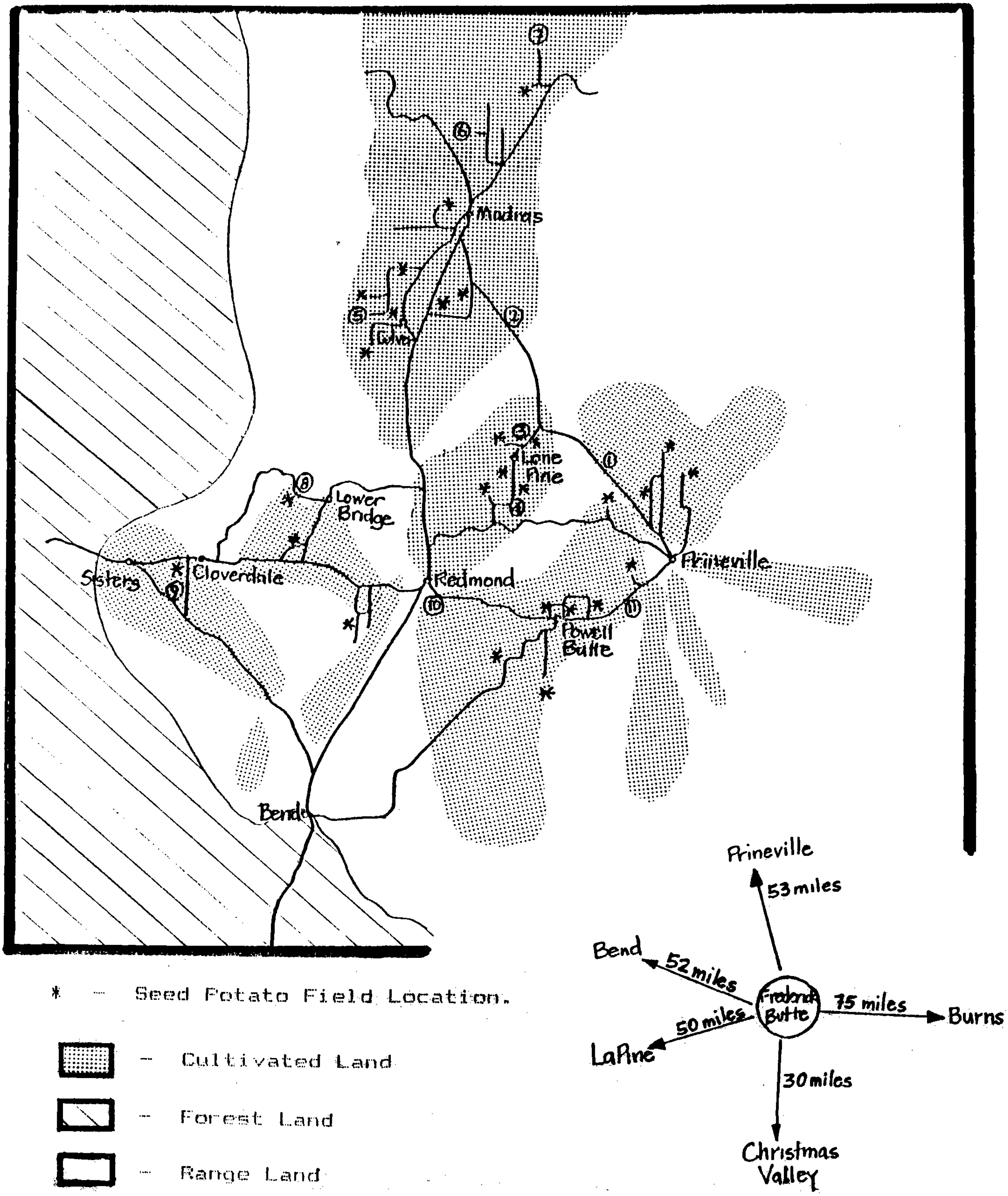
Figure 3: Seasonal aphid distributions, Hermiston, OR, 1988.

Figure 4: Seasonal PLRV and PVY in potato plants at Madras, OR, 1988.

Figure 5: Seasonal PLRV and PVY in potato plants at Hermiston, OR, 1988.

Figure 6: Seasonal PLRV and PVY in potato plants at Aurora, OR, 1988.

Figure 1: Location of range plant samples and potato seed fields in Central Oregon in 1988.



Note: Numbers indicate location of all range plants sampled in 1988.

Table 1. Percent virus detection of PVY, PLRV and PVS using ELISA on native range plants sampled from 12 sites in Central Oregon in 1988.

Green Rabbit Brush (Chrysothamnus viscidiflorus)

Location* (Sample Size)	PVY	PLRV	PVS
1 (20)	40	80	0
2 (20)	0	30	0
3 (50)	62	0	0
4 (50)	0	0	0
5 (20)	25	0	0
6 (20)	65	0	0
7 (20)	100	0	0
8 (20)	65	15	0
9 (20)	50	15	0
10 (35)	14	3	0
11 (50)	2	12	0
12 (48) Remote Site**	22	12	0
Total (373) Average	38%	14%	0%

Grey Rabbit Brush (Chrysothamnus nauseosus)

Location* (Sample Size)	PVY	PLRV	PVS
1 (0)			
2 (0)			
3 (50)	5	10	0
4 (0)			
5 (20)	5	0	0
6 (20)	0	0	0
7 (20)	55	0	10
8 (20)	10	5	0
9 (20)	0	0	0
10 (0)			
11 (50)	0	0	0
12 (0)			
Total (200) Average	7%	2%	1%

* See Figure 1.
** Remote site was at Frederick Butte (see Figure 1.)

Figure 2: Seasonal aphid distributions, Madras, OR, 1988.

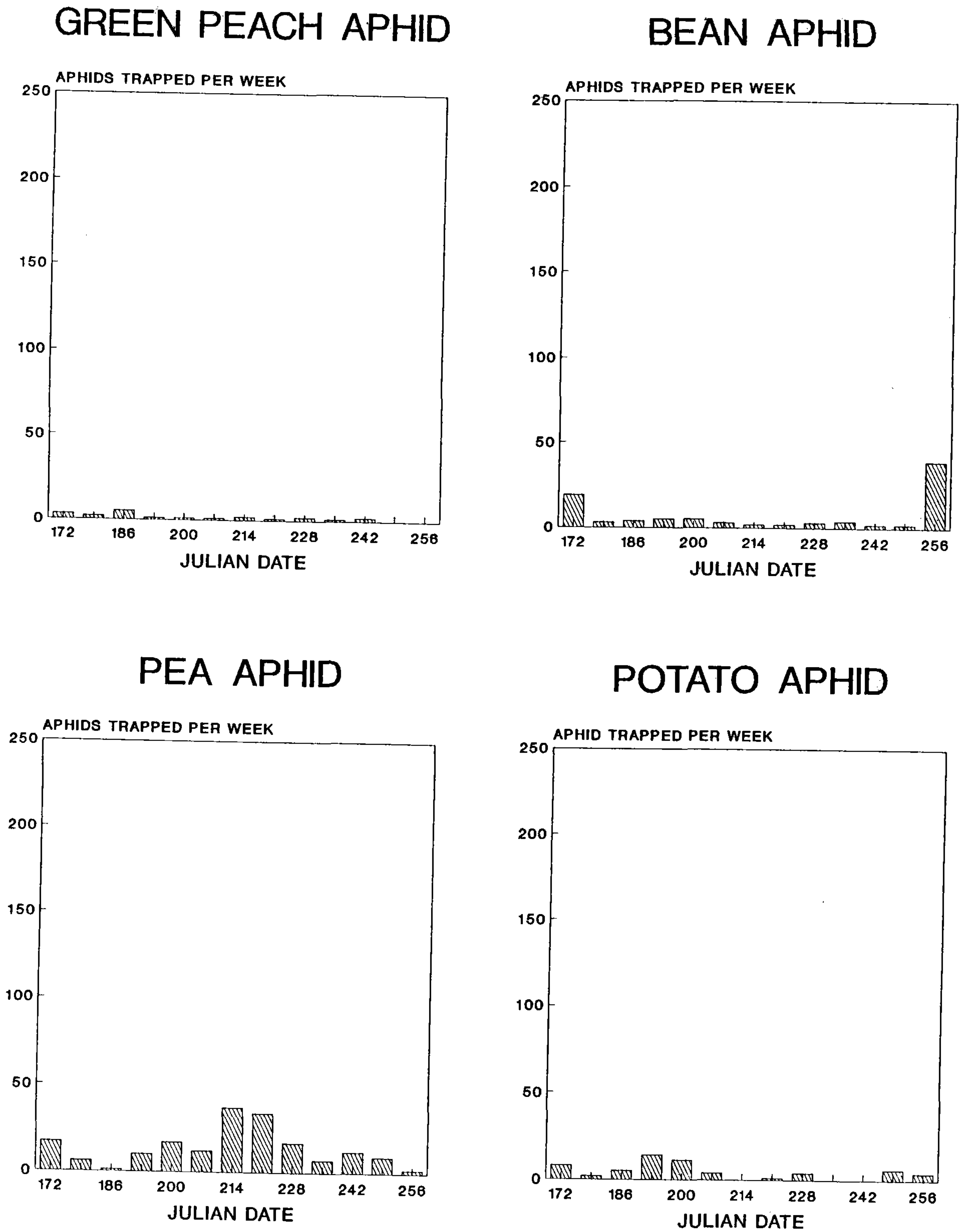


Figure 2: Seasonal aphid distributions, Madras, OR, 1988.

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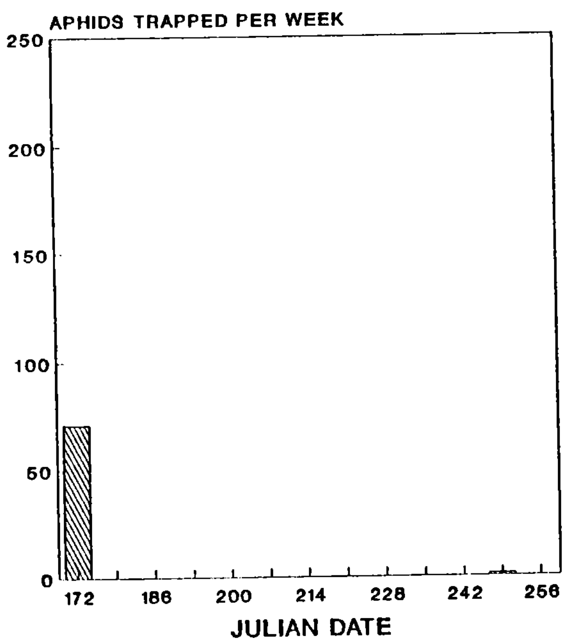

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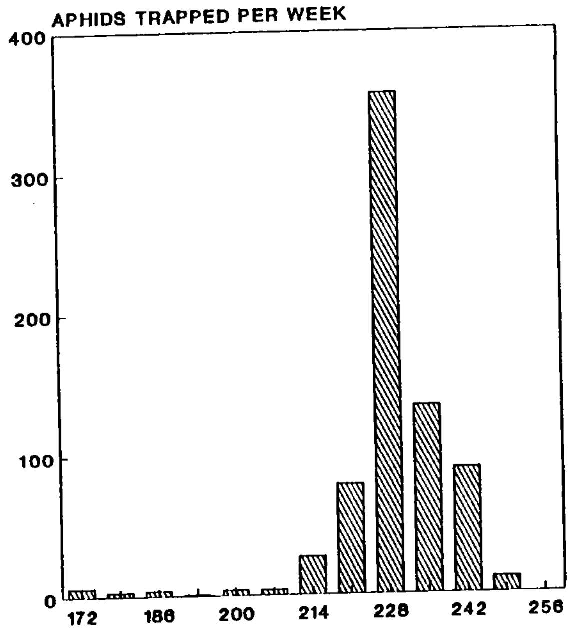


Figure 3: Seasonal aphid distributions, Hermiston, OR, 1988.

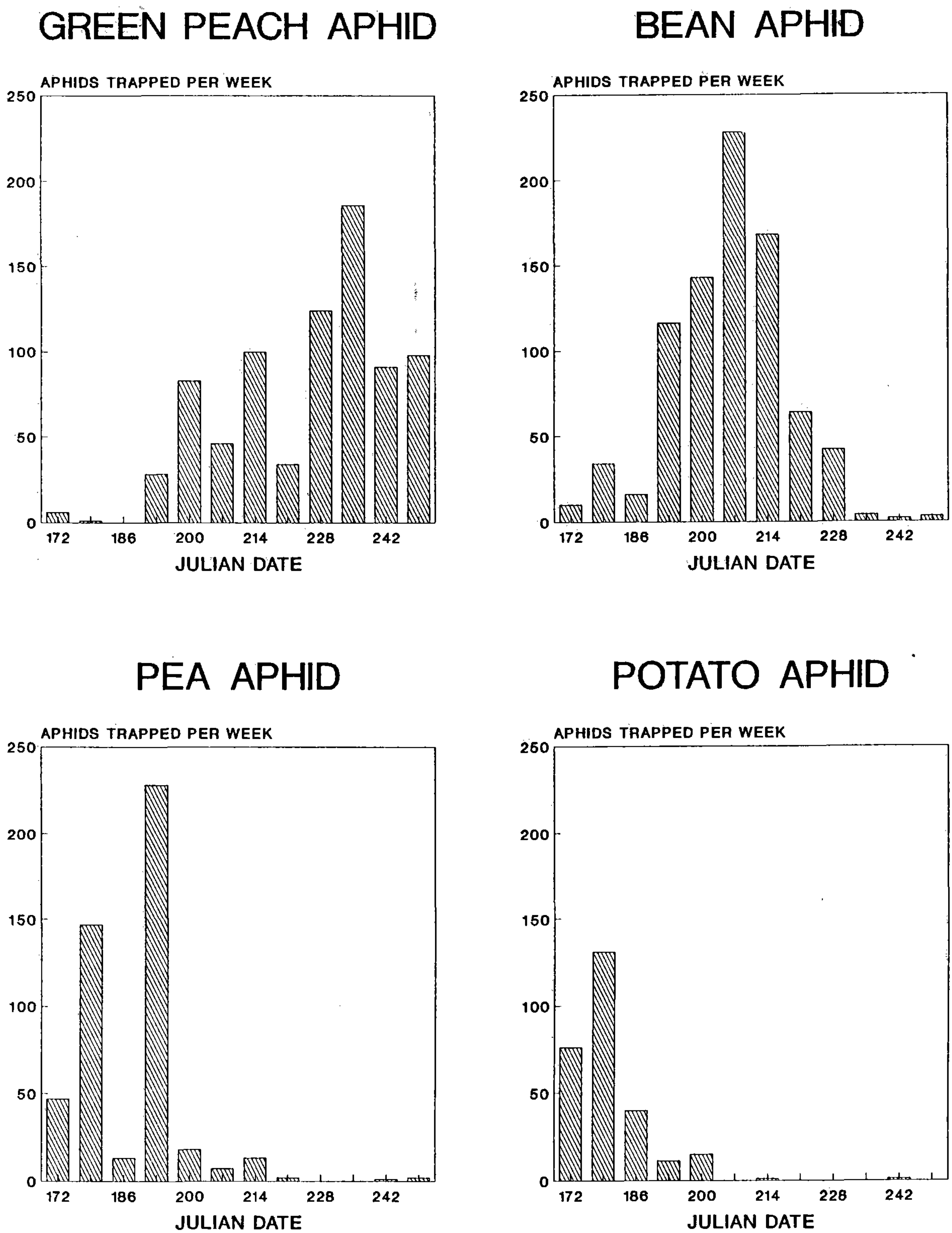


Figure 3: Seasonal aphid distributions, Hermiston, OR, 1988.

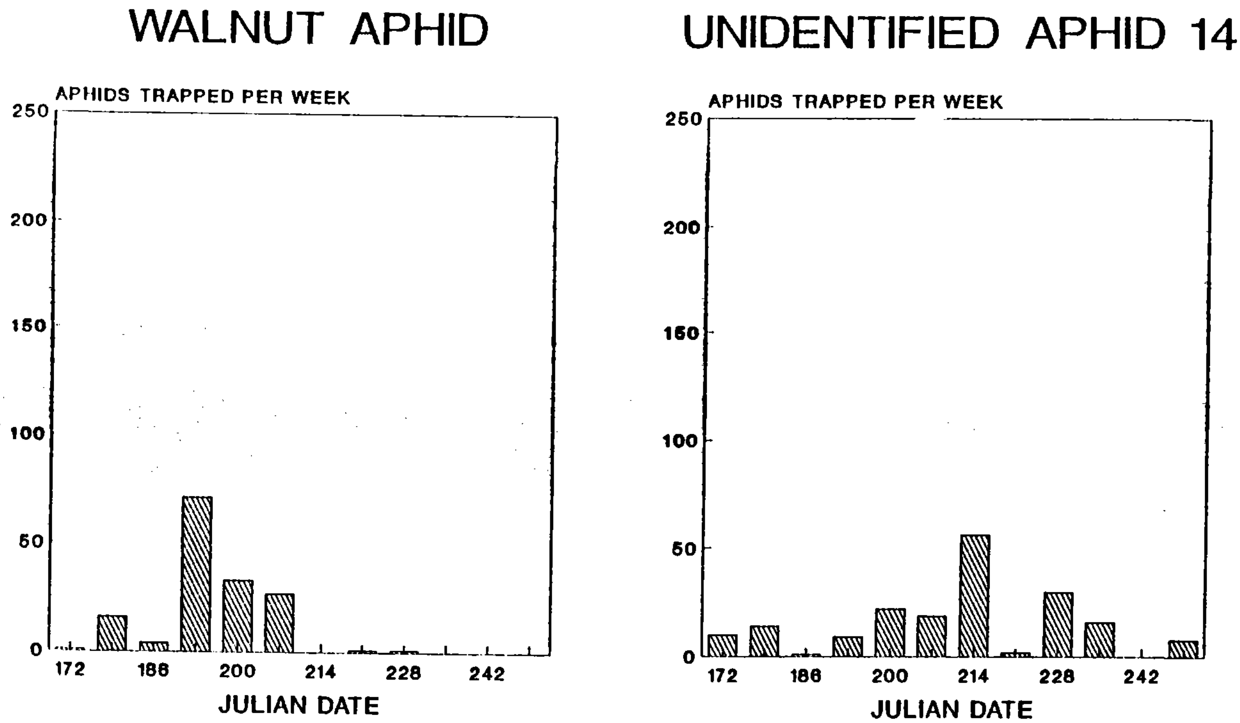
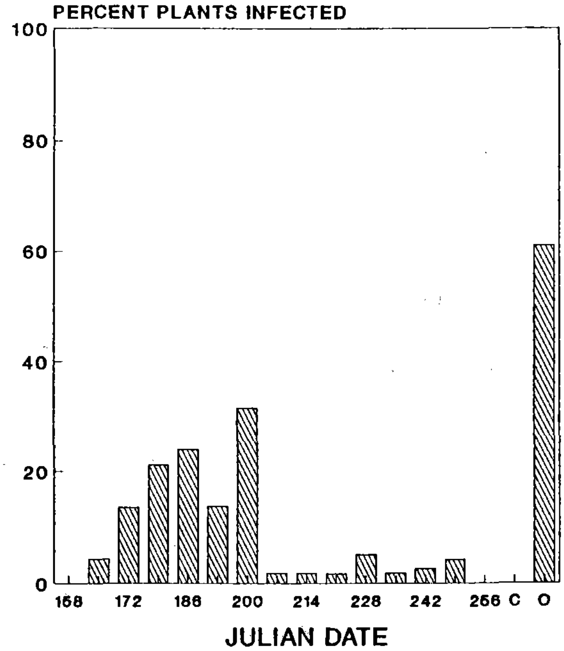


Figure 4: Seasonal PLRV and PVY in potato plants at Madras, OR, 1988.

PVY



PLRV

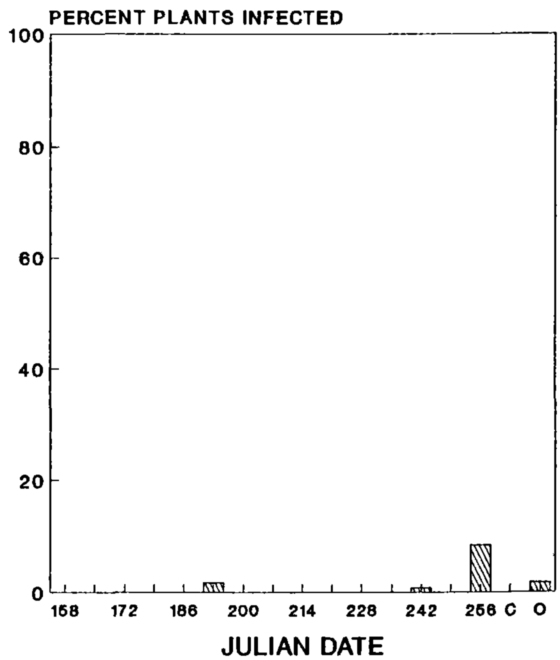
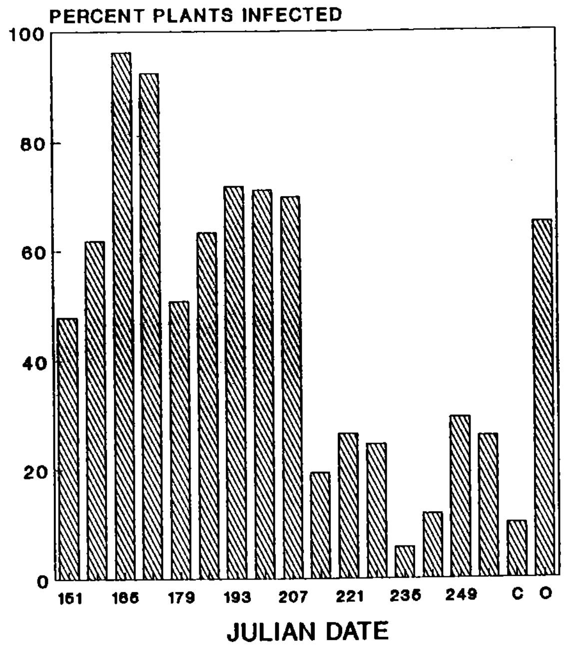


Figure 5: Seasonal PLRV and PVY in potato plants at Hermiston, OR, 1988.

PVY



PLRV

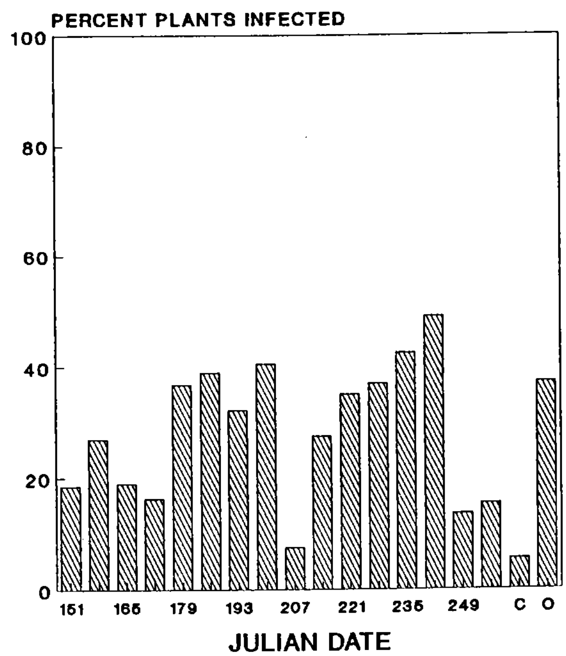
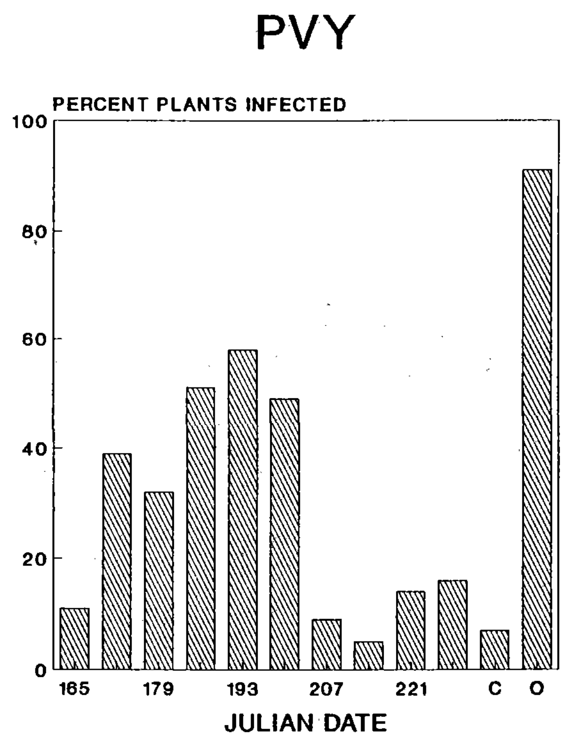
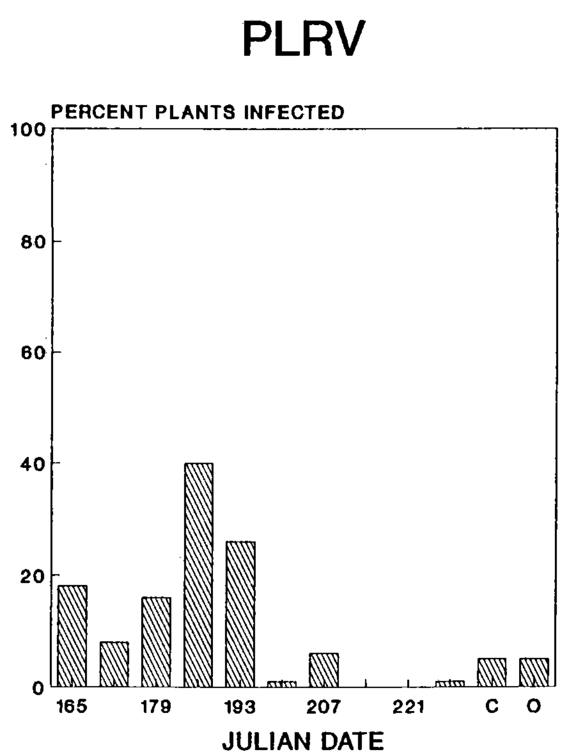


Figure 6: Seasonal PLRV and PVY in potato plants at Aurora, OR, 1988.





NEW POTATO VARIETIES FOR OREGON

1988 PROGRESS REPORT

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ABSTRACT

Over 30,000 unique potato clones were grown and evaluated at the Powell Butte Site of Central Oregon Experiment Station in 1988. Of the 30,054 singe-hill tuber families grown, 602 were selected for further testing in 1989 at Hermiston and Powell Butte. Three hundred fifty-two clones were evaluated at Hermiston and Powell Butte in second field generation trials; sixty-two were advanced to statewide preliminary replicated field trials; and 50 clones were evaluated in advanced statewide yield trials.

The seed produced at Powell Butte for statewide, tri-state, and regional variety trials remained relatively disease free. All advanced lines were ELISA tested for viruses PVX, PVY, and PLRV at the OSU Botany and Plant Pathology laboratory prior to vine kill. Seed for 1989 seed increases was harvested from virus free plants.

Over 150 promising clones were received from Hermiston. These clones were selected from single-hills and grown in early generation screening trials at Hermiston. Each clone was eye-indexed, grown in the greenhouse, and ELISA tested for viruses. Minitubers were produced from clones in which no viruses were found. The clones which tested positive for PVX, PVY, and PLRV were meristemmed and placed into tissue culture to eliminate viruses. All clones will be evaluated in statewide tests once sufficient virus-free seed is increased.

ACKNOWLEDGEMENT: This research was supported in part by grants from the Oregon Potato Commission and the U.S. Department of Agriculture.

Six Oregon clones show potential for release in the future. A74212-1 was evaluated for the fresh market, CO08014-1, A081216-1, A082283-1, and A082611-7 were evaluated for freshmarket and processing, and ND01496-1 was tested in chipping trials.

INTRODUCTION

Promising clones from Oregon's potato variety development program are being advanced to regional trials at a steady pace. Clones suited for fresh market, processing, and chipping are being identified under the current selection program. Promising selections also have a wide adaptability range because of evaluation in Oregon's major potato producing areas.

New facilities constructed at Powell Butte will benefit the overall variety development effort. Seed production, sorting, packaging, shipping, and general coordinating have been streamlined by the development of the new facilities. More precise storage evaluation of the clones is now possible. These improvements will enhance the efforts to produce new potato varieties for Oregon growers.

This report will focus on advanced selections in the Oregon program. For details of the methods utilized for the various seed increases and variety trials, see the paper "New Potato Variety Development at Central Oregon Experiment Station - 1987" elsewhere in this publication.

METHODS

Statewide variety trial. A statewide potato variety trial with 50 entries was planted at Powell Butte in 1988. The plots were arranged in a randomized block experimental design replicated four times.

The planting area was treated with 5 1/2 pints/acre of Eptam 7-E on May 15, 1988, prior to planting. The trial was planted May 17, 1988. Plots were 3 feet by 20 feet, rows were spaced 3 feet apart, and seedpieces were placed nine inches apart within the rows. Fertilizer was banded at planting at a rate of 1100 lbs/acre of 19-14-15.8-6.1 (NPKS). Weeds were controlled by an application of 0.25 lbs ai/acre of Sencor when plants were approximately 3-4 inches. Sevin was applied on July 13, 1988, and Monitor on August 6, 1988, to control potato beetles. The vines were killed by frost on September 10-13, 1988 and the plots harvested October 12, 1988.

For each plot the total number of tubers was recorded and the total weight was recorded for each of six categories:

under four ounces, culls, twos, four to six ounce US number ones, six to twelve ounce ones, and over twelve ounce ones.

A 10 pound sample from each plot was taken for french frying, specific gravity determination, and internal defect grading.

Specific gravities were determined by weighing approximately 10 pounds of tubers in air and water. Sixteen tubers from each plot were sliced longitudinally and internal defects were recorded as percent of tubers with a given defect. Four tubers from each plot were stored for two months at 50°F for french frying. Four one-quarter inch square strips from each of four tubers were fried for four minutes at 350°F. Each strip was evaluated for color and dark ends. Color was scored from 0-4 based on the "USDA Standard Color Chart for Frozen French-fried Potatoes".

RESULTS

A summary of the Oregon advanced potato variety trial grown at Powell Butte in 1988 is shown in Table 1. Four check varieties and 19 experimental clones were retained for further evaluation. A brief summary of released varieties and some of the most promising clones follows.

<u>Fresh market and/or processing varieties</u>

Russet Burbank. This variety has been grown on a wide scale for many years. Tubers are generally long with a medium to medium- light russet skin. Russet Burbank matures late and can be used for processing or fresh market. It stores well for long periods and has excellent culinary quality. It is susceptible to stress which produces malformations, second growth, hollow heart, brown center, and sugar ends.

Lemhi Russet. Lemhi was released in 1981 by the USDA, Idaho, Oregon, Washington, California, and North Dakota. Yields and maturity are similar to Russet Burbank and tubers are typically oblong, smooth, and covered with a medium russet skin. Lemhi has a high specific gravity and fries well from storage. It has an attractive appearance and high percentage of No. 1's, but has not been widely grown because of its susceptibility to black spot bruise and hollow heart.

Norgold Russet. North Dakota released Norgold in 1964. Norgold has been widely grown as an early fresh market variety. This variety produces medium yields of oval tubers with a smooth, medium russet skin. It has low specific gravities and is seldom used for processing. Norgolds strengths are early maturity and uniform tuber shape; its weaknesses are severe hollow heart on occasion, low yields, and susceptibility to early dying.

Russet Norkotah. Norkotah is a relatively new variety released by North Dakota in 1987. Tubers are extremely attractive, smooth, oblong in shape, and covered with a medium russet skin. Plants are typically small, determinate and mature early. Norkotah has a low specific gravity and fries dark from 45^{o}F storage. It is primarily used as a fresh market variety because of its attractive appearance, uniform shape, high percentage of U.S. No. 1 yield, and good internal quality. Norkotah is susceptible to early dying.

Shepody. This variety was released by Agriculture Canada New Brunswick in 1980. Tubers are often large, oblong and slightly flattened. Shepody has had limited fresh market use in the west because of its white and unattractive skin. It matures two weeks earlier than Russet Burbank and has had limited use as an early processing variety in the western U.S. Shepody has excellent culinary qualities, can be utilized for processing, and produces moderately heavy yields. Tubers are not as dormant as Russet Burbank and contain fewer eyes.

HiLite. This is a proprietary variety released by Northwest Potato Sales, Inc. in 1987. HiLite has very small plants, and moderate yields of oval, pear shaped, smooth tubers with a medium russet skin. HiLite has primarily been used for the early fresh market because of low specific gravities and marginal fry color. It seldom has internal or external defects.

Experimental selections

A74212-1. This selection has been tested in Oregon since 1981. Tubers are very attractive, smooth, oblong, and lightly russetted. Plants are generally moderately large and resistant to early dying. A74212-1 is a late maturing variety. Yields have been outstanding and internal quality good (Table 2). The major problem encountered in commercial testing has been skinning damage if harvested too soon after top kill. This has led to storage rots and poor seed performance.

A74212-1 Early. During the 1986 growing season, the vines of some of the tuber units of A74212-1 senesced earlier than the majority of the tuber units. Tubers from these early maturing plants were harvested separately and increased. The tubers from the early clone are identical to the late maturing clone. In fact, the only difference noted as of this writing between the clones is maturity. A47212-1 (early) will be evaluated in future statewide variety trials and initial testing has indicated it may be better adapted to the short growing season areas.

C008014-1. After statewide and regional testing, this selection has shown promise both for the fresh market and processing industry. Tubers are oblong, attractive, and have a medium russet skin. Yields are medium to medium high and grade is excellent. Maturity is similar to Russet Burbank. C00814-1 has a good specific gravity and fries well from storage. It has a tendency to develop folded bud ends.

A081216-1. Selection A081216-1 was tested in tri-state trials in 1987 and 1988. Tubers are long, smooth medium russetted, and medium-small in size. Maturity is similar to Russet Burbank. This selection can be used for processing or fresh market. Its major weakness is small size.

A082283-1. This selection was grown in 1988 tri-state trials and was advanced to the 1989 regional trial. It is a medium-late maturing selection which produces beautiful smooth, oblong tubers with shallow eyes, heavy russet skin, and yellow flesh. Yields are better than Russet Burbank and it has processed very well. A082283-1 is moderately susceptible to blackspot bruise and some growth cracks have been observed at some test locations.

A082611-7. This selection was also grown in 1988 tri-state trials and advanced to the 1989 regional trial. A082611-7 is medium maturing and produces high yields of large, oblong, medium russetted tubers. This selection has a high specific gravity and fries well from storage. It has excellent internal quality. At times, it has had a tendency to be rough, knobby, and similar to Russet Burbank in grade.

A7411-2. This selection is being considered by Idaho for release. It is medium-late maturing and produces high yields of tubers similar in appearance to Russet Burbank. Tubers usually grade better and have higher specific gravities than Russet Burbank. A7411-2 also had excellent internal quality, including resistance to sugar ends. It can be utilized as a fresh market or processing variety. It does not store as well as Russet Burbank.

A74114-4. This is another selection that likely will be released in the near future by Idaho. A74114-4 is an early maturing selection with fresh market or early processing potential. Tubers are smooth, oblong to long and uniform with a medium russet skin. It has a specific gravity similar to Russet Burbank. A74114-4 processes best from the field as it tends to accumulate sugars in storage.

<u>Chipping varieties and experimental selections</u>

Norchip. Norchip was released by North Dakota in 1968. It has been a popular chipping variety in the U.S. This variety produces average yields of medium maturing, white-skinned, round to oval tubers. It usually chips well from storage. Growth cracks, mediocre yields, and susceptibility to early dying sometimes plague Norchip.

Atlantic. This variety was released in 1976 by the USDA, Maine, Florida, and New Jersey. Recently, it has gained popularity. Tubers are round with a very lightly russetted skin. Plants are medium maturing and produce high yields of tubers with high specific gravities. Atlantic chips well from storage. Western chip growers have noted problems with hollow heart, heat necrosis, shatter bruise, and storage rots.

ND01496-1. This Oregon selection has been tested in statewide and regional trials. ND01496-1 is medium maturing and produces high yields of beautiful white-skinned, round tubers. It has a high specific gravity. Internal quality is excellent, but is susceptible to scab and shatter bruising.

Table 1. Statewide potato variety trial, Powell Butte, Oregon, 1988

Variety	Yield-cwt/a Total	Yield-cwt/a No. 1	% RB	Spec grav	Fry color[1]	Percent[2] HH	Percent[2] BS	Percent[2] BC	Disposition
R. BURBANK	460	287	100	1.081	1.56	5	4	15	KEEP
LEMHI	469	362	102	1.079	1.92	8	31	0	KEEP
NORGOLD	417	308	91	1.069	2.92	8	0	0	KEEP
NORKOTAH	395	333	86	1.071	1.50	0	0	0	KEEP
A74212-1E	547	469	119	1.072	2.81	0	5	0	KEEP
A74212-1L	606	533	132	1.076	3.69	0	3	0	KEEP
AO81178-12	454	392	99	1.076	2.81	1	0	0	KEEP
AO81216-1	343	223	75	1.079	1.78	1	1	0	KEEP
A81362-3	476	375	103	1.077	2.36	0	11	0	KEEP
AO82254-24	444	380	97	1.075	2.58	1	3	0	DROP
AO82260-8	432	329	94	1.081	1.97	10	1	0	DROP
AO82281-1	513	417	112	1.076	1.69	4	4	0	KEEP
AO82283-1	470	359	102	1.080	0.59	8	3	0	KEEP
AO82611-7	548	443	119	1.079	2.31	1	3	0	KEEP
AO82616-18	485	367	105	1.085	0.84	1	11	0	KEEP
COO83008-1	460	391	100	1.083	1.05	1	5	6	KEEP
COO83020-5	437	350	95	1.073	2.53	3	1	0	DROP
COO83021-1	453	390	98	1.080	2.31	3	0	0	KEEP
COO83021-5	354	305	77	1.084	2.80	18	0	0	KEEP
COO83023-9	355	279	77	1.074	2.09	8	0	0	DROP
COO83066-1	464	365	101	1.085	1.06	10	3	0	DROP
COO83067-3	450	386	98	1.074	1.00	0	1	0	DROP
COO83085-5	460	391	100	1.074	2.50	0	0	0	KEEP
COO83120-5	398	273	87	1.077	2.94	3	1	0	DROP
COO82177-3	366	271	80	1.073	2.75	14	1	0	KEEP
AO83005-1	469	372	102	1.083	1.72	3	4	0	DROP
AO83010-7	440	363	96	1.073	0.44	1	11	0	DROP
AO83019-10	428	301	93	1.067	3.31	0	8	0	DROP
AO83026-3	545	389	118	1.082	2.75	1	4	0	DROP
AO83029-8	505	391	110	1.071	2.80	0	4	0	DROP
AO83037-6	437	319	95	1.078	2.81	6	0	3	DROP
AO83037-10	500	411	109	1.072	1.94	0	4	0	KEEP
AO83065-2	365	253	79	1.078	1.75	0	3	0	DROP
AO83088-2	521	411	113	1.066	3.63	0	4	0	DROP
AO83093-2	417	317	91	1.066	1.72	1	0	0	DROP
AO83110-3	488	362	106	1.075	1.84	1	3	0	KEEP
AO83119-2	422	255	92	1.079	1.86	0	1	0	DROP
AO83119-3	444	291	106	1.080	1.75	0	6	0	KEEP
AO83148-1	437	310	92	1.079	1.38	1	1	0	DROP
AO83177-5	429	364	97	1.082	0.00	0	4	0	DROP
AO83177-6	524	435	95	1.079	1.38	0	1	1	KEEP
AO83196-12	473	405	93	1.078	3.27	1	0	0	DROP
AO83196-15	498	404	114	1.072	3.39	1	1	0	KEEP
AO83206-2	419	354	103	1.080	2.38	10	0	10	DROP
AO83218-10	421	314	108	1.075	1.52	14	1	0	DROP
AO83222-6	381	240	91	1.075	1.13	1	1	0	DROP
AO83222-7	444	356	92	1.076	1.50	0	6	0	DROP
AO81323-4	516	424	83	1.077	2.69	3	1	0	DROP
AO81323-20	426	342	97	1.083	3.56	1	3	0	DROP
HILITE	375	306	112	1.069	2.50	0	0	0	DROP
LSD, 5%	60	66	---	0.003	0.95	5	6	2	--

1 0 = Lightest; 4 = darkest
2 HH = hollow heart; BS = black spot; BC = brown center

Table 2. Performance of selection A74212-1 at four Oregon locations.

LOCATION	YEAR	TOTAL YIELD cwt/a	TOTAL %RB	NO. 1 YIELD cwt/a	NO. 1 %	NO. 1 %RB	SPECIFIC GRAVITY	FRY COLOR	HH %	BC/IBS %	BS %
Powell Butte	1981	538	113	415	77	132	1.073	3.6	0	-	-
	1982	336	84	251	75	88	1.079	2.5	0	0	10
	1983	529	102	502	95	112	1.078	1.4	0	0	6
	1984	592	123	496	84	138	1.077	1.5	0	0	8
	1985	528	108	396	75	127	1.083	3.5	0	0	9
	1986	589	115	481	81	180	1.087	3.5	0	3	13
	1987	634	104	490	77	123	1.081	3.4	0	0	5
	1988	606	131	533	87	186	1.076	3.7	0	0	0
Hermiston	1981	768	102	684	89	150	1.078	3.6	0	3	0
	1982	899	110	734	82	118	1.077	2.7	0	0	0
	1983	832	112	707	85	119	1.076	3.8	0	0	15
	1984	723	118	674	93	135	1.077	3.5	0	2	14
	1985	938	123	786	84	147	1.070	3.0	1	0	0
	1986	794	107	568	71	111	1.080	0.8	0	1	4
	1987	944	148	777	82	162	1.076	1.3	0	0	0
	1988	823	144	577	70	152	1.063	2.2	0	0	2
Klamath Falls	1981	471	193	398	85	-	1.081	-	3	-	-
	1982	524	107	395	75	-	1.083	-	23	-	-
	1983	484	134	409	84	170	1.070	-	3	-	-
	1984	634	128	539	85	144	1.076	-	5	-	-
	1985	510	128	414	81	146	1.067	-	7	20	-
	1986	621	116	545	87	139	1.068	-	0	-	-
	1987	495	133	405	81	193	1.066	-	-	-	-
	1988	568	122	514	90	161	1.081	-	0	-	-
Malheur	1981	546	119	504	92	133	-	-	-	-	-
	1984	756	134	648	86	145	-	-	-	-	-
	1985	730	113	578	79	129	-	-	-	-	-
	1987	416	93	326	78	114	-	-	-	-	-
	1988	910	157	798	87	218	-	-	0	0	0
Powell Butte	Ave	544	110	446	81	136	1.079	2.9	0	0	7
Hermiston	Ave	840	121	688	82	137	1.075	2.6	0	1	4
Klamath Falls	Ave	538	133	452	84	159	1.074	-	6	-	-
Malheur	Ave	672	123	571	84	148	-	-	-	-	-
All Locations	Ave	646	121	536	83	131	1.076	2.8	2	2	5

ERADICATION OF THE WHITE ROT FUNGUS FROM INFESTED SOIL BY STIMULATION OF SCLEROTIA IN THE ABSENCE OF HOST CROPS.

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ABSTRACT

A single application of di-allyl di-sulfide (DADS), a stimulant of germination of sclerotia of the white rot fungus (*Sclerotium cepivorum*), was irrigated into furrows of an infested field which had been planted to bluegrass seed. Pretreatment populations of sclerotia in the soil were estimated, then compared with those present one month and one year later. After one month many sclerotia were actively germinating or had germinated already. After one year, no sclerotia were found in beds receiving various rates of product, neither were sclerotia found in water-only treatments and border beds to the treated areas. The population of sclerotia in field soil more than 20 ft away from the test area remained measurable during this period. Odors of the product were detected in soil and air space in the test area for several months and may have stimulated sclerotia away from the points of application. Bluegrass production apparently was unaffected. These results confirm that DADS and/or related compounds might be utilized to reduce soil populations of the white rot fungus, and possibly to eliminate the pathogen from field soils at times when *Allium* crops are absent.

INTRODUCTION

Sclerotia of the white rot fungus may lie dormant in soil for years until stimulated by sulfur compounds naturally emitted as gaseous vapor from roots of onions or onion relatives. In small, closed test systems, 100% of sclerotia may respond to stimulation. Stimulation is optimal at near 65^{o}F, and is restricted to the temperature range between 48-75^{o}F. Germination of sclerotia is optimal at intermediate soil moisture levels. Prolonged saturation promotes sclerotia decay. The pathogen has been reported unable to grow

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and reproduce on plants other than Allium species or on soil organic matter.

Using a naturally-infested field site in central Oregon, we attempted to irrigate into the soil profile a commercial, petroleum-derived source of di-allyl di-sulfide (DADS), one of the stimulants found garlic. This was done in an attempt to rapidly reduce soil populations of the white rot fungus in the absence of onions or other Allium species. We presume that repeated applications will be necessary to reduce populations sufficiently for successful recropping of susceptible crops. If the amount and cost of material are low enough, and the delivery system is inexpensive and non-disruptive to other cropping, treatments could be repeated as necessary.

Initially we chose to test various concentrations of DADS applied in single irrigation. In doing so, we hoped to determine an appropriate working range of concentrations, to determine the approximate number of applications which might be required commercially, and to determine if the oil-based product even could be effectively moved through the soil profile with irrigation water.

METHODS

Field site selection: The field relebted was near Madras OR. Based on preliminary analyses, the most highly infested area was selected for location of test plots. The field was in bluegrass seed production since fall 1982, and was furrow irrigated.

Experimental design: There were five replications of each treatment, in a randomized block design. Data collected were: 1) pre-treatment inoculum densities from soil collected from each plot on October 13, 1987, 2) 1-month post-treatment inoculum densities from soil collected from each plot on November 17, 1987, and 3) 1-year post-treatment inoculum densities from soil collected from each plot on November 28, 1988.

Population estimation: From plots, two sub-samples of twenty composited 1-in dia x 6-in deep cores were taken uniformly along the tops of beds. Care was taken not to sample from furrow sides or bottoms, so as not to disturb normal irrigation water infiltration of the bed profile. Additional soil samples were collected from alleys, beds between plots, and from areas 20 or more ft outside the test area. Cores were bulked, air-dried, coarsely ground and mixed well, and stored air-dry at room temperature. Samples were assayed by wet-sieving through screens, and observing residue under a binocular microscope. Sclerotia were collected, forced to grow and identified. Inoculum density was expressed as the number of sclereotia per 100 mo (cc) soil.

Plot design and DADS treatments: Treatment was initiated on October 15, 1987. At that time, daytime soil temperature at four inches in the bed was 49-58°F. Plot irrigation treatments were into the three furrows bordering two 20-ft long bed sections. Bed sections were separated along the row by dammed 3-ft alleys which were unirrigated, and which were left dammed over the winter. Side-by-side, plots were separated by two additional bed sections, and the furrow between these beds was irrigated with water only at the time of plot treatment. DADS was 70% product, obtained from Phillips Petroleum. Because the bulk of the impurities were related compounds, also thought to be stimulatory, concentrations were developed based on total product. In addition to a water-only treatment, treatments were four 10-fold dilutions from a maximum dosage of 1% (v/v). Dosage calculation was based on the estimated total water held at saturation in the soil within 8 in from the top of the beds. Water already in the soil profile was included in the calculation. DADS, along with 20 ml non-ionic wetting agent was mixed with 4 gal water in buckets and applied uniformly to each 20-ft furrow section. No wetting agent was applied with water-only controls. Separate buckets were used for each rate of application. As soon as this amount had infiltrated the soil (approx. 1 min), the furrows were filled three times with additional water, totalling 195 gal per plot. The water source was normal ditch water. Water was dispensed directly into all three plot furrowsw at a time from the ditch, using a submersible pump, a hose and a PVC manifold.

Following the test irrigation, dams were left in place over the winter. No additional irrigations were made commercially or experimentally to the field in 1987 or 1988. In March 1988, dams were removed and the field was irrigated commercially, including all furrows through plot areas.

"Garlic" odors: DADS smells much like garlic. Observations were periodically made of odors in the air around plots and from soil samples as a measure of determining the persistence of treatments.

Kentucky bluegrass growth: Visual observations were made on the condition of Kentucky bluegrass plants in the first month after treatment and during 1988.

RESULTS

Inoculum densities from outside the test: The average number of sclerotia per 100-ml soil from samples taken from outside the test area was 1.75 in August 1984, 1.37 in August 1987, and 0.75 in Dec 1988 (Figure 1). The population may have naturally dropped slightly during this period, but Figure 1 primarily shows that the field remained measurably infested during the test period.

<u>Inoculum densities from within the test area</u>: Plots averaged 2.28 sclerotia per 100 ml in October 1987, prior to treatment. The plot area was selected because it initially was higher than the field average. One year after treatment (Dec 1988), no sclerotia were recovered from soil collected from any plots; a total of 5,000 ml soil was assayed (25 samples, two sub-samples each). Figure 2 shows average pre-treatment and 1-yr post-treatment inoculum density from both within and outside the test area. Additionally, soil was collected from five inter-plot borders and from alleys. One year after treatment, no sclerotia were found from four of these samples (2,000 ml soil). One sclerotium was found in 500-ml soil, from one sample taken from 3-5 ft outside the plots.

Pre-treatment and one-month post-treatment inoculum densities are shown for each treatment in Figure 3. Notably, inoculum density significantly increased over pre-treatment levels during this period for applications of 10, 100 and 1000 ppm DADS. Many sclerotia were found in a state of germination in soil from these treatments. Furthermore, numerous objects which clearly were the old shells of sclerotia already germinated/decayed were present in soil from these treatments. Not surprisingly, little activity was noted in the first month from the water-only treatment and from the DADS concentration of 10,000 ppm (1%). Allyl sulfide is known to be inhibitory at concentrations above this amount.

<u>"Garlic odors"</u>: The immediate atmosphere surrounding the entire test area smelled strongly of garlic for at least one month. In the field it proved impossible to determine by smell if low rates of application were odoriferous due to the intense odors emanating from nearby plots at higher rates. A faint garlic odor could be detected in the air around the plots even during March of 1988, 4-5 months later. At the time of 1-month post-treatment soil sampling for sclerotia population estimation, a few additional cores were collected from each treatment and placed in sealed metal cannisters. After various testers' had not smelled garlic for several days, cannisters were opened and tested for garlic odor, beginning with the water-only check, and thereafter with increasing treatment concentration. No garlic odor was detected in samples from the water-only check or from the lowest DADS treatment (10 ppm). For progressively increasing concentrations, garlic odor was present and increasingly strong. By March, 1988, faint garlic odor still was present in soil taken from the highest concentration treatment.

Kentucky bluegrass growth: No affect was noted on bluegrass plants growing in plots in 1987 or 1988. Except in one case where an oily scum separated from water in the furrow of the highest concentration. This coated and quickly killed seedling bluegrass plants growing in the furrow. Seedlings in furrows of other treatments of lesser concentration showed no effect. Plants growing from the top of the bed in high-concentration treatment showed no effect.

DISCUSSION AND CONCLUSIONS

Based on highly active germination one month after treatment within the treated area, and inability to recover sclerotia from treated areas after one year, we were able to stimulate sclerotia to germinate using DADS applied in a commercially equivalent manner with irrigation water. We drew this conclusion by comparing the response of populations within the test area with the response of populations from areas away from the test area. Populations away from the test area remained measurable for sclerotia of the white rot fungus, whereas within the test area sclerotia either were eradicated, or at least reduced to a level well below our ability to detect them. Based on other studies in the western United States, 1 or more sclerotia per 100 ml soil is sufficient inoculum to result in the loss of 90-100% of fall-planted garlic or onions, or the same proportion of onions spring-planted in areas with a cool summer. Populations below 1 sclerotium per 1000 ml soil would result in less than 10% plant loss. It proves difficult to measure populations below 1 per 1000 mls soil (about 1 qt), but the post-treatment populations within the test area fell to well below this level; no sclerotia were found from 30 samples and over 50 separate assays (7,000 mls soil). Disease-loss relationships have not been determined for regions with other climates and cropping systems. Spring-planted onions in the Treasure Valley might be expected to suffer less loss, because high soil temperatures might limit fungal germination and growth during the summer, however, white rot could be active on summer onions in this area during the spring and fall.

It is likely that DADS influenced sclerotia to germinate in nearby untreated plots and alleys within 5 ft from the application site. Because of the equal response among all treated and untreated plots, any potentially differential germination response to various rates of application was obscurred. Without detailed knowledge of manner of movement of stimulant within soil and air, we cannot make conclusions concerning dosage and time responses of application of this product in the field. Clearly, continued testing, with design modifications, is called for to further test rates, methods of application, influence of wetting agents, and influence of soil type.

Although detailed data was not collected on effects of DADS on bluegrass plants, no significant effect was noted from casual observations. Because our treatments were to the furrows rather than direclty onto plants via overhead irrigation, additional data are required to determine if DADS applied with sprinkler irrigation might affect crop plants.

EFFECTS OF HOT WATER AND FORMALDEHYDE SEED TREATMENTS ON SCLEROTIA OF THE WHITE ROT FUNGUS

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ABSTRACT

All garlic cloves infected at harvest with the white rot fungus (Sclerotium cepivorum) decayed while in storage. The white rot fungus was not recovered from any decayed trashy material in this seedlot other than sclerotia. Nevertheless some sclerotia of the white rot fungus survived traditional hot water-formaldehyde seed treatment processes. Those surviving were aggregated within decayed cloves, which might pass through the mechanical processors associated with cracking and seed treatment. Reduction in time and/or temperature of the treatment solutions allowed partial survival even of unaggregated sclerotia. It remains unclear if sclerotia surviving hot water treatments are fully competent.

Hypothetical Question: May the garlic industry feel secure that the standard Lear-Johnson seed treatment, and possibly milder variations of it, will eradicate the white rot fungus from a seed lot.

METHODS

In the summer of 1987, a bag of garlic infected with the white rot fungus (Sclerotium cepivorum) was collected in Monterey County CA, and shipped to the University of California Tulelake Field Station in Tulelake, CA. It was held as per normal seed storage until January, 1988. In January, 1988, the stored garlic was separated into several components: 1) loose sclerotia and 2) fully-decayed cloves in which abundant sclerotia were aggregated together with clove tissue and mycelium ("aggregates"), these varied from 0.5 mm to 1.5 mm in various irregular cross sections and were calculated to contain from 4,000-25,000 sclerotia each and 3) cloves which appeared normally developed and uninfected (no signs of the fungus on either stem plates or covering leaf sheaths).

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An attempt was made to find cloves on which the fungus appeared to be present either as partly decayed covering leaf sheaths, partly-decayed storage leaves or partly-decayed stem plates, but none were found -- it appeared as if all active mycelium present at harvest had progressed in storage to fully decay any cloves which had been infected. Bulbs were identified which had entirely decayed, but most had only certain cloves decayed, and these apparently were fully-decayed into either loose sclerotia or aggregates. If additional cloves became infected during storage, these had fully decayed by January.

The garlic was hand cracked and all variations of the above components of the infested/infected seedlot were placed separately within loose single-layer bags of cheesecloth and suspended and treated (in Tulelake) as listed in Table 1. All treatments utilized a single laboratory hot water bath containing 40 liters of treatment solution. All treatment solutions were prepared on site, using tap water with or without laboratory sources of formalin. Once equilibriated, treatment solutions maintained the listed temperatures within 1 degree Fahrenheit. This was true even after bags were immersed in the solution -- at the most, less than 250 g of material was present in any solution at one time. Even though only one bath was utilized, practice in removing and then adding set amounts of additional treatments solutions prepared with lab heating devices allowed solution type and/or temperature to be adjusted in less than 30 seconds. Some treatments were run simultaneously, and all treatments were completed within 3 hours. Following treatment, all bags were drained on paper towels on a lab bench overnight, then stored in open paper bags. The next day, all treated material was transferred to the lab of the Central Oregon Experiment Station in Redmond, OR. At that time, all materials appeared air-dry, with no free surface moisture.

Materials were cultured within 7-8 days following seed treatment. Treated materials were divided into four lots of each type and plated onto both plain agar (WA) and potato dextrose agar (PDA), following surface sterilization for 2 minutes with 0.05 percent sodium hypochlorite. From both intact and decayed bulbs, pieces of covering bulb leaf sheathes, clove protective leaves and stem plates were plated with or without surface sterilization. Additionally, intact and apparently uninfected cloves from bulbs with nearby decayed cloves were similarly cultured for the white rot fungus. Sclerotia on WA were cracked with forceps and on PDA they were not. Aggregates were separated into sclerotia from their surfaces and sclerotia from their centers. Following the experiments, all active white rot fungus, and sclerotia were destroyed.

Analysis of variance was developed for data from the four lots of each material type cultured after treatment. The validity of such analysis is discussed below.

RESULTS

No *Sclerotium cepivorum* grew from any living or decayed garlic tissue on either medium with or without surface sterilization. Roughly 40 pieces of each material described above were plated and intact cloves were cultured from several locations in addition to stem plates. Other organisms cultured from these materials included a typical range of bacteria and other fungi, but these fungi were not predominated by *Trichoderma* and *Penicillium* as reported below for sclerotia.

Two hundred sclerotia were plated from each of four treatment lots. Sclerotia plated on PDA were difficult to assess for germination, due to abundance and rapid advance of other organisms present, especially bacteria, and *Trichoderma* and *Penicillium* fungi, and also due to irregular germination of *S. cepivorum*. Such confirmation problems have been found in other studies and is the reason that the use of WA with cracking was developed. Cracking elicits simultaneous growth of the white rot fungus. WA discourages aggressive competitive growth, and encourages formation of characteristic spermatia-like structures, for easy identification of *S. cepivorum*. The same other contaminating organisms also grew from many sclerotia placed on WA, but did not seem to interfere with growth of *S. cepivorum* from the same sclerotium. A presumption was made that if *S. cepivorum* did not grow from a sclerotium, then it was not alive within that sclerotium at the time of culturing. If *S. cepivorum* grew from a sclerotium, the sclerotium was rated as germinable. These presumptions proved reliable in previous studies in which statistical comparisons were made between sclerotia plated on various growth media and in various manners compared with sclerotia naturally stimulated to germinate in soil (1). Although not listed within Table 1, the amount of contamination due to the above organisms was far less on treatments A (i.e. water at room temperature) and F (i.e. the standard Lear-Johnson treatment) than on any "intermediate" treatment. Detailed notes on degree of sclerotium contamination were not developed.

Sclerotia on the surface of aggregates behaved similarly to loose sclerotia. The percentage germination for aggregated and unaggregated (loose) sclerotia for the various seed treatments is listed in Table 1. Most sclerotia (85-89 percent) were alive and germinable with water treatment at room temperature. Progressive reduction in germinability was achieved with progressive harshness of treatment, both higher temperatures and longer durations. Maximum effect was achieved with the Lear-Johnson treatment, both with and without 1 percent formalin. For each treatment, sclerotia in the center of aggregates survived better than loose sclerotia, and approximately 20 percent of sclerotia near the center of aggregates survived the Lear-Johnson treatment, with and without 1 percent formalin.

DISCUSSION

The study can be criticized in at least one major technical way; because there was inadequate decayed garlic in the stored lot to provide many aggregates and decayed cloves, replications of each treatment series were not conducted. In other words, each listed treatment was only prepared once, with all the sets of garlic materials immersed in each one. Statistics presented in Table 3 thus were developed on only "pseudo-replications", wherein the treated material were divided into four batches after treatment. Done properly, each separate treatment would have been prepared four separate times, since the solutions and temperatures series are what were under investigation. Future investigations should provide true replication of treatment solutions.

Clearly, each increase in duration and temperature decreased the survival of the white rot fungus. At intermediate treatments, there was substantial survival of the pathogen, but also substantial occurrence of other micro-organisms within the sclerotia. Conceivably, sclerotia in which substantial bacteria, _Trichoderma_, and _Penicillium_ developed might have been less effective in eliciting white rot disease, but this was not determined. Conservatively, this can not be assumed, since previous studies have indicated that contamination of living sclerotia can exist which still allows sclerotia to be able to germinate and infect _Allium_ crops (1). However, additional testing may show that, following hot water treatment, 1) sclerotia from which contaminating organisms are abundant, are in fact greatly incapacitated from causing disease, and/or 2) with longer storage, these sclerotia might become fully decayed by the contaminating organisms.

With treatments E and F, the Lear-Johnson temperature and duration series without and with 1 percent formalin, respectively, there was little contamination of plates with other organisms. Presumably, most contaminants also succumbed to these more severe treatment conditions.

There was roughly 20 percent survival of _S. cepivorum_ within the interior of aggregates. Presumably, this survival reflected reduced heat and/or moisture penetration into the interior of aggregates.

Loose sclerotia might pass through the seed treatment process held within leaf sheaths and protective leaves, and between doubled cloves, etc. Aggregates might have substantial enough mass to simulate cloves during the cracking, blowing and seed treatment processes. In either case, the bodies of sclerotia might pass through a seedlot and become planted in the field. With the Lear-Johnson treatment, the primary risk would be from aggregates, since loose sclerotia and those directly contacting the treatment solution would die. Less severe seed treatments might allow even loose sclerotia to survive through the seed treatment process. Formalin, at least within the usage in this study, did not increase the effectiveness of the Lear-Johnson temperatures and durations. [In other unpublished studies, it has been shown that formaldehyde solutions can kill sclerotia, but that temperature and duration of treatment is critical.]

[Note: in discussion with Mike Davis, Univ. Calif. Davis, survival might even be greater if sclerotia were tested for survival immediately following seed treatments. In the study above, there was a week's delay between treatment and culturing. The other organisms found in sclerotia in Oregon might have developed aggressively during this post-treatment period. Future investigation might further clarify if a time delay effects sclerotia survival following treatment.]

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Table 1. Effect of Garlic Seed Treatments on Germinability of Sclerotia of Sclerotium Cepivorum recovered from garlic affected by white rot disease

Trt.		Temp, Time	% Germinability: Unaggregated[a] sclerotia	% Germinability: Aggregated[b] sclerotia
A.	Water	62F, 20 min.	85	89
B.	Water Water	100F, 30 min. 62F, 10 min.	20[c]	76[c]
C.	Water Water	120F, 10 min. 62F, 10 min.	14[c]	30[c]
D.	Water Water	120F, 20 min. 62F, 10 min.	18	20
E.	Water Water Water	100F, 30 min. 120F, 20 min. 62F, 10 min.	0	18
F.	1% formalin 1% formalin Water (Lear-Johnson)	100F, 30 min. 120F, 20 min. 62F, 10 min.	0	24

LSD ($P \leq 0.05$), all treatments[d] --------11--------

a Sclerotia already loose within fully decayed cloves. Results were similar for sclerotia recovered from the exterior of aggregates.

b Sclerotia held en masse (4,000-25,000 per clove) by dried mycelium and garlic tissue within partially-decayed, dried cloves. Data here are shown only for those from the interior of aggregates.

c Bacteria, Trichoderma and Penicillium grew extensively from most sclerotia from these treatments.

d LSD ($P \leq 0.05$) calculated according to Duncan's new multiple range test. Technically, this analysis is invalid, since hot water seed treatments were not replicated, and treated lots of sclerotia taken from each treatment were divided into pseudo-replications.

WINTER LOSSES IN CARROT SEED FIELDS IN CENTRAL OREGON IN 1987-88

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ABSTRACT

An experiment with eight treatments (control, mulches of straw, mint slug material, wood shavings, a six-inch deep soil cut on one and both sides of the carrot row, soil on carrot crown, and a foliar nutrient spray of high potassium) was established in 1987-88 at each of eight locations from Agency Plains to Powell Butte. Carrots were counted in the fall and again in the spring from which loss values were calculated. Both male and female parents of hybrids and open pollinated varieties were studied. Winter plant loss averaged over all locations ranged from 29 to 41 percent for straw, mint, and wood mulch compared to 57 percent for control plants. Soil slicing increased plant loss (64 and 63 percent) but the loss of plants with soil on the crown of plants (55 percent) was similar to control plants.

INTRODUCTION

Carrot seed is produced by the seed-to-seed method in Central Oregon. Fields are planted in August so carrot seedlings can grow sufficiently and become hardened for winter survival. However, with all the many contributing factors, winter losses have still reached or exceeded 30 percent or more in some years. During the 1985-86 winter in two tests at Madras the percent winterkill ranged from 14.2 to 21.7 with plants spaced six-12 inches apart compared to 2.8 percent or less winterkill with about one inch between plants (1). There can be less winter losses with high plant stand densities. Stands are thinned in the spring to a carrot each four to eight inches, depending on plant vigor and seed company preference (2). Therefore, if winter losses are not too severe, erratic normal field practices can be followed. However, on occasion, transplanting is necessary to obtain the correct plant stand density for some varieties

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to maximize yield. Techniques to reduce winter losses could result in large savings to growers.

MATERIALS AND METHODS

Seven treatments were compared with a control or untreated check in a randomized complete block design. The amounts of each mulch applied were adjusted to minimize leaf coverage and still get some root crown coverage. Each treatment was replicated four times. Identification and description of each treatment is shown in Table 1. An individual plot was a row either 30 or 36 inches wide by 20 feet long. Treatments were applied to the whole plot but data were collected only from the center 10 feet. Plant counts were made November 16 and 17, 1987, prior to any treatment application. Plants that survived the winter were counted March 15-18, 1988. The percent of plants lost during the winter were calculated and analyzed statistically. The significance among treatment means was tested with least significant differences statistic at the 5 percent level of probability. In cooperation with seed company personnel, eight (grower fields) were selected for study representing different varieties (both hybrids and open-pollinated), size of carrots, and various other factors or conditions. Fields were distributed throughout central Oregon (Table 2).

Observations on carrot height, diameter of carrot root, the amount of soil cracking, and carrot heaving were made on all fields. One inch air and two inch soil temperatures were recorded January 28 to February 18, 1988 for the control and straw mulch treatment in field I. One soil sample from the zero to eight inch depth was taken from each field on March 15,1988 and analyzed by the Oregon State University Soil Testing Laboratory for pH, P, K, total N, and organic matter.

RESULTS AND DISCUSSION

Percentage plant loss on control plots ranged from 23 in field III to 90 percent on field V (Table 2). Mulching was beneficial to winter survival except for wood on field III and mint on field VII. Based on winter survival, straw appeared to be the best mulch on five fields. The physical nature and mat characteristics of the straw mulch on the carrot roots seemed to be more ideal for protection. Straw was longer, less dense, and provided more air spaces for insulating value than mint or wood. However more of the straw had blown off the plots than either mint or wood pieces. Nevertheless, all products remained sufficiently in place to serve their purpose as a mulch. No mulch inhibited the spring regrowth of carrots although this might be a problem if too much mulch was applied. Sizeable reductions in plant loss were obtained at relatively low mulch rates per acre (Table 1). During the mild winter of 1986-87, some carrots which had been covered with two to three inch deep straw and mint mulch were retarded and etiolated in regrowth . However, thick layers of mulch would probably give greater protection than the light rates and still not interfere with early spring regrowth if proper timing of mulch removal occurred. In practice, a grower may be able to move the mulch from top of the carrots with a side delivery rake or similar piece of equipment.

Variety Effects. The degree of winter hardiness of male and female parents of a carrot hybrid may be expected to differ. This was observed in three fields tested on the Agency Plains. Percentage of plant loss averaged 53 among males in field II, compared to only 5 in field III (Table 3). However, beside genetic effects, the condition of the carrots along with environmental influences confound the results observed. The size and vigor of male and female plants varied among fields. In field II the mulch treatments were applied to the male parent because it was small and weak. The percentage of plant loss during the winter ranged from 30 to 78 for this parent compared to 3 to 15 loss for the larger and more vigorous female parent. Consequently there may be some advantage to applying mulch differentially in a hybrid field to the weakest parent. It was interesting to observe that in field III the weakest parent was the male but differences between parents was not as marked as in field II. It has be assumed that different male and female parents were used in each field but this has not been confirmed.

Influence of soil characteristics. No clear pattern averaged to indicate whether soil characteristics affected winter survival (Table 4).

Effect of straw mulch on air and soil temperature. Data are not shown here, but straw acted as insulator. Temperature was either warmer or cooler under the straw than ambient air temperature. Carrot plants received some protection from the straw, both in terms of injury from heaving as well as from the cold temperature.

Recommendations. Growers interested in mulching to reduce winter carrot plant loss should experiment on a limited scale. An application technique compatible with grower ability and/or resources needs to be devised. There may be a possibility that a manure spreader or commercial mulch machine could be effective. The results reported here on eight sites from the Agency Plains to Powell Butte were obtained in a wide range of biotic and physical factors. Nevertheless, winter plant survival is a complex process, care must be exercised in launching a program to improve it. Every grower is well aware of seasonal differences in weather effect plant responses significantly. Therefore caution is urged for growers who may try mulching to reduce winter plant loss.

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Table 1. Identification and description of treatments in 1987-88 winter survival tests on carrot seed fields in Central Oregon

No.	Name	Description
1.	Control (Ck)	Check plot -- normal field conditions and grower practices.
2.	Straw (St)	Air dry baled wheat straw was passed through a garden/greenhouse soil shredder to obtain a chunk-free mulch. It was spread uniformly by hand directly over the carrot plants. Most of the straw filtered through the carrot canopy and covered the carrot root crown about one inch deep. From four-six inches of soil on each side of the carrot row was also covered. About one ton of 12% moisture straw was applied per acre in the band on November 23, 1987. A five gallon pail of the straw mulch weighed 2.1 lbs. This mulch was the lightest and had the largest particle size of the three types of mulch tested.
3.	Mint (Mt)	Air-dry material (70% dry matter) from a mint slug pile was shredded in a manner similar to the wheat straw. It was applied at 2.5 T/A in a 12 inch wide band over the carrot row on November 23, 1987. A five gallon pail of the mint mulch weighed 6.7 lbs.
4.	Wood (Wd)	Wood shavings (56% dry matter) from a planer were applied in a 12 inch wide band over the carrot row at 1.5 T/A on November 23, 1987. A five gallon pail of this product weighed 4.5 lbs.
5.	1-Cut (1c)	A straight coulter was used to cut six-inches deep four inches to one side of the carrot row. No carrot leaves were pruned nor carrot roots disturbed. Treatment was performed November 18 and 19, 1987.
6.	2-Cut (2c)	Similar to treatment five except soil cut was made on each side of the carrot row. Treatment made November 18 and 19, 1987.
7.	Soil	Soil was pushed by hand to cover the crown of the carrot root but not the leaves on November 20 and 21, 1987.
8.	K	A nutrient foliar spray, High K, (12-8-30+S+micronutrients), distributed by Smith & Ardussi, Inc., was applied on the carrot row at ten lbs/A on November 20 and 21, 1987.

Table 2. Average plant stand in fall 1987 and percent winterloss after seven fall treatments compared to a control on carrots grown for seed in Central Oregon, 1987-88

Field no.	Variety type	Site[3]	Ck	St	Mt	Wd	1c	2c	Soil	K	LSD/ (5%)	CV (%)
			Percentage of original stand[1] — Treatments[2]									
			% winterloss									
I	Hy	AP	31	12	14	19	40	41	26	38	16	39
II	Hy	AP	53	17	27	45	73	50	49	52	28	42
III	Hy	AP	23	7	7	31	42	21	26	20	18	54
IV	O.P.	WM	60	34	45	33	73	78	38	69	21	26
V	O.P.	EM	90	57	74	73	93	90	98	87	24	19
VI	O.P.	WC	73	25	17	22	67	83	75	61	23	29
VII	O.P.	SJB	65	39	66	56	62	74	73	66	22	23
VIII	O.P.	PB	61	40	46	45	65	64	--[4]	73	26	26
Treatment over Site Avg.			57	29	37	41	64	63	55	58		

1 Original plant stands (average number of plants in 32-10 feet sections of row) were 81, 35, 40, 60, 59, 33, 76 and 71 plants per 10 foot for fields I through VIII, respectively. These stands were adjusted to 100 percent for establishment of a baseline against which to measure percentages of winter losses.

2 For full explanation of various mulch treatments, see Table 1.

3 Site: AP = Agency Plains; WM = West of Metolius; EM = East of Metolius; WC = West of Culver; SJB = South of Juniper Butte; PB = Powell Butte.

4 This treatment and replication four for all treatments were lost so an analysis of variance was conducted on seven treatments replicated three times.

Table 3. Percent winterloss among female and male parents by replication in three hybrid carrot fields on the Agency Plains, Madras, Oregon, 1987-88

Parent type	Replicate no.	Field Number I	II	III
		--% winterloss[1]--		
Female	1	33	10	12
	2	28	15	24
	3	29	3	26
	4	33	7	30
	Avg.	31	9	23
Male	1	0	30	0
	2	0	67	8
	3	0	78	9
	4	0	37	2
	Avg.	0	53	5

1 Percent winterloss = $\frac{\text{Spring plant number per 10 row-ft.}}{\text{Fall plant number per 10 row-ft.}} \times 100$

Table 4. Soil sample results from 0-8 inch depth on winter survival test fields in Central Oregon, March 15, 1988

Field no.	pH	P	K	Total N	Organic matter
		---------ppm---------			%
I	5.9	33	316	0.08	1.74
II	6.3	33	304	0.10	2.30
III	6.3	37	569	0.07	1.40
IV	6.4	36	324	0.10	1.91
V	5.6	36	433	0.10	1.97
VI	6.2	74	585	0.09	1.80
VII	6.7	32	312	0.11	2.42
VIII	6.0	16	183	0.16	3.15