Special Report 965
July 1996

Crop Research in the Klamath Basin 1995 Annual Report

in cooperation with Klamath County

Agricultural Experiment Station
Oregon State University

For additional copies of this publication, write:

Ken Rykbost
Klamath Experiment Station
6941 Washburn Way
Klamath Falls, OR 97603-9365

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Introduction

One purpose of this annual report, and the eight that have preceded it since 1988, is to share information developed through our research efforts at the Klamath Experiment Station (KES). Our audience includes our colleagues and collaborators, clientele in the agricultural industry, supporting agencies and industries, and others with an interest in our research activities and findings. In my view, the most compelling reason for preparing the annual report of our research is to develop a reference document that can be used on short notice to answer questions from our clientele. Ready access to information obtained one or several years ago is invaluable when attempting to answer questions for callers or drop-in visitors. Undoubtedly, Randy Dovel and I are the primary beneficiaries of the efforts expended to produce our annual reports. We hope others will also find portions of the document to be useful.

Much of the information in this report is also shared through presentations at local, regional, and occasionally, national or international meetings. Brief articles in the media, stories in commodity trade magazines, publications in scientific journals, and progress reports to agencies or other sources of funding also contribute to the dissemination of information. But all of these sources of information reach limited audiences. A new opportunity for communication with an almost unlimited audience has become available. The information superhighway has become a reality. People in all walks of life are gaining access to the internet. We at KES are just beginning to develop our story and get our programs and agricultural research in the Klamath Basin out on the Internet. We are presently creating a home page on the internet. Those of you who have access to the internet may wish to look for our page. Our address is: **http://www.orst.edu/dept/kes.** We welcome any suggestions you might offer on contents.

Computers continue to influence us in ways we could not imagine a few short years ago. It seems impossible to keep up with the opportunities they offer, or to pay for the upgrades needed to avail ourselves of those opportunities. We recently implemented a new financial accounting system at Oregon State University. When the bugs have been worked out this may be a significant improvement. Major upgrades to our computer systems were required to bring the capability to our facility. We are most fortunate to have a staff member, Greg Chilcote, who has the expertise to keep us up to speed in the computer area.

A major change occurred at the KES in June 1995. Our facilities, owned by Klamath County, have been used exclusively by the KES in the past. We now share one of the former residences at KES with the Klamath County Watermaster and his staff assistant. This has brought new traffic to the premises. We anticipate even greater activity in the near future as the Watermaster will be involved as a resource person with the planned adjudication of water rights in the Upper Klamath Basin.

As usual, there is no lack of new challenges for the industry we serve. The confirmation that barley stripe rust has arrived in the Klamath Basin has created new issues for cereal producers to consider as they formulate management strategies for cereal crops. Potato growers face the threat of a new, more aggressive, strain of late blight that cost the growers on the Oregon side of the Columbia River $8 million in control costs and crop

Introduction

losses in 1995. The Klamath Basin appears to be the only production area in the northwest that escaped late blight problems in 1995. Why it was not found, or whether we can expect to remain free of this devastating disease, remains a big question.

The seed potato sector in Klamath County was not so fortunate in dodging bullets. High potato virus Y infection levels were found in several seed lots of Russet Norkotah. Growers face a difficult decision of whether to risk planting virus infected seed from local seed growers, or bringing in seed from other production areas that may have been exposed to late blight infection.

These three examples of relatively new problems must be kept in perspective. We can hardly afford to ignore the long term challenges of nematodes, wheat stem maggot, weeds, water management, and many other natural, political, and regulatory constraints to success. KES programs will continue to focus on old challenges and address the most urgent new opportunities within the limitations of staffing, finances, and expertise. We will take advantage of established partnerships, where possible, to optimize resources and broaden the scope of research efforts. A list of the major cooperators in KES research programs follows. We deeply appreciate their involvement and contributions to KES research efforts.

Financial support of KES operations and programs is derived from the Oregon Agricultural Experiment Station (60 percent), Klamath County General Fund (15 percent), gifts and grants from various sources (20 percent), and sales of residues from research activities (5 percent). We thank the Klamath County Board of Commissioners and the county Budget Committee for their continuing support of the KES. Gift and grant support for individual projects is recognized in acknowledgments in project reports.

I also express appreciation to past and present members of the KES Advisory Board. Their counsel on programs, facilities, and issues, and support for funding is invaluable. Their attendance at field days, stakeholder meetings, Extension programs, and other OSU functions sets an example of support and encouragement.

Last, but certainly not least, I thank all KES staff members for their continuing efforts and dedication. They have managed to maintain and improve on past programs with one less full-time staff member, with less government funding, and with ever increasing regulations and obstacles.

Kenneth A. Rykbost
Klamath Experiment Station

Major Cooperators in KES Research Programs

Oregon State University

Mr. Mylen Bohle
Crook County Cooperative Extension Agent
Mr. Oscar Gutbrod
Department of Crop and Soil Science
Mr. Dan Hane
Hermiston Agricultural Research & Extension Center
Dr. David Hannaway
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Department of Crop and Soil Science
Dr. Russell Ingham
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Department of Crop and Soil Science
Dr. Warren Kronstad
Department of Crop and Soil Science
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Klamath County Cooperative Extension Agent
Dr. Alvin Mosley
Department of Crop and Soil Science
Dr. Clinton Shock
Malheur Experiment Station
Mr. Rodney Todd
Klamath County Cooperative Extension Agent

University of California, Davis

Dr. Harry Carlson
Director, DANR, Fac Plan & Mgmt
Mr. Don Kirby
Intermountain Research & Extension Center
Mr. Don Lancaster
Modoc County Cooperative Extension Director
Dr. Steve Orloff
Siskiyou County Farm Advisor
Mr. Jerry Schmierer
Lassen County Cooperative Extension Director
Dr. Ron Voss
Department of Vegetable Crops

Others

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Washington State University
Dr. David Holm
Colorado State University
Dr. J. Creighton Miller
Texas A & M University
Dr. Joseph Pavek
USDA-ARS, Aberdeen, Idaho
Dr. Gary Secor
North Dakota State University
Dr. Darrell Wesenberg
USDA-ARS, Aberdeen, Idaho
Dr. Chuck Brown
USDA-ARS, Prosser, Washington

We deeply appreciate their involvement and contributions to KES research efforts

Staff and Advisory Board

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Weather and Crop Summary, 1995

K.A. Rykbost and J. Maxwell[1]

The 1995 growing season in the Klamath Basin started late with cool temperatures in March and April, and higher than normal precipitation in March, April, and June. Summer months were cooler than normal with very little rainfall from mid-June through November. The drought of the past several years appeared to come to an end with over 5 inches of rainfall in December, 1995, and nearly 4 inches, from over 40 inches of snow, in January, 1996. Total annual precipitation measured at the Klamath Experiment Station in 1995 was 19.06 inches. This was the highest recorded at Klamath Falls during the past 25 years. Interestingly, the lowest annual precipitation recorded during this 25-year period from 1970 occurred in 1994 when only 7.72 inches was recorded. The average annual precipitation during the 25-year period was 11.98 inches.

A National Oceanic and Atmospheric Administration official weather station, located at Kingsley Field, one-half mile east of the KES, has served the region since 1949. This station, at 4,092 feet elevation, 42°09'N latitude, and 121°44'W longitude, was officially closed in 1995. Personnel at Kingsley Field continue to make daily observations, but this is no longer an official weather station. KES maintains limited weather observation capabilities. Data from Kingsley Field and KES have generally been very similar except that daily minimum air temperatures are usually 2 to 4 °F lower at KES. The proximity of large buildings and pavement at Kingsley Field probably accounts for this difference.

Monthly air and soil temperatures and precipitation are summarized for 1995 and the 12-year period from 1984 to 1995 in Table 1. Weekly weather summaries are presented for the 30-week period from April through October for 1995, and the 16 years from 1979 to 1994, in Tables 2 and 3. This period includes most field activities from early field preparation to harvest. A 25-year summary of growing season temperatures and precipitation is presented in Table 4. "Climatological Data, Oregon," published by the National Oceanic and Atmospheric Administration, provided the data base for years prior to 1989. KES data was used to replace missing observations prior to 1989, and as the base for 1989 through 1995.

Mean monthly air temperatures were 6 °F higher in 1995 than the 1984-1995 mean in January, February, November, and December (Table 1). The average temperature during the remaining months was 2 °F cooler in 1995. Similar trends were observed in soil temperatures. Monthly precipitation totals were more than twice the long term average in January, March, April, June, and December. In contrast, only 0.51 inches of precipitation was recorded at KES from mid-June through October. Total annual precipitation was 160 percent of the 12-year mean.

Growing season weather conditions are presented in more detail in Tables 2 and 3. Periods of high rainfall in early and late April, and in early June resulted in wet soil conditions that significantly delayed field activities in most areas. In general, delays in planting were

[1]/ Superintendent/Professor and Biological Sciences Research Technician III, respectively, Klamath Experiment Station, Klamath Falls, OR.

Weather and Crop Summary, 1995

longer in the mineral soils of the northern part of the Klamath Basin than in organic soils in the Tulelake area.

Scattered areas throughout the basin experienced a hail storm on June 2. Over 400 acres of sugarbeets were lost to this storm. At KES, the 1/4-inch hail pellets covered the soil, accumulating 0.76 inches of precipitation. The frost-free season at KES was limited to 73 days, from June 6 to August 18. From August 25 to September 8, minimum air temperatures hovered near 35 °F at KES. Frost-prone areas in the basin experienced frosts nearly every night during this two-week period. On October 4, a minimum air temperature of 21 °F was recorded at KES. Frosts were experienced on 21 days in October at KES.

The combination of late planting, cool temperatures through much of the summer, and frequent frosts in August and September, reduced yields in all crops. The average yield for over 10,000 acres of sugarbeets declined from about 23 tons/acre in 1994 to less than 19 tons/acre in 1995. Sugar content of the crop was similar to 1994, at about 18.5 percent sugar. At KES, sugarbeet trials were planted one month later than in 1994. Average yields declined from about 35 tons/acre in 1994 to 25 tons/acre in 1995. A small acreage in the basin that was intended for sugarbeets was planted to other crops due to wet conditions persisting until late May. Over 400 acres lost to hail was not replanted to sugarbeets. This crop remained relatively free of disease problems in 1995.

The major shift to Russet Norkotah by local potato growers in the past two years prevented a serious yield and size reduction that would have been experienced if the majority of the acreage was still Russet Burbank. While some fields were planted on a timely basis, a significant acreage was planted in June. Russet Norkotah crops planted after the first of June produced respectable yields under 1995 conditions. Crops in those areas where frost protection was required almost nightly for two weeks experienced some disease damage. Some tuber frost injury was also experienced in tubers exposed at the soil surface. At KES, Russet Norkotah and several other selections had quite a few tubers exposed. These were frozen on October 4. During grading, tubers rotted due to frost damage were found at levels up to 5 percent in some samples. The Klamath Basin was the only production area in Oregon where late blight was not found in the 1995 potato crop.

Cereal crop yields and quality varied widely in 1995. Late planting, frost damage in August in late plantings, and perhaps some effect from barley stripe rust, resulted in low yields and very low test weights in some areas. At KES, oats produced excellent yields for both hay and grain crops. Yields and quality were generally poor in KES barley and wheat crops. A widespread invasion of barley stripe rust into the region will be monitored closely. Varietal resistance may be available in two years. In the interim, seed treatment, foliar fungicides, cultural management options such as date of planting, or growing oats or other non-host crops will be important to minimize the effects of this potentially serious disease.

Alfalfa was also adversely affected by weather conditions in 1995. First cutting harvest was delayed by rains through mid-June, reducing quality. Growth was slowed in August and September by low tempera-

Weather and Crop Summary, 1995

tures, including frost, resulting in reduced yields. Unirrigated forages benefitted from early season rains. Forage production in rangeland situations was excellent through July.

High rainfall, late planting, and delayed onset of irrigation contributed to a recharge of surface water storage in the region. Klamath Lake remained at full pool well into June. Storage also recovered well in Clear Lake and Gerber Reservoir. Full season irrigation was available for all water-users for the first time in three years. However, the future of irrigated agriculture in the basin remains uncertain as the Klamath Project management is changed to increase flows to Klamath River and maintain higher levels in Klamath Lake.

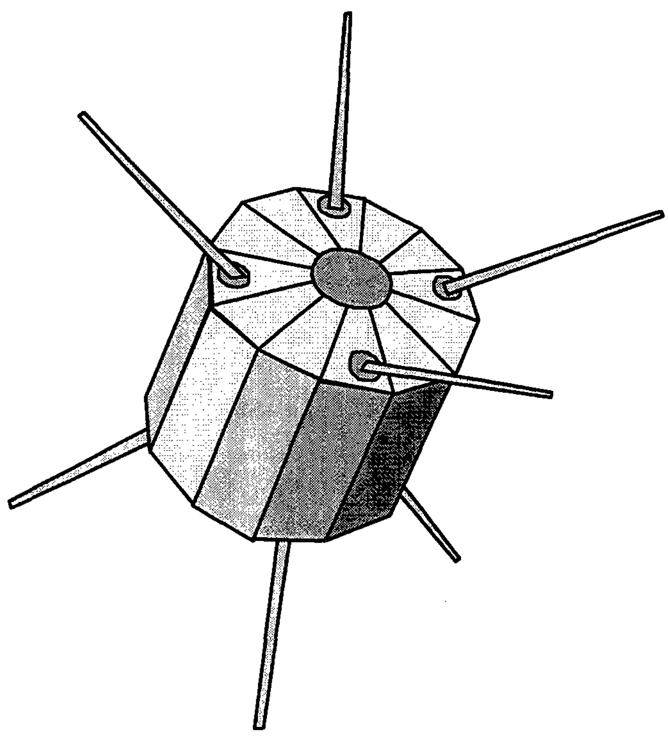

Table 1. Mean monthly maximum, minimum, and mean air and 4-inch soil temperatures, and total monthly precipitation recorded at the Klamath Experiment Station, OR for 1995 and the 12-year period from 1984 through 1995.

Month	Mean monthly temperature: Air Max	Air Min	Air Mean	4" Soil Max	4" Soil Min	4" Soil Mean	Total monthly precipitation
	°F						inches
				1995			
January	41	28	35	36	35	36	2.73
February	55	26	40	42	40	41	0.35
March	47	27	37	42	40	41	3.07
April	54	29	42	45	43	44	3.01
May	64	38	51	55	52	53	1.14
June	71	43	57	60	56	58	2.54
July	80	46	63	68	63	66	0.38
August	81	41	61	67	62	64	0.00
September	79	40	59	63	60	62	0.03
October	65	29	47	54	51	52	0.10
November	55	29	42	48	46	47	0.48
December	42	27	34	41	40	41	5.23
Mean / Total	61	34	47	52	49	50	19.06
				1984 - 1995			
January	39	18	29	33	32	33	1.38
February	45	21	33	35	33	34	1.04
March	51	27	39	40	37	38	1.38
April	60	31	45	49	43	46	0.91
May	66	36	51	56	50	53	1.10
June	75	44	60	64	56	60	0.82
July	83	48	65	70	62	66	0.43
August	83	45	64	70	61	66	0.43
September	77	39	58	62	56	59	0.83
October	66	30	48	53	48	50	0.68
November	48	23	36	42	40	41	1.41
December	38	18	28	34	34	34	1.57
Mean / Total	61	32	46	51	46	48	11.98

Table 2. Weekly average maximum, minimum, and mean air temperatures for the 1995 growing season and the 16-year period from 1979-1994 at Klamath Falls, OR.

		1995 Weekly average			1979 - 1994 Weekly average		
Weekly period		Max	Min	Mean	Max	Min	Mean
		°F					
April	1 - 7	59	32	46	55	29	42
	8 - 14	50	30	40	57	30	44
	15 - 21	45	23	34	61	33	46
	22 - 28	64	32	48	59	32	45
	29 -5	55	37	46	63	34	49
May	6 - 12	53	33	43	63	35	49
	13 - 19	65	37	51	66	35	50
	20 - 26	72	41	56	70	40	55
	27 - 2	79	46	62	69	41	55
June	3 - 9	64	37	50	69	41	55
	10 - 16	68	42	55	73	43	58
	17 - 23	65	40	53	76	45	61
	24 - 30	86	53	69	78	47	62
July	1 - 7	80	46	63	78	46	62
	8 -14	73	44	59	82	47	65
	15 - 21	85	53	69	83	50	66
	22 -28	85	47	66	85	50	68
	29 - 4	86	47	66	85	49	67
August	5 - 11	80	44	62	86	49	67
	12 - 18	76	38	57	83	48	66
	19 - 25	85	42	64	81	46	63
	26 - 1	79	36	57	79	43	61
September	2 - 8	80	38	59	80	44	62
	9 - 15	85	43	64	75	40	58
	16 - 22	83	43	63	74	39	56
	23 - 29	71	40	56	74	39	57
	30 - 6	67	30	48	72	36	54
October	7 - 13	65	29	47	68	34	51
	14 - 20	71	31	51	63	30	46
	21 - 27	60	26	43	61	32	47
Mean		71	39	55	72	40	56

Table 3. Weekly minimum air temperatures, frost days, and precipitation for the 1995 growing season and the 16-year period from 1979 to 1994 at Klamath Falls, OR.

Weekly period		Weekly min.		Frost days/week		Weekly precip.		Accum. precip.	
		1995	16 - year	1995	16 - year	1995	16 - year	1995	16 - year
		°F		%		inches			
April	1 - 7	22	11	43	77	0.60	0.15	0.60	0.15
	8 - 14	22	17	57	65	0.90	0.11	1.50	0.26
	15 - 21	18	17	100	50	0.42	0.22	1.92	0.48
	22 - 28	26	20	57	54	0.39	0.27	2.31	0.75
	29 -5	28	19	14	36	1.37	0.17	3.68	0.92
May	6 - 12	23	23	29	45	0.24	0.19	3.92	1.11
	13 - 19	30	19	14	35	0.00	0.22	3.92	1.33
	20 - 26	37	24	0	17	0.01	0.23	3.93	1.56
	27 - 2	40	27	0	19	0.51	0.33	4.44	1.89
June	3 - 9	30	27	14	9	0.96	0.24	5.40	2.13
	10 - 16	36	27	0	9	1.04	0.10	6.44	2.23
	17 - 23	33	30	0	3	0.25	0.06	6.69	2.29
	24 - 30	49	31	0	0	0.00	0.09	6.69	2.38
July	1 - 7	39	33	0	0	0.07	0.07	6.76	2.45
	8 -14	35	34	0	0	0.25	0.02	7.01	2.47
	15 - 21	46	36	0	0	0.06	0.15	7.07	2.62
	22 -28	41	35	0	0	0.00	0.05	7.07	2.67
	29 - 4	36	36	0	0	0.00	0.07	7.07	2.74
August	5 - 11	34	35	0	0	0.00	0.06	7.07	2.80
	12 - 18	29	37	14	0	0.00	0.10	7.07	2.90
	19 - 25	36	30	0	3	0.00	0.13	7.07	3.03
	26 - 1	35	32	0	1	0.00	0.22	7.07	3.25
September	2 - 8	34	31	0	3	0.00	0.08	7.07	3.33
	9 - 15	40	24	0	13	0.00	0.10	7.07	3.43
	16 - 22	39	26	0	12	0.00	0.38	7.07	3.81
	23 - 29	35	24	0	21	0.03	0.16	7.10	3.97
	30 - 6	21	20	43	22	0.00	0.07	7.10	4.04
October	7 - 13	23	18	71	38	0.09	0.17	7.19	4.21
	14 - 20	26	18	71	67	0.00	0.08	7.19	4.29
	21 - 27	19	20	86	59	0.01	0.34	7.20	4.63

Table 4. Mean maximum, minimum, and mean air temperature for April through September, mean maximum, minimum, and mean 4-inch soil temperatures for May through October, and total precipitation for April through September from 1970 through 1995 at Klamath Falls, OR.

Year	Air temperature April - September			4" Soil temperature May - October			Total precipitation Apr - Sept
	Max	Min	Mean	Max	Min	Mean	
	°F						inches
1995	72	40	56	61	57	59	7.10
1994	76	40	58	63	59	61	3.42
1993	70	38	54	60	55	58	5.82
1992	77	42	60	66	58	62	3.41
1991	73	40	57	61	55	59	3.41
1990	74	41	58	61	55	58	5.66
1989	72	40	56	62	55	59	5.16
1988	75	41	58	64	56	60	3.13
1987	76	41	59	65	56	61	3.24
1986	73	42	58	70	59	64	3.87
1985	74	40	57	64	53	59	5.50
1984	71	41	56	70	57	64	4.36
1983	69	40	55	73	59	66	3.88
1982	70	40	55	71	57	64	4.18
1981	74	42	58	73	58	66	2.43
1980	71	41	56	74	59	67	2.75
1979	74	42	58				3.77
1978	70	40	55	71	58	65	4.57
1977	73	43	58	71	58	65	4.97
1976	69	41	55	72	57	65	4.94
1975	71	41	56				4.10
1974	74	42	58	70	56	63	1.82
1973	75	42	59	69	55	62	1.29
1972	73	41	57				1.87
1971	70	40	55				4.68
1970	74	39	57	70	57	64	1.25
Mean	73	41	57	68	57	62	3.87

Spring Barley Variety Screening, 1995

R.L. Dovel[1], R.S. Karow[2], and G. Chilcote[1]

Introduction

Spring barley accounts for about 80 percent of cereal crops grown on over 100,000 acres in the Klamath Basin. Both feed and malting types are important in the region. Barley variety trials planted at the Klamath Experiment Station (KES) in 1995 included: entries in the Western Regional Spring Barley trial done in cooperation with western states plant breeders, and a collection of new and promising lines from the Oregon State University (OSU) barley breeding program. The trial, in cooperation with OSU, was planted at KES and at two sites in the Lower Klamath Lake area. Screening of early selections from Idaho, Montana, and Washington breeding programs was also conducted in nonreplicated trials.

Procedures

All small grain variety trials at the KES were on land planted in potatoes the previous year. Soils at the station include Poe, Fordney, and Hosley series, all of which have a fine-loamy to sandy texture, and are moderately deep and somewhat poorly drained. The off-station trials were on very deep, poorly drained, lake bottom soils with high organic matter content. These fields are cropped in spring cereals continuously. All plots at KES were sprinkler irrigated. Only one organic soil site was irrigated.

All trials were arranged in a randomized complete block design with four replications. Crops at the KES were planted on May 16 and 17. Irrigated and unirrigated organic soil sites were planted on June 8 and 12, respectively. Seed was planted to a depth of 1 inch at a seeding rate of 100 lb/A. All plots were fertilized with 100 lb N, 60 lb P_2O_5, and 44 lb S/A at time of seeding. Plots measured 5 x 20 feet, with a row spacing of 6 inches (10 rows). At KES, bromoxynil and MCPA were applied at labeled rates to control broadleaf weeds. Weed control at organic soil sites was achieved with a mixture of 2,4-D and Banvel. Plots were harvested in late September at the KES, and in late October at off-station sites using a plot combine with a 5-foot wide header. Grain yield was recorded for all plots. Test weight, percent plumps, and percent thins were measured in only one replication.

Results and Discussion

Grain yields of barley variety trials at KES were lower in 1995 than in 1994 due to late planting in 1995 caused by unusually wet spring conditions. Wet conditions in 1995

1/ Associate Professor, and Research Technician, respectively, Klamath Experiment Station, Klamath Falls, OR.

2/ Professor, Crop and Soil Sciences Department, Oregon State University, Corvallis, OR.

Acknowledgments: Henzel Farms provided the off-station sites and crop care. Trials were supported by a grant from the Oregon Grains Commission. The Experiment Station greatly appreciates their support and participation.

Spring Barley Variety Screening, 1995

were also conducive to the development of common root rot, which further lowered yields. Barley stripe rust (BSR) was detected in the Klamath Basin for the first time in 1995. Infestation was widespread throughout the Klamath Basin but in general was not severe enough to produce large economic losses. Infestation levels at KES were fairly low and did not significantly reduce grain yield.

Western Regional Spring Barley Nursery

There was no one outstanding entry in the 1995 Western Regional Spring Barley Nursery. Grain yields of the 15 highest yielding varieties were not significantly different (Table 1). The highest yielding entry in the trial, MT 890008, was a 2-row feed barley. It produced significantly higher yields than Steptoe and Morex, but not Klages. A number of 6-row feed lines from Utah were also in the highest yielding group. These Utah lines (UT 1705D, UT 1705, UT 2144, UT 1705L) produced the four highest grain yields over the 1994 and 1995 (Table 2). Over a three-year period, UT 1705D, UT 1705L, and UT 2144 produced significantly higher grain yields than several other lines in the trial (Table 3).

OSU Spring Barley Trials

OSU spring barley variety trials were established at three different locations in 1994. The 18-entry trial was located at the KES on mineral soil, and at two organic soil locations on the Lower Klamath Lake. One organic soil site was irrigated by overhead sprinkler irrigation. The other site was flood irrigated prior to planting, with no further irrigation. In general, the yield potential of the two irrigated sites is similar, as is reflected in the three-year trial means at each site. In contrast, the unirrigated organic soil site is less productive and has a trial mean yield that is only 85 percent of the irrigated organic soil site. Although the two irrigated sites have similar yields, the relative performance of varieties at the two sites is quite different.

Irrigated Mineral Soil Site

Yield trends over the past three years at KES were similar to those seen in the Western Regional Spring Barley Nursery discussed above. Barley yields in 1994 were significantly higher than 1993 and 1995. Wheatstem maggot damage was extensive in 1993, and undoubtedly reduced yields. Yields were reduced in 1993 and 1995 by late planting and a severe infestation of common root rot. Baroness was the highest yielding entry in 1995 (Table 4). Although Baroness was the highest yielding entry in 1993 and 1995, it produced significantly less grain in 1994 than most entries in the trial. Baroness was less affected by wheatstem maggot and possibly common root rot than other varieties in 1993. In 1994, when higher yields were possible due to favorable weather and the absence of pests, the relative ranking of Baroness was lower due to better performance by high producing varieties. BSR 41 is another entry in this trial in 1995 that should be noted. BSR 41 is a source of resistance to barley stripe rust. It has been used in breeding programs to incorporate resistance to BSR in more agronomically desirable lines. However, yields of this line are not significantly lower than a number of commercially available spring barley varieties, and are 83 and 91 percent of Baroness and Steptoe, respectively (Table 4).

Spring Barley Variety Screening, 1995

Average yields from 1992, 1993, and 1995 were compiled for this trial (Table 5). Yields from 1994 were not included due to the exclusion of a number of important varieties in that year. Baroness produced the highest average yield for 1993 and 1995. Steptoe was the highest yielding entry in the trial when averaged over the three years included in Table 5. Other entries with three-year average yields not significantly lower than Steptoe include Maranna, Columbia, and Gustoe.

Irrigated Organic Soil Site

Colter was the highest yielding entry in the trial in 1995 (Table 6). Colter was the highest yielding entry at the irrigated organic soil site for four years in a row prior to 1994. In 1994, it was the second highest yielding variety and its yields were not significantly lower than Crest, the highest yielding variety in 1994 (Table 6). Average yields from 1992, 1993, and 1995 were compiled for this trial (Table 7). Yields from 1994 were not included in this table due to the exclusion of a number of important varieties in that year. Although Baroness was the highest yielding entry at the mineral soil site over a two-year period, it ranked ninth at the organic soil site over the same period. Colter was the highest yielding entry in the trial when averaged over the three years included in Table 7. Other entries with three-year average yields not significantly lower than Steptoe include Russell, Gustoe, and Maranna.

Unirrigated Organic Soil Site

A severe mid-August frost at the unirrigated Lower Klamath Lake site severely damaged heads in the early stages of grain fill resulting in blasted heads and almost total yield loss. Due to this severe damage the unirrigated Lower Klamath Lake site was not harvested.

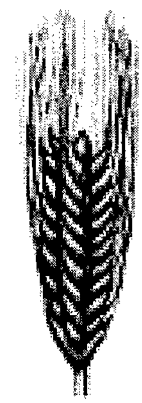

Table 1. 1995 Western Regional Spring Barley Nursery.
Grain yield, test weight, percent thins, lodging, plant height, and date of 50% heading in Julian days (number of days after January 1) of spring barley lines planted in the 1995 Western Regional Spring Barley Nursery. Plots were established on May 16 at Klamath Experiment Station, Klamath County, OR.

Entry	Variety or selection	Row	Use[1]	Yield	Test wt	6/65	Thins 5.5/65	Pan	Height	50% Heading
				lb/A	lb/bu		%		inches	Julian
1	Steptoe	6	F	4590	53.0	95.0	3.4	1.6	27	191
2	Klages	2	M	4770	56.0	95.3	3.3	1.4	32	200
3	Morex	6	M	4130	54.0	95.9	3.2	0.9	33	189
4	Excel	6	M	4320	54.0	96.5	2.6	0.8	31	193
5	Harrington	2	M	4630	55.0	95.8	2.7	1.6	30	195
6	UT 1705L	6	F	4950	51.5	92.5	5.0	2.5	32	190
7	UT 1705D	6	F	4930	50.5	92.4	5.6	2.0	28	193
8	UT 2144	6	F	4520	50.0	90.2	6.9	2.9	26	188
9	DA 587-170	6	F	3520	52.5	91.3	6.3	2.5	23	198
10	BU 585-82	6	F	3800	51.0	90.5	6.1	3.4	20	196
11	MT 890008	2	F	5270	54.0	94.9	3.4	1.7	30	200
12	BA 2B89-4311	2	M	4740	55.0	96.6	2.2	1.2	30	198
13	BA 2B91-4947	2	M	4940	53.5	91.6	5.1	3.3	31	197
14	ND 11055	6	M	4780	53.0	96.9	2.1	0.9	34	193
15	ND 13299	2	M	3720	56.0	98.4	1.1	0.5	27	192
16	ND 13300	2	M	4140	54.5	96.4	2.6	1.0	29	192
17	ID 86326	2	M	4480	56.5	96.8	2.0	1.2	29	199
18	WA 7758-89	2	M	4630	55.0	98.1	1.2	0.7	29	197
19	WA 9908-89	6	M	4730	53.0	95.0	3.5	1.5	29	192
20	SS SDM306B	6	F	4140	51.5	91.4	6.1	2.5	26	189
21	UT 1705	6	F	5230	50.0	87.4	9.4	3.2	29	192
22	MT 886610	2	M	4410	55.5	93.0	4.0	3.1	31	197
23	MT 889106	2	M	4370	56.5	98.2	1.3	0.5	25	192
24	BA 2B91-4248	2	M	4740	57.0	95.3	2.8	1.9	28	195
25	ID 862626	2	M	4200	54.0	92.7	4.3	3.0	29	199
26	ID 90321	2	M	4840	54.5	92.7	4.2	3.0	26	191
27	ND 14636	2	M	4480	57.0	97.2	1.5	1.3	29	191
28	DA 592-47	6	F	4340	48.0	92.2	6.0	1.8	25	199
29	UT 5201	6	M	4360	52.0	91.9	5.9	2.2	32	193
30	WA 7058-91	6	M	4530	55.0	96.6	2.5	0.9	31	193
31	WA 9339-91	6	M	4730	53.0	94.5	4.0	1.5	30	193
32	WA 12668-91	2	M	4850	55.0	94.7	3.3	2.0	29	198
	Mean			**4530**	**53.7**	**94.3**	**3.9**	**1.8**	**29**	**194**
	LSD (0.05)			**640**	--	--	--	--	**4**	**2**
	CV (%)			**10.1**	--	--	--	--	**11.1**	**0.8**

[1] F denotes a feed barley variety, while M denotes a malting line.

Table 2. Three-Year Summary of Western Regional Spring Barley Nursery. Summary of grain yield of the Western Regional Spring Barley Nursery grown from 1993 to 1995. Two-year averages represent 1995 and 1994 grain yields. Plots were established at Klamath Experiment Station, Klamath County, OR.

Variety or selection	Row	Use[1]	Yield 1995	1994	1993	2-year Avg		3-year Avg	
			lb/A	lb/A	lb/A	lb/A	rank	lb/A	rank
Steptoe	6	F	4590	4420	4730	4500	20	4580	6
Klages	2	M	4770	4980	4070	4880	15	4610	5
Morex	6	M	4130	4640	3520	4380	22	4090	9
Excel	6	M	4320	4530	3980	4420	21	4270	8
UT 1705L	6	F	4950	6490	4580	5720	4	5340	2
UT 1705D	6	F	4930	7370	4450	6150	1	5580	1
UT 2144	6	F	4520	7000	4110	5760	3	5210	3
DA 587-170	6	F	3520	6350	3580	4940	14	4490	7
BU 585-82	6	F	3800	7250	3580	5520	5	4870	4
MT 890008	2	F	5270	5000		5130	8		
BA 2B89-4311	2	M	4740	5380		5060	11		
BA 2B91-4947	2	M	4940	5660		5300	7		
ND 11055	6	M	4780	4770		4770	17		
ND 13299	2	M	3720	5350		4530	19		
ND 13300	2	M	4140	5900		5020	13		
ID 86326	2	M	4480	5040		4760	18		
WA 7758-89	2	M	4630	5590		5110	10		
WA 9908-89	6	M	4730	5340		5030	12		
SS SDM306B	6	F	4140	6710		5430	6		
UT 1705	6	F	5230	6860		6040	2		
MT 886610	2	M	4410	5300		4860	16		
MT 889106	2	M	4370	5870		5120	9		
BA 2B91-4248	2	M	4740						
ID 862626	2	M	4200						
ID 90321	2	M	4840						
ND 14636	2	M	4480						
DA 592-47	6	F	4340						
UT 5201	6	M	4360						
WA 7058-91	6	M	4530						
WA 9339-91	6	M	4730						
WA 12668-91	2	M	4850						
Harrington	2	M	4630						
Mean			**4520**	**5720**	**4070**	**5110**		**4780**	
LSD (0.05)			**640**	**970**	**520**	**590**		**510**	
CV (%)			**10.1**	**12.0**	**9.0**	**11.6**		**13.1**	

1/ F denotes a feed barley line, while M denotes a malting line.

Table 3. General Summary of Western Regional Spring Barley Nursery.
Grain yield, test weight, percent thins, lodging, plant height, and date of 50% heading in Julian days (number of days after January 1) of spring barley lines planted in the Western Regional Spring Barley Nursery from 1993 to 1995. Values represent three-year average of plots at Klamath Experiment Station, Klamath County, OR.

Variety or selection	Row	Use[1]	Yield		Test wt	Thins 6/65	Thins 5.5/65	Thins Pan	Lodge	Height	50% Heading
			lb/A	rank	lb/bu	%			%	inches	Julian
Steptoe	6	F	4580	6	51.7	92.1	5.1	2.8	28	33	185
Klages	2	M	4610	5	55.7	94.4	3.7	1.9	23	36	195
Morex	6	M	4090	9	53.3	92.5	5.2	2.3	22	40	185
Excel	6	M	4270	8	53.2	93.0	5.2	1.8	22	38	188
UT 1705L	6	F	5340	2	51.5	94.9	3.8	1.4	8	36	185
UT 1705D	6	F	5580	1	51.0	93.8	4.6	1.5	0	34	187
UT 2144	6	F	5210	3	49.3	92.0	5.8	2.2	0	32	184
DA587-170	6	F	4490	7	52.5	93.3	4.7	2.0	5	27	193
BU 585-82	6	F	4880	4	52.2	94.9	3.4	1.7	0	27	192
Mean			4780		52.3	93.4	4.6	2.0	12	34	188
LSD (0.05)			510		2.3	NS	NS	NS	10	3	1
CV (%)			13		2.5	5.9	3.7	2.3	102	11	1

1/ F denotes a feed barley line, while M denotes a malting line.

Table 4. 1995 OSU Spring Barley Trial (Irrigated mineral soil site).
Grain yield, test weight, percent protein, lodging, plant height, and date of 50% heading in Julian days (number of days after January 1) of spring barley lines planted in the 1995 State-wide Variety Testing Program. Plots were established on May 16 on irrigated mineral soil, at Klamath Experiment Station, Klamath County, OR.

Entry	Variety or selection	Row	Use[1]	Yield	Test wt	Protein	Lodge	Height	50% Heading
				lb/A	lb/bu	%	%	inches	Julian
1	Baroness	2	F	5150	54.0	10.7	0	27	194
2	Columbia	6	F	4780	46.8	10.4	0	24	199
3	Colter -ID	6	F	4610	51.0	10.4	0	24	189
4	Crest	2	M	4240	54.4	11.4	0	27	198
5	Gus	2	M	4500	48.9	11.0	0	22	192
6	Maranna -ID	6	F	4740	51.2	10.2	0	26	198
7	Russell -ID	6	M	3810	51.8	10.1	0	30	191
8	Steptoe	6	F	4710	51.1	9.8	0	29	189
9	78Ab10274	2	M	4940	54.9	10.0	0	30	197
10	82Ab23222 (Payette)	6	F	4010	51.0	10.5	0	26	200
11	BSR 41	2	M	4300	52.9	10.7	0	28	188
12	WPB Sissi	6	F	4610	52.9	10.2	0	26	194
13	WPB BZ 489-74	6	H	3480	60.6	13.7	0	27	201
14	Gustoe	6	F	4230	49.6	10.1	0	21	195
15	Foster	6	M	4220	52.1	10.7	0	30	190
16	Stander	6	M	4180	51.9	11.0	0	31	194
17	BA 2601	6	M	3880	51.4	11.0	0	30	196
18	BA 2602	6	M	4940	54.5	10.6	0	30	195
	Mean			4410	52.3	10.7	0	27	194
	LSD (0.05)			580	1.3	0.9	NS	2	2
	CV (%)			351	1	1	0	1	1

[1/] F denotes a feed barley variety, while M denotes a malting line and H denotes a hay line.

Table 5. Three-Year Summary of OSU Spring Barley Trials (Mineral Soil Site).
Summary of grain yield of OSU Spring Barley Trials grown in 1992, 1993, and 1995. Two-year averages represent 1995 and 1993 grain yields. Plots were established at Klamath Experiment Station, Klamath County, OR.

Entry	Variety or selection	Yield 1995	1993	1992	2-year Avg		3-year Avg	
		lb/A	lb/A	lb/A	lb/A	rank	lb/A	rank
1	Steptoe	4710	4460	5590	4590	2	4920	1
2	Columbia	4780	3630	4880	4200	4	4430	3
3	Colter	4610	3160	5410	3880	6	4390	5
4	Maranna	4740	3860	5300	4300	3	4630	2
5	Russell	3810	3090	4580	3450	9	3830	8
6	Gustoe	4230	3560	5400	3890	5	4390	4
7	BA2601	3880	3470	5090	3680	7	4150	6
8	Payette	4010	3080	5010	3540	8	4030	7
9	Baroness	5150	4680		4920	1		
	Mean	4430	3660	5160	4050		4350	

Table 6. 1995 OSU Spring Barley Trial (Irrigated organic soil site).
Grain yield, test weight, and percent thins of spring barley lines planted in the 1995 State-wide Variety Testing Program. Plots were established on June 8 on irrigated organic soil, in Klamath County, OR.

Entry	Variety or selection	Row	Use[1]	Yield	Test wt	Thins 6/64	Thins 5.5/64	Thins Pan
				lb/A	lb/bu	%		
1	Baroness	2	M	2570	36.0	71.9	14.6	13.4
2	Columbia	6	F	3510	41.5	93.0	3.8	3.2
3	Colter -ID	6	F	4520	39.0	63.2	21.4	15.4
4	Crest	2	M	2390	42.0	85.9	7.8	6.3
5	Gus	2	M	3780	37.0	75.1	14.9	10.0
6	Maranna -ID	6	F	3060	41.5	85.9	7.9	6.2
7	Russell -ID	6	M	3640	38.5	70.1	15.5	14.4
8	Steptoe	6	F	3480	32.0	85.5	6.2	8.3
9	78Ab10274	2	M	1960	43.0	81.9	10.2	8.0
10	82Ab23222 (Payette)	6	F	3110	40.0	84.6	8.1	7.3
11	BSR-41[2]	2	M	--	--	--	--	--
12	WPB Sissi	6	F	3080	38.0	77.0	12.0	10.9
13	WPB BZ 489-74	6	H	3710	53.5	77.7	9.8	12.5
14	Gustoe	6	F	3180	36.0	78.7	11.3	9.9
15	Foster	6	M	2920	37.0	76.8	10.8	12.3
16	Stander	6	M	4400	45.0	86.1	7.5	6.4
17	BA 2601	6	M	4230	40.5	81.7	9.5	8.8
18	BA 1215	6	M	2440	40.5	77.3	10.4	12.3
Mean				**3290**	**40.1**	**79.6**	**10.7**	**9.7**
LSD (0.05)				**780**				
CV (%)				**14**				

1/ F denotes a feed barley variety, while M denotes a malting line and H denote a hay line.

2/ BSR-41 not included at this site due to lack of seed.

Table 7. Three-Year Summary of OSU Spring Barley Trials (Organic Soil Site).
Summary of grain yield of OSU Spring Barley Trials grown in 1992, 1993, and 1995. Two-year averages represent 1995 and 1993 grain yields. Plots were established in Klamath County, OR.

Variety or selection	Yield 1995	1993	1993	2-year Avg		3-year Avg	
	lb/A	lb/A	lb/A	lb/A	rank	lb/A	rank
Steptoe	3480	3870	4770	3680	8	4040	6
Columbia	3510	4680	4340	4090	6	4170	5
Colter	4520	6220	6030	5370	1	5590	1
Maranna	3060	5140	5030	4100	5	4410	4
Russell	3640	5610	5900	4620	3	5050	2
Gustoe	3180	5940	5500	4560	4	4870	3
BA2601	4230	5780		5000	2		
Payette	3110	4950		4030	7		
Baroness	2570	3620		3090	9		
Mean	**3480**	**5090**	**5260**	**4280**		**4690**	

Spring Wheat Variety Screening in the Klamath Basin, 1995

R.L. Dovel[1], R.S. Karow[2], and G. Chilcote[1]

Introduction

Spring wheat is grown on approximately 8,500 acres annually in the Klamath Basin. Soft white (SW) and hard red (HR) selections predominate; however, interest has grown recently in the hard white (HW) class. In 1995, spring wheat variety trials were conducted at the KES in cooperation with Oregon State University and Western Regional plant breeding and evaluation programs. Cold-tolerant, short-season cultivars are needed in the Klamath Basin due to a short growing season with the possibility of frost throughout the growing season. Entries evaluated in these trials included SW, HW, and HR selections. Historically, there has been little disease or insect pressure on small grains in the Klamath Basin. However, the recent introduction of the Russian wheat aphid has altered this situation. Wheatstem maggot is endemic in the area and generally causes only slight damage at the KES. Under mild winter and warm spring conditions in 1992 and 1993, significant damage to cereal crops was experienced, with up to 50 percent of the tillers affected at KES and with serious crop losses in several commercial fields in the Lower Klamath Lake area.

Procedures

All small grain variety trials at the KES were on land planted in potatoes the previous year. Soils at the station include Poe, Fordney, and Hosley series, all of which have a fine loamy to sandy texture, and are moderately deep and somewhat poorly drained. All plots were sprinkler irrigated.

All trials were arranged in a randomized complete block design with three or four replications. Plots at the KES were planted on May 17. Irrigated and unirrigated organic soil sites were planted on June 8 and 12, respectively. Seed was planted at a depth of 2 inches. The seeding rate for wheat trials was 80 lb/A. All plots were fertilized with 100 lb N, 60 lb P_2O_5, and 44 lb S/A at time of seeding. Plots measured 5 x 20 feet, with 10 rows at 6-inch spacing. At KES, Bromoxynil and MCPA were applied at labeled rates to control broadleaf weeds. Weed control at organic soil sites was achieved with a mixture of 2,4-D and Banvel. Plots were harvested in late September at the KES and in late October at off-station sites using a plot combine with a 5-foot wide header. Grain yield was recorded for all plots. Test weight was measured in only one replication.

Results and Discussion

Western Regional Spring Wheat Nursery

Wheat yields at KES were lower in 1995 than in the previous five years due to poor stand establishment and late planting due to an

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1/ Associate Professor and Research Technician, respectively, Klamath Experiment Station, Klamath Falls, OR.

2/ Professor, Crop and Soil Science Department, Oregon State University, Corvallis, OR.

Acknowledgments: Henzel Farms provided the off-station site and crop care.

Spring Wheat Variety Screening in the Klamath Basin, 1995

unusually wet spring. Seed was inadvertently planted at a 2 inch planting depth instead of 1 inch. This allowed attack by common root rot on the emerging coleoptile and resulted in reduced stands. Late planting prevented additional tillering that may have compensated for lower plant density.

The highest yielding entry in the trial in 1995 was ID 488 (Table 1). Other entries with yields not significantly different than ID 488 in 1995 include Alpowa, UT 1117, ID 448, ID 456, UT 1175, ID 459, and ID 474. This is the first year that ID 488 has been grown at KES and further testing will be required to assess its adaptation in the Klamath Basin. Another Idaho soft white entry, ID 448, has consistently been a top yielding variety for three years and is the highest yielding variety over a three-year period (Table 2). The next highest yielding soft white entries over a three-year period were Penawawa and Alpowa. Alpowa is a soft white wheat recently released from Washington State. All three of these entries had test weights averaging above 62 lb/bu over a three-year period and have similar plant heights and heading dates (Table 3).

Statewide Spring Wheat Trials

Statewide spring wheat variety trials were established at three different locations in Klamath County in 1995. The 21-entry trial was located at the KES on mineral soil, and at two organic soil locations on the Lower Klamath Lake. One organic soil site was irrigated by overhead sprinkler irrigation. The other site was flood irrigated prior to planting, with no further irrigation. In general, the yield potential of the two irrigated sites is similar, as is reflected in the three-year trial means at each site. In contrast, the unirrigated organic soil site is less productive and has a trial mean yield that is only 85 percent of the irrigated organic soil site. Although the two irrigated sites have similar yields, the relative performance of varieties at the two sites is quite different.

Irrigated Mineral Soil Site

Yield trends over the past three years at KES were similar to those seen in the Western Regional Spring Wheat Nursery discussed above. Yields were reduced in 1995 by late planting and a severe infestation of common root rot. Treasure was the highest yielding entry in the trial in 1995, followed closely by ID 448 and Alpowa (Table 4). All these entries are soft white lines. Two triticale varieties, Juan and Victoria, were also included in this trial. They produced yields significantly lower than the highest yielding soft white entries mentioned above.

The hard white line ID 377S was the fourth highest yielding entry in the trial in 1995 and has been one of the highest yielding entries in a number of trials over a four-year period. It has good milling and baking quality and is being considered for release by the University of Idaho.

Irrigated Organic Soil Site

Grain yields at this site in 1995 were roughly half the long-term average for this and similar sites in the Klamath Basin. Yield reduction may be attributed to late planting, frost damage, and low level infestation of barley stripe rust. Alpowa was the highest yielding entry in the trial in 1995 (Table 5). Other entries with yields not significantly lower than Alpowa include ID 377S, ID 448, Juan,

Spring Wheat Variety Screening in the Klamath Basin, 1995

Penawawa, and Wawawai. It should be noted that the top three yielding entries at this site were among the highest yielding lines at the mineral soil site as well.

Unirrigated Organic Soil Site

A severe mid-August frost at the unirrigated Lower Lake site severely damaged heads in the early stages of grain fill, resulting in blasted heads and almost total yield loss. Due to this severe damage, the unirrigated Lower Lake site was not harvested.

OSU Hard White Spring Wheat Variety Trial

Two of the highest producing entries in the OSU Hard White Spring Wheat Variety Trial in 1995 were ID 03775(SPHWE10) and ID 03775(WRSWN6) (Table 6). These are actually two different seed sources of ID 377S. Over a two-year period, ID 377S has been the second highest yielding entry in the trial, exceeded only by SERI 82 (Table 7). Entries that produced significantly higher yields than Klasic, the current industry standard, include OR 4870453, SERI 82, OR 4895181, OR 484013, and OR 4870255. However, all of these entries have a later heading date than Klasic, which may be a disadvantage in the Klamath Basin (Table 8). OR 4870279 produced yields equivalent to Klasic in this trial over a three-year period and much higher yields in the Western Regional trial. This HW line has good baking quality and may be released if yields in other areas of the Pacific Northwest justify it.

OSU Hard Red Spring Wheat Variety Trial

Standard HR spring wheat varieties in the Klamath Basin are Westbred 906R and Yecora Rojo. Spillman, a recently released variety, is increasing in acreage. There was not a significant difference in grain yield among these varieties in the 1995 trial (Table 9). However, over a three-year period Spillman produced significantly higher yields than Westbred 906R (Table 10). The highest yielding entries in this trial in 1995 included OR 4900041, OR 4920002, and OR 4920028. This was the first year for OR 4920028 to be in the trial, but OR 4900041 and OR 4920002 have been in the trial three years and are the two highest producing entries over a three-year period. Both of these experimental entries produced significantly more grain than Spillman over a three-year period (Table 10). Another entry that should be noted is OR 4910028, which is the third highest yielding entry over a three-year period. All three of these experimental lines have produced high test weights and are of comparable height to Spillman and Westbred 906R (Table 11). The heading date of OR 4910028 is only one day later than Yecora Rojo (Table 11). Grain baking quality is an important consideration in the selection of HR wheat varieties. Further evaluation of baking quality of top yielding entries will be needed prior to release of these lines.

Soft White Spring Wheat Variety Trial

OR 4880013 was among the highest yielding entries in the trial in 1995 (Table 12) and was the highest yielding entry over a

Spring Wheat Variety Screening in the Klamath Basin, 1995

three-year period (Table 13). Centennial was the second highest yielding entry over the same period. Centennial is a recent release from the University of Idaho that was planted in joint trials at KES and the Intermountain Research and Extension Center from 1989 to 1991. Yields of this line were comparable or superior to all released SW varieties at both locations. Centennial is also an earlier maturing variety. It reached 50 percent heading earlier than all other entries except one over a three-year period (Table 14). Soft white wheat varieties have been slow to mature in the cool fall conditions common in the Klamath Basin. The development of an earlier maturing, high yielding SW variety should help producers who choose to grow this commodity in the Basin. Further plot scale testing and small field scale testing of this variety is warranted and should be undertaken prior to large field scale planting.

Table 1. 1995 Western Regional Spring Wheat Nursery.
Grain yield, test weight, lodging, plant height, and date of 50% heading in Julian days (number of days after January 1) of spring wheat lines planted in the 1995 Western Regional Spring Wheat Nursery. Plots were established on May 17 at Klamath Experiment Station, Klamath County, OR.

Entry	Variety or selection	Type[1]	Yield	Test wt	Lodge	Height	50% Heading
			lb/A	lb/bu	%	inches	Julian
1	McKay	HR	4060	62.0	0	28	196
2	Federation	SW	3630	59.5	0	35	198
3	Penawawa	SW	4110	62.0	0	30	198
4	Klasic	HW	2770	64.0	0	22	189
5	Serra	HR	3430	60.0	0	26	193
6	Alpowa	SW	4590	63.5	0	31	198
7	Wawawai	SW	3850	62.0	0	31	196
8	UT 1117	HR	4520	63.0	0	31	198
9	ID 448	SW	4970	62.5	0	28	198
10	OR 487374	HW	3140	60.5	0	20	195
11	OR 487410	HR	3850	60.5	0	30	197
12	OR 489224	SW	3550	60.5	0	26	198
13	ID 456	SW	4850	63.0	0	31	198
14	ID 462	HR	4240	63.5	0	30	194
15	OR 488372	HW	3490	63.0	0	28	198
16	OR 895181	HW	3800	61.0	0	28	198
17	UT 2464	HR	4140	62.0	0	30	198
18	UT 1146	HR	4300	61.0	0	30	195
19	UT 1175	HR	4510	62.5	0	31	197
20	CA 896	HW	3410	64.0	0	30	194
21	ID 459	SW	4780	62.0	0	28	198
22	ID 469	SW	4290	63.0	0	26	189
23	ID 474	SW	4910	63.5	0	30	195
24	ID 476	HR	3590	61.5	0	24	191
25	ID 488	SW	5100	62.0	0	26	191
26	ID 492	HR	4280	63.5	0	30	192
27	ID 494	HW	3900	64.0	0	28	191
28	ML 316402	HW	4360	62.5	0	30	195
29	SDM 50014	HR	3180	63.0	0	30	198
30	FMBR 9154	HR	3840	62.0	0	24	189
31	FMBR 5783	HR	3970	61.0	0	24	198
32	OR 493032	HR	4250	64.0	0	28	195
33	OR 487401	HR	4050	64.0	0	30	198
	Mean		**4050**	**62.3**	**0**	**28**	**195**
	LSD (0.05)		**600**	**--**	**0**	**--**	**1**
	CV (%)		**10**	**--**	**0**	**--**	**0**

[1] HR, SW, and HW denote hard red, soft white, and hard white spring wheat lines, respectively.

Table 2. Three-Year Summary of Western Regional Spring Wheat Nursery.
Summary of grain yield of the Western Regional Spring Wheat Nursery grown from 1993 to 1995. Two-year averages represent 1995 and 1994 grain yields. Plots were established at Klamath Experiment Station, Klamath County, OR.

Variety or selection	Type[1]	Yield 1995	1994	1993	2-year Avg		3-year Avg	
		lb/A	lb/A	lb/A	lb/A	rank	lb/A	rank
McKay	HR	4060	6230	5500	5140	12	5260	5
Federation	SW	3630	4940	4980	4280	18	4520	11
Penawawa	SW	4110	7750	6120	5930	2	5990	2
Klasic	HW	2770	6270	4900	4520	17	4650	9
Serra	HR	3430	6500	5060	4970	14	5000	8
Alpowa	SW	4590	7020	5270	5800	3	5620	3
Wawawai	SW	3850	6310	4900	5080	13	5020	7
UT 1117	HR	4520	6550	5190	5530	8	5420	4
ID 448	SW	4970	7320	5950	6150	1	6080	1
OR 487374	HW	3140	5350	4380	4250	19	4290	12
OR 487410	HR	3850	6790	4910	5320	9	5180	6
OR 489224	SW	3550	5720	4640	4630	16	4640	10
ID 456	SW	4850	6460		5650	5		
ID 462	HR	4240	6360		5300	10		
OR 488372	HW	3490	6320		4900	15		
OR 895181	HW	3800	7670		5730	4		
UT 2464	HR	4140	6240		5190	11		
UT 1146	HR	4300	6980		5640	6		
UT 1175	HR	4510	6660		5580	7		
CA 896	HW	3410						
ID 459	SW	4780						
ID 469	SW	4290						
ID 474	SW	4910						
ID 476	HR	3590						
ID 488	SW	5100						
ID 492	HR	4280						
ID 494	HW	3900						
ML 316402	HW	4360						
SDM 50014	HR	3180						
FMBR 9154	HR	3840						
FMBR 5783	HR	3970						
OR 493032	HR	4250						
OR 487401	HR	4050						
Mean		**4050**	**6500**	**5150**	**5240**		**5140**	
LSD (0.05)		**600**	**660**	**460**	**480**		**370**	
CV (%)		**10**	**7**	**6**	**9**		**8**	

[1] HR, SW, and HW denote hard red, soft white, and hard white spring wheat lines, respectively.

Table 3. General Summary of Western Regional Spring Wheat Nursery.
Grain yield, test weight, lodging, plant height, and date of 50% heading in Julian days (number of days after January 1) of spring wheat lines planted in the Western Regional Spring Wheat Nursery from 1993 to 1995. Values represent three-year average of plots at Klamath Experiment Station, Klamath County, OR.

Type[1]	Yield		Test wt	Lodge	Height	50% Heading
	lb/A	rank	lb/bu	%	inches	Julian
HR	5260	5	61.0	0	31	192
SW	4520	11	60.2	0	42	197
SW	5990	2	62.2	0	32	193
HW	4650	9	63.3	0	25	187
HR	5000	8	61.3	0	30	189
SW	5620	3	63.0	0	32	195
SW	5020	7	32.5	1	33	192
HR	5420	4	62.2	0	34	194
SW	6080	1	62.0	0	31	194
HW	4290	12	60.7	0	21	190
HR	5180	6	61.0	0	32	193
SW	4640	10	59.7	0	26	194
	5140		**59.1**	**0**	**31**	**192**
	360		**1**	**NS**	**4**	**1**
	8		**1**	**1**	**7**	**1**

[1] HR, SW, and HW denote hard red, soft white, and hard white spring wheat lines, respectively.

Table 4. 1995 OSU Spring Wheat Trial (Irrigated mineral soil site).
Grain yield, test weight, percent protein, lodging, plant height, and date of 50% heading in Julian days (number of days after January 1) of spring wheat and triticale lines planted in the 1995 State-wide Variety Testing Program. Plots were established on May 17 on irrigated mineral soil, at Klamath Experiment Station, Klamath County, OR.

Variety or selection	Type[1]	Yield	Test wt	Protein	Lodging	Plant height	50% Heading
		lb/A	lb/bu	%	%	inches	Julian
Alpowa	SW	5200	62.8	11.3	0	31	202
Calorwa	Club	3470	59.6	12.5	0	28	194
Centennial	SW	4260	61.9	11.9	0	24	194
Dirkwin	SW	4330	58.5	11.3	0	30	199
ID 377S	HW	5190	62.0	12.6	0	30	192
ID 448	SW	5470	61.6	10.6	0	30	198
ID 471	SW	4950	62.3	11.4	0	26	194
Klasic	HW	3120	62.0	13.8	0	20	189
Juan	TRIT	4070	53.4	10.5	0	36	199
OR 8510	HR	3760	61.7	12.7	0	28	195
Owens	SW	4380	61.8	11.5	0	30	192
Penawawa	SW	4730	61.7	11.8	0	27	196
Treasure	SW	5620	61.8	11.1	0	28	196
Victoria -RSI	TRIT	3300	52.4	10.9	0	33	200
Wakanz	SW	4790	61.5	11.3	0	31	203
Wawawai	SW	4010	62.1	12.0	0	31	193
WPB Vanna	SW	3090	58.8	11.6	0	28	197
WPB 926R	HR	3380	61.2	13.7	0	28	191
WPB 936R	HR	2830	58.9	14.2	0	24	191
Yecora Rojo	HR	2950	61.8	13.9	0	19	190
Kuhlm	HR	3390	60.3	14.4	0	30	191
Mean		**4110**	**60.4**	**12.1**	**0**	**28**	**195**
LSD (0.05)					**NS**	**3**	**3**
CV (%)					**0**	**2**	**2**

[1] HR, SW, HW, Club, and TRIT denote hard red, soft white, hard white, and club spring wheat and triticale lines, respectively.

Table 5. 1995 OSU Spring Wheat Trial (Irrigated mineral soil site).
Grain yield and test weight of spring wheat and triticale lines planted in the 1995 State-wide Variety Testing Program. Plots were established on June 8 on irrigated organic soil, in Klamath County, OR.

Entry	Variety or selection	Type[1]	Yield	Test wt
			lb/A	lb/bu
1	Alpowa	SW	3740	55.0
2	Calorwa	SW	1360	42.0
3	Centennial	SW	1460	53.0
4	Dirkwin	SW	2680	47.0
5	ID 377S	HW	3240	52.0
6	ID 448	SW	3170	52.5
7	ID 471	SW	1610	49.0
8	Klasic	HW	1570	36.5
9	Juan	TRIT	3020	38.0
10	OR 8510	HR	580	49.0
11	Owens	SW	1670	44.5
12	Penawawa	SW	2950	51.5
13	Treasure	SW	1900	50.5
14	Victoria -RSI	TRIT	2390	37.0
15	Wakanz	SW	2050	47.5
16	Wawawai	SW	2950	47.5
17	WPB Vanna	SW	2360	50.5
18	WPB 926R	HR	1080	45.0
19	WPB 936R	HR	900	39.5
20	Yecora Rojo	HR	1030	38.0
21	Kuhlm	HR	3470	55.0
	Mean		**2150**	**46.7**
	LSD (0.05)		**810**	
	CV (%)		**23**	

[1] HR, SW, HW, and TRIT denote hard red, soft white, and hard white spring wheat and triticale lines, respectively.

Table 6. 1995 OSU Hard White Spring Wheat Nursery.
Grain yield, test weight, lodging, plant height, and days to 50% heading of OSU hard white spring wheat elite varieties at the Klamath Experiment Station, OR, 1995.

Entry	Variety or selection	Yield	Test wt	Lodge	Plant height	50% Heading
		lb/A	lb/bu	%	inches	Julian
1	Klasic	3290	64.0	0	18	189
2	OR 484013	3780	62.5	0	28	200
3	OR 4870279	3700	65.5	0	26	197
4	OR 4870453	3940	62.5	0	24	201
5	OR 4870255	3560	63.5	0	26	191
6	OR 4870374	2260	58.5	0	18	194
7	OR 4880372	3180	64.5	0	30	198
8	OR 4895181	4100	60.0	0	28	199
9	ID 03775 (SPHW	4190	64.0	0	28	192
10	OR 488528	3330	64.0	0	24	195
11	SERI 82	3560	61.5	0	24	198
12	OR 918090	2650	62.5	0	26	200
13	ID 03775 (WRSW	4070	64.5	0	26	191
14	OR 4920074	3780	62.0	0	28	195
15	OR 4920090	3590	60.5	0	28	198
16	OR 4920092	3510	60.0	0	26	199
17	OR 4920105	3720	63.5	0	28	198
18	OR 9437524	3150	61.0	0	26	195
19	OR 9437525	3090	62.5	0	24	191
20	OR 9437534	3740	61.5	0	28	195
21	OR 4920274	3130	64.0	0	24	198
22	OR 4920276	2890	63.0	0	26	195
23	OR 4920278	3370	61.5	0	28	199
24	OR 4920283	3330	63.0	0	24	198
25	OR 4920292	2910	61.5	0	26	193
26	OR 4880287	3080	58.5	0	20	200
27	OR 4920301	2600	62.5	0	26	198
28	OR 4920311	3240	63.0	0	24	199
29	OR 4920312	3080	64.5	0	28	197
30	OR 4920313	3100	62.5	0	24	198
31	OR 938964	3150	65.0	0	22	188
32	OR 938965	2860	63.0	0	20	190
33	OR 938966	2970	63.0	0	20	188
Mean		**3330**	**62.5**	**0**	**25.0**	**196**
LSD (0.05)		**690**	**--**	**NS**	**--**	**2**
CV (%)		**15**	**--**	**0**	**--**	**1**

Table 7. Three-Year Yield Summary of OSU Hard White Spring Wheat Nursery.
Summary of grain yield of the OSU Hard White Spring Wheat Elite Nursery grown from 1993 to 1995. Two-year averages represent 1995 and 1994 grain yields. Plots were established at Klamath Experiment Station, Klamath County, OR.

	Yield						
Variety	**1995**	**1994**	**1993**	**2-Year Avg**		**3-Year Avg**	
	lb/A	**lb/A**	**lb/A**	**lb/A**	**rank**	**lb/A**	**rank**
Klasic	3290	5780	2960	4540	8	4010	9
OR 484013	3780	5910	4100	4850	6	4600	4
OR 4870279	3700	5860	3590	4780	7	4380	6
OR 4870453	3940	6570	4570	5250	3	5030	1
OR 4870255	3560	6150	3800	4860	5	4500	5
OR 4870374	2260	5970	2960	4110	11	3730	10
OR 4880372	3180	5780	3380	4480	10	4110	8
OR 4895181	4100	6120	4600	5110	4	4940	3
OR 488528	3330	5720	3850	4520	9	4300	7
SERI 82	3560	7150	4310	5360	1	5010	2
OR 918090	2650	5390		4020	12		
ID 377S	4130	6400		5270	2		
OR 4920074	3780						
OR 4920090	3590						
OR 4920092	3510						
OR 4920105	3720						
OR 9437524	3150						
OR 9437525	3090						
OR 9437534	3740						
OR 4920274	3130						
OR 4920276	2890						
OR 4920278	3370						
OR 4920283	3330						
OR 4920292	2910						
OR 4880287	3080						
OR 4920301	2600						
OR 4920311	3240						
OR 4920312	3080						
OR 4920313	3100						
OR 938964	3150						
OR 938965	2860						
OR 938966	2970						
Mean	**3330**	**6040**	**3810**	**4710**		**4460**	
LSD (0.05)	**680**	**1100**	**680**	**660**		**490**	
CV (%)	**15**	**14**	**12**	**14**		**13**	

Table 8. Three-Year Summary of OSU Hard White Spring Wheat Nursery.
Grain yield, test weight, lodging, plant height, and date of 50% heading in Julian days (number of days after January 1) of spring wheat lines planted in the OSU Hard White Spring Wheat Elite Nursery from 1993 to 1995. Values represent three-year average of plots at Klamath Experiment Station, Klamath County, OR.

Entry	Variety or selection	Yield		Test wt	Lodge	Height	50% Heading
		lb/A	rank	lb/bu	%	inches	Julian
1	Klasic	4010	9	63.2	0	22	185
2	OR 484013	4600	4	62.5	0	30	196
3	OR 4870279	4380	6	63.0	0	28	192
4	OR 4870453	5030	1	62.3	0	29	196
5	OR 4870255	4500	5	64.2	0	31	188
6	OR 4870374	3730	10	60.5	0	21	190
7	OR 4880372	4110	8	64.3	0	32	196
8	OR 4895181	4940	3	61.0	0	32	193
9	OR 488528	4300	7	63.8	0	26	190
10	SERI 82	5010	2	61.8	0	29	193
Mean		**4460**		**62.7**	**0**	**28**	**192**
LSD (0.05)		**490**		**2**	**NS**	**2**	**1**
CV (%)		**10**		**2**	**0**	**5**	**1**

Table 9. 1995 OSU Spring Hard Red Wheat Nursery.
Grain yield, test weight, lodging, plant height, and days to 50% heading of OSU hard red spring wheat elite varieties at the Klamath Experiment Station. OR. 1995.

Entry	Variety or selection	Type[1]	Yield	Test wt	Lodge	Height	50% Heading
			lb/A	lb/bu	%	inches	Julian
1	McKay	HR	3780	60.0	0	30	195
2	Westbred 906R	HR	3330	61.0	0	28	191
3	Yecora Rojo	HR	3120	64.5	0	18	190
4	Spillman	HR	3630	60.0	0	28	195
5	OR 485010	HR	3530	64.0	0	30	197
6	Klasic	HW	3150	63.5	0	22	189
7	OR 4870400	HR	3200	61.5	0	30	198
8	OR 4870401	HR	3090	59.0	0	31	198
9	OR 4880189	HR	3280	62.0	0	26	194
10	OR 4870410	HR	3650	61.5	0	28	195
11	OR 4895019	HR	3500	63.5	0	26	191
12	OR 4895103	HR	3890	62.5	0	28	198
13	OR 4930032	HR	3730	63.5	0	26	196
14	OR 4920002	HR	4270	61.5	0	26	198
15	OR 4910028	HR	3840	61.0	0	28	190
16	OR 4900041	HR	4300	62.0	0	28	198
17	Express	HR	3680	59.0	0	26	198
18	WPB 926	HR	3430	60.0	0	28	191
19	WPB 936	HR	3470	60.5	0	26	191
20	OR 4930034	HR	3390	62.0	0	20	191
21	OR 4895011	HR	3890	64.5	0	26	191
22	OR 918030	HR	3740	64.5	0	28	198
23	OR 3900362	HR	3670	61.5	0	24	195
24	OR 4920023	HR	3600	62.0	0	26	194
25	OR 4920024	HR	3250	61.5	0	26	194
26	OR 4920028	HR	4060	64.5	0	30	193
27	TUI	HR	3500	64.5	0	28	198
Mean			**3590**	**62.1**	**0**	**27**	**194**
LSD (0.05)			**530**	**–**	**NS**	**–**	**1**
CV (%)			**10**	**–**	**0**	**–**	**0**

[1] HR and HW denote hard red and hard white spring wheat lines, respectively.

Table10. Three-Year Yield Summary of OSU Hard Red Spring Wheat Nursery.
Summary of grain yield of the OSU Hard Red Spring Wheat Elite Nursery grown from 1993 to 1995. Two-year averages represent 1995 and 1994 grain yields. Plots were established at Klamath Experiment Station, Klamath County, OR.

		Yield						
Variety	Type[1]	1995	1994	1993	2-Year Avg		3-Year Avg	
		lb/A	lb/A	lb/A	lb/A	rank	lb/A	rank
McKay	HR	3780	6270	4550	5020	4	4870	6
Westbred 906R	HR	3330	5790	3950	4560	19	4360	15
Yecora Rojo	HR	3120	6050	4060	4580	18	4410	14
Spillman	HR	3630	6340	4560	4980	7	4840	7
OR 485010	HR	3530	5880	4280	4700	15	4560	13
Klasic	HW	3150	6020	3260	4580	17	4140	16
OR 4870400	HR	3200	6560	4860	4880	11	4870	5
OR 4870401	HR	3090	5970	5140	4530	20	4730	11
OR 4880189	HR	3280	6160	4410	4720	14	4620	12
OR 4870410	HR	3650	6400	4360	5020	5	4800	10
OR 4895019	HR	3490	6900	4510	5200	3	4970	4
OR 4895103	HR	3890	6110	4500	5000	6	4840	8
OR 4920002	HR	4270	6950	4680	5610	1	5300	1
OR 4910028	HR	3840	6120	4950	4980	8	4970	3
OR 4900041	HR	4300	6590	4970	5440	2	5280	2
OR 4895011	HR	3890	6030	4550	4960	9	4820	9
OR 4930032	HR	3730	5290		4510	21		
Express	HR	3680	6050		4870	12		
WPB 926	HR	3430	5770		4600	16		
WPB 936	HR	3470	6400		4940	10		
OR 4930034	HR	3390	6200		4790	13		
OR 918030	HR	3840						
OR 3900362	HR	3670						
OR 4920023	HR	3600						
OR 4920024	HR	3250						
OR 4920028	HR	4060						
TUI	HR	3500						
Mean		3590	6180	4470	4880		4770	
LSD (0.05)		530	680	650	450		400	
CV (%)		10	10	10	10		10	

[1] HR and HW denote hard red and hard white spring wheat lines, respectively.

Table 11. Three-Year Summary of OSU Hard Red Spring Wheat Nursery.
Grain yield, test weight, lodging, plant height, and date of 50% heading in Julian days (number of days after January 1) of spring wheat lines planted in the OSU Hard Red Spring Wheat Elite Nursery from 1993 to 1995. Values represent three-year average of plots at Klamath Experiment Station, Klamath County, OR.

Entry	Variety or selection	Type	Yield		Test wt	Lodge	Height	50% Heading
			lb/A	rank	lb/bu	%	inches	Julian
1	McKay	HR	4870	6	62.3	0	31	192
2	Westbred 906R	HR	4360	15	61.5	0	30	188
3	Yecora Rojo	HR	4410	14	63.3	0	21	186
4	Spillman	HR	4840	7	61.5	0	32	191
5	OR 485010	HR	4560	13	64.2	0	32	193
6	Klasic	HW	4140	16	63.8	0	24	185
7	OR 4870400	HR	4870	5	63.7	0	33	196
8	OR 4870401	HR	4730	11	62.7	0	34	195
9	OR 4880189	HR	4620	12	62.5	0	30	190
10	OR 4870410	HR	4800	10	62.0	0	32	192
11	OR 4895019	HR	4970	4	63.8	0	30	188
12	OR 4895103	HR	4840	8	63.2	0	32	194
13	OR 4920002	HR	5300	1	62.5	0	30	194
14	OR 4910028	HR	4970	3	61.8	0	31	187
15	OR 4900041	HR	5280	2	63.5	0	30	194
16	OR 4895011	HR	4820	9	64.2	0	29	189
Mean			**4770**		**62.9**	**0**	**30**	**191**
LSD (0.05)			**400**		**2**	**NS**	**2**	**1**
CV (%)			**10**		**2**	**0**	**5**	**1**

Table 12. 1995 OSU Spring Soft White Wheat Nursery.
Grain yield, test weight, lodging, plant height, and days to 50% heading of OSU soft white spring wheat elite varieties at the Klamath Experiment Station, OR, 1995.

Entry	Variety or selection	Type[1]	Yield	Test wt	Lodge	Height	50% Heading
			lb/A	lb/bu	%	inches	Julian
1	Dirkwin	SW	4210	62.5	0	30	199
2	Centennial	SW	4140	62.5	0	28	194
3	Penawawa	SW	3880	60.0	0	33	200
4	WA 7677	SW	4160	63.0	0	31	200
5	ORS 8501	SW	4170	63.0	0	30	194
6	OR 487570	SW	2850	60.5	0	33	207
7	OR 4880013	HW	4800	63.5	0	31	204
8	WUC 657	Club	3650	60.5	0	26	196
9	OR 4900154	HW	4260	54.0	0	28	201
10	OR 4900085	--	3000	65.5	0	30	191
11	OR 4895224	--	3600	60.0	0	28	200
12	Juan	Trit	3280	51.0	0	43	199
13	M92-1535	SW	4420	59.0	0	39	197
14	OR 4920021	HW	4230	62.0	0	30	199
15	OR 4920095	HW	3980	63.0	0	30	199
16	OR 4930236	SW	2960	62.5	0	28	198
17	OR 948037	--	3910	63.0	0	26	192
18	OR 4930240	SW	4930	60.5	0	30	204
	Mean		**3910**	**60.9**	**0**	**31**	**199**
	LSD (0.05)		**500**		**NS**		**2**
	CV (%)		**10**		**0**		**1**

[1] SW, HW, Club, and Trit denote soft white, hard white and club spring wheat lines, and spring triticale respectively.

Table 13. Three-Year Summary of OSU Soft White Spring Wheat Nursery.
Summary of grain yield of the OSU Soft White Spring Wheat Nursery grown from 1993 to 1995. Two-year averages represent 1995 and 1994 grain yields. Plots were established at Klamath Experiment Station, Klamath County, OR.

		Yield						
Variety	**Type[1]**	**1995**	**1994**	**1993**	**2-Year Avg**		**3-Year Avg**	
		lb/A	**lb/A**	**lb/A**	**lb/A**	**rank**	**lb/A**	**rank**
Dirkwin	SW	4210	6280	4930	5250	9	5140	6
Centennial	SW	4140	7420	5450	5780	2	5670	2
Penawawa	SW	3880	6810	4960	5340	7	5210	5
ORS 8501	SW	4170	7340	5310	5750	3	5610	3
OR 487570	SW	2850	5350	4670	4100	15	4290	9
OR 4880013	HW	4800	7330	5280	6060	1	5800	1
OR 4900154	HW	4260	5900	5500	5080	10	5220	4
OR 4900085	--	3000	5920	4710	4460	13	4540	7
OR 4895224	--	3600	5320	4340	4460	14	4420	8
WA 7677	SW	4160	7080		5620	5		
WUC 657	Club	3650	6490		5070	11		
Juan	Trit	3280	6810		5040	12		
M92-1535	SW	4420	6900		5660	4		
OR 4920021	HW	4230	6540		5390	6		
OR 4920095	HW	3980	6510		5250	8		
OR 4930236	SW	2960						
OR 948037	--	3910						
OR 4930240	SW	4930						
Mean		3910	6530	5020	5220		5100	
LSD (0.05)		500	820	430	440		330	
CV (%)		10	10	10	10		10	

[1] SW, HW, Club, and Trit denote soft white, hard white and club spring wheat lines, and spring triticale respectively.

Table 14. Three-Year Summary of OSU Soft White Spring Wheat Nursery.
Grain yield, test weight, lodging, plant height, and date of 50% heading in Julian days (number of days after January 1) of spring wheat lines planted in the OSU Soft White Spring Wheat Elite Nursery from 1993 to 1995. Values represent three-year average of plots at Klamath Experiment Station, Klamath

Entry	Variety	Type[1]	Yield		Test wt	Lodge	Height	50% Heading
			lb/A	rank	lb/bu	%	inches	Julian
1	Dirkwin	SW	5140	6	60.3	0	32	195
2	Centennial	SW	5670	2	63.0	0	30	190
3	Penawawa	SW	5210	5	60.5	0	36	195
4	ORS 8501	SW	5610	3	63.3	0	33	191
5	OR 487570	SW	4290	9	60.8	0	33	200
6	OR 4880013	HW	5800	1	62.3	0	35	199
7	OR 4900154	HW	5220	4	58.7	0	32	199
8	OR 4900085	--	4540	7	64.0	0	32	188
9	OR 4895224	--	4420	8	60.5	0	43	195
	Mean		**5100**		**61.5**	**0**	**34**	**195**
	LSD (0.05)		**330**		**3**	**NS**	**NS**	**1**
	CV (%)		**10**		**3**	**0**	**20**	**1**

[1] SW, and HW denote soft white, and spring wheat lines respectively.

Oat Variety Screening in the Klamath Basin, 1995

R.L. Dovel and G. Chilcote[1]

Introduction

Oats have been a major crop in the Klamath Basin in the past. Although local oat acreage has declined to about 5,000 acres in Klamath County, it remains an important commodity in the area. Klamath Experiment Station has cooperated in the Uniform Northwestern States Oat Nursery since the 1970s. Over the years, several outstanding varieties have been identified and adopted by the agricultural industry. Such varieties include Cayuse, Appaloosa, Border, and Ogle. Most of these varieties are still in use today; however, there are several experimental lines that appear to have higher yield potentials than the currently grown varieties. Several high yielding lines are also more lodging resistant and have higher test weights than current industry standards. The Uniform Northwestern States Oat Nursery is planted at KES each year to identify promising new oat lines for release by public and private breeding programs.

Procedures

The Uniform Northwestern States Oat Nursery was established at KES on Fordney fine sandy loam that is moderately deep and somewhat poorly drained. The previous crop was potatoes. The crop was irrigated by a solid set sprinkler system. The trial was arranged in a randomized complete block design with four replications. Seed was planted on May 18 at a depth of 2 inches and a seeding rate of 100 lb/A. All plots were fertilized with 80 lb N, 100 lb P_2O_5, and 60 lb S/A at time of seeding. Plots measured 5 x 20 feet with a row spacing of 6 inches. Bromoxynil and MCPA were applied at labeled rates to control broadleaf weeds. Plots were harvested in late September using a plot combine with a 5-foot wide header. Grain yield was recorded for all plots. Test weight was measured in only one replication.

Results and Discussion

The Uniform Northwestern States Oat Nursery produced a higher average grain yield than most other variety trials at KES in 1993, 1994, and 1995. In 1993, oat yields were higher than other small grains at the station due to infestations of wheat stem maggot and common root rot in barley, wheat and triticale, while oats were relatively unaffected. In 1995, wheat and barley yields were reduced due to poor emergence and common root rot. Oat yields in 1994 were significantly higher than in 1995 and slightly higher than in 1993 (Tables 1 and 2).

The highest yielding entry in the 1995 trial was 90AB1322. It was the second ranked entry in 1994 and over a two-year period it produced more grain than any other entry in the trial (Tables 2 and 3). Other entries producing yields in 1995 not significantly lower than 90AB1322 were 87AB4983, Ajay, Rio Grande, and Prairie. Over a three-year period, 87AB4983 was the highest yielding entry, followed by Rio Grande, 87AB5125, and Ajay. Rio Grande, a newly released oat variety developed in Idaho, has performed well at

[1] Associate Professor and Research Technician, respectively, Klamath Experiment Station, Klamath Falls, OR.

Oat Variety Screening in the Klamath Basin, 1995

KES over an extended period of time. It is slightly shorter than Border and more lodging resistant, with test weights similar to Border and superior to Cayuse. Field scale planting of this variety on small acreages is needed to examine the adaptation of this promising new variety on a larger scale.

Ajay is another variety that may fit some production niches. It is a semi-dwarf line recently released by the University of Idaho. Commercial quantities of this variety are now available. It is generally 8-12 inches shorter than Cayuse and is very resistant to lodging, even at high N fertilization rates. In a N fertility management study conducted at KES, Ajay produced grain yield equivalent or superior to Cayuse and Monida at all fertilization rates, and was much less prone to lodging (see 1990 Crop Research at KES). Due to lodging resistance and high yield potential, Ajay may be a viable option in high N situations where traditional oat varieties would not be a wise choice.

Seed of both 83Ab3250 and 86Ab664 is being increased in preparation for varietal release in other states. Over a five-year period from 1990 to 1994, lodging of 83Ab3250 and 86Ab664 was 3.6 and 12.2 percent, compared to 15.0 and 10.2 percent for Cayuse and Border. Test weight of 83Ab3250 was superior to both Cayuse and Border over the same period. Superior yield, test weight, and lodging resistance make 83Ab3250 a promising oat line. Efforts to secure its release will continue.

Table 1. 1995 Northwestern Uniform Oat Nursery.
Grain yield, test weight, lodging, plant height, and date of 50% heading in Julian days (number of days after January 1) of spring wheat lines planted in the 1995 Northwestern Uniform Oat Nursery. Plots were established on May 18 at Klamath Experiment Station, Klamath County, OR.

Entry	Variety or selection	Yield	Test wt	Lodge	Height	50% Heading
		lb/A	lb/bu	%	inches	Julian
1	Park	4050	39.0	15	48	207
2	Cayuse	4670	38.0	25	45	204
3	Otana	3730	40.5	30	50	206
4	Monida	4550	38.5	30	47	207
5	Ogle	5930	38.5	0	40	204
6	Calibre	1830	38.0	24	53	209
7	Rio Grande (81Ab5792)	6210	40.5	8	38	202
8	Valley (ND 820603)	5100	42.0	8	45	204
9	82Ab248	5050	38.0	38	44	207
10	Ajay (82Ab1142)	6600	40.5	0	39	207
11	83Ab3119	5800	38.5	0	40	208
12	83Ab3250	4850	37.5	51	41	205
13	86Ab664	4930	37.5	1	47	206
14	86Ab1867	5330	39.5	0	41	206
15	Newdak	5720	38.0	6	45	201
16	ND 860416	4690	42.0	23	49	204
17	87Ab5125	5620	40.5	0	40	208
18	84Ab825	5160	38.5	3	40	208
19	88Ab3073+	4940	46.0	0	42	208
20	Derby	3250	40.5	0	49	204
21	86Ab1616+	4300	45.0	0	47	209
22	87Ab4983	6840	41.0	0	37	201
23	89Ab6153	5740	41.0	0	35	203
24	IA H61-3-3	3990	36.5	5	50	206
25	Whitestone (ND 870258)	4960	39.5	13	45	206
26	Paul (ND 862915)+	3940	44.5	0	55	207
27	89Ab1545	5640	41.0	0	40	201
28	90Ab1322	6970	42.0	1	40	206
29	Celsia	5120	39.5	0	48	206
30	Prairie	6160	40.0	0	44	200
31	89Ab4088	5280	42.0	4	43	202
32	91Ab502	5700	39.5	45	39	200
	Mean	**5080**	**40.1**	**10**	**44**	**205**
	LSD (0.05)	**1000**	**--**	**21**	**4**	**2**
	CV (%)	**10**	**--**	**147**	**6**	**1**

Table 2. Three-Year Summary of Northwestern Uniform Oat Nursery.
Summary of grain yield of the Northwestern Uniform Oat Nursery grown from 1993 to 1995. Two-year averages represent 1995 and 1994 grain yields. Plots were established at Klamath Experiment Station, Klamath County, OR.

Variety or selection	Yield						
	1995	1994	1993	2-year Avg			
	lb/A	lb/A	lb/A	lb/A	rank	lb/A	rank
Park	4050	5730	4580	4890	22	4790	20
Cayuse	4670	6520	5660	5600	17	5620	15
Otana	3730	5880	5220	4800	23	4940	19
Monida	4550	6400	5500	5470	19	5480	16
Ogle	5930	6370	5800	6150	7	6030	7
Calibre	1830	5580	3760	3710	28	3720	24
Rio Grande (81Ab5792)	6210	6970	6460	6590	3	6550	2
Valley (ND 820603)	5100	6510	5480	5800	15	5700	14
82Ab248	5050	6880	5460	5960	10	5800	13
Ajay (82Ab1142)	6600	6100	5950	6350	4	6220	4
83Ab3119	5800	6100	6680	5950	11	6190	5
83Ab3250	4850	7200	6340	6030	8	6130	6
86Ab664	4930	6700	6140	5820	14	5920	9
86Ab1867	5330	6630	5950	5980	9	5970	8
Newdak	5720	6100	5910	5910	13	5910	12
ND 860416	4690	6350	4870	5520	18	5300	17
87Ab5125	5620	6870	6430	6250	5	6310	3
84Ab825	5160	6690	5880	5920	12	5910	11
88Ab3073+	4940	4500	4100	4720	25	4510	22
Derby	3250	5530	3450	4390	26	4080	23
86Ab1616+	4300	5180	4140	4740	24	4540	21
87Ab4983	6840	6790	7120	6810	2	6910	1
89Ab6153	5740	5780	6250	5760	16	5920	10
IA H61-3-3	3990	6540	4900	5260	20	5140	18
Whitestone (ND 870258)	4960	5520		5240	21		
Paul (ND 862915)+	3940	4380		4160	27		
89Ab1545	5640	6840		6240	6		
90Ab1322	6970	7170		7070	1		
Celsia	5120						
Prairie	6160						
89Ab4088	5280						
91Ab502	5700						
Mean	**5080**	**6210**	**5500**	**5610**		**5570**	
LSD (0.05)	**1000**	**730**	**1030**	**630**		**540**	
CV (%)	**10**	**10**	**10**	**10**		**10**	

Table 3. General Summary of Northwestern Uniform Oat Nursery.
Grain yield, test weight, lodging, plant height, and date of 50% heading in Julian days (number of days after January 1) of spring wheat lines planted in the Northwestern Uniform Oat Nursery from 1993 to 1995. Values represent three-year average of plots at Klamath Experiment Station, Klamath County, OR.

Entry	Variety or selection	Yield		Test wt	Lodge	Height	50% Heading
		lb/A	rank	lb/bu	%	inches	Julian
1	Park	4790	20	39.2	15	51	202
2	Cayuse	5620	15	39.2	10	47	199
3	Otana	4940	19	41.7	10	50	200
4	Monida	5480	16	40.0	17	49	203
5	Ogle	6030	7	39.0	0	44	196
6	Calibre	3720	24	40.0	8	53	203
7	Rio Grande	6550	2	40.8	3	44	197
8	Valley	5700	14	43.0	8	46	200
9	82Ab248	5800	13	39.0	22	46	202
10	Ajay	6220	4	40.5	0	39	200
11	83Ab3119	6190	5	38.5	0	43	202
12	83Ab3250	6130	6	39.2	17	44	202
13	86Ab664	5920	9	39.3	5	48	201
14	86Ab1867	5970	8	41.5	0	42	197
15	Newdak	5910	12	39.5	3	47	196
16	ND 860416	5300	17	40.8	23	49	200
17	87Ab5125	6310	3	41.3	0	45	203
18	84Ab825	5910	11	38.8	8	44	202
19	88Ab3073+	4510	22	47.5	0	43	203
20	Derby	4080	23	41.8	0	54	201
21	86Ab1616+	4540	21	46.0	7	49	203
22	87Ab4983	6910	1	41.2	7	43	197
23	89Ab6153	5920	10	41.8	0	40	196
24	IA H61-3-3	5140	18	38.8	2	51	201
Mean		**5570**		**40.8**	**7**	**46**	**200**
LSD (0.05)		**540**		**2.0**	**13**	**2**	**1**
CV (%)		**10**		**3**	**24**	**6**	**1**

Barley Seed Treatment

R.L. Dovel and G. Chilcote[1]

Introduction

Seed treatment is an environmentally safe method of protecting small grains from seed and soil borne pathogens. The use of seed treatments for control of a number of smut species is universally accepted in the industry. New products are being developed for controlling other pathogens as well. Two trials were established at three sites in Klamath County to examine several new products for effectiveness against local diseases and pests.

Baytan is a fungicidal seed treatment that may be effective in controlling early season infestation by barley stripe rust. Barley stripe rust has been introduced into the United States from Europe and was found in neighboring states in 1993. Several barley plants with symptoms typical of the disease were found in the Lower Lake leases in 1994, but confirmation of the presence of the disease in the laboratory was not possible. Economically significant occurrences of the disease were seen in the Klamath Basin for the first time in 1995. Baytan was included in the trial to test its effectiveness against this new fungal organism in the Klamath Basin.

Imazalyl has been an effective control against common root rot in other areas, but has not been tested in the Klamath Basin. Common root rot is a continuing problem in the Klamath Basin and is especially damaging in continuously cropped small grains. This pathogen is favored by wet, cold springs and improper irrigation management.

Kodiak is a bacterial inoculant that is antagonistic to a number of soil borne pathogens. The bacteria grows along the root of the plant and inhibits infection of the root by fungal pathogens. The bacterial spores are resistant to most fungicidal seed treatments and it is recommended that the product be used in conjunction with chemical seed treatments. This product has not been tested in the Klamath Basin.

Gaucho is a systemic insecticide that will soon be labeled for use as a seed treatment on small grains. It has proven very effective in control of Russian wheat aphid and other pests. There is also some indication that it may be effective in controlling Hessian fly, which is similar to the wheat stem maggot (WSM), a significant pest of grain in Klamath County. The use of the chemical as labeled has little impact on the environment because the use of a seed treatment delivers a very small amount of material in a way that is relatively unavailable to non-target species, and Gaucho has a relatively low acute toxicity (very high LD_{50}) in non-target species. It is not known if Gaucho seed treatment on small grains is effective in controlling WSM.

Procedures

Two seed treatment trials were established at KES and at two organic soil sites in Klamath County in 1995. Trial 1 examined the effectiveness of various seed treatments in protecting spring seeded barley from a variety

1/ Associate Professor and Research Technician, respectively, Klamath Experiment Station, Klamath Falls, OR.

Barley Seed Treatment

of fungal pathogens. Trial 2 examined the effectiveness of various rates of Gaucho seed treatment in controlling damage by the wheat stem maggot and other insects.

The trials at KES were established on land planted to potatoes the previous year. Soils at the station include Poe, Fordney, and Hosley series, all of which have a fine-loamy to sandy texture, and are moderately deep and somewhat poorly drained. The off-station trials were on very deep, poorly drained, lake bottom soils with high organic matter content. These fields are cropped in spring cereals continuously. All plots at KES were irrigated by a solid set sprinkler irrigation system. Only one organic soil site was irrigated by sprinkler irrigation after planting. Both organic soil sites were flood irrigated prior to planting.

Trial 1. Fungicide Seed Treatments

Seed of Gus barley was treated with eight seed treatments prior to planting. Treatments included: one rate of Baytan and Captan; two rates of Imazalyl and RTU VT; one Kodiak treatment; one rate of Kodiak and RTU VT; one Raxil and Thiram treatment; one System 3 treatment; and one RTU VT treatment, which is the industry standard. An untreated control was also included in the trial. All seed treatment rates are reported in ounce product/cwt of seed in Table 1. All trials were arranged in a randomized complete block design with four replications. The trial at KES was planted on May 16. Irrigated and unirrigated organic soil sites were planted on June 8 and 12, respectively. Seed was planted to a depth of 1 inch at a seeding rate of 100 lb/acre. All plots were fertilized with 100 lb N, 60 lb P_2O_5, and 44 lb S/acre at time of seeding. Plots measured 5 x 20 feet with a row spacing of 6 inches (10 rows). At KES, bromoxynil and MCPA were applied at labeled rates to control broadleaf weeds. Weed control at organic soil sites was achieved with a mixture of 2,4-D and Banvel. Plots were harvested using a plot combine with a 5-foot wide header. Grain yield was recorded for all plots. Test weight, percent plumps, and percent thins were measured in only one replication.

Trial 2. Gaucho Seed Treatment

Seed was treated with three rates of Gaucho in addition to the standard rate of RTU VT. Rate of Gaucho application was 1.5, 3.0 or 6.0 oz of material per 100 lb seed. An untreated control was also included in the trial. The trial was arranged in a randomized complete block design with four replications. Cultural practices used, including locations and planting dates, were identical to Trial 1.

Results

Trial 1. Fungicidal Seed Treatments

There was no significant difference in grain yield or quality due to fungicidal seed treatment at either the mineral soil location or the irrigated organic soil site (Table 1). A light infestation of barley stripe rust was seen at all three sites in August 1995. The infestation was not severe enough to cause dramatic yield losses in most instances. The occurrence of the disease was also so late in the season that the early season protection provided by Baytan was no longer effective. A severe mid-August frost at the unirrigated organic soil site severely damaged heads in the early stages of grain fill resulting in blasted heads and almost total yield loss. Due to this severe damage the

Barley Seed Treatment

unirrigated organic soil site was not harvested.

Barley stripe rust was not confirmed in Oregon in 1994 and the effectiveness of Baytan against this pest was not evaluated. In the absence of barley stripe rust or other rust species, yields of plots treated with Baytan were not significantly different than the control, RTU VT, at any test site (Table 2). The spring of 1994 was one of the driest on record and common root rot infestation was very low. There was no significant difference in grain yield or quality parameters between Imazalyl or Kodiak treated plots and the RTU VT treated control at any test site (Table 2).

Trial 2. Gaucho Seed Treatments

Gaucho seed treatment did not affect barley grain yield or quality at either the mineral soil or irrigated organic soil site in 1995 (Table 3). The unirrigated organic soil site was not harvested.

In 1994, yields of Gaucho treated plots were significantly higher than the control at both irrigated sites, but not at the unirrigated site (Table 2). Although infestation of wheat stem maggot was very light in 1994, there was a low level of Russian wheat aphid at the experiment station, and a high level of infestation of corn leaf aphids at the irrigated organic soil site. It appears that the Gaucho seed treatment was effective in maintaining these insects at lower levels than the non-insecticide treatments, resulting in higher yields. Grain quality parameters such as test weight and percent plumps (percent above 6/64 screen) were also higher for the Gaucho treatment than the control at the two organic soil sites (Table 2).

Further testing is needed to determine the effectiveness of these seed treatments against the various pest species in the Klamath Basin.

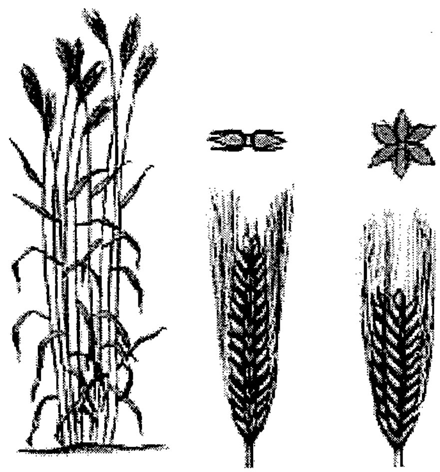

Table 1. 1995 Seed Treatment Trial

Grain yield, test weight, and percent thins of Gus spring barley treated with various chemical and biological seed treatments. Plots were established at two locations in Klamath County, OR.

	Mineral irrigated					Organic irrigated					Two-location average				
		Test	--% Above Screen--				Test	--% Above Screen--				Test	--% Above Screen--		
Treatment	Yield	wt	6/64	5.5/64	Pan	Yield	wt	6/64	5.5/64	Pan	Yield	wt	6/64	5.5/64	Pan
oz chemical/cwt seed	**lb/A**	**lb/bu**		**%**		**lb/A**	**lb/bu**		**%**		**lb/A**	**lb/bu**		**%**	
1 Baytan @ 1.25 + Captan @ 2.0	4100	51.1	86.6	9.3	4.1	2880	34.0	79.7	11.4	8.9	3490	42.6	83.2	10.4	6.5
2 Imazalyl @ 0.25 + RTU VT @ 6.0	3650	51.5	87.6	8.6	3.9	2490	36.5	81.7	10.0	8.3	3070	44.0	84.7	9.3	6.1
3 Imazalyl @ 0.50 + RTU VT @ 6.0	4200	51.8	87.1	8.8	4.0	2700	35.5	82.3	9.4	8.3	3450	43.7	84.7	9.1	6.2
4 Kodiak @ 0.1	4170	51.9	89.2	7.7	3.1	2480	36.1	83.0	8.9	8.1	3320	44.0	86.1	8.3	5.6
5 Kodiak @ 0.1 + RTU VT @ 6.0	4190	51.4	88.5	8.0	3.4	2730	37.0	85.1	8.4	6.5	3460	44.2	86.8	8.2	5.0
6 Raxil / Thiram @ 3.5	4340	51.8	87.1	8.8	4.0	2540	36.3	81.6	10.4	8.0	3440	44.1	84.4	9.6	6.0
7 Control = RTU VT @ 6.0	4260	51.0	85.6	9.8	4.6	2580	36.5	80.9	10.4	8.7	3420	43.8	83.3	10.1	6.7
8 Clean Control	3940	49.8	84.1	10.5	5.4	2690	34.5	80.2	10.9	8.9	3320	42.2	82.2	10.7	7.2
9 System 3 @ 4.0	3930	50.9	87.0	9.2	3.9	2030	34.1	80.3	10.7	8.9	2980	42.5	83.7	10.0	6.4
Mean	**4090**	**51.2**	**87.0**	**9.0**	**4.0**	**2570**	**35.6**	**81.6**	**10.1**	**8.3**	**3330**	**43.4**	**84.3**	**9.5**	**6.2**
LSD (0.05)	**NS**	**1**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Table 2. 1994 Seed Treatment Trial
Grain yield and test weight of Gus spring barley treated with various chemical and biological seed treatments in 1994. Plots were established at three locations in Klamath County, OR.

	Mineral irrigated		Organic irrigated		Organic unirrigated		Three-location avg	
Treatment	Yield	Test weight	Yield	Test weight	Yield	Test weight	Yield	Test wt
oz chemical/cwt seed	lb/A	lb/bu	lb/A	lb/bu	lb/A	lb/bu	lb/A	lb/bu
1 Baytan @ 0.75 + Captan @ 2.0	8080	53.3	5840	51.3	3850	51.4	5930	52.0
2 Baytan @ 1.25 + Captan @ 2.0	8070	53.0	6030	51.3	4420	51.5	6170	51.9
3 Imazalyl @ 0.25 + RTU VT @ 5.0	8200	53.3	5850	51.1	4030	51.0	6030	51.8
4 Imazalyl @ 0.50 + RTU VT @ 5.0	8100	53.0	5800	51.0	4080	51.1	5990	51.7
5 Kodiak @ 0.1	8180	53.0	6090	51.8	4130	50.9	6130	51.9
6 Gaucho @ 2 oz	8610	52.6	6990	52.5	3720	52.0	6440	52.4
7 Gaucho @ 4 oz	8540	53.5	7140	52.6	4570	51.6	6750	52.6
8 Control = RTU VT @ 5.0	7930	53.3	5990	51.0	4210	51.1	6040	51.8
Mean	**8210**	**53.1**	**6210**	**51.6**	**4130**	**51.3**	**6190**	**52.0**
LSD (0.05)	**530**	**0.8**	**420**	**0.8**	**510**	**0.7**	**270**	**0.4**

Table 3. 1995 Gaucho Seed Treatment Trial.

Grain yield, test weight, and percent thins of Gus spring barley treated with various rates of Gaucho seed treatment. Plots were established at two locations in Klamath County, OR.

		Mineral irrigated					Organic Irrigated					Two-location average				
	Gaucho treatment	Yield	Test wt	--% Above Screen-- 6/64	5.5/64	Pan	Yield	Test wt	--% Above Screen-- 6/64	5.5/64	Pan	Yield	Test wt	--% Above Screen-- 6/64	5.5/64	Pan
		lb/A	lb/bu	—— % ——			lb/A	lb/bu	—— % ——			lb/A	lb/bu	—— % ——		
1	Control	3720	51.1	87.7	8.7	3.6	2290	38.6	81.9	9.8	8.3	3000	44.9	84.8	9.3	6.0
2	Gaucho 1.5	3940	50.9	85.2	10.3	4.5	2440	38.6	81.9	8.4	9.7	3190	44.8	83.6	9.4	7.1
3	Gaucho 3.0	4170	50.9	87.8	8.5	3.8	1950	36.5	82.8	8.9	8.3	3060	43.7	85.3	8.7	6.1
4	Gaucho 6.0	4040	50.5	87.3	8.8	3.9	2430	36.8	81.6	9.8	8.6	3230	43.7	84.5	9.3	6.3
	Mean	**3990**	**50.7**	**86.5**	**9.4**	**4.1**	**2270**	**37.4**	**81.8**	**9.4**	**8.8**	**3130**	**44.0**	**84.2**	**9.4**	**6.5**
	LSD (0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Intercropping Barley and Annual Legumes for Grain and Forage

R.L. Dovel, G. Chilcote, and J. Rainey[1]

Introduction

The Klamath Basin has a short growing season with frequent frosts throughout the summer, which limits cropping options in the area primarily to small grains, alfalfa, potatoes, sugar beets, and pasture. Much of the acreage planted to small grains is on soils that are not suitable for potatoes or alfalfa, and are maintained in a continuous small grain rotation. Due to greater susceptibility of spring wheat to frost damage, and lower oat yields and price, barley is planted on over 80 percent of the acreage devoted to small grains.

Under continuous cropping, diseases and pests such as wheat stem maggot, common root rot, and barley root knot nematode have become serious problems in some areas. Wind erosion is also a problem on some soils. Much of the cropland in the lower Klamath Basin is reclaimed lake bottom. Some of these soils have very poor structure and poor aggregate strength. The inclusion of legumes and forage grasses in a rotation has been shown to improve soil structure, soil aggregate strength, and other measures of soil health. It may be possible to intercrop forage legumes and grasses with spring planted barley and derive some of the benefits of a legume or forage rotation, as well as provide late season grazing and ground cover to prevent fall and early spring erosion.

Interseeding of legumes into small grains has increased grain yield in some locations. Increased yield has been attributed to nitrogen transfer from the legume, weed suppression, and improved soil conditions. The effects of legume interseeding on the subsequent year's crop is attributable to residual nitrogen transfer from decaying plant material and improved soil conditions. It seems that indeterminate legumes with lower seed yield potentials are more beneficial to associated cereals in terms of nitrogen transfer in the current season and as residual nitrogen for subsequent crops. The production of a second grain crop by interseeding is impossible in the Klamath Basin due to an extremely short growing season; however, it is possible to extend the growing season past grain harvest date by interseeding a forage species for either hay or pasture. Interseeding a forage legume would enhance nitrogen transfer to the associated cereal and maximize residual nitrogen for the following crop.

Annual forage legume variety trials have been conducted at KES over the past three years. Several annual medic, rose clover, and sub clover species have shown promise for interseeding in barley for grain. In an annual legume trial in central Oregon, good fall regrowth was seen in plots interseeded with annual medic species; however, regrowth of berseem clover entries was roughly twice that of annual medic entries. Further testing of annual forage legumes is needed to determine which is appropriate for inclusion in a small grain-forage intercropping system in the Klamath Basin. A trial to evaluate annual legumes for interseeding in spring-planted barley was established at the Klamath Experiment Station in 1994.

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[1] Associate Professor, Research Technician, and Biological Sciences Research Technician III, respectively, Klamath Experiment Station, Klamath Falls, OR.

Intercropping Barley and Annual Legumes for Grain and Forage

Procedures

The trial was arranged in a randomized complete block design with four replications. Gustoe barley seed was sown to a depth of one inch with a modified Kincaid planter. Plots were fertilized with 50 lb N, 62 lb P_2O_5, and 37 lb S / acre in a band application at planting. Seed of the forage species was broadcast using the same drill and incorporated by light raking. Plots measured 5 x 20 feet with a barley row spacing of six inches. The study was sprinkler irrigated by a solid set irrigation system.

Small grain data collected included plant height, percent lodging, date of 50 percent heading, grain yield, bushel weight, percent thins, test weight, and grain protein content. Fall herbage production was monitored as well. Plant height of the forage component and grain contamination by the forage component were also measured. No chemical weed control was applied and weed population density was monitored.

Results

Clean grain yields of interseeded plots were not superior to the control (Tables 1 and 2). All interseeded annual medic entries and berseem clover decreased grain yield when compared to the non-interseeded control in 1994, but there was no difference in yield due to interseeding in 1995. Interseeded legume stands were much better in 1994 than 1995, and account for the difference in interseeding effect on yield between the two years. Depression of cereal grain yield by interseeded legumes has also been seen in other areas. Lodging was increased by several of the most productive annual medic entries in the trial in 1994, but not in 1995. This is again due to poorer interseeded legume stands in 1995. Increased lodging in interseeded plots was also reported by other researchers.

Barley grain was significantly contaminated with legume seed of all barrel medic, burr medic, and black medic entries at KES in 1994. Sava snail medic, Multicut berseem clover, and all sub and rose clover entries were not significant seed contaminants in 1994. Only Caliph barrel medic was a significant contaminant in 1995. Only the sub and rose clovers were shorter than grain harvest height at grain harvest in either year. Berseem clover was the only entry with substantial fall growth at KES in 1994 or 1995. In an annual legume trial in central Oregon, good fall regrowth was seen in plots interseeded with annual medic species; however, regrowth of berseem clover entries was roughly twice that of annual medic entries.

The seeding rate of the two species included in an intercropping system will determine the relative competitiveness of the two species. In the intercropping system that we are examining, seeding rates of the two components should be adjusted to optimize grain yield, and have enough interseeded legume for ground cover and regrowth following grain harvest. Nitrogen fertilization management will also affect the relative competitiveness of the grain and legume components. Competition of the interseeded component with the primary crop may be affected by the planting date of the two components. When the planting date of the interseeded species is delayed until after that of the primary crop the competitive ability of the interseeded species is reduced. This may reduce any negative effect of interseeding on primary crop yield; however, yield of the interseeded species will be

Intercropping Barley and Annual Legumes for Grain and Forage

reduced. By delaying interseeding the legume component until after chemical weed control, control of broadleaf weeds in a small grain-legume intercropping system may be simplified. In a trial at KES, legumes interseeded by broadcast seeding with no incorporation following broadleaf weed control (about six weeks after planting the small grain component) failed to establish. No information is currently available on seeding rate, nitrogen fertilization, and planting date effects on a grain-legume intercropping system in the Klamath Basin. More information about species and variety selection as well as seeding rate, nitrogen fertilization, and planting date is needed.

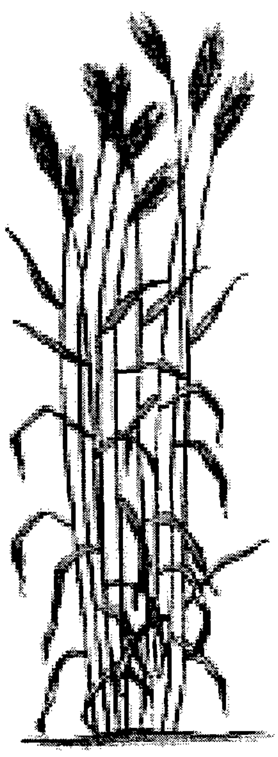

Table 1. 1994 Intercropping Barley and Annual Legumes for Grain. Grain yield, test weight, plumps and thins, lodging, legume maturity at grain harvest, and relative legume height of barley-legume mixtures planted at Klamath Experiment Station, OR, 1994.

Entry	Variety	Grain Yield Dirty	Grain Yield Clean	Grain Yield Difference	Test wt	Plumps and Thins --% Above Screen-- 6/64	5.5/64	Pan	Lodge	Legume maturity[1]	Relative legume height[2]
		lb/A	lb/A	lb/A	lb/bu	6/64	5.5/64	Pan	%		
1	Ascot Barrel Medic	4180	3630	550	49.6	79.7	13.9	6.4	30	0.0	1.0
2	Borung Barrel Medic	4350	3900	460	50.0	82.1	12.3	5.5	16	0.0	1.0
3	Caliph Barrel Medic	4560	4230	330	51.4	89.5	8.0	2.5	0	0.0	1.0
4	Mogul Barrel Medic	4230	3820	410	49.6	83.0	12.1	4.9	6	0.0	1.0
5	Parabinga Barrel Medic	5120	4780	340	51.5	89.3	8.0	2.7	0	0.0	0.8
6	Parraggio Barrel Medic	4220	3750	470	50.6	83.6	11.4	5.0	14	0.0	1.0
7	George Black Medic	4790	4190	600	49.9	85.0	11.1	3.9	1	1.0	1.0
8	Santiago Burr Medic	4180	3850	330	48.8	87.5	8.9	3.6	11	0.0	1.0
9	Sava Snail Medic	4560	4340	220	51.3	85.1	10.8	4.1	6	0.0	1.0
10	Berseem Clover Multicut	4650	4400	250	50.9	85.8	10.6	3.7	0	1.0	1.0
11	Clare Sub Clover	5370	5190	190	52.0	91.6	6.4	2.0	0	1.0	0.3
12	Karridale Sub Clover	5340	5130	210	51.8	91.0	6.8	2.1	0	1.0	0.3
13	Monte Frio Rose Clover	5020	4740	280	51.5	90.6	6.9	2.5	0	1.0	1.0
14	Overton Rose Clover	5530	5340	190	51.4	91.2	6.7	2.1	0	1.0	0.3
15	Trikkala Sub Clover	5460	5210	250	51.6	91.2	6.8	2.1	3	1.0	0.0
16	No Legume (Control)	5420	5220	190	51.6	90.3	7.3	2.3	0	na	na
Mean		**4810**	**4480**	**330**	**50.8**	**87.3**	**9.3**	**3.5**	**5**	**0.5**	**0.8**
LSD (0.05)		**560**	**460**	**329**	**1.1**	**3.2**	**2**	**1.2**	**12**		
CV (%)		**8**	**9**	**27**	**2**	**3**	**15**	**25**	**155**		

[1] Legume Maturity - 1=Green at grain harvest, 2=mature and senecing at grain harvest.

[2] Relative Legume Height - 0=below cutting height at grain harvest, 1=above cutting height at grain harvest.

Table 2. 1995 Intercropping Barley and Annual Legumes for Grain. Grain yield, test weight, plumps and thins, lodging, legume maturity at grain harvest, and relative legume height of barley-legume mixtures planted at Klamath Experiment Station, OR, 1995.

Entry	Variety	ID	Grain Yield Dirty	Grain Yield Clean	Grain Yield Difference	Test wt	Plumps and Thins --% Above Screen-- 6/64	5.5/64	Pan	Lodge	Legume maturity[1]	Relative legume height[2]
			lb/A	lb/A	lb/A		6/64	5.5/64	Pan	%		
1	Ascot Barrel Medic	ABM	7020	6840	180	49.6	91.6	5.5	2.9	0	0.63	1.00
2	Borung Barrel Medic	BBM	7260	7100	170	50.4	95.2	2.9	1.9	0	0.50	1.00
3	Caliph Barrel Medic	CBM	6450	6050	400	49.8	93.9	3.9	2.2	0	0.88	1.00
4	Mogul Barrel Medic	MBM	7020	6810	210	49.1	91.8	5.4	2.8	0	0.50	1.00
5	Parabinga Barrel Medic	PBM	7350	7230	120	50.1	93.9	4.0	2.2	0	0.25	0.75
6	Parraggio Barrel Medic	RBM	7030	6810	220	50.0	89.8	6.8	3.4	0	0.63	1.00
7	George Black Medic	GBM	7360	7250	110	49.6	93.5	4.0	2.5	0	1.00	0.75
8	Santiago Burr Medic	SBM	6950	6830	120	50.3	95.3	2.9	1.8	0	1.00	0.25
9	Sava Snail Medic	SSM	6190	6010	180	50.0	91.8	5.3	2.9	0	1.00	1.00
10	Multicut Berseem Clover	BCM	7170	7000	170	50.5	94.1	3.6	2.2	0	1.00	1.00
11	Clare Sub Clover	CSC	7140	7040	100	50.8	94.6	3.4	2.0	0	1.00	0.00
12	Karridale Sub Clover	KSC	7420	7310	110	49.8	94.3	3.9	1.8	0	1.00	0.00
13	Monte Frio Rose Clover	MRS	7130	7050	80	49.6	94.2	3.7	2.1	0	1.00	0.75
14	Overton Rose Clover	ORS	7320	7230	90	51.4	94.4	3.7	1.9	0	1.00	0.00
15	Trikkala Sub Clover	TSC	6950	6880	70	50.8	92.9	4.5	2.6	0	1.00	0.00
16	No Legume (Control)	NOL	7720	7600	130	49.4	93.1	4.6	2.4	0	na	na
Mean			7090	6940	150	**50.1**	**93.4**	**4.3**	**2.4**	**0**	**0.83**	**0.63**
LSD (0.05)			**1170**	**1180**	**93**	**2.0**	**3.3**	**2.3**	**1.1**	**0**	**0.19**	**0.34**
CV (%)			**12**	**12**	**43**	**3**	**3**	**38**	**34**	**----**	**16.0**	**38.0**

[1] Legume Maturity - 1=Green at grain harvest, 2=mature and senecing at grain harvest.

[2] Relative Legume Height - 0=below cutting height at grain harvest, 1=above cutting height at grain harvest.

Intercropping Oats and Annual Legumes for Hay

R.L. Dovel, J. Rainey, and G. Chilcote[1]

Introduction

Oat hay is a valuable forage commodity in the Klamath Basin. An increasing acreage of oat hay is being produced in the basin due to rising hay prices and declining grain prices. The possibility of water shortages is also fostering increased interest in cereal hay production. In trials at KES, oat and hooded barley hay harvested at the soft dough stage averaged 38 and 39 percent total digestible nutrients (TDN) and 8.9 and 9.6 percent crude protein (CP), respectively. Oat hay CP concentration usually ranges from 6 to 10 percent in the Klamath Basin, and TDN content may be less than 35 percent. Forage quality of cereal hay is generally lower than is required to meet production goals for many livestock classes. Interseeding annual legumes into small grains has increased both forage production and quality across a number of environments. It provides the possibility for additional production when irrigation or timely rains prolong the growing season past the cutting date for small grain hay crops.

Annual forage legume variety trials have been conducted at KES over the past three years. In 1992 and 1993, legumes were planted in monoculture, and total biomass production and forage quality were monitored. Several annual medic, field pea, and clover varieties showed promise for interseeding in oats for hay. Several entries produced more dry matter than Austrian winter peas, the most common legume currently used in oat-legume mixtures. Some fall regrowth was seen in plots interseeded with annual medic species; however, regrowth of berseem clover entries was roughly twice that of annual medic entries. Further testing of annual forage legumes is needed to determine which is appropriate for inclusion in a small grain-forage intercropping system in the Klamath Basin. A trial to evaluate annual legumes for interseeding in oats for hay was established at the Klamath Experiment Station in 1994 and 1995.

Procedures

The trial was arranged in a randomized complete block design with four replications. Oat seed was sown to a depth of one inch with a modified Kincaid planter. Plots were fertilized with 50 lb N, 62 lb P_2O_5, and 37 lb S/acre in a band application at planting. Seed of the forage species was broadcast using the same drill and incorporated by light raking. Plots measured 5 x 20 feet with an oat row spacing of six inches. The crop was sprinkler irrigated by a solid set irrigation system.

Forage was harvested when oat plants reached the soft dough stage. Prior to harvest, plots were trimmed to 17 feet long. The crop was harvested using a flail harvester with a three-foot wide head. All yields were reported on a dry weight basis. Subsamples were collected and analyzed for forage quality, acid detergent fiber (ADF), neutral detergent fiber (NDF), crude protein (CP), and relative feed value (RFV) using a near-infrared reflectance spectrophotometer (NIRS). Fall herbage production was monitored as well. No

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[1]/ Associate Professor, Biological Sciences Research Technician III, and Research Technician, respectively, Klamath Experiment Station, Klamath Falls, OR.

Intercropping Oats and Annual Legumes for Hay

chemical weed control was applied and weed population density was monitored. All data collected were analyzed by analysis of variance procedures.

Results

Interseeding forage legumes into oats for hay at KES did not affect forage yield in 1994 or 1995 (Tables 1 and 2). However, interseeding with four different legume entries (Austrian winter peas, Maple peas, Magnus field pea, and Ascot barrel medic) produced significantly higher CP levels than the non-interseeded control in 1994. In 1995, George black medic, Parabinga barrel medic, and Maple peas produced significantly higher CP levels than the non-interseeded control. Only Austrian winter peas produced significantly lower ADF and NDF values than the control in 1994. Similarly, only Austrian winter peas produced significantly higher RFV than the non-interseeded control.

There was no difference in ADF, NDF, or RFV due to legume interseeding in 1995. When averaged over two years, only Austrian winter peas and Maple peas produced significantly higher CP levels than the non-interseeded control (Table 3). Similarly, only Austrian winter peas produced significantly higher RFV and lower ADF values than the non-interseeded control over a two-year period (Table 3). Although Magnus field pea and maple pea produced significantly higher yields than Austrian winter pea when grown in monoculture in 1993 and 1992, there was no yield or quality advantage of any entry over Austrian winter pea when grown in an oat-legume mixture.

Fall regrowth following cutting was visually monitored and only Multicut berseem clover produced significant regrowth. Barrel medic, burr medic, and snail medic entries had set seed and were senescing at forage harvest due to their determinate growth habit. Although they were green, black medic, sub clover, and rose clover entries did not produce significant amounts of regrowth following cutting. This may have been due to drought stress or, in the case of sub clover, it may have been due to low fall temperatures. Where fall growth following hay harvest is important, berseem clover may be the best choice. It produced forage yields and forage quality equivalent to Austrian winter pea and produced the best fall regrowth.

This trial was well irrigated and moisture stress did not limit production. The results of this trial are applicable to irrigated highly productive situations. In areas and management systems where moisture would limit plant growth, more drought resistant legumes such as the annual medics may be more productive than the pea varieties included in this trial.

Table1. 1994 Intercropping Oat Hay and Annual Legumes.
Forage yield, crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), and relative feed value (RFV) of oat-legume mixtures planted at Klamath Experiment Station, OR, 1994.

Variety	Yield	CP	ADF	NDF	RFV
	ton/A	%	%	%	
Ascot Barrel Medic	6.1	8.6	39.3	55.1	99
Borung Barrel Medic	6.1	7.8	40.2	56.8	95
Caliph Barrel Medic	6.5	8.1	39.8	56.1	97
Mogui Barrel Medic	5.6	8.4	41.0	58.4	91
Parrabinga Barrel Medic	6.7	7.1	42.0	60.3	87
Parraggio Barrel Medic	6.2	8.3	38.9	55.7	99
George Black Medic	6.1	7.3	40.2	58.7	91
Santiago Burr Medic	5.8	7.2	42.3	59.8	87
Sava Snail Medic	6.4	7.7	39.0	55.9	97
Berseem Clover Multicut	6.4	8.3	37.7	55.1	101
Clare Sub Clover	6.4	6.2	41.4	59.8	89
Karridal Sub Clover	5.8	7.7	38.5	56.1	98
Monte Frio Rose CLover	6.5	6.7	39.7	57.9	94
Overton Rose Clover	6.0	6.3	42.4	61.2	85
Trikkala Sub Clover	6.9	7.4	38.4	55.9	98
Austrian Winter Pea	6.1	9.5	37.0	53.3	106
Magnus Field Pea	6.1	8.7	38.4	56.0	99
Maple Pea	6.7	8.8	39.1	56.4	97
No legume (control)	6.4	6.8	41.5	59.9	88
Mean	**6.2**	**7.7**	**39.8**	**57.3**	**95**
CV (%)	**12.1**	**15**	**7.6**	**7.2**	**11.8**
LSD (0.05)	**NS**	**1.7**	**4.3**	**5.9**	**16**

Table 2. 1995 Intercropping Oat Hay and Annual Legumes.
Forage yield, crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), and relative feed value (RFV) of oat-legume mixtures planted at Klamath Experiment Station, OR, 1995.

Variety	Yield	Protein	ADF	NDF	RFV
	ton/A	%	%	%	
Ascot Barrel Medic	4.5	9.6	39.7	56.0	96.4
Borung Barrel Medic	4.4	9.3	39.8	56.7	95.3
Caliph Barrel Medic	3.8	9.6	37.5	53.6	103.8
Mogui Barrel Medic	3.8	9.0	38.1	53.7	103.4
Parabinga Barrel Medic	4.4	10.6	35.9	52.5	108.2
Parraggio Barrel Medic	4.0	9.7	38.4	54.2	102.2
George Black Medic	4.5	10.9	37.0	53.2	105.4
Santiago Burr Medic	3.9	9.4	38.4	54.6	101.0
Sava Snail Medic	3.8	9.8	39.7	56.8	95.9
Berssem Clover Multicut	3.9	9.1	40.7	58.3	91.7
Clare Sub Clover	3.7	9.5	38.6	54.6	100.6
Karridale Sub Clover	4.3	9.1	37.9	54.1	102.3
Monte Frio Rose Clover	4.3	10.1	38.3	54.8	100.7
Overton Rose Clover	5.0	9.8	38.5	54.8	100.1
Trikkala Sub Clover	4.2	9.7	36.8	53.4	105.1
Austrian Winter Pea	4.2	10.0	38.9	54.9	99.3
Magnus Field Pea	3.8	9.9	38.6	55.4	99.0
Maple Pea	4.0	10.5	37.6	52.9	105.6
No Legume (Control)	4.1	10.0	40.0	56.4	95.4
Mean	**4.1**	**9.8**	**38.4**	**54.8**	**100.7**
CV (%)	**16.0**	**8.8**	**6.0**	**5.7**	**8.5**
LSD (0.05)	**NS**	**1.2**	**NS**	**NS**	**NS**

Table 3. Two-year Summary of Intercropping Oat Hay and Annual Legumes.
Forage yield, crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), and relative feed value (RFV) of oat-legume mixtures planted at Klamath Experiment Station, OR, 1994 and 1995.

Variety	Yield	Protein	ADF	NDF	RFV
	ton/A	%	%	%	
Ascot Barrel Medic	5.3	9.1	39.5	55.6	97.7
Borung Barrel Medic	5.2	8.6	40.0	56.7	95.2
Caliph Barrel Medic	5.1	8.9	38.7	54.9	100.4
Mogui Barrel Medic	4.7	8.7	39.6	56.0	97.2
Parabinga Barrel Medic	5.5	8.9	39.0	56.4	97.6
Parraggio Barrel Medic	5.1	9.0	38.7	54.9	100.6
George Black Medic	5.3	9.1	38.6	55.9	98.2
Santiago Burr Medic	4.8	8.3	40.4	57.2	94.0
Sava Snail Medic	5.1	8.8	39.3	56.3	96.5
Berssem Clover Multicut	5.2	8.7	39.2	56.7	96.4
Clare Sub Clover	5.1	7.8	40.0	57.2	94.8
Karridale Sub Clover	5.1	8.4	38.2	55.1	100.1
Monte Frio Rose Clover	5.4	8.4	39.0	56.3	97.3
Overton Rose Clover	5.5	8.1	40.4	58.0	92.6
Trikkala Sub Clover	5.5	8.6	37.6	54.6	101.5
Austrian Winter Pea	5.1	9.8	37.9	54.1	102.6
Magnus Field Pea	5.0	9.3	38.5	55.7	99.0
Maple Pea	5.3	9.6	38.4	54.6	101.3
No Legume (Control)	5.2	8.4	40.7	58.2	91.7
Mean	**5.2**	**8.8**	**39.1**	**56.0**	**97.9**
CV (%)	**13.2**	**11.8**	**6.9**	**6.5**	**10.1**
LSD (0.05)	**NS**	**1.1**	**2.6**	**NS**	**9.8**

Oat Hay Variety Trial

R.L. Dovel, J. Rainey, and G. Chilcote[1]

Introduction

Oat hay is an important commodity in the Klamath Basin. An increasing acreage of oat hay is being produced in the basin. Oat hay variety trials were conducted at KES in 1989 and 1990. Since that time, several new oat varieties have been released for grain production and some oat varieties have been released specifically for hay production. A variety trial examining the hay yield potential and forage quality of standard and newly developed varieties is needed to provide producers with a basis for variety selection. Oat hay variety trials were established at KES in 1994 and 1995 to examine the forage yield and quality of oat varieties.

Procedure

The trials were established at KES on Fordney fine sandy loam that is moderately deep and somewhat poorly drained. The previous crop was potatoes. The crop was irrigated by a solid set sprinkler system. The trials were arranged in a randomized complete block design with four replications. Seed was planted on April 20 in 1994 and May 23 in 1995. Seed was planted to a depth of 1 inch at a seeding rate of 100 lb/acre. All plots were fertilized with 50 lb N, 62 lb P_2O_5, and 37 lb S / acre at time of seeding. Plots measured 5 x 20 feet with a row spacing of 6 inches. Bromoxynil and MCPA were applied at labeled rates to control broadleaf weeds.

Plots were harvested when Magnum oat plants reached the soft dough stage in 1994. In 1995, there were two harvest dates. Plots that were in the soft dough stage were harvested on August 10. All remaining plots were harvested on August 23. Prior to harvest, plots were trimmed to 17 feet long. The crop was harvested using a flail harvester with a three-foot wide head. All yields were reported on a dry weight basis. Subsamples were collected and analyzed for forage quality measured as, acid detergent fiber (ADF), neutral detergent fiber (NDF), crude protein (CP), and relative feed value (RFV), using a near-infrared reflectance spectrophotometer.

Results

Variability was high in the trial in 1994, making variety separation difficult. The highest yielding variety, Magnum, was not significantly different than eight other varieties (Table 1). The only two entries with significantly lower yield than Magnum in 1994 were Magnum II and Dusty. These two varieties are very short season while Magnum is a late maturing variety. Harvesting all entries when Magnum was at soft dough resulted in the early varieties reaching stages too advanced for optimal production. This is reflected in the lower CP and higher fiber content of the earlier maturing varieties.

In 1995, Westford hooded barley and Byrd were the two highest yielding entries in the trial (Table 2). They produced significantly higher forage yields than the five lowest yielding entries. The trial was harvested when most varieties were in the soft dough stage in

[1]/ Associate Professor, Biological Sciences Research Technician III, and Research Technician, respectively, Klamath Experiment Station, Klamath Falls, OR.

Oat Hay Variety Trial

1995. Dusky, the earliest maturing oat variety in the trial, was harvested on August 10 with the hooded barley entries (Table 2). All other oat varieties were harvested on August 23 when the majority of oat entries were at soft dough. Magnum, a late maturing variety, was not yet at the soft dough stage and yields were suppressed when compared to the previous year. When Dusky was harvested at an appropriate stage in 1995, it yielded much better than in 1994, and also produced better forage quality values. It appears that Dusky would be a good oat variety for short season oat hay production. The hooded barley entries would also be an excellent choice for short season cereal hay production.

When averaged over a two-year period, Magnum, Cayuse, and Otana were the highest yielding entries. There was a large group of entries that were slightly lower yielding than the top group. They include most grain varieties currently in use in the Pacific Northwest. It is interesting to note that Ajay, a semi-dwarf variety, is in this group. In spite of its short stature, Ajay produced forage yields comparable to all but the two highest yielding entries (Table 3). Due to its short stature, there is less stem and a higher percentage of leaves in Ajay than in taller varieties. This resulted in higher than average forage quality values for the short variety.

Although forage yield was higher in 1994 than in 1995, forage quality was highest in 1995. This is due largely to harvesting at a more appropriate time in 1995, while harvest was delayed past the appropriate time for many varieties in 1994. Average crude protein concentration in the 1995 trial was 10.0 percent compared to 7.3 percent in 1994. ADF, which is a predictor of forage digestibility and thus animal performance, averaged 35.0 in 1995 and 41.3 in 1994, indicating that feeding oat hay produced in the 1995 trial would result in better animal performance than that produced in the 1994 trial. Minimal nutritional requirements for a dry pregnant cow in the middle third of pregnancy are 7.0 percent crude protein and 48.6 percent TDN, which corresponds to 55 percent ADF. Oat hay produced in both years was adequate to meet the energy needs of a dry cow, but hay from 1994 was only marginally adequate in crude protein. Crude protein concentration of some varieties dropped below minimal levels in 1994. The variability in forage quality between varieties and between years illustrates the need for forage testing when purchasing hay, even oat hay to feed dry cows.

Table 1. 1994 Oat Hay Variety Trial.
Forage yield, dry matter, crude protein, acid detergent fiber (ADF), neutral detergent fiber (NDF), and relative feed value (RFV) of oat varieties grown for hay at Klamath Experiment Station, OR, 1994.

Variety or selection	Yield	Dry matter	Crude protein	ADF	NDF	RFV
	ton/A	%	%	%	%	
Cayuse	6.8	31	7.3	40.2	58.3	92
Border	6.3	29	8.6	38.8	55.6	99
Ajay	5.9	29	7.5	39	57.9	95
Magnum II	5.7	33	6.9	42.3	61.4	85
83Ab3250	5.8	25	7.2	41	59.2	90
Rio Grande	5.8	31	6.6	42.5	61.6	84
Monida	6.1	26	7.8	41	59.5	91
Magnum	7.3	29	8.8	38.5	57	97
B-3	5.0	27	7.2	43.7	63.9	80
DU-1	5.5	33	6.7	44.2	64.6	79
Magnum/Magnum II	6.0	25	6.4	44.4	63.3	80
Otana	6.8	29	7.2	39.4	57.3	95
Mean	**6.1**	**29**	**7.3**	**41.3**	**60**	**89**
CV (%)	**18.7**	**8.1**	**19.7**	**8.8**	**7.8**	**13**
LSD (0.05)	**1.5**	**2.5**	**2.1**	**5.2**	**6.6**	**17**

Table 2. 1995 Oat Hay Variety Trial.
Forage yield, dry matter, harvest date in julian days (number of days after Jan. 1), crude protein, acid detergent fiber (ADF), neutral detergent fiber (NDF), and relative feed value (RFV) of oat varieties grown for hay at Klamath Experiment Station, OR, 1995.

Variety or Selection	Yield	Dry matter	Harvest date	Crude protein	ADF	NDF	RFV
	ton/A	%	Julian	%	%	%	
Cayuse	4.5	37	235	9.3	35.6	52.1	109.3
Border	3.9	40	235	9.5	35.5	52.9	108.0
Ajay	4.4	34	235	10.6	34.0	50.7	114.6
Magnum 2000 (Magnum II)	4.0	33	235	9.6	37.6	55.8	100.2
83Ab3250	4.6	34	235	10.3	33.3	50.4	116.4
Rio Grande (81Ab5792)	4.6	33	235	10.1	34.8	49.8	115.9
Monida	4.5	34	235	9.8	34.5	51.9	111.3
Magnum	4.5	35	235	9.5	36.0	53.3	106.5
Byrd (B-3)	5.0	38	235	9.2	35.5	51.6	111.4
Dusky (DU-1)	4.7	30	223	10.6	34.8	52.9	108.9
Otana	4.5	38	235	9.1	36.1	53.7	105.5
Park	4.3	34	235	10.3	36.2	53.7	105.2
Ogle	4.3	33	235	9.8	37.4	53.4	104.5
Westford (Barley)	5.0	34	223	10.7	34.1	51.9	112.1
Belford (Barley)	3.5	36	223	10.0	31.2	50.0	120.6
WA 7999-88 (Barley)	4.6	28	223	11.3	34.0	53.0	110.1
Mean	**4.4**	**34.0**	**232**	**10.0**	**35.0**	**52.3**	**110.0**
CV (%)	**13**	**9**	**1**	**10**	**6**	**5**	**8**
LSD (0.05)	**0.6**	**8.0**	**1**	**1.5**	**3.1**	**NS**	**NS**

Table 3. Two-year Summary of Oat Hay Variety Trial 1994-1995.
Two-year summary of forage yield, crude protein, acid detergent fiber (ADF), neutral detergent fiber (NDF), and relative feed value (RFV) of oat varieties grown for hay at Klamath Experiment Station, OR, 1994 and 1995.

Variety or Selection	Yield	Crude protein	ADF	NDF	RFV
	ton/A	%	%	%	
Cayuse	5.7	8.3	37.9	55.2	79.7
Border	5.1	9.0	37.2	54.2	79.9
Ajay	5.1	9.0	36.5	54.3	83.0
Magnum 2000 (Magnum II)	4.9	8.3	40.0	58.6	73.9
83Ab3250	5.2	8.7	37.2	54.8	82.8
Rio Grande (81Ab5792)	5.2	8.3	38.7	55.7	81.7
Monida	5.3	8.8	37.7	55.7	80.3
Magnum	5.9	9.1	37.3	55.1	79.3
Byrd (B-3)	5.0	8.2	39.6	57.8	78.7
Dusky (DU-1)	5.1	8.6	39.5	58.7	77.2
Otana	5.6	8.2	37.8	55.5	78.3
Mean	**5.3**	**8.6**	**38.1**	**56.0**	**79.5**
CV (%)	**17.5**	**14.8**	**7.9**	**6.9**	**8.5**
LSD (0.05)	**0.5**	**1.3**	**3.0**	**3.9**	**6.8**

Cool-Season Grass Agroecozone Trial

R.L. Dovel and J. Rainey[1]

Introduction

Irrigated pastures occupy over 95,000 acres in Klamath County and provide summer grazing for over 100,000 cattle. The currently recommended grass variety for irrigated pastures is Fawn tall fescue, a variety released in 1964. Quackgrass is also an important hay and pasture species in the area. Recently developed cultivars need to be evaluated for adaptation to the Klamath Basin. The acquisition of new germplasm from international forage breeding programs adds further emphasis to the development of a forage variety screening program in the Klamath Basin. Results from a single trial location would be applicable only to that location. By establishing identical trials in different locations and documenting environmental conditions in each location, extrapolation of the data to other areas may be possible. Environmental conditions that should be monitored include soil type and pH, maximum and minimum daily temperature, precipitation, slope and aspect, and irrigation. Such a trial, called an agroecozone trial, was proposed with a complement of perennial forage grasses representing a range of forage species.

Procedures

An agroecozone trial was established on sandy loam soil at the KES in August, 1994. A similar trial was established in Powell Butte at the Central Oregon Agricultural Research Center. Only data from KES will be discussed here. The trial was arranged in a randomized complete block design with four replications. Soil samples were analyzed, and appropriate fertilizer was applied prior to planting. Seed was drilled to a depth of 1/4 inch using a modified Kincaid plot drill. Seeding rates used in the trial are included in Table 1 . Plots were 5 x 20 feet with 3-foot wide alleyways. Plots were irrigated with solid set sprinklers.

Forages were allowed to grow uncut through the first growing season. Three harvests per year were taken when plants began to flower in 1995. Crops were harvested with a flail harvester. All yields are reported on a dry weight basis. Forage quality, as determined by crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), total digestible nutrients (TDN), and relative feed value (RFV), was evaluated from samples obtained at all harvests.

Results

The greatest early season growth was produced by PCR, a perennial cereal rye. This entry produced over 5 tons of dry matter per acre by June 22 (Table 2). The second highest yielding entry in the trial was Matua prairie grass. It produced significantly higher levels of forage than all other entries except for the two tall fescue entries. Other entries with high levels of early spring growth, over 2 tons of dry matter per acre by June 22, included Fawn tall fescue, Festorina tall fescue, Potomac orchardgrass, Gala grazing brome, Bromar mountain brome, and Linn perennial ryegrass. Wana, a grazing tolerant orchardgrass, did not

[1] Associate Professor and Biological Sciences Research Technician III, respectively, Klamath Experiment Station, Klamath Falls, OR.

Cool-Season Grass Agroecozone Trial

produce much early spring growth and only yielded 1,180 lb dry matter/acre by June 22. Palaton reed canarygrass also produced low levels of forage in the first cutting compared to its forage production in the second cutting. PCR had the lowest forage quality, based on all quality parameters measured, of any entry at the first cutting (Table 2). Gala grazing brome also had lower quality than most entries at the first cutting, probably due to advanced maturity. Forage quality of Linn perennial ryegrass was also depressed in the first cutting due to advanced maturity.

Although PCR produced more dry matter than any other entry at the first cutting, regrowth following cutting was poor. PCR only produced 970 and 730 lb dry matter/acre in the second and third cuttings, respectively (Tables 3 and 4). Matua prairie grass produced almost 3 tons of dry matter/acre in the second cutting, significantly higher than all other entries in the trial (Table 3). Other high yielding varieties in the second cutting included Bromar mountain brome, Potomac and Wana orchardgrass, Palaton reed canarygrass, Festorina and Fawn tall fescue, and Gala grazing brome. Second cutting yields of both Wana orchardgrass and Palaton reed canarygrass were significantly higher than their first cutting yields. Matua prairie grass produced significantly higher third cutting forage yields than all other entries. Other entries producing above average third cutting forage yields included Fawn and Festorina tall fescue, Wana and Potomac orchardgrass, Bromar mountain brome, and Gala grazing brome.

Matua produced the highest total season forage production, almost 7.5 tons of dry matter /acre, which was significantly higher than all other entries (Table 5). Despite the excellent hay yields and quality of Matua, growers should be cautious of planting this variety due to winter kill and stand loss due to mismanagement. This variety has experienced severe stand losses in the winter, probably due to fungal attack. It also will not withstand continuous grazing or prolonged flooding. Due to high production and high protein content, nitrogen fertilization requirements are higher for Matua than other grass species. The second highest yielding entry was PCR, which produced forage mostly in the first cutting and had forage quality similar to hay produced by other cereal rye varieties. Other more typical grasses that produced high total forage yields include Bromar mountain brome, Fawn and Festorina tall fescue, and Potomac orchardgrass. Bromar mountain brome is a short lived perennial. It is sod forming and is used extensively in reclamation work. It would make a significant contribution to forage yields for short term pastures, but would eventually be replaced by stronger perennial grasses. Festorina is actually a Festulolium or tall fescue-perennial ryegrass cross. It is a forage-type tall fescue that has smoother, finer leaves than traditional tall fescue varieties. It is said to have higher forage quality than traditional tall fescues like Fawn. There was no difference in forage yield or quality between Fawn and Festorina in this trial. Leaves of Festorina are not as rough as leaves of Fawn and it is reported to be more palatable than Fawn. More study is required to determine if tall fescue-perennial ryegrass crosses are as persistent in the Klamath Basin as tall fescue.

Table 1. Seeding rates for species included in forage agroecozone trials established at Klamath Falls, OR in 1994.

Species	Common name	Seeding Rate		
		lb/A	**Kg/ha**	**g/m**
Bromus willdenowii	prairie grass	35	39.2	392
B. stamineus	grazing brome	25	28.0	280
B. riparius	meadow brome	35	39.2	392
B. marginatus	mountain brome	35	39.2	392
Dactylis glomerata	orchardgrass	20	22.4	224
Festuca arundinacea	tall fescue	25	28.0	280
Lolium perenne	perennial ryegrass	30	33.6	336
Poa pratensis	bluegrass	10	11.2	112
Alopecuras arundinaceus	creeping foxtail	5	5.6	56
Thinopyrum intermedium	intermediate wheatgrass	10	11.2	112
Elymus lanceolatus	thick spike wheatgrass	10	11.2	112
Secale cereale	perennial cereal rye	60	67.8	678
Phalaris arundinacea	reed canarygrass	15	16.8	168
Phleum pratense	timothy	10	11.2	112

Table 2. Agroecozone First Cutting, 1995.
1995 first cutting forage yield, protein concentration, acid detergent fiber (ADF), neutral detergent fiber (NDF), total digestible nutrients (TDN), and relative feed value (RFV) of various cool-season grasses planted at Klamath Experiment Station in August, 1994.

				Quality				
Selection	**Species[1]**	**Yield**	**Yield**	**Protein**	**ADF**	**NDF**	**TDN**	**RFV**
		lb/A	**ton/A**		**%**			
Park	BLG	740	0.37	13.4	32.4	48.4	59.2	123
Madera	PRG	3920	1.96	10.8	30.3	45.7	61.5	133
Garrison	CFT	2050	1.03	12.0	34.0	51.8	57.3	112
Palaton	RCG	1730	0.86	14.4	31.0	50.0	60.7	120
Wana	OG	1180	0.59	14.2	31.2	50.1	60.5	120
Clair	OG	3350	1.67	9.8	33.2	52.7	58.2	112
Cereal	PCR	10410	5.20	9.7	38.1	59.9	52.6	92
Carlton	TIM	3330	1.67	11.7	33.1	52.6	58.3	112
Fawn	TF	5510	2.76	11.6	33.7	51.6	57.7	113
Gala	GB	4480	2.24	10.8	37.1	57.3	53.6	97
Matua	PG	6820	3.41	9.2	34.8	53.8	56.3	107
Festorina	TF	5390	2.70	12.0	34.1	53.0	57.1	110
Potomac	OG	4780	2.39	11.0	32.5	50.3	59.0	118
Linn	PRG	4990	2.50	8.6	35.3	53.8	55.7	106
Critana	TSWG	1760	0.88	11.1	36.0	57.0	54.9	99
Regar	MDB	3710	1.86	11.3	34.6	54.0	56.5	107
Bromar	MTB	4870	2.43	10.0	33.8	52.3	57.5	111
Oahe	IWG	3270	1.64	11.3	33.9	54.8	57.4	106
Mean		**4020**	**2.01**	**11.3**	**33.8**	**52.7**	**57.4**	**111**
CV (%)		**27**	**27.10**	**9**	**3**	**3**	**2**	**4**
LSD (0.05)		**1550**	**0.77**	**1.5**	**1.3**	**2.4**	**1.4**	**6**

[1]**BLG**	bluegrass	**PCR**	perennial cereal rye
CFT	creeping foxtail	**PG**	prairie grass
GB	grazing brome	**PRG**	perennial ryegrass
IWG	intermediate wheatgrass	**RCG**	reed canarygrass
MDB	meadow brome	**TF**	tall fescue
MTB	mountain brome	**TIM**	timothy
OG	orchardgrass	**TSWG**	thick spike wheatgrass

Table 3. Agroecozone Second Cutting, 1995.
1995 second cutting forage yield, protein concentration, acid detergent fiber (ADF), neutral detergent fiber (NDF), total digestible nutrients (TDN), and relative feed value (RFV) of various cool-season grasses planted at Klamath Experiment Station in August, 1994.

				Quality				
Selection	**Species[1]**	**Yield**	**Yield**	**Protein**	**ADF**	**NDF**	**TDN**	**RFV**
		lb/A	**ton/A**		%			
Park	BLG	830	0.42	17.5	32.4	46.1	59.1	129
Madera	PRG	2960	1.48	13.2	35.0	49.1	56.1	117
Garrison	CFT	2210	1.11	16.9	35.6	53.3	55.4	107
Palaton	RCG	3810	1.91	14.8	34.9	53.7	56.2	107
Wana	OG	3760	1.88	13.3	37.7	57.8	53.0	96
Clair	OG	2950	1.48	12.6	34.6	53.3	56.5	108
Cereal	PCR	970	0.49	17.7	29.8	45.1	62.1	135
Carlton	TIM	2450	1.22	16.2	33.5	50.7	57.8	115
Fawn	TF	3690	1.85	13.9	34.1	50.7	57.2	114
Gala	GB	3550	1.78	14.0	39.8	57.7	50.6	93
Matua	PG	5940	2.97	11.1	38.3	57.5	52.3	95
Festorina	TF	3910	1.96	14.5	34.6	51.8	56.5	111
Potomac	OG	4070	2.04	14.0	35.4	54.4	55.6	105
Linn	PRG	2260	1.13	13.2	35.0	51.3	56.1	112
Critana	TSWG	1870	0.93	15.2	34.7	54.6	56.4	105
Regar	MDB	2440	1.22	16.5	35.4	52.8	55.7	108
Bromar	MTB	4840	2.42	13.3	35.5	53.8	55.6	106
Oahe	IWG	1980	0.99	16.8	32.3	51.1	59.2	116
Mean		**3030**	**1.51**	**14.7**	**34.9**	**52.5**	**56.2**	**110**
CV (%)		**26**	**26**	**3**	**1**	**1**	**1**	**2**
LSD (0.05)		**1130**	**0.56**	**0.6**	**0.7**	**1.0**	**0.8**	**3**

[1]BLG	bluegrass	**PCR**	perennial cereal rye
CFT	creeping foxtail	**PG**	prairie grass
GB	grazing brome	**PRG**	perennial ryegrass
IWG	intermediate wheatgrass	**RCG**	reed canarygrass
MDB	meadow brome	**TF**	tall fescue
MTB	mountain brome	**TIM**	timothy
OG	orchardgrass	**TSWG**	thick spike wheatgrass

Table 4. Agroecozone Third Cutting, 1995.
1995 third cutting forage yield, protein concentration, acid detergent fiber (ADF), neutral detergent fiber (NDF), total digestible nutrients (TDN), and relative feed value (RFV) of various cool-season grasses planted at Klamath Experiment Station in August, 1994.

				Quality				
Selection	**Species[1]**	**Yield**	**Yield**	**Protein**	**ADF**	**NDF**	**TDN**	**RFV**
		lb/A	**ton/A**	———	%	———		
Park	BLG	140	0.07	17.2	29.8	40.5	62.1	152
Madera	PRG	350	0.18	15.5	27.5	38.5	64.7	163
Garrison	CFT	220	0.11	18.0	27.6	40.6	64.6	155
Palaton	RCG	410	0.21	17.4	26.7	41.9	65.6	153
Wana	OG	1350	0.68	15.7	31.7	49.6	59.9	121
Clair	OG	300	0.15	14.9	26.7	40.8	65.7	156
Cereal	PCR	730	0.37	15.0	28.2	44.1	63.9	142
Carlton	TIM	210	0.11	19.7	25.4	38.1	67.1	169
Fawn	TF	1480	0.74	14.6	29.3	44.2	62.6	139
Gala	GB	1210	0.61	15.9	34.8	49.7	56.3	116
Matua	PG	2180	1.09	13.8	31.7	46.6	59.9	128
Festorina	TF	1320	0.67	14.4	30.0	44.3	61.8	138
Potomac	OG	1200	0.60	14.5	29.8	44.7	62.1	137
Linn	PRG	450	0.23	15.4	30.1	42.9	61.7	142
Critana	TSWG	390	0.20	15.9	31.0	48.9	60.7	123
Regar	MDB	330	0.17	18.1	28.4	41.4	63.7	150
Bromar	MTB	1280	0.64	15.7	31.1	45.9	60.6	131
Oahe	IWG	840	0.42	16.5	28.1	43.9	64.1	142
Mean		**800**	**0.40**	**16.0**	**29.3**	**43.7**	**62.6**	**142**
CV (%)		**36**	**35**	**8**	**6**	**5**	**3**	**8**
LSD (0.05)		**410**	**0.20**	**1.8**	**2.4**	**3.3**	**2.8**	**15**

[1]BLG	bluegrass	**PCR**	perennial cereal rye
CFT	creeping foxtail	**PG**	prairie grass
GB	grazing brome	**PRG**	perennial ryegrass
IWG	intermediate wheatgrass	**RCG**	reed canarygrass
MDB	meadow brome	**TF**	tall fescue
MTB	mountain brome	**TIM**	timothy
OG	orchardgrass	**TSWG**	thick spike wheatgrass

Table 5. Agroecozone 1995 Yield Summary.
1995 forage yield summary of cool-season grasses planted at Klamath Experiment Station in August, 1994.

Selection	Species[1]	Yield			Total	Total
		Cut 1	Cut 2	Cut 3		
		lb/A			lb/A	ton/A
Park	BLG	740	830	140	1710	0.85
Madera	PRG	3920	2960	350	7220	3.61
Garrison	CFT	2050	1960	230	4250	2.13
Palaton	RCG	1730	3810	410	5940	2.97
Wana	OG	1180	3760	1350	6280	3.14
Clair	OG	3360	2950	300	5760	2.88
Cereal	PCR	10410	970	730	12110	6.05
Carlton	TIM	3330	2450	210	5980	2.99
Fawn	TF	5510	3690	1480	10680	5.34
Gala	GB	4480	3550	1210	9240	4.62
Matua	PG	6820	5940	2180	14940	7.47
Festorina	TF	5390	3910	1320	10630	5.32
Potomac	OG	4780	4070	1200	10050	5.03
Linn	PRG	4990	2260	450	7700	3.85
Critana	TSWG	1760	1870	390	4030	2.01
Regar	MDB	3710	2440	330	6490	3.24
Bromar	MTB	4870	4840	1280	10990	5.50
Oahe	IWG	3270	1980	840	6090	3.05
Mean		**4020**	**3010**	**800**	**7780**	**3.89**
CV (%)		**27**	**27**	**35**	**19**	**19**
LSD (0.05)		**1550**	**1150**	**410**	**2060**	**1.03**

[1]**BLG**	bluegrass	**PCR**	perennial cereal rye
CFT	creeping foxtail	**PG**	prairie grass
GB	grazing brome	**PRG**	perennial ryegrass
IWG	intermediate wheatgrass	**RCG**	reed canarygrass
MDB	meadow brome	**TF**	tall fescue
MTB	mountain brome	**TIM**	timothy
OG	orchardgrass	**TSWG**	thick spike wheatgrass

Bromus Screening Trial

R.L. Dovel and J. Rainey[1]

Introduction

Matua prairie grass (Bromus willdenowii Kunth) has produced outstanding yields in the Klamath Basin in experimental plots and has had exceptional quality; however, it has failed to survive winter conditions common to the area. A trial was established to screen promising lines of B. willdenowii and related Bromus species at the Klamath Experiment Station for winter survival, forage production, and seed yield.

Procedure

Seed of 81 plant introductions (PIs) of B. catharticus, which includes B. willdenowii and closely related species, was obtained from the USDA Western Regional Plant Introduction Station in Pullman, Washington. Grassland Matua and Grassland Gala, the two standard Bromus varieties in the industry, were also included in the trial. The seed were planted in flats on April 3, 1994 and grown out in a greenhouse until individual plants were large enough to transplant into separate containers. Plants were transplanted into the field on May 15. Individual PIs were planted in rows 14 feet long with 1 foot between plants and 2 feet between rows.

Prior to transplanting, fertilizer was applied and incorporated as indicated by soil tests. Approximately 50 lb N/acre was applied at planting. Following establishment, 50 lb N/acre was applied after each cutting and in early spring prior to the initiation of rapid growth (May 15-April 15).

The first cutting following establishment was at soft dough stage. Subsequent cuttings were at early heading. Plots were cut to a 2-inch height using a Carter flail plot harvester. Plots were irrigated by solid set sprinkler irrigation. Measurements of seedling vigor, forage yield, seed production, and stand survival were made by visual scoring. Measurements will be taken for three full production years. Winter survival will be determined for three winter periods.

Results

Germination of the seed was quite variable. Of the 81 PIs planted, only 70 produced enough healthy plants to be included in the trial. Seed quality of Matua and Gala was quite good. Visual evaluations of forage desirability and seed production indicated that a number of PIs had forage and seed production capabilities equivalent to or superior to Matua and Gala (Table 1). Gala and a number of PIs did not flower the first year. However, following vernalization, these lines produced adequate to excellent amounts of seed. PIs in this group include PI 197848, 284111, 316176, 316177, 331172, and 442079. Plant introductions from Peru were small determinate plants that appeared to be annuals. Few of these plants survived into the second year. Both Gala and Matua survived the winter in 1994 and 1995. Other than the Peruvian lines, there was no difference in winter survival between lines. The winters of both 1994 and 1995 were warmer than normal

[1]/ Associate Professor and Biological Sciences Research Technician III, respectively, Klamath Experiment Station, Klamath Falls, OR.

Bromus Screening Trial

and were not good tests of winter hardiness. The trial will be maintained and screened for winter hardiness. A number of lines appear to have forage production superior to Matua and Gala. Lines selected for further study due to good forage production and early spring growth include PI 193144, 197848, 209100, 284111, 316175, 331172, 442077, 442079, 477057, 338633, 442081, 442082, 442080, and 442083.

Table 1. USDA Bromus catharticus collection.
Visual assessments of forage and seed production potential in 1994 and 1995, and forage yield in 1995 of Bromus catharticus lines obtained from the USDA world collection and planted at Klamath Falls, OR.

		8/8/94 Ratings		28/6/95 Ratings		2/7/95 Forage	11/9/95 Forage	Average forage	Average seed
Identification		Forage	Seed	Forage	Seed	yield	rating	rating	rating
						ton/A			
PI	158372	4	4	3	3	2.09	4	3.4	3.5
PI	468556	4	4	3	3	1.28	4	3.1	3.5
PI	168564	4	4	3	3	2.30	4	3.3	3.5
PI	185500	4	4	3	3	1.87	4	3.2	3.5
PI	187000	3	4	3	3	1.38	4	2.8	3.5
PI	189612	4	4	3	3	2.25	5	3.6	3.5
PI	193144	4	4	4	3	3.08	5	3.8	3.5
PI	195476	4	4	3	3	2.08	4	3.5	3.5
PI	197848	5	1	4	5	3.04	4	3.8	3.0
PI	197849	4	3	3	3	2.26	4	3.6	3.0
PI	202360	4	4	3	3	2.14	4	3.3	3.5
PI	202693	4	4	3	3	1.93	4	3.2	3.5
PI	203616	3	4	3	3	0.70	4	2.7	3.5
PI	204157	3	3	3	3	1.57	4	2.9	3.0
PI	209100	4	3	3	3	1.92	3	3.0	3.0
PI	217582	4	3	3	3	0.74	3	2.7	3.0
PI	217583	5	2	3	3	1.92	4	3.5	2.5
PI	219801	3	5	3	3	0.84	4	2.7	4.0
PI	219802	3	5	3	3	0.82	4	2.7	4.0
PI	237793	4	2	3	3	1.71	3	2.9	2.5
PI	250648	3	3	3	3	1.69	3	2.7	3.0
PI	283201	3	3	3	3	1.82	4	3.0	3.0
PI	283202	4	3	3	3	1.59	4	3.1	3.0
PI	283203	3	4	3	3	1.86	3	2.7	3.5
PI	284110	4	4	3	5	1.31	3	2.8	4.5
PI	284111	4	1	3	4	3.20	5	3.8	2.5
PI	284788	5	3	3	3	1.38	4	3.3	3.0
PI	292258	4	3	3	3	1.64	4	3.2	3.0
PI	299500	3	4	2	3	1.44	4	2.9	3.5
PI	303640	4	4	3	3	1.78	5	3.2	3.5
PI	304864	2	3	2	3	1.01	3	2.3	3.0
PI	306289	1	3	2	2	0.44	2	1.4	2.5
PI	308503	2	3	3	3	0.89	3	2.0	3.0
PI	308504	1	2	2	2	0.55	2	1.6	2.0
PI	308506	1	2	2	2	0.46	3	1.6	2.0
PI	308507	1	2	2	2	0.23	1	1.1	2.0
PI	308509	1	2	3	3	0.41	1	1.1	2.5
PI	309955	4	4	3	3	2.09	4	3.3	3.5
PI	309956	3	4	3	3	2.29	4	3.1	3.5

Table 1. USDA Bromus catharticus collection, Klamath Falls, OR. Continued.

Identification		8/8/94 Ratings Forage	8/8/94 Ratings Seed	28/6/95 Ratings Forage	28/6/95 Ratings Seed	2/7/95 Forage yield	11/9/95 Forage rating	Average forage rating	Average seed rating
						ton/A			
PI	309957	4	4	3	3	2.12	3	3.0	3.5
PI	309958	4	3	3	4	2.22	4	3.4	3.5
PI	315677	4	2	3	2	0.96	4	3.0	2.0
PI	316173	4	2	3	3	1.93	4	3.2	2.5
PI	316175	4	4	4	3	2.76	5	3.7	3.5
PI	316176	3	4	2	3	2.35	3	3.1	3.5
PI	316177	4	3	3	3	2.11	3	2.8	3.0
PI	331171	4	3	3	3	1.61	2	2.7	3.0
PI	331172	5	2	4	4	3.15	3	3.5	3.0
PI	337517	4	3	4	5	2.43	3	3.4	4.0
PI	338633	4	3	4	3	2.93	4	3.7	3.0
PI	345967	4	4	3	4	1.44	2	2.9	4.0
PI	364329	2	3	2	3	2.18	3	2.5	3.0
PI	364330	2	3	3	3	0.94	3	2.0	3.0
PI	377533	4	2	3	3	1.00	3	2.8	2.5
PI	409137	2	4	3	3	1.53	3	2.4	3.5
PI	409138	2	3	3	3	1.72	3	2.4	3.0
PI	409139	4	2	4	3	2.15	3	3.0	2.5
PI	436806	2	4	1	2	0.28	1	1.8	3.0
PI	442076	4	3	3	3	1.60	4	2.7	3.0
PI	442077	3	4	3	5	4.51	4	3.6	4.5
PI	442078	4	3	3	3	1.54	5	3.4	3.0
PI	442079	4	1	4	4.5	3.29	4	3.6	2.8
PI	442080	5	3	3	3	2.41	4	3.9	3.0
PI	442081	5	3	4	3	2.87	4	3.7	3.0
PI	442082	5	2	4	3	2.82	4	4.0	2.5
PI	442083	4	3	4	3	2.73	5	3.9	3.0
PI	442467	3	5	3	4	1.98	4	3.2	4.5
PI	477057	4	2	3	3	1.85	4	3.2	2.5
PI	478512	1	2	2	2	0.45	1	1.4	2.0
PI	495807	4	3	4	3	1.25	4	2.8	3.0
	Matua	3	4	3	3	1.89	5	3.5	3.5
	Gala	3	1	3	3	1.79	3	2.7	2.0
	Mean	**3.5**	**3.1**	**3.0**	**3.1**	**1.84**	**3.6**	**3.0**	**3.1**

Sugarbeet Variety Evaluations in the Klamath Basin

K.A. Rykbost[1], H.L. Carlson[2], R.L. Dovel[1], and D. Kirby[2]

Introduction

Three California Beet Growers Association (CBGA) variety trials were conducted in the Intermountain Region in 1995. Trials at the Klamath Experiment Station (KES), Intermountain Research and Extension Center (IREC) lease, and at the Tulelake High School (THS) evaluated 38 entries from six sugarbeet seed companies. Performance in these on-going trials, and in disease response evaluation trials conducted outside the region, provide the basis for CBGA Seed Committee determinations on acceptability of varieties for commercial production in the Intermountain Region. The third trial site at THS was included for the first time in 1995 due to difficult weather conditions that threatened an early planting at IREC.

Procedures KES

The trial site at KES was a Hosley fine sandy loam soil cropped with potatoes in 1994. The field was plowed on May 13, and harrowed on May 14. A broadcast application of 300 lb/acre of 16-20-0 fertilizer was incorporated during bed-forming with tool-bar mounted sweeps on May 15. Seed beds were firmly packed with a Brillion roller. Thirty-eight varieties were planted in a randomized complete block design on May 17. Seed was planted at a depth of 0.5 inches at 8 to 12 seeds/foot in 22-inch rows with a hand operated Planet-Junior type planter. Individual plots were two rows, 20 feet long. Two border rows were planted on both sides of the experiment, and 5-foot borders were used on end plots. Stands were hand-thinned to approximately 9-inch plant spacing on June 23.

Weed control was achieved with applications of Betamix at 0.25 lb active ingredient (ai)/acre on May 30 and June 9, and Betamix at 0.375 lb ai/acre plus Nortron at 0.5 lb ai/acre on June 26. Flea beetle and cutworm infestations were controlled with carbaryl applied at 1.0 lb ai/acre on June 20 and 1.5 lb ai/acre on August 7, respectively. Supplemental nitrogen was applied as solution 32 at 50 lb N/acre and incorporated immediately with irrigation on June 24. The above applications were made with a conventional ground sprayer. Irrigation, applied with solid-set sprinklers arranged on a 48- by 40-foot spacing, totalled 19 inches. Rainfall from planting to harvest measured 3.5 inches.

Beet tops were removed with a flail chopper immediately prior to harvest. Beets were mechanically lifted and hand harvested on October 17. All beets from both rows of each plot were counted and weighed. Approxi-

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[1]/ Superintendent/Professor and Associate Professor, respectively, Klamath Experiment Station, Klamath Falls, OR.

[2]/ Past Superintendent/Farm Advisor and Acting Superintendent/Research Associate, respectively, University of California Intermountain Research and Extension Center, Tulelake, CA.

Acknowledgments: Financial support from American Crystal Sugar Company, Betaseed, Inc., Hilleshog Mono-hy, Inc., Holly Sugar Corporation, Seedex, Inc., and Spreckels Sugar Company, and sample analysis for sugar content by Spreckels is gratefully recognized.

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mately 20 lb samples from one row of each plot were analyzed for percent sucrose by Spreckels Sugar company. Total beet yields were adjusted for tare losses determined in laboratory analyses. Gross crop values were calculated for each plot based on beet yield and price/ton for beets at the observed sugar content, as determined by terms of the Holly Sugar Corporation contract. The price/ton is described by the equation: Price/ton = (3.418 x % sugar) -15.4, for a selling price of $23.00/ cwt. Beet population, yield, sugar content, total sugar production, and gross crop value were analyzed statistically using MSUSTAT software.

Procedures IREC

The trial was established on Tulebasin fine silty loam soil with approximately 12 percent organic matter content, a highly fertile soil with a near neutral reaction. The previous crop was spring barley. Primary tillage was accomplished with a roto-harrow. Fertilization included a broadcast application of 42 lb N/ acre and a sidedress application of 32 lb N/ acre, and 40 lb P_2O_5/acre. Beets were seeded into raised 24-inch wide beds using a modified, three-row cone planter on April 21. Seeding rates were adjusted for seed size to achieve a uniform spacing of 2.5 inches for all varieties. Planting depth was approximately 0.25 inches. Individual plots were three rows, 50 feet long, arranged in a randomized complete block design with four (same at all locations) replications.

Post-emergence applications of Betamix herbicide were made at 0.18 lb ai/acre on May 18, 0.25 lb ai/acre on May 24, 0.17 lb ai/acre on May 29, 0.25 lb ai/acre on June 1 and June 13, and 0.375 lb ai/acre on June 22. Poast herbicide was applied at 0.375 lb ai/acre on May 27 and July 5 to control wild oats. Flea beetles and cutworms were controlled with carbaryl applied at 1.5 lb ai/acre on May 24, 1.0 lb ai/acre on May 29 and June 11, and 1.5 lb ai/acre on July 22 and July 29. Stands were hand thinned to plant spacings of approximately 7 inches on June 19. The trial area was irrigated with solid-set sprinklers. Total irrigation plus rainfall for the season was 26 inches.

Beet tops were removed with a flail chopper immediately prior to harvest. Beets were harvested with a modified one-row harvester on October 16. All beets from 45 feet of the center row were weighed and counted. Samples of approximately 20 lb/plot were analyzed for sucrose content. Gross crop value was calculated as described above.

Procedures THS

Procedures closely followed those described for the IREC site. Beets were planted on May 19, thinned on June 26 , and harvested on October 18. Herbicides included Betamix applied at 0.25 lb ai/acre on June 6 and June 11, and at 0.36 lb ai/acre on June 22 and July 4. Poast herbicide was applied at 0.375 lb ai/ acre on June 3 and July 5. Total irrigation and rainfall for the season was approximately 27 inches. Data collection was as described for the IREC site.

Results and Discussion

Crop establishment was delayed by record breaking precipitation in April. Total rainfall recorded at KES in April was 3.68 inches. Field work at this location was delayed until mid-May by high soil moisture content. The April 21 planting at IREC was two weeks later

Sugarbeet Variety Evaluations in the Klamath Basin

than normal and early growth was slowed by cool weather through mid-May. Cool conditions in early June further delayed crop establishment at all locations. The KES site experienced a hail storm on June 2 that caused some damage to beets still in the cotyledon stage. Excellent final plant populations were only possible at KES due to a high initial plant density. The combination of slow establishment and slow growth during cooler than normal weather in August, resulted in reduced beet size and lower yields at all locations. Yields at KES were 26 percent lower than those obtained in 1994, while IREC yields were 10 percent lower than in 1994. In contrast, average sugar content was nearly the same at both locations as in 1994. Yields, sugar content, total sugar production, gross crop value, and population of harvested beets are presented for all locations (Table 1).

With the exception of 2BG6305 at IREC and THS, plant population was not a factor in yield differences observed between varieties. Statistically significant differences were observed in all parameters at all locations and over location. The three highest varieties in total sugar production were 3BG6360, Chinook, and HM7006 at KES; HM7006, HM Bighorn, and HH-88 at IREC; and Beta 8450, KW6000, and ACH 318 at THS. Averaged over locations, the highest total sugar production and gross crop value was achieved by HM7006, HM Bighorn, and 3BG6360, respectively. HM7006 produced significantly higher sugar yield than 28 other selections. The interaction between variety and location was not statistically significant for beet yield, total sugar production, or gross crop value.

Sugar content differences among varieties were greater than in previous years. The range from high to low was 19.6 to 16.7 at KES, 19.9 to 16.9 at IREC, and 19.4 to 17.7 at THS. The THS site had slightly, but not significantly, higher average sugar content. This may have been related to much higher plant populations and smaller average beet size. The location effect on beet yields between IREC and KES was largely due to the four week difference in planting dates. Low yields at THS were probably influenced by late planting, but also by high plant populations. These relationships are documented in planting date and population studies conducted at IREC in 1995, and IREC and KES in previous years.

Many of the varieties included in the 1995 trials have been evaluated locally for several years. A three-year performance summary for 21 varieties is presented (Table 2). ACH 318 and HM7006 have consistently achieved high sugar yields at both KES and IREC. Several other selections have shown more location dependence. For example, Chinook, Monohikari, and SS-T1 are ranked 2, 3, and 4, respectively at KES, but 13, 16, and 15, respectively at IREC. Conversely, WS-62 and Ranger ranked 3 and 5 in sugar yield at IREC, but 16 and 17, respectively at KES.

Six varieties included in 1995 trials have only been evaluated locally for two years. Their performance is compared to ACH 318 and HM7006 over two years in Table 3. HM Bighorn, HH-88, and H 92488 appear to be equivalent to ACH 318 and HM7006 in yield potential. The performance of these varieties and several that were evaluated for the first time in 1995 indicates a continuing supply of acceptable varieties for the region.

Diseases continued to be unimportant in Klamath Basin sugarbeet crops in 1995. The

Sugarbeet Variety Evaluations in the Klamath Basin

curly top virus has not impaired crop performance in the region to date. All varieties approved for commercial production are evaluated for resistance to this and other diseases in trials conducted at other locations. Minimum levels of curly top virus resistance are required for acceptance of new varieties for commercial use.

Conclusions

Adverse weather conditions resulted in delayed planting, slow crop establishment, and reduced yields in variety trials and commercial crops, compared with outstanding yields achieved in 1994. However, trends in variety performance were similar to results obtained in previous years. With the exception of ACH 318 and HM7006, varieties appear to differ in response to soil and microclimate variations between Tulelake and Klamath Falls. It seems appropriate to consider these differences in decisions of variety acceptance for commercial production in the Intermountain Region.

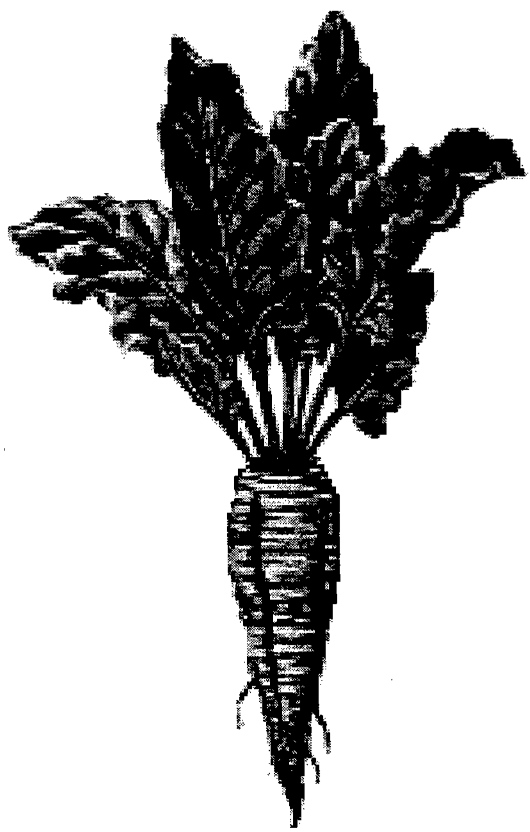

Table 1. Beet yield, percent sugar, total sugar production, gross crop value and plant population for 38 sugarbeet varieties grown at Klamath Falls, OR (KES), Tulelake leases (IREC), and Tulelake High School, CA (THS), 1995.

Variety	Beet yield				Sugar content				Total sugar production				Gross crop value				Population			
	KES	IREC	THS	Mean	KES	IREC	THS	Mean	KES	IREC	THS	Mean	KES	IREC	THS	Mean	KES	IREC	THS	Mean
	ton/A				%				ton/A				$/A				1000 beets/A			
ACH 191	24.5	30.3	21.1	25.3	18.1	19.1	18.7	18.6	4.42	5.77	3.94	4.71	1140	1510	1020	1220	30.8	29.1	39.4	33.1
ACH 203	26.3	29.7	21.2	25.7	18.3	18.3	18.5	18.4	4.79	5.45	3.92	4.72	1240	1400	1010	1220	32.3	31.0	38.8	34.0
ACH 211	25.0	29.4	21.2	25.2	18.2	18.0	18.0	18.1	4.53	5.29	3.83	4.55	1170	1360	980	1170	31.4	29.9	42.4	34.6
ACH 318	27.4	34.0	24.3	28.6	17.2	17.0	18.2	17.5	4.69	5.76	4.47	4.97	1190	1450	1150	1260	30.8	29.8	39.9	33.5
ACH 322	21.8	28.1	19.8	23.2	19.4	18.6	18.7	18.9	4.22	5.24	3.68	4.38	1110	1360	950	1140	31.8	27.8	35.3	31.6
Beta 1996	25.1	28.2	19.2	24.2	18.2	18.2	19.3	18.6	4.53	5.13	3.70	4.45	1180	1320	970	1160	30.5	30.4	41.4	34.1
Beta 4885	24.0	31.1	20.7	25.3	18.5	17.9	18.9	18.4	4.47	5.55	3.90	4.64	1150	1420	1020	1200	32.4	28.3	44.6	35.1
Beta 8422	26.1	29.7	20.7	25.5	18.0	17.7	18.7	18.1	4.70	5.26	3.89	4.62	1200	1340	1010	1180	32.2	30.3	36.3	32.9
Beta 8450	24.4	29.0	21.9	25.1	18.0	18.5	18.6	18.4	4.36	5.35	4.06	4.59	1130	1380	1050	1190	32.3	28.8	41.1	34.1
KW 6000	25.3	30.9	24.3	26.8	18.0	18.6	19.4	18.7	4.54	5.74	4.70	4.99	1170	1490	1230	1300	30.6	29.9	40.3	33.6
1BG 6164	25.0	28.6	24.3	26.0	18.3	18.0	19.0	18.4	4.57	5.15	4.61	4.78	1180	1320	1200	1230	31.2	20.2	27.8	26.4
2BG 6305	24.4	24.0	19.6	22.7	18.4	19.9	19.4	19.2	4.54	4.74	3.78	4.35	1160	1250	990	1130	27.0	11.3	14.4	17.6
3BG 6360	27.7	30.8	22.2	26.9	19.6	18.4	18.2	18.7	5.42	5.65	4.02	5.03	1430	1460	1030	1310	32.4	25.4	30.4	29.4
4CG 6245	26.1	32.1	22.5	26.9	18.3	18.0	18.2	18.2	4.76	5.77	4.10	4.88	1230	1480	1050	1250	29.0	25.9	34.2	29.7
HM 5892	26.3	29.1	21.0	25.5	17.9	17.7	18.3	18.0	4.68	5.17	3.84	4.56	1200	1320	990	1170	33.4	31.1	38.0	34.2
HM 7006	27.0	32.2	23.0	27.4	18.7	18.6	18.7	18.7	5.06	5.99	4.31	5.12	1310	1550	1120	1330	34.2	30.3	40.1	34.9
HM Bighorn	27.2	31.3	22.2	26.9	18.6	19.0	19.1	18.9	5.04	5.93	4.24	5.07	1310	1540	1110	1320	27.9	28.3	31.9	29.4
HM WS-62	26.5	31.6	20.3	26.1	16.7	17.2	17.9	17.3	4.42	5.42	3.65	4.50	1110	1370	930	1140	31.4	31.7	44.6	35.9
HM WS-91	25.0	29.9	22.1	25.7	18.8	17.9	18.0	18.2	4.71	5.34	3.98	4.68	1220	1370	1020	1200	31.1	26.8	42.4	33.4
HH-50	25.7	32.5	22.0	26.7	19.4	17.2	18.0	18.2	5.01	5.58	3.96	4.85	1310	1410	1010	1240	31.4	29.9	43.9	35.1
HH-55	25.6	28.8	20.1	24.8	18.1	17.7	18.3	18.0	4.63	5.10	3.67	4.47	1190	1300	940	1140	33.4	30.8	35.6	33.3
HH-88	26.4	29.6	21.5	25.8	18.6	19.6	19.1	19.1	4.98	5.79	4.12	4.96	1270	1520	1080	1290	32.1	26.6	36.1	31.6
HH-95	26.1	25.8	21.2	24.4	17.7	17.7	18.1	17.8	4.62	4.55	3.83	4.33	1180	1160	980	1110	31.5	28.2	42.5	34.1
Rival	26.6	29.5	21.0	25.7	18.4	18.1	18.1	18.2	4.88	5.36	3.79	4.68	1260	1380	970	1200	32.0	31.8	37.3	33.7
95 HX20	26.3	27.5	21.7	25.2	17.5	18.1	18.2	17.9	4.58	5.00	3.96	4.51	1170	1280	1020	1160	32.6	27.8	35.9	32.1
95 HX306	23.8	26.2	19.5	23.2	17.6	18.2	18.0	17.9	4.19	4.75	3.51	4.15	1070	1220	900	1060	30.9	28.5	39.8	33.1
95 HX311	23.5	28.2	21.4	24.4	18.4	18.3	18.4	18.4	4.31	5.15	3.93	4.46	1120	1330	1010	1150	29.9	25.7	35.7	30.4

Table 1. (continued) Beet yield, percent sugar, total sugar production, gross crop value and plant population for 38 sugarbeet varieties grown at Klamath Falls, OR (KES), Tulelake leases (IREC), and Tulelake High School, CA (THS), 1995.

	Beet yield				Sugar content				Total sugar production				Gross crop value				Population			
Variety	KES	IREC	THS	Mean	KES	IREC	THS	Mean	KES	IREC	THS	Mean	KES	IREC	THS	Mean	KES	IREC	THS	Mean
	ton/A				%				ton/A				$/A				1000 beets/A			
Chinook	28.4	30.1	20.7	26.4	18.4	17.3	18.0	17.9	5.23	5.20	3.72	4.72	1350	1310	950	1200	32.1	30.5	33.9	32.2
Monohikari	27.8	26.2	22.4	25.5	17.9	18.4	18.9	18.4	4.97	4.82	4.23	4.67	1270	1240	1100	1200	32.6	30.1	40.3	34.3
Ranger	28.1	32.1	22.3	27.5	17.3	17.5	18.1	17.6	4.85	5.61	4.02	4.83	1230	1420	1030	1230	32.5	31.4	38.7	34.2
SX-1	26.5	26.0	20.8	24.4	17.5	17.9	18.5	18.0	4.63	4.63	3.84	4.37	1180	1180	990	1120	31.7	28.4	35.1	31.7
SX-1404	26.0	27.6	21.1	24.9	17.7	18.0	18.7	18.1	4.67	4.96	3.93	4.52	1170	1270	1020	1150	32.8	25.4	33.9	30.7
SX-1405	23.1	26.5	21.1	23.6	19.0	17.8	18.3	18.4	4.38	4.72	3.86	4.32	1130	1210	1080	1140	24.6	27.7	36.1	29.5
SS-502	24.9	29.0	20.9	24.9	17.9	17.2	17.7	17.6	4.47	4.96	3.68	4.37	1140	1250	940	1110	30.6	27.8	38.8	32.4
SS-T1	26.1	28.5	21.7	25.4	18.5	18.8	18.5	18.6	4.83	5.37	4.01	4.74	1250	1400	1040	1230	30.8	25.8	36.9	31.2
H 90448	24.4	28.3	20.6	24.4	17.8	17.7	18.5	18.0	4.34	5.03	3.81	4.39	1110	1280	990	1130	31.4	30.4	42.7	34.8
H 91264	22.5	29.0	21.1	24.2	18.4	16.9	18.1	17.8	4.14	4.90	3.81	4.28	1070	1230	980	1090	32.0	25.9	37.9	31.9
H 92488	25.0	30.8	20.6	25.5	18.2	17.9	18.5	18.2	4.54	5.52	3.80	4.62	1170	1410	980	1190	30.3	26.5	39.0	31.9
Mean	25.6	29.3	21.4	25.4	18.2	18.1	18.5	18.3	4.65	5.28	3.95	4.63	1200	1350	1020	1190	31.2	28.0	37.5	32.2
CV (%)	10	7	9	9	5	5	4	5	10	8	10	9	11	9	10	10	6	12	12	10
LSD (0.05)	3.7	2.8	2.6	1.8	1.4	1.4	1.0	0.7	0.68	0.60	0.54	0.35	190	180	150	100	2.5	4.5	6.2	2.7

Table 2. Summary of sugarbeet variety performance for 1993 - 1995 at Klamath Falls, OR (KES) and Tulelake, CA (IREC).

KES: 3 - Year Means

Variety	Beet yield	Sugar content	Sugar yield
	(T/A)	(%)	(T/A)
ACH 318	32.4	17.3	5.62
Chinook	31.2	17.9	5.60
Monohikari	30.5	18.1	5.52
SS-T1	29.9	18.4	5.48
HM 7006	29.8	18.2	5.44
WS-91	30.4	17.9	5.44
HH-50	29.9	18.1	5.42
ACH 203	30.5	17.8	5.41
KW 6000	30.6	17.7	5.40
Beta 1996	29.0	18.5	5.38
SX-1	29.5	17.8	5.27
Beta 4885	28.8	18.2	5.24
HM 5892	29.3	17.8	5.23
Beta 8422	29.0	17.9	5.22
HH-55	29.7	17.6	5.22
WS-62	29.9	17.2	5.15
Ranger	29.5	17.3	5.11
ACH 191	28.3	17.9	5.10
Beta 8450	28.5	17.6	4.99
SS-502	28.5	17.4	4.94
1BG 6164	27.3	18.0	4.92
Mean	29.6	17.8	5.29

IREC: 3 - Year Means

Variety	Beet yield	Sugar content	Sugar yield
	(T/A)	(%)	(T/A)
HM 7006	31.2	18.3	5.70
ACH 318	32.2	17.7	5.67
WS-62	32.8	17.3	5.67
WS-91	31.6	17.7	5.59
Ranger	31.6	17.6	5.58
KW 6000	31.1	17.9	5.56
ACH 203	30.8	18.0	5.55
ACH 191	30.8	18.0	5.54
HH-50	31.9	17.3	5.54
1BG 6164	29.9	18.4	5.50
Beta 8450	30.3	18.0	5.42
Beta 4885	29.9	18.1	5.41
Chinook	30.3	17.6	5.32
Beta 1996	29.0	18.1	5.28
SS-T1	29.1	18.1	5.28
Monohikari	29.0	18.1	5.26
HM 5892	29.7	17.7	5.26
Beta 8422	29.2	17.9	5.23
HH-55	29.5	17.3	5.10
SS-502	29.0	17.3	5.01
SX-1	26.5	17.4	4.59
Mean	30.3	17.8	5.39

Table 3. Summary of sugarbeet variety performance for 1994 - 1995 at Klamath Falls, OR (KES) and Tulelake, CA (IREC).

KES: 2 - Year Means

Variety	Beet yield	Sugar content	Sugar yield
	(T/A)	(%)	(T/A)
ACH 318*	33.7	17.6	5.90
HM 7006*	31.1	18.6	5.77
Bighorn	33.3	18.4	6.12
H 92488	31.6	18.1	5.70
HH-88	29.9	18.6	5.59
ACH 211	29.5	18.5	5.44
HH-95	29.2	17.9	5.24
H 91264	28.1	18.1	5.07
Mean	30.8	18.2	5.61

IREC: 2 - Year Means

Variety	Beet yield	Sugar content	Sugar yield
	(T/A)	(%)	(T/A)
ACH 318*	34.2	17.5	5.96
HM 7006*	32.7	18.3	5.97
HH-88	32.0	19.2	6.12
Bighorn	33.3	18.5	6.12
H 92488	32.4	17.7	5.71
H 91264	32.4	17.4	5.65
ACH 211	29.6	18.2	5.35
HH-95	28.9	17.7	5.10
Mean	31.9	18.0	5.75

* High yielding standards - 1994 and 1995 data.

Sugarbeet Response to Nitrogen Fertilizer Rates

K.A. Rykbost and R.L. Dovel[1]

Introduction

Sugarbeet response to nitrogen fertilizer was evaluated on the mineral soils at KES in 1992 and 1994. In 1992, following three years of barley production, nitrogen rates of 30, 60, 90, 120, and 150 lb N/acre were evaluated. No significant differences were found in beet yield, sugar content, total sugar production, or crop value. Sugar yields ranged from a low of 6.2 tons/acre at 30 lb N/acre to a high of 6.7 tons/acre at 120 lb N/acre. In 1994, nitrogen fertilizer rates of 50, 100, 150, and 200 lb N/acre were evaluated following five years of grass forage production. Maximum yield, sugar content, total sugar production, and crop value occurred at the 50 lb N/acre rate. A significant decline in sugar content was observed as N rate increased from 50 to 200 lb N/acre. Responses in yields and crop value were not statistically significant. In 1995, the study was repeated following a potato crop.

Procedures

The experimental site was a Hosley sandy loam soil with pH at 7.0 and 1.0 percent organic matter content in the surface foot. Field preparation methods are described on page 77. A uniform application of 50 lb N/acre was broadcast and incorporated during bed forming prior to planting. The experimental design was a randomized complete block with five replications. Individual plots were five 22-inch rows, 36 feet long. Seed of the WS-62 variety was planted at 0.5-inch depth with a hand-operated, one-row planter on May 17. Cultural practices for weed and insect control and irrigation were the same as described for the KES variety trial (page 77). Nitrogen fertilizer rates of 50, 100, 150, and 200 lb N/acre were achieved by application of URAN Soln. 32 with a conventional ground sprayer at rates of 0, 50, 100, or 150 lb N/acre to appropriate plots on June 24, followed immediately by 0.5 inches of irrigation. Plants were hand-thinned to approximately 8-inch spacing on June 27.

Petiole samples were taken from the center two rows of all plots on August 2 and September 7. Nitrate nitrogen content was determined on the August 2 samples. Complete analyses were performed on all samples taken on September 7. Beet tops were removed with a flail chopper immediately prior to harvest on October 16. Beets were hand-harvested from 30 feet of the center two rows in each plot, leaving 3-foot borders at each end of plots. All beets were counted and weighed. Samples of 10 beets/plot were analyzed for tare loss and sugar content by Spreckels Sugar Company laboratory personnel. Data were processed as described on page 78.

[1] Superintendent/Professor and Associate Professor, respectively, Klamath Experiment Station, Klamath Falls, OR.

Acknowledgment: Partial funding of this study by the California Beet Growers Association and laboratory analyses of beet sugar content by Spreckels Sugar Company is gratefully recognized.

Sugarbeet Response to Nitrogen Fertilizer Rates

Results and Discussion

Emergence occurred quite uniformly 7 to 10 days after planting. Beets were in the cotyledon stage on June 2 when a hail storm, lasting several minutes, covered the field with 0.25-inch diameter hail stones. All plants were damaged to some extent. Due to a high seeding rate, sufficient plants survived and recovered to produce adequate populations. The crop was set back at least one week by the hail damage. Normal growth and development was experienced through the rest of the season.

Beet tops were smaller and lighter in color in the lower nitrogen rate treatments by August. Petiole nitrate-N levels were significantly lower than all other treatments at 50 lb N/acre at both sampling dates (Table 1). Differences among the three higher N rates were smaller. Beet tops remained quite vigorous until harvest, particularly in the 150 and 200 lb N/acre treatments.

Nitrogen fertilizer rates did not significantly affect yield, sugar content, or crop value (Table 1). As in 1994, there was no benefit to nitrogen fertilizer rates above the 50 lb N/acre minimum. A trend for reduced sugar content in response to higher nitrogen rates has been observed in each year.

Crop nutritional status was monitored from complete analyses of petiole samples collected from each plot on September 7 (Table 2). Nitrogen rate did not affect nutrient content except for potassium, which declined from 2.1 percent at 50 lb N/acre to 1.5 percent at 200 lb N/acre. Lower values for phosphorus and magnesium in 1995 are probably due to later sampling time than in 1992 or 1994. Other nutrient levels were similar to those observed in previous years. Sufficiency range estimates have not been established for local crops. Values reported from an Idaho laboratory are commonly used for comparison with local data. In each year, results of petiole analyses suggest serious deficiencies in several nutrients. However, relatively high yields and sugar contents were obtained in each year, indicating that the sufficiency range data are probably not appropriate for local conditions.

Summary

Delayed planting, crop damage from hail at the cotyledon stage, and an extended period of cool weather in late August and early September contributed to lower yields than were observed in similar trials in 1992 and 1994. In each year, beet yields were not significantly affected by nitrogen rate. In both 1994 and 1995, high yield and economic returns were realized at the lowest nitrogen rate. A trend for reduced sugar content at high nitrogen rates was significant in 1994, but not in 1995.

Petiole analysis appears to be a useful means for monitoring the nitrogen status of local sugarbeet crops. The value of petiole analysis for determining the status of secondary and micro nutrients is questionable, at least when locally derived sufficiency range data is unavailable. Typically, local data suggest serious deficiencies in calcium, magnesium, zinc, and copper when compared with data from other beet production areas.

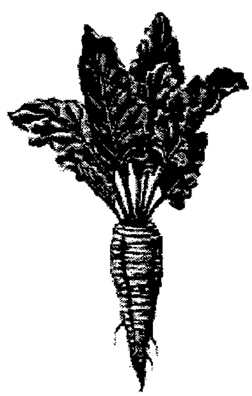

Table 1. Effect of nitrogen fertilizer rate on petiole nitrate-N content, beet yield, sugar content, total sugar production, and gross crop value of WS-62 sugarbeet at Klamath Falls, OR, 1995.

Nitrogen rate	Petiole NO_3-N August 2	Petiole NO_3-N September 7	Plant population	Beet yield	Sugar content	Total sugar production	Gross crop value
lb N/A	ppm	ppm	1000/A	ton/A	%	ton/A	$/A
50	7530	1630	33.3	27.7	17.5	4.85	1230
100	13160	3330	33.2	26.7	17.2	4.66	1160
150	15700	5070	33.9	27.2	17.6	4.77	1210
200	17600	4840	33.7	26.9	16.9	4.53	1140
Mean	13500	3720	33.5	27.1	17.3	4.70	1180
CV (%)	20	30	10	11	3	11	11
LSD (0.05)	3750	1530	NS	NS	NS	NS	NS

Table 2. Sugarbeet petiole nutrient levels observed in mid-July in 1992 and 1994, and in early September in 1995 samples from nitrogen rate experiments at Klamath Falls, OR.

Nutrient	Sufficiency level [1]	KES samples		
		July 1992	July 1994	September, 1995
P - %	0.2	0.16	0.28	0.07
S - %	0.2	0.04	0.13	0.07
K - %	2.5	1.4	3.9	1.8
Ca - %	0.4	0.07	0.27	0.06
Mg - %	0.3	0.17	0.24	0.11
Zm - ppm	17	8	16	6
Cu - ppm	5	3	5	2
Fe - ppm	40	83	400	98
Mn - ppm	27	17	68	30

1/ As reported by Western Laboratories, Inc., Parma, ID.

Weed Control in Sugarbeets

K. Locke[1], R.L. Dovel[2], and K.A. Rykbost[2]

Introduction

Lack of adequate weed control continues to be the most limiting factor for profitable sugarbeet production in the intermountain region. The cost of chemical and mechanical weed control represents 20 percent of variable costs of production. Field trials were conducted to evaluate herbicides for sugarbeet tolerance and weed control.

Procedures

The study site was previously planted to potatoes. Field cultural practices are described on page 77. The variety WS 62 was planted in 22-inch rows on May 17, and hand-thinned to approximately 30,000 plants/acre on June 27. The study consisted of three-row plots, 25 feet long, with seven treatments replicated five times. Chemical treatments were applied with a CO_2 backpack sprayer in 20 gallons per acre (gpa) of solution on May 31, June 9, and June 13. Weed species were identified and counted from a 15-square-foot quadrant of the middle row on August 10. Plots were allowed to go to harvest without further weed control. Beets were hand harvested on October 16. Yields were measured from the center row. An approximate 30 pound sample from each plot was collected and analyzed for tare loss and sugar content.

Results and Discussion

The first treatments were applied when the sugarbeets and weeds were in the cotyledon stage. Redroot pigweed, hairy nightshade, and lambsquarter were the main weed species. Redstem filaree, mallow, and volunteer potatoes were present in minor numbers. Treatments are defined in Table 1. All treatments gave significantly better weed control than the check (Figure 1). Herbicide treatments were not significantly different in weed control from each other. Slight early phytotoxicity symptoms noted in treatment 5, the three-way combination, were not reflected in the yield data (Table 2). Treatment 5 controlled weeds better than the other treatments (Figure 1), but it was not more cost effective than treatment 6 due to a slight reduction in sugar produced (Table 2).

Yields for the control treatment would be less than reported if the crop had been harvested with commercial equipment. Most of the beets in control plots were under 2 inches in diameter. Although they were recovered in hand harvesting, many would have been lost in a mechanized harvest.

The combination treatments with Upbeet, Stinger, and Nortron SC would not justify the extra expense and added work, at least on the weed spectrum in this study. Betamix

[1/] Klamath County Cooperative Extension Agent, Klamath Falls, OR.

[2/] Associate Professor and Superintendent/Professor, respectively, Klamath Experiment Station, Klamath Falls, OR.

Acknowledgments: Financial support for the study, provided by the California Beet Growers Association and E.I. du Pont de Nemours and Co., Inc., and sample analyses provided by Spreckels Sugar Company, are gratefully recognized.

Weed Control in Sugarbeets

Progress alone continues to be the most cost effective treatment in this study. The gross value column in Table 2 was calculated using an average value of $44.92/ton.

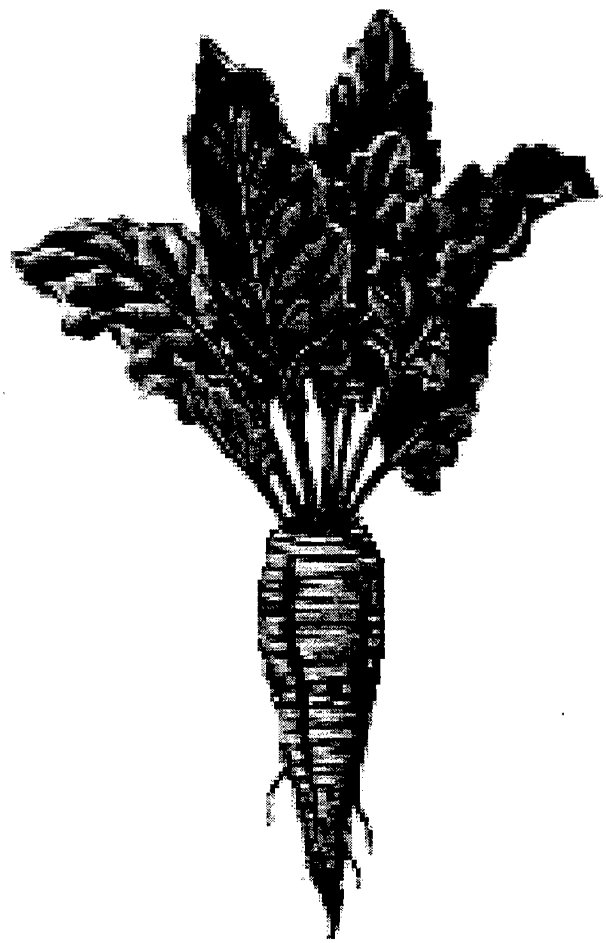

Table 1. Herbicide treatments evaluated for sugarbeets at Klamath Falls, OR, 1995.

Treatment number	Product and rate	Application date(s)
1	Untreated Control	---
2	Betamix @ 0.25 lb ai/A	5/31
	Betamix @ 0.33 lb ai/A	6/9 & 6/13
3	Betamix @ 0.25 lb ai/A + Upbeet @ 0.5 oz/A	5/31 & 6/9
	Betamix @ 0.33 lb ai/A + Upbeet @ 0.5 oz/A	6/13
4	Upbeet @ 0.5 oz/A + Stinger @ 3 fl. oz/A + Surfactant @ 1/4 % v/v	5/31 & 6/9
5	Upbeet @ 0.5 oz/A + Stinger @ 3 fl. oz/A + Nortron SC @ 8 fl. oz/A + Surfactant @ 1/4 % v/v	5/31 & 6/9
6	Betamix Progress @ 0.25 lb ai/A	5/31
	Betamix Progress @ 0.33 lb ai/A	6/9 & 6/13
7	Betamix Progress @ 0.25 lb ai/A + Upbeet @ 0.5 oz/A	5/31
	Betamix Progress @ 0.33 lb ai/A + Upbeet @ 0.5 oz/A	6/9 & 6/13

Figure 1. Effect of herbicide treatments on density of lambsquarter (LQ), hairy nightshade (NS), redroot pigweed (RP), and the three-species total in sugarbeets grown at Klamath Falls, OR, 1995.

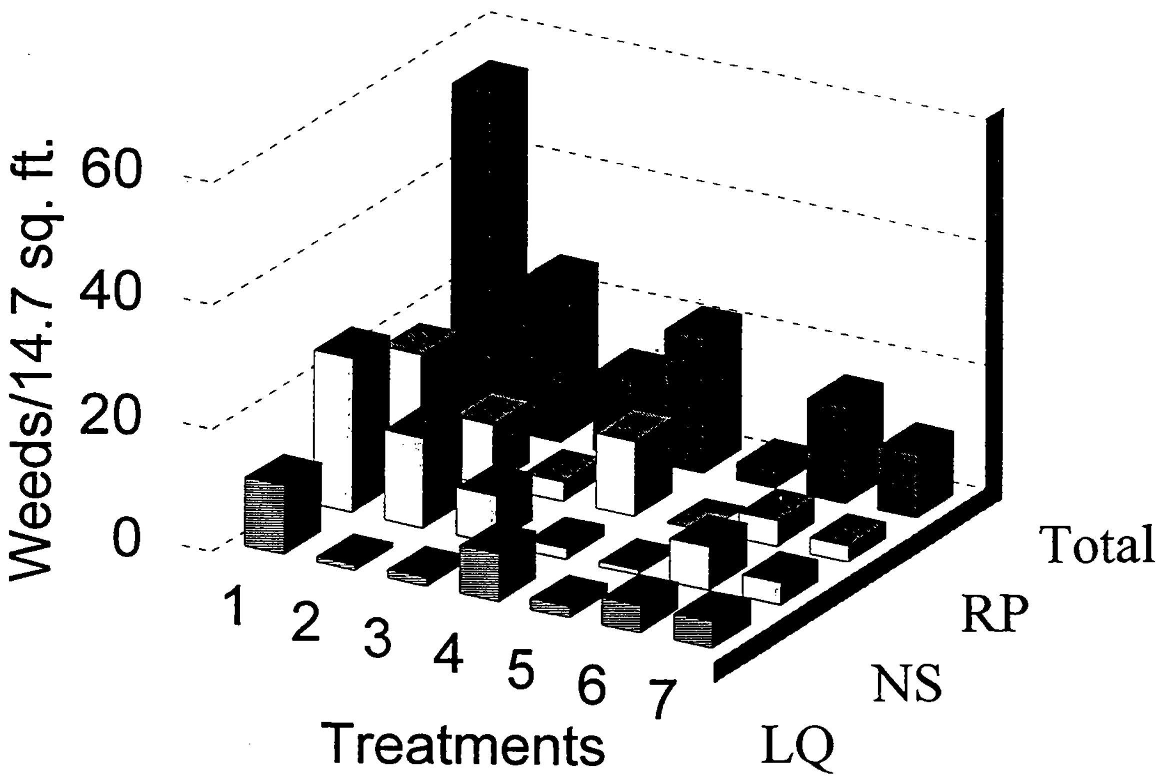

Table 2. Effect of seven herbicide treatments on beet yield, sugar content, sugar production, and gross value of sugarbeets grown at Klamath Falls, OR, 1995.

Treatment/rate	Beet yield	Sugar content	Sugar production	Gross value
	ton/A	%	ton/A	$/A
1. Control	7.7	17.5	1.35	324
2. Betamix	20.2	17.5	3.52	851
3. Betamix + Upbeet	20.2	17.3	3.49	842
4. Upbeet + Stinger	21.4	17.6	3.72	906
5. Upbeet + Stinger + Nortron	21.1	17.7	3.75	898
6. Betamix Progress	22.1	17.5	3.85	931
7. Betamix Progress + Upbeet	21.4	17.5	3.74	902
Mean	19.2	17.5	3.30	808
CV(%)	6	2	5	5
LSD (0.05)	3.2	1.2	0.51	125

Potato Variety Screening Trials

K.A. Rykbost and J. Maxwell[1]

Introduction

The Oregon Agricultural Experiment Station cooperates on a formal basis with other western states to identify and develop new high-yielding, agronomically efficient potato varieties with resistance to important diseases and pests, and with unique or improved quality for fresh market, frozen processing, or chipping uses. The Klamath Experiment Station plays an integral role in the Oregon component of the overall efforts toward this end. The KES conducts replicated trials at the preliminary, statewide, and western regional levels; evaluates culinary quality for fresh preparation methods on all selections at the statewide or regional levels; in alternate years, evaluates advanced selections for resistance to root-knot nematodes and corky ringspot, vectored by stubby-root nematodes; and conducts trials to refine agronomic practices for advanced selections. This report summarizes performance of selections in the preliminary, statewide, and regional trials.

The Oregon program cooperatively released its first potato variety, Century Russet, in 1995. Two Oregon selections with promise as dual purpose varieties with excellent processing characteristics are being prepared for release in the next year. Several additional selections in advanced stages of evaluation show promise for the future. At the annual meeting of the Western Regional Variety Development Committee, it was noted that all selections in the 1995 western regional trials demonstrated superior performance to the standard variety, Russet Burbank.

Procedures

Variety screening trials were conducted on Poe fine sandy loam soil in a two-year, cereal/potato rotation. Above normal rainfall delayed spring field work by several weeks. Telone II fumigant was applied at 18 gallons per acre (gpa) on May 15 to control minor infestations of root-knot and stubby-root nematodes. The field was plowed on May 30. Agricultural gypsum was applied at 1 ton/acre and incorporated to a depth of 6 inches with a disc and harrow on June 6.

Seed for all variety trials was hand-cut to 1.5 to 2.0 ounce seedpieces on May 23. It was suberized at approximately 95 percent relative humidity and held at about 55 °F until planting on June 12. Potatoes were planted with a two-row, assisted-feed planter in 32-inch rows at 8.7-inch seed spacing. Di-Syston was applied at 3.0 lb active ingredient (ai)/acre in the seed furrow. Fertilizer included 730 lb/

[1] Superintendent/Professor and Biological Sciences Research Technician III, respectively, Klamath Experiment Station, Klamath Falls, OR.

Acknowledgments: Appreciation is expressed for funding support from the Oregon Potato Commission, the Cooperative State Research Education and Extension Service (CSREES), and the USDA Agricultural Research Service (ARS).

Potato Variety Screening Trials

acre of 16-8-8-14S banded at planting, and 30 lb N/acre applied as URAN soln. 32 and incorporated with a rolling cultivator on June 21.

The preliminary yield trial included five standard varieties and 70 numbered selections in single-row, 20-hill plots with two replications. Five standard varieties and 28 numbered selections were evaluated in single-row, 30-hill plots with four replications in the statewide trial. The western regional trial included three standard varieties and 18 numbered selections in single-row, 30-hill plots with four replications.

Weed control measures included Eptam applied at 3.0 lb ai/acre with a conventional ground sprayer on June 21, and metribuzin applied aerially at 0.5 lb ai/acre on July 15. Fungicides, applied aerially, included Ridomil-Bravo at 2.0 lb ai/acre on July 20, Bravo at 2.0 lb ai/acre on August 4, and Kocide at 2.0 lb ai/acre on August 16 and September 16. The insecticide Monitor was included at 0.75 lb ai/acre with fungicides on July 20 and August 16. Irrigation was applied twice weekly with solid-set sprinklers on a 40-foot by 48-foot spacing. The total irrigation water application for the season was approximately 15 inches.

Vines were desiccated with Diquat applied at 1.0 pint/acre with a ground sprayer on September 21. Potatoes were harvested with a one-row, digger-bagger on October 3 (preliminary), October 4 (western regional), and October 5 (statewide). All tubers from each plot were stored at about 55 °F and 90 percent relative humidity until samples were graded between October 30 and November 1.

Plant emergence data were recorded on July 5, 10, and 17. Vine vigor ratings were made on July 31 and vine maturity was rated on September 21. External tuber characteristics were noted for each replication during grading. Ten large tubers (usually over 10 ounces) from each plot were cut longitudinally and inspected for internal defects. Specific gravity was determined by the weight-in-air, weight-in-water method on a 10-pound sample of U.S. No.1s in the 6- to 12-ounce size fraction. USDA grade standards were used to separate B size (under 4 ounces), U.S. No.1s (4 to 12 ounces and over 12 ounces), U.S. No.2s, and culls. Yields of No.1s were not adjusted for external blemishes such as rhizoctonia or scab, or internal disorders such as hollow heart or brown center. Samples of 6- to 10-ounce No.1s were saved from one replication of each selection in all trials for culinary quality evaluations.

French fry tests were conducted to determine fry color for all selections in each trial. Samples from the statewide and regional trials were also evaluated for boiling, oven baking, and microwave baking preparation methods. The tests were conducted to identify serious deficiencies such as off flavors, after-cooking darkening, sloughing, or poor texture. All tests were completed between late November and mid-December.

Since the preliminary yield trial was limited to two replications, yield data was not analyzed statistically. All yield, grade, and specific gravity data from the statewide and regional trials were subjected to statistical analyses using MSUSTAT software. Only a portion of the data collected in these experiments is presented in this report. Additional information is considered in determining the disposition of selections at all levels of the variety evaluation program.

Potato Variety Screening Trials

Results and Discussion

High soil moisture content at time of planting, and an inch of rain two days after planting resulted in some seed decay, delayed emergence, and significant injury to stems and roots by rhizoctonia in some selections. Due to late planting and cool weather in late summer, crops experienced an unfavorable growing season. Vines were quite immature at the time of vine desiccation. Late maturing selections in each of the trials experienced moderate to severe skinning injury at harvest. Frost injury was also experienced in several selections in the statewide and regional trials, which were harvested after a 21 °F frost on October 4. In general, crop yields and quality were relatively good in selections with early maturity, while late maturing selections were clearly at a disadvantage. Weather conditions were also an important factor at the other Oregon sites for these trials. Powell Butte had very similar conditions, including late planting. Ontario had delayed planting and a cool season. A hail storm in July destroyed the preliminary and statewide trials at Hermiston.

Preliminary Yield Trial:

After reviewing all data from trials at Klamath Falls, Ontario, and Powell Butte, 10 numbered selections from the preliminary yield trial were advanced to the statewide trial for 1996. Information obtained at Klamath Falls on plant characteristics, yield, and grade is presented for the standard varieties and selections retained for further evaluation (Tables 1 and 2). The late maturing Russet Burbank and Lemhi standard varieties produced relatively low U.S. No.1 yields. The only selection retained for further evaluation that was lower than Russet Burbank in No.1 yield at KES was AO88162-2. The early maturing Russet Norkotah and Shepody standards produced higher No.1 yields than all but three of the numbered selections at KES.

There appeared to be more variability between locations for a given selection in 1995 than is commonly experienced. For example, the ranking of total U.S. No.1 yields at the three locations were 52, 12, and 22 for Shepody; 34, 8, and 52 for Russet Norkotah; and 29, 3, and 35 for AO88103-3 at Powell Butte, Klamath Falls, and Ontario, respectively. Notable exceptions were Atlantic, which ranked 7, 7, and 1, and AO91522-4 at 1, 5, and 7. The inconsistency in yield performance was a major factor in the relatively low number of selections advancing to the statewide trial. Three of the selections retained are round white chipping lines (AO91812-1, AO91812-2, and AO91821-3). All others are russet types.

Statewide Trial:

Crop development was subject to the same limitations of late planting, high soil moisture after planting, and a short season. While crop canopy development appeared similar in both trials, which were adjacent in the same field, yields of standard varieties and numbered selections were much lower in the statewide trial (Tables 3 and 4). Only three selections achieved 400 cwt/acre of No.1s. Shepody and Russet Norkotah were over 200 cwt/acre lower in No.1 yield than in the preliminary trial. The highest yields at KES were achieved by AO85165-1, COO90071-1, and COO83008-1. These selections ranked 9, 2, and 3, respectively, in No.1 yields across locations. At KES, Russet Burbank had a lower No.1 yield than 23 out of 28 numbered

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selections.

Three selections (AO87119-3, AO87277-6, and AO89128-4) were advanced to the tri-state trial for 1996. Six other selections were retained for further evaluation in the statewide trial. NDO2904-7 has been discarded due to high levels of glycoalkaloids. COO83008-1 and AO82611-7 will be released in the near future. AO85165-1 will be evaluated in the regional trial for the third year in 1996.

Western Regional Trial:

The KES was one of 14 sites for 1995 western regional trials. This is the final stage of formal evaluation of potato selections from all western states. Crop performance in the KES trial was similar to results observed in the statewide trial (Tables 5 and 6). The yield of Russet Burbank was lower than has been observed in any variety trial at KES since at least 1987. Total No.1 yield for Russet Burbank was significantly lower than all entries except A84420-5W. Several selections produced over 200 percent of Russet Burbank's No.1 yield. The Oregon selection, AO85165-1, achieved the highest No.1 yield at KES and three other regional locations.

Selections remain in the regional trial up to three years. Those that are not discarded are usually evaluated commercially for two or more years before release. Six of the 1995 entries completed three years of testing, including, A81386-1, A84180-8, A8495-1, AC83064-1, AC83064-6, and A83115-12. The most promising of these are A8495-1, and AC83064-6. Both are considered dual purpose russets suitable for processing and fresh market use. A8495-1 has produced outstanding appearance with acceptable yields at KES. AC83064-6 has not been as good as A8495-1 in appearance or yields at KES, but is considered an excellent prospect for organic soils in the Tulelake area.

Five selections dropped from the regional trial included AC84487-1, CO84074-2, A84420-5, AO80432-1, and W1099 Ru. The seven selections not dropped or graduated will remain in the regional trial in 1996.

Summary

In two out of the past three years, adverse growing seasons have been experienced in the western states, particularly in high elevation, short season areas. Russet Burbank crops have suffered from reduced yields, reduced size, and reduced economic returns due to late planting, frost damage, and slow growth during cool weather. One result is greater interest in alternatives to Russet Burbank for both processing and fresh market use. In 1995, Russet Burbank declined to less than 50 percent of the acreage in the Klamath Basin. Increased production of chipping varieties has been responsible for some reduction in Russet Burbank acreage, but the major shift has been to Russet Norkotah for the fresh market. Areas devoted primarily to processing crops have experienced large substitution of Shepody for early season processing, and replacement of Russet Burbank with Shepody in the Treasure Valley, where sugar ends are a serious problem in Russet Burbank.

While the erosion of Russet Burbank dominance in the northwest is well underway, there is much room for further progress in variety development. Replacement varieties such as Shepody, Norkotah, Ranger, and Frontier have different, but important limitations. The Oregon variety development program currently has two dual purpose

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russets with good prospects for successful introduction. COO83008-1 and AO82611-7 are primarily French fry processing selections. The selection AO85165-1 continues to demonstrate good potential as a fresh market russet with high yields and excellent appearance. Several selections from Idaho and Colorado programs continue to warrant interest and enthusiasm. Most of the material in the 1995 Oregon statewide and preliminary trials was superior to Russet Burbank in yield potential. Northwest variety development programs have many promising selections to offer the industry in the near future.

Table 1. Characteristics of entries selected from the Preliminary Yield Trial for further evaluation, Klamath Falls, OR. 1995.

Variety / selection	Percent stand	Vigor rating[1]	Vine maturity[2]	Specific gravity	Percent H.H. & B.C.[3]
Russet Burbank	93	4.0	3.5	1.084	0
Lemhi	98	3.0	3.0	1.088	10
Shepody	95	3.5	2.0	1.080	0
Norkotah	98	4.5	2.5	1.071	30
Atlantic	98	4.0	3.0	1.098	25
AO88102-6	100	4.0	3.0	1.093	0
AO88103-3	100	4.5	3.5	1.085	20
AO88162-2	95	4.0	2.5	1.085	0
AO88166-9	95	3.5	4.0	1.087	0
AO88198-7	98	4.5	4.0	1.077	0
AO91004-6	100	5.0	4.0	1.095	5
AO91522-4	100	4.0	3.5	1.078	0
AO91812-1	93	4.5	4.0	1.089	0
AO91812-2	95	4.5	3.5	1.083	10
AO91821-3	100	4.5	3.5	1.089	5

1/ Vigor rating: (1 - small, weak; 5 - large, robust)

2/ Vine maturity: (1 - early; 5 - late)

3/ H.H. & B.C. = (Hollow heart plus brown center - % in 10 large tubers/sample)

Table 2. Tuber yield by grade for entries selected from the Preliminary Yield Trial for further evaluation, Klamath Falls, OR. 1995.

Variety / selection	Yield U.S. No. 1s			Yield			
	4 -12 oz	> 12 oz	Total	Bs	No. 2s	Culls	Total
	cwt/A						
Russet Burbank	339	28	367	127	0	10	504
Lemhi	265	144	409	58	8	11	485
Shepody	230	267	497	19	49	15	580
Norkotah	432	84	516	49	6	15	586
Atlantic	358	161	519	38	8	11	575
AO88102-6	467	30	497	116	14	28	654
AO88103-3	518	81	599	75	6	15	695
AO88162-2	315	19	334	95	7	21	457
AO88166-9	287	162	449	24	5	8	485
AO88198-7	356	75	431	55	0	5	490
AO91004-6	409	23	432	85	30	21	568
AO91522-4	318	256	574	36	0	29	639
AO91812-1	417	72	489	57	0	10	556
AO91812-2	500	74	574	103	0	7	684
AO91821-3	383	20	403	140	0	2	545
Mean[1]	373	100	473	72	9	14	568

[1/] Means for standard varieties and clones selected only.

Table 3. Characteristics of entries in the Oregon Statewide Trial, Klamath Falls, OR. 1995.

Variety / selection	Percent stand	Vigor rating[1]	Vine maturity[2]	Specific gravity	Percent H.H. & B.C.[3]
Russet Burbank	98	4.5	2.8	1.083	5
Lemhi	91	3.3	3.5	1.082	20
Shepody	94	2.8	3.3	1.080	0
Norkotah	98	3.5	2.0	1.073	25
Atlantic	89	4.0	3.3	1.096	38
AO82611-7	97	3.8	3.0	1.084	0
COO83008-1	88	4.0	4.3	1.088	10
NDO2904-7	93	4.0	3.0	1.076	0
AO85165-1	93	2.8	3.5	1.079	10
AO87018-23*	99	3.8	1.8	1.084	33
AO87119-3*	93	4.3	3.3	1.067	0
AO87277-6*	95	3.8	2.8	1.088	3
AO89128-4*	93	4.5	3.5	1.093	0
AO89142-2	75	2.0	4.3	1.077	3
COO90071-1*	94	4.3	3.0	1.084	0
AO85058-10	98	2.5	4.0	1.082	18
AO89396-3	97	3.5	4.0	1.079	3
AO90007-1	79	2.3	3.8	1.081	0
AO90007-11	92	3.8	3.5	1.078	18
AO90014-1*	94	3.5	3.3	1.086	0
AO90017-4*	89	3.5	3.8	1.084	10
AO90021-9	90	4.8	3.3	1.085	0
AO90033-6	83	3.0	4.0	1.073	0
AO90033-7	84	2.8	3.0	1.076	0
AO90036-5	95	4.3	2.8	1.092	8
AO90045-13*	83	3.0	3.8	1.081	13
AO90072-3	90	3.8	3.5	1.087	0
AO90087-3	97	3.3	3.3	1.074	8
AO90088-1	96	4.5	2.8	1.085	0
AO90089-5	99	4.0	3.0	1.094	0
AO90310-2	90	2.3	3.8	1.083	0
AO90319-1*	95	3.5	3.0	1.082	5
AO90321-1	98	2.3	2.5	1.079	5
Mean	92	3.5	3.3	1.082	7
LSD (0.05)				0.005	

* retained for further evaluations

1/ Vigor rating: (1 - small, weak; 5 - large, robust)

2/ Vine maturity: (1 - early; 5 - late)

3/ H.H. & B.C. = (Hollow heart plus brown center in 10 large tubers/sample)

Table 4. Tuber yield by grade for entries in the Oregon Statewide Yield Trial, Klamath Falls, OR. 1995.

Variety / selection	Yield U.S. No. 1s 4 - 12 oz	Yield U.S. No. 1s > 12 oz	Yield U.S. No. 1s Total	Yield Bs	Yield No. 2s	Yield Culls	Yield Total
	cwt/A						
Russet Burbank	275	13	289	78	4	8	378
Lemhi	196	40	235	27	11	12	285
Shepody	241	39	279	25	0	13	318
Norkotah	246	63	309	41	6	19	375
Atlantic	277	110	386	30	2	11	429
AO82611-7	266	62	328	45	16	13	403
COO83008-1	320	103	423	26	6	11	465
NDO2904-7	289	78	367	32	5	4	409
AO85165-1	299	138	437	25	18	6	487
AO87018-23*	289	50	339	42	3	11	394
AO87119-3*	313	66	379	52	9	6	446
AO87277-6*	263	70	332	44	5	4	385
AO89128-4*	359	23	382	47	4	7	440
AO89142-2	182	170	352	14	17	9	393
COO90071-1*	359	68	428	43	15	12	497
AO85058-10	182	20	202	23	4	2	230
AO89396-3	306	52	358	34	5	4	401
AO90007-1	234	66	300	26	0	9	335
AO90007-11	295	87	382	26	12	15	436
AO90014-1*	327	17	344	31	0	6	382
AO90017-4*	329	14	344	45	8	7	403
AO90021-9	341	16	357	75	1	3	436
AO90033-6	235	65	301	20	6	36	362
AO90033-7	233	116	350	25	7	6	387
AO90036-5	278	44	322	40	8	6	376
AO90045-13*	177	221	398	18	40	8	464
AO90072-3	286	71	357	32	3	5	397
AO90087-3	250	106	356	14	27	14	411
AO90088-1	312	41	353	71	11	14	450
AO90089-5	196	0	196	90	0	4	289
AO90310-2	203	24	227	46	3	4	280
AO90319-1*	220	8	228	48	2	3	282
AO90321-1	108	21	129	41	1	1	171
Mean	263	63	326	39	8	9	382
CV (%)	22	57	21	45	112	96	18
LSD (0.05)	80	51	94	25	13	12	94

* Retained for further evaluations

Table 5. Characteristics of entries in the Western Regional Trial, Klamath Falls, OR. 1995.

Variety / selection	Percent stand	Vigor rating[1]	Vine maturity[2]	Specific gravity	Percent H.H. & B.C.[3]	Culinary quality[4]
Russet Burbank	98	4.5	3.3	1.084	0	68
Ranger Russet	99	4.5	2.8	1.085	8	67
Russet Norkotah	97	3.8	1.8	1.073	30	67
A81386-1	93	4.3	3.0	1.076	8	68
A83115-12	99	4.3	4.5	1.075	3	62
A8495-1	98	2.8	4.3	1.082	0	56
A84118-3	92	2.8	4.5	1.083	5	61
A84180-8	97	3.5	2.8	1.074	10	61
AC83064-1	86	2.5	3.8	1.072	0	71
AC83064-6	88	3.0	3.0	1.075	15	66
AC84487-1	95	3.3	2.8	1.074	3	57
AO80432-1	87	3.3	3.5	1.089	3	50
AO85165-1	93	3.0	4.0	1.081	10	64
ATX84706-2	89	3.3	3.8	1.077	5	57
CO84074-2	83	2.3	3.5	1.069	0	64
TX1229-2	88	3.0	3.0	1.079	8	53
A82360-7Ru	96	3.8	5.0	1.093	0	51
A84420-5W	97	4.8	3.3	1.106	0	47
CO85026-4Ru	85	4.0	4.3	1.085	0	51
TXA86057-27Ru	85	4.0	3.0	1.082	0	62
W1099 Ru	94	4.0	2.3	1.077	0	69
Mean	92	3.6	3.6	1.081	5	60
LSD (0.05)				0.005		

1/ Vigor rating: (1 - small, weak; 5 - large, robust)

2/ Vine maturity: (1 - early; 5 - late)

3/ H.H. & B.C. (Hollow heart plus brown center in 10 large tubers/samples)

4/ Culinary quality: (total score for boiling, oven baking, microwave baking methods - higher score = better quality)

Table 6. Tuber yield by grade for entries in the Western Regional Trial, Klamath Falls, OR. 1995.

Variety / selection	Yield U.S. No. 1s			Yield			
	4 - 12 oz	>12 oz	Total	Bs	No. 2s	Culls	Total
	cwt/A						
Russet Burbank	180	10	190	111	3	10	314
Ranger Russet	278	107	385	37	23	24	470
Russet Norkotah	241	74	316	32	14	11	373
A81386-1	257	79	336	81	5	25	447
A83115-12	257	37	294	48	5	36	383
A8495-1	272	96	368	35	2	16	420
A84118-3	256	27	283	52	2	15	353
A84180-8	302	77	379	44	11	42	476
AC83064-1	198	55	254	17	10	15	296
AC83064-6	202	95	297	13	1	16	328
AC84487-1	295	43	338	35	4	22	399
AO80432-1	281	32	313	36	1	9	359
AO85165-1	259	164	423	22	7	19	470
ATX84706-2	190	219	410	8	6	54	477
CO84074-2	232	82	314	20	14	11	359
TX1229-2	157	204	361	11	21	36	429
A82360-7Ru	327	37	363	41	1	8	413
A84420-5W	244	15	260	125	1	8	393
CO85026-4Ru	334	78	413	29	2	13	457
TXA86057-27Ru	281	86	367	59	3	13	441
W1099 Ru	295	31	325	44	0	8	378
Mean	254	79	333	43	6	19	402
CV (%)	21	35	19	42	122	60	16
LSD (0.05)	75	39	91	25	11	17	93

Red-skinned Potato Variety Development, 1995

K.A. Rykbost[1], R. Voss[2], A. Mosley[3], J. Maxwell[1], and B. Charlton[3]

Introduction

A red-skinned potato variety screening program was initiated at KES in 1988.

Breeding lines from North Dakota State University, USDA-ARS Aberdeen, Idaho, and Colorado State University potato breeding programs are acquired for first-year, single-hill screening. Progeny saved from single-hills are grown at KES in 12-hill plots in the second year, and 50-hill plots in the third year. Eye-indexed, disease-free tubers from second-year production are provided to the Central Oregon Agricultural Research Center (COARC) for future seed increases. Third-year selections are also screened in observational trials at two California sites if seed supplies are adequate. Advanced replicated trials, beginning in year four, include sites in the Willamette Valley. A regional red-skinned evaluation trial established in 1994 was conducted at eight sites in six states and included four red-skinned selections from the Oregon program in 1995. This report will summarize all levels of the KES red-skinned variety development program.

I. Single-hill Seedling Screening Procedures

Material for evaluation in first-generation, single-hills included 3,140 clones from 36 crosses from the North Dakota State University breeding program, 3,040 lines from 9 crosses from Colorado State University, and 1,800 tuberlings from 9 crosses made at the USDA-ARS program. Space limitations required the number of clones to be reduced to about 5,000. Preplanting selections were made based on skin color, shape, size, and general condition of the greenhouse produced minitubers.

The site for all KES red-skinned variety trials was in alfalfa production from 1986 until 1994. Alfalfa was desiccated with glyphosate herbicide in mid-summer 1994. Crowns were shredded by discing three times in late summer and fall. The field was treated with Telone II at 25 gpa on May 18, 1995 to control nematode infestations. Gypsum was applied at 1.0 ton/acre and incorporated during plowing on June 9.

All single-hill selections were planted at 36-inch spacing in 32-inch rows with a two-row, assisted-feed planter on June 13. Fertilizer was banded at planting at 730 lb/acre of 16-8-8-14S. Di-Syston was applied in the seed furrow at 3.0 lb ai/acre for early season insect control. Excellent weed control was achieved with Eptam applied at 3.0 lb ai/acre on June 21 and Matrix (E9636) applied at 1.5

1/ Superintendent/Professor and Biological Sciences Research Technician III, respectively, Klamath Experiment Station, Klamath Falls, OR.

2/ Extension Specialist, Vegetable Crops Department, University of California, Davis, CA.

3/ Extension Specialist and Research Assistant, respectively, Department of Crop and Soil Science, Oregon State University, Corvallis, OR.

Acknowledgment: Appreciation is expressed to potato breeding programs at Aberdeen, Idaho, North Dakota State University, and Colorado State University for providing breeding lines for evaluation. Partial funding from the CSREES, USDA-ARS, and the Oregon Potato Commission is gratefully recognized.

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ounce/acre on August 2. Fungicide and foliar insecticide treatments were applied as described on page 95. Vines were desiccated with Diquat applied at 1.0 pint/acre on September 14. Tuber families were dug with a two-row, flat-bed digger and displayed for selection on October 6.

Results and Discussion

Low plant populations and the inability to use metribuzin due to red-skinned selections' sensitivity to injury, has resulted in difficulty in controlling weeds in single-hill production in the past. Matrix appears to be an excellent solution to this problem. No injury was observed in potato plants that ranged from recently emerged to row closure size at the time of application. The product provided excellent control of most weed species present. The main exception was lambsquarter, which was stunted but not killed by Matrix.

Most of the minitubers produced plants. About 10 percent of plants were rank in vegetative growth and did not initiate tubers. Due to late planting, some clones were very immature when vines were killed. Skinning damage was serious in many of the selections. Ninety-two clones were selected at harvest (Table 1). Approximately two percent of the North Dakota and Colorado selections and one percent of Idaho clones planted were selected. After three months in storage they were displayed for comparison with standard varieties and 33 clones were retained for further evaluation. These were eye-indexed in January and tested in a greenhouse for virus diseases. Preliminary readings suggest that at least nine of the clones will have to be discarded due to potato virus Y (PVY) infection. Several others will have insufficient disease-free seed to plant 12-hill plots in 1996.

II. Multi-hill Observational and Replicated Yield Trials: Procedures

Forty-seven clones from 1994 single-hill selections were planted in 12-hill plots, and 4 selections from 1993 single-hills were planted in 50-hill plots at KES on June 20. Seedpieces were spaced at 8.7 inches in 32-inch rows. Cultural practices were the same as described for single-hill production. Potatoes were dug and displayed for selection on October 6.

Several additional KES red-skinned selections from 1992 or earlier single-hills were evaluated at one or more locations. At Corvallis and Klamath Falls, advanced KES selections were included in replicated yield trials with standard varieties and entries in the western regional trial. The KES trial was planted on June 20, vines were killed on September 14, and potatoes were harvested on October 2. Individual plots were 36 hills, with seed spaced at 8.7 inches in 32-inch rows. The Corvallis trial was planted on May 29, vines were desiccated on September 14, and potatoes were harvested on October 16. Crops were grown under standard local cultural practices at Corvallis, and as described for single-hill plots at KES. Crops at Bakersfield were planted on February 21 and harvested on June 19.

Results

Four 12-hill selections and one 50-hill selection were saved for further evaluation (Table 2). The selection NDO5108-1 was also included in observational trials at Bakersfield,

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California. It was selected for further testing at that site. Thirty tubers of each of these selections were eye-indexed and virus-tested in greenhouse culture. No virus was detected in AO92657-3. From 4 to 12 plants were infected with PVY in the other four clones. Five disease-free tubers from 12-hill selections will be provided to COARC for seed increase. Remaining seed will be used for observational trials at KES and California sites. Five advanced selections from 1991 and 1992 single-hills were evaluated in replicated trials at both KES and Corvallis (Table 3), and in observational plots at Bakersfield. Performance was inconsistent between locations, partly due to virus infections in the seed. NDO4323-2R produced a high yield at Corvallis and the highest average yield of No.1s across locations. It was rated quite high in a strip trial in Texas. This selection will be retained in spite of growth cracks observed at KES and Bakersfield. NDO4300-1R, NDO4588-5R, and NDO4615-1R will also be kept for further testing. NDO4578-1R was not considered acceptable at any of the three sites and will be discarded. In the KES plots, this selection had nearly 30 percent PVY infection. NDO4592-3R and NDO4784-2R produced low yields at Corvallis and were not selected at Bakersfield. NDO4592-3R was highly rated in a seed increase plot in California and will be retained one more year in Bakersfield.

NDO3994-2 produced relatively high yields of small, attractive tubers in Texas and Bakersfield. This selection was not evaluated in Oregon trials in 1995 due to low yields observed in 1994. Remaining seed supplies will be used for Texas trials in 1996. NDO2686-4R was also discarded in Oregon but retained in California where it has been considered better than the sister line, NDO2686-6R. An attempt will be made to obtain a new seed supply for Oregon.

III. Western Regional Red-skinned Trial:

Procedures

Three standard varieties, 2 Nebraska strains of Redsen, 10 western regional entries, and 5 advanced KES reds were included in the randomized block design experiment described above. Seed was hand cut to 1.5 to 2.0 ounces on May 25, suberized, and held at about 55 °F until planting on June 20. Cultural practices are described above. Plant emergence was recorded on July 7, 11, and 18. The incidence of virus infection, based on visual symptoms, was recorded on July 18. Vine vigor was rated on August 3 and vine maturity was noted on September 8.

Vines were desiccated with 1.0 pint/acre of Diquat applied on September 14. Potatoes were harvested on October 2 with a one-row, digger-bagger. All tubers from each plot were stored and graded in early November. External tuber characteristics were noted for each replication at grading. Ten large tubers from each plot were cut and inspected for internal defects. Samples of 6- to 8-ounce tubers were saved from one replication of each entry for evaluation of culinary quality in boiling, oven baking, and microwave baking preparation methods.

Results and Discussion

Crop development was seriously affected by the long delay between seed cutting and planting, and by poor quality seed in some lots. Excessive sprouting occurred in some lots

Red-skinned Potato Variety Development, 1995

before planting. Fungal and bacterial infections were noted on several lots. Low emergence and poor vine vigor was noted in Sangre, CO86142-3R, CO86218-2R, and COTX86146-2R (Table 4). Severe PVY infection was found in NDO2438-7R, NDO2686-6R, and NDO4578-1R. The virus infection in NDO2438-7R and NDO2686-6R was noted at all western regional red-skinned trial sites. Late maturity and severe skinning was observed in AD82705-1R, AD82706-2R, and COTX86146-2R.

Yields observed in this trial were about 50 percent of typical yields obtained in red-skinned selections at KES in recent years. Red LaSoda achieved the highest yield of all entries (Table 5). AD82705-1R, AD82706-2R, and NDO4615-1R were not significantly lower in No.1 yield than Red LaSoda. The Oregon selection NDO2469-1R produced the lowest yield at KES and was also low in yield at other regional sites. This selection is being discarded. The Texas selection, COTX86146-2R, was also discarded based on performance at all locations. None of the official entries in the regional trial were impressive in the KES trial. Seed-borne diseases and very late planting undoubtedly contributed to poor performance in most of the selections. The data obtained in this experiment may be useful to identify weaknesses such as late maturity, susceptibility to skinning, and poor tuber appearance. It is not valid for comparing yield, grade, and tuber size distribution, or as a basis for decisions regarding disposition of selections.

Summary

Seed production for the red-skinned variety development program presents a challenge. In an attempt to avoid powdery scab infections, the COARC seed increase was moved from Powell Butte to Madras in 1994. High levels of PVY infection occurred in several selections. Some of the red-skinned selections mask symptoms quite effectively, reducing the ability to rogue diseased plants. The net effect of changing locations for seed increase was a serious PVY problem. The 1995 increase was moved back to Powell Butte and powdery scab was encountered again. The program clearly needs a new location for production of seed for varieties susceptible to powdery scab, including red- and white-skinned selections.

Virus infections were also encountered in early generation material at KES in 1995. In previous years, very few single-hill selections have become infected with PVY. The high incidence in 1995 coincides with a high infection level in several local seed crops. These problems have resulted in a temporary setback for the program. The KES selections in the western regional trial could not be fairly evaluated in 1995 trials. Seed supplies will be insufficient for entering them in 1996 trials. When adequate, good quality seed becomes available, NDO2438-6R, NDO2438-7R, NDO2686-6R, and COO86107-1R will be returned to the regional trial. Disease-free tissue culture plantlets of these selections will be provided to Colorado State University in 1996, to obtain an alternate seed source for the future. The early generation aspects of the program will continue at KES in 1996.

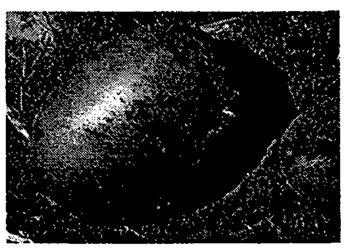

Table 1. Single-hill red-skinned potato seedlings planted and selected at Klamath Falls, OR, 1995.

	Parents		Number of	No. selected	
Family No.	**female**	**male**	**plants**	**fall**	**winter**
NDO5178	MN15620	W1100R	63	0	0
NDO5183	MN15622	4421-3R	9	1	0
NDO5225	2050-1R	3904-6R	100	0	0
NDO5227	2224-5R	3904-6R	49	0	0
NDO5261	2686-2R	3630-17R	31	2	1
NDO5262	2686-2R	4269-9R	41	0	0
NDO5292	3630-17R	4164-1R	26	0	0
NDO5409	4224-1R	4407-8R	36	1	0
NDO5413	4229-3R	W1100R	46	2	0
NDO5438	4339-10R	4269-9R	30	5	1
NDO5465	4398-1R	3904-6R	58	2	1
NDO5473	4407-8R	2224-5R	40	0	0
NDO5484	4422-2R	W1100R	53	2	1
NDO5504	Bison	1871-3R	17	0	0
NDO5534	Fontenot	Bison	18	0	0
NDO5538	Fontenot	3261-5R	20	1	0
NDO5587	Reddale	S. gourlavi	46	0	0
NDO5588	Reddale	2050-1R	18	0	0
NDO5589	Reddale	3261-5R	18	0	0
NDO5593	Red Norland	4255-3R	16	0	0
NDO5755	1871-3R	Bison	41	0	0
NDO5760	2050-1R	Reddale	14	0	0
NDO5762	2050-1R	4253-3R	15	1	0
NDO5765	2224-5R	Fontenot	16	0	0
NDO5766	2224-5R	Red Norland	21	0	0
NDO5768	2225-1R	Red Norland	12	0	0
NDO5785	3530-13R	1871-3R	22	0	0
NDO5838	4229-3R	Red Norland	74	0	0
NDO5839	4229-3R	1871-3R	126	0	0
NDO5844	4251-3R	3574-5R	157	2	0
NDO5846	4253-3R	2224-5R	141	9	2
NDO5847	4255-3R	Bison	136	0	0
NDO5849	4255-3R	Reddale	76	0	0
NDO5853	4255-3R	1871-3R	26	0	0
NDO5862	4299-7R	Fontenot	183	13	4
NDO Sub-Total			**1,805**	**41**	**10**

Table 1. (continued) Single-hill red-skinned potato seedlings planted and selected at Klamath Falls, OR, 1995.

Family No.	Parents		Number of	No. selected	
	female	male	plants	fall	winter
CO093025	AC88482-1	CO86142-3	149	3	3
CO093026	AC88482-1	CO86218-3	133	0	0
CO093027	AC88482-1	NDO2438-7	72	2	2
CO093028	AC88482-1	NDO4030-12	215	12	4
CO093032	BC0981-2	CO86218-3	316	0	0
CO093036	C082177-9	CO86218-3	222	1	0
CO093037	C082177-9	NDO4030-12	206	3	1
CO093052	CO86142-3	NDO4030-12	99	2	1
CO093053	CO86218-3	NDO4030-12	185	8	2
CO093068	NDO2438-6	NDO4030-12	108	3	2
CO093069	NDO2438-7	NDO4030-12	235	6	3
CO093070	NDO4030-12	CO86142-3	83	1	1
COO Sub Total			**2,023**	**41**	**19**
AO93456	AD82705-1	Fontenot	154	0	0
AO93457	AD82705-1	NDO2686-10R	131	1	0
AO93459	COA87154-1	A82705-1R	54	1	1
AO93469	COTX86147-4	NDA4146-2R	94	0	0
AO93471	COTX86147-4	NDO2686-10R	73	1	0
AO93477	Fontenot	NDO2686-6R	96	3	2
AO93485	NDO2686-10R	Fontenot	213	4	1
AO93490	NDO3573-3R	A82705-1R	48	0	0
AO93536	Reddale	AD82705-1R	45	0	0
AO Sub-Total			**908**	**10**	**4**
Total			**4,736**	**92**	**33**

Table 2. Potato clones selected from 1995 12-hill and 50-hill plots at Klamath Falls, OR.

Selection	Parents female	Parents male	Vine vigor[1]	Vine maturity[2]
		12-hill selections		
NDO5437-7R	4339-10R	1618-13R	3	2
NDO5464-3R	4398-1R	1618-13R	3	4
AO92655-9R	COA87154-1R	TW4	3	2
AO92657-3R	NDO2686-6R	NDO3503-2R	4	2
		50-hill selection		
NDO5108-1R	4128-5R	2225-1R	3	2

1/ Vigor: 1 - small weak plant; 5 - large, robust plant

2/ Maturity: 1 - early; 5 - late

Table 3. Yield, grade, and size distribution of KES red-skinned potato selections grown in replicated yield trials at Corvallis and Klamath Falls, OR, 1995.

Variety / selection	Yield U.S. No. 1s 4-10 oz[1]	Yield U.S. No. 1s > 10 oz	Yield U.S. No. 1s Total	Yield Bs	Yield No. 2s & Culls	Yield Total
	cwt / A					
Corvallis						
Red LaSoda	313	136	449	29	38	517
Dark Red Norland	369	69	438	50	115	603
NDO4300-1R	280	33	313	77	28	418
NDO4323-2R	398	69	467	60	73	600
NDO4578-1R	310	23	333	109	34	476
NDO4588-5R	301	57	358	56	25	438
NDO4592-3R	137	39	176	47	46	269
NDO4615-1R	181	46	227	42	59	328
NDO4784-2R	203	11	214	94	15	323
Mean[2]	262	52	314	56	45	424
CV (%)	21	42	20	27	38	16
LSD (0.05)	77	31	91	20	24	99
Klamath Falls						
Red LaSoda	252	122	374	36	41	450
Dark Red Norland	206	49	255	53	50	357
NDO4300-1R	221	2	223	138	4	365
NDO4323-2R	237	24	261	63	67	391
NDO4578-1R	183	43	226	92	16	334
NDO4588-5R	227	64	291	62	8	361
NDO4615-1R	246	85	332	66	17	414
Mean[2]	206	62	267	60	18	345
CV (%)	26	51	19	25	73	17
LSD (0.05)	47	45	73	21	19	81

1/ Size breakdown at Corvallis was 4 -12 and over 12 ounces.

2/ Means and statistical parameters are based on additional entries.

Table 4. Plant and tuber characteristics of red-skinned potato varieties and selections in the western regional and advanced KES trial at Klamath Falls, OR, 1995.

Variety / selection	Percent stand	Vine vigor[1]	Vine maturity[2]	Percent PVY	Appearance ratings[3] color	eyes	shape	uniformity	skinning
Dark Red Norland	92	4.0	2.8	0	3.3	3.3	2.0	2.8	3.5
Red LaSoda	98	4.8	2.8	0	2.8	2.5	2.0	2.5	3.8
Sangre-14	74	2.1	4.5	0	3.5	3.0	2.0	2.0	2.8
AD82705-1R*	88	2.9	4.5	0	3.3	4.0	1.3	3.3	2.3
AD82706-2R*	90	2.4	5.0	0	4.0	3.8	1.0	3.5	2.3
CO86142-3R*	59	2.3	3.0	0	4.0	4.0	1.5	3.5	3.8
CO86218-2R*	76	2.1	3.8	0	3.5	4.0	1.0	2.8	3.8
COO86107-1R*	94	3.8	3.0	5	4.3	5.0	1.0	3.5	4.0
COTX86146-2R*	64	1.8	4.0	0	4.0	4.0	2.0	1.3	2.0
NDO2438-6R*	88	3.0	2.5	2	5.0	4.5	1.0	3.5	4.0
NDO2438-7R*	93	3.0	3.0	34	5.0	4.0	1.0	4.5	3.5
NDO2469-1R*	87	4.0	2.8	8	5.0	5.0	1.0	3.3	3.5
NDO2686-6R*	86	3.8	2.3	28	5.0	5.0	1.0	4.3	4.3
NDO4300-1R	90	4.5	2.5	0	5.0	5.0	1.0	5.0	4.3
NDO4323-2R	93	4.0	3.0	4	4.5	4.0	1.3	3.3	4.8
NDO4578-1R	89	3.5	2.3	21	5.0	4.0	1.0	3.3	4.0
NDO4588-5R	85	3.0	3.0	5	4.0	3.5	2.0	3.8	4.0
NDO4615-1R	92	4.5	3.8	1	4.5	4.0	1.0	4.0	4.0
Redsen Strain	95	5.0	2.5	0	4.5	4.0	1.0	3.5	4.0
Super Red	79	3.0	2.5	0	4.0	4.0	1.0	2.5	3.3
Mean	86	3.4	3.2	5	4.2	4.1	1.3	3.3	3.6

* Official entries in western region trial.

1/ Vine vigor: 1 - small; 5 - large (8/3)

2/ Vine maturity: 1 - early; 5 - late (9/8)

3/ Color: 1 - pale to pink; 5 - bright red
Eyes: 1 - deep; 5 - shallow
Shape: 1 - round; 2 - oval;
Uniformity: 1 - poor; 5 - excellent
Skinning: 1 - severe; 5 - none

Table 5. Yield, grade, and size distribution of red-skinned potato varieties and advanced selections at Klamath Falls, OR, 1995.

Variety / selection	Yield U.S. No. 1s 4-6 oz	6-10 oz	>10 oz	Total	Yield Bs	No. 2s & Culls	Total
	cwt / A						
Dark Red Norland	69	137	49	254	53	50	357
Red LaSoda	84	168	122	373	36	41	450
Sangre-14	54	114	115	283	34	23	340
AD82705-1R	100	164	88	352	70	9	431
AD82706-2R	71	167	119	357	51	15	423
CO86142-3R	59	94	33	186	41	5	233
CO86218-2R	59	107	59	225	48	11	283
COO86107-1R	85	152	45	281	67	12	360
COTX86146-2R	38	79	105	222	23	11	256
NDO2438-6R	87	108	58	253	56	17	326
NDO2438-7R	76	132	60	267	43	3	313
NDO2469-1R	83	86	10	178	89	29	295
NDO2686-6R	88	109	14	211	66	3	279
NDO4300-1R	142	79	2	223	138	4	365
NDO4323-2R	93	144	24	262	63	67	392
NDO4578-1R	90	93	43	226	92	16	333
NDO4588-5R	70	157	64	291	62	8	361
NDO4615-1R	99	147	85	332	66	17	414
Redsen Strain	85	170	43	298	68	16	382
Super Red	61	108	105	273	30	13	316
Mean	80	126	62	267	60	18	345
CV (%)	26	26	51	19	25	73	17
LSD (0.05)	29	47	45	73	21	19	81

Potato Cultivar Response to Plant Population

K.A. Rykbost and J. Maxwell[1]

Introduction

The 1995 potato crop in the Klamath Basin was less than 50 percent Russet Burbank for the first time. Chipping potatoes accounted for over 2,500 acres. Russet Norkotah was the leading variety for fresh market use. Local interest in alternatives to Russet Burbank and Russet Norkotah remains high. A sharp rise in infection of local Norkotah seed crops in 1995 with potato virus Y points out one of the serious weaknesses of this variety. Potato variety selection and development programs in the western states continue to produce new selections with advantages over established varieties. Since 1988, the KES has evaluated the response of the most promising new varieties or advanced selections to cultural management practices including nitrogen fertilization rates and plant population. In 1995, plant population response was evaluated for three varieties and six advanced selections. Snowden, a popular new chipping variety, NDO1496-1, an Oregon selection with excellent chip quality out of cool storage, and NDO2904-7, an Oregon fresh market russet selection were included for the third year. AO85165-1, a high yielding Oregon fresh market russet was included for the second year. Two dual purpose russets from the Idaho program, A8495-1 and A84180-8, and the Oregon selection AO84275-3 were included for the first time.

Procedures

Nine varieties or advanced selections were included in a split-plot design experiment with four replications. Main plots were seed spacings of 6.8, 8.7, or 12.0 inches in 32-inch rows. Split-plots were the nine selections in two rows, 30 feet long. Seed was hand cut to 1.5 to 2.0 ounces and suberized for over three weeks prior to planting. Potatoes were planted with a two-row, assisted-feed planter on June 12. Standard cultural practices were followed for weed, insect, nematode, and disease control (page 95). Fertilizer included 730 lb/acre of 16-8-8-14S banded at planting, and 30 lb N/acre applied as solution 32 and incorporated with a rolling cultivator on June 21. Vines were desiccated with Diquat on September 26. Potatoes were harvested with a one-row, digger-bagger on October 10. Field weights were determined for all tubers from both rows. Approximately 120-pound samples from each plot were stored and graded to USDA standards on November 2. Specific gravity was determined by the weight-in-air, weight-in-water method on a 10-pound sample of 6- to 10-ounce No.1 tubers. Ten large tubers from each plot were cut longitudinally and inspected for internal defects.

[1/] Superintendent/Professor and Biological Sciences Research Technician III, respectively, Klamath Experiment Station, Klamath Falls, OR.

Acknowledgments: Partial funding from the Oregon Potato Commission and CSREES is gratefully recognized.

Potato Cultivar Response to Plant Population

Results and Discussion

High soil moisture levels at planting, an inch of rain in the 24 hours following planting, and some deterioration of seed vigor with planting delays all contributed to adversity for this and other trials. Rhizoctonia damage to stems and roots was common. Some seedpiece decay occurred in Russet Burbank, NDO2904-7, AO85165-1, and A8495-1. Final stands were 75 to 85 percent in these selections, compared to more than 95 percent in the others. Yields, grade, and tuber size of these lines were affected by poor stands.

As was the case in several other 1995 variety trials, the late maturing Russet Burbank produced low yields and small size (Table 1). Yield of No.1s was significantly less for Russet Burbank than all other selections. AO85165-1 was significantly higher in No.1 yield than all other selections, even though emergence was only 80 percent. A84180-8 also produced a high yield of No. 1s. The remaining selections were similar in total yield of No.1s, but varied widely in tuber size distribution. Snowden and NDO1496-1 produced a high proportion of small tubers. AO85165-1, NDO2904-7, and Russet Norkotah had high yields of tubers over 10 ounces. These results are consistent with previous experience with these selections.

Averaged over varieties, effects of seed spacing on total and total No.1 yields were small and not significant. However, tuber size distribution was significantly affected by seed spacing. Lower plant populations resulted in increased yield of 10-ounce tubers and reduced yield of tubers under 4 ounces. Similar trends have been observed in each year and in all varieties or selections evaluated. The interaction between selection and seed spacing was only significant for yield of 6- to 10-ounce No.1s. The chipping selections, Snowden and NDO1496-1, had higher yields in this size range at lower populations, while russet skinned selections had similar or lower yields of 6- to 10-ounce tubers at low populations.

Considering No.1 yields and tuber size distribution, optimum seed spacing clearly differed among selections. Russet Burbank, Russet Norkotah, Snowden, NDO1496-1, and AO84275-3 benefitted from reduced populations. High populations were advantageous for NDO2904-7 and AO85165-1. While poor stands contributed to reduced yields, previous experience has shown low tuber set and large size is characteristic of both of these selections. The intermediate population appeared optimum for A8495-1 and A84180-8.

The 1995 experiment completed three years of evaluation of Snowden, NDO2904-7, and NDO1496-1. The response of these selections and Russet Burbank and Russet Norkotah to seed spacing over 1993, 1994, and 1995 is shown in Table 2. Russet Burbank, Snowden, and NDO1496-1 produce high tuber numbers and small size. The lowest plant population was optimum for these selections in each year. NDO2904-7 produced higher No.1 yields at the highest plant population in 1993 and 1995. In 1994, seed spacing had little effect on total yield of No.1s. This selection, like Norkotah, produces excessive tuber size at the 12-inch spacing.

The Oregon selection NDO1496-1 has shown promise as an excellent out-of-storage chipper, except for a susceptibility to shatter bruising. The industry in Idaho remains quite interested in this selection. Oregon research personnel are inclined to discard the clone to

Potato Cultivar Response to Plant Population

protect growers from potential losses due to shatter bruises. A similar dilemma exists with NDO2904-7. Very high glycoalkaloids have been observed in this selection. The problem has not occurred in southern California, where NDO2904-7 has been very promising. Again, the interests of the industry will probably be best served by discarding the clone.

Response of AO85165-1 to seed spacing will be evaluated for the third year in 1996. This fresh market russet has consistently produced high yields with good appearance. Results to date show a need for high plant populations to achieve high yields and avoid excessive tuber size. A8495-1 will also be evaluated again in 1996. This selection has a good chance of being released. It has looked good in trials at KES, although it does not yield as well as Norkotah in most trials.

A84180-8 and AO84275-3 will not be pursued. The former has experienced a hollow heart problem in some locations, although not at KES. AO84275-3 was thought to have some important disease resistances that would be useful for home garden situations. More extensive testing in 1995 was not as encouraging and this line is being discarded.

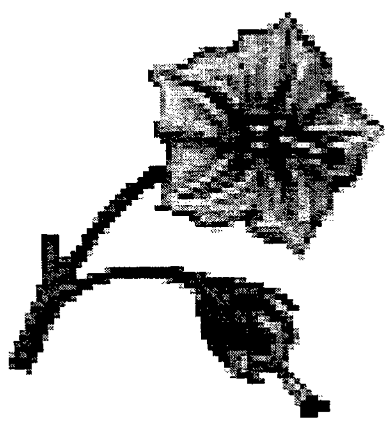

Table 1. Effects of seed spacing on performance of nine potato selections, Klamath Falls, OR, 1995.

Variety/ selection	Seed spacing	Yield U.S. No. 1s				Yield				Specific gravity
		4 - 6 oz	6 - 10 oz	>10 oz	Total	Bs	No. 2s	Culls	Total	
	inches	cwt/A								
R. Burbank	6.8	111	125	58	293	104	10	11	418	1.085
	8.7	94	106	91	291	74	14	33	411	1.087
	12.0	99	125	93	316	52	19	29	417	1.084
R. Norkotah	6.8	81	147	177	405	54	16	17	492	1.071
	8.7	80	121	201	402	32	13	15	462	1.071
	12.0	64	151	228	443	26	12	17	497	1.071
Snowden	6.8	155	123	79	357	110	1	9	477	1.094
	8.7	161	149	57	366	115	2	8	492	1.091
	12.0	168	167	69	404	80	1	12	497	1.094
NDO 1496-1	6.8	163	135	61	359	115	0	18	492	1.091
	8.7	161	130	91	382	99	2	11	494	1.092
	12.0	150	155	98	403	87	2	11	503	1.093
NDO 2904-7	6.8	77	112	255	444	30	11	9	493	1.069
	8.7	51	98	235	384	29	11	17	440	1.068
	12.0	26	62	283	370	13	14	22	418	1.071
AO85165-1	6.8	74	160	265	500	29	18	14	560	1.070
	8.7	71	144	293	508	31	15	20	574	1.074
	12.0	52	109	320	481	28	14	35	558	1.071
AO84275-3	6.8	137	126	66	329	103	5	6	442	1.081
	8.7	134	147	129	410	80	3	10	503	1.083
	12.0	135	156	129	420	61	4	12	497	1.082
A8495-1	6.8	111	146	108	365	46	8	8	426	1.084
	8.7	86	138	158	382	38	6	8	435	1.083
	12.0	67	145	165	377	25	8	8	418	1.088
A84180-8	6.8	100	169	146	415	30	16	40	500	1.075
	8.7	116	189	149	454	42	6	25	527	1.077
	12.0	115	179	159	452	36	15	22	525	1.077

Table 1. (continued) Effects of variety and seed spacing on performance of potato selections, Klamath Falls, OR, 1995.

Variety/ selection	Seed spacing	Yield U.S. No. 1s				Yield				Specific gravity
		4 - 6 oz	6 - 10 oz	>10 oz	Total	Bs	No. 2s	Culls	Total	
	inches	cwt/A								
Variety effect (average of three spacings)										
R. Burbank		101	118	80	300	77	14	24	415	1.085
R. Norkotah		75	140	202	417	37	13	16	484	1.071
Snowden		161	146	68	376	102	1	10	488	1.093
NDO 1496-1		158	140	83	381	100	1	14	496	1.092
NDO 2904-7		51	90	258	399	24	12	16	450	1.069
AO85165-1		66	138	293	496	29	16	23	564	1.072
AO84275-3		135	143	108	386	81	4	9	481	1.082
A8495-1		88	143	144	375	36	7	8	426	1.085
A84180-8		110	179	151	440	36	12	29	517	1.076
Mean		105	138	154	397	58	9	17	480	1.080
CV (%)		17	18	24	11	27	82	73	9	0.3
LSD (0.05)		16	21	30	36	13	6	10	37	0.003
Seed spacing main effect (average of nine selections)										
	6.8	112	138	135	385	69	9	15	478	1.080
	8.7	106	136	156	398	60	8	16	482	1.081
	12.0	97	139	171	407	45	10	19	481	1.081
CV (%)		26	15	22	11	22	46	67	9	0.4
LSD (0.05)		NS	NS	20	NS	8	NS	NS	NS	NS

Table 2. Three-year summary of effects of seed spacing on yield, grade, and tuber size distribution of Russet Burbank, Russet Norkotah, Snowden and two numbered selections evaluated at Klamath Falls, OR, from 1993 through 1995.

Variety/ selection	Seed spacing	Yield U.S. No. 1s				Yield			
		4 - 6 oz	6 - 10 oz	>10 oz	Total	Bs	No. 2s	Culls	Total
	inches	cwt/A							
R. Burbank	6.8	140	109	30	280	130	27	18	455
	8.7	120	111	53	284	99	40	36	459
	12.0	124	135	65	323	73	29	18	444
	Mean	128	118	49	296	101	32	24	453
R. Norkotah	6.8	108	173	109	389	72	9	9	479
	8.7	103	159	143	405	45	15	10	475
	12.0	77	155	181	412	32	11	14	469
	Mean	96	162	144	402	50	12	11	474
Snowden	6.8	164	123	48	335	136	2	9	482
	8.7	157	140	41	338	127	1	7	474
	12.0	166	170	59	395	100	1	8	505
	Mean	162	144	49	356	121	1	8	487
NDO 1496-1	6.8	148	140	50	337	127	0	13	477
	8.7	154	145	69	369	111	3	8	490
	12.0	140	164	82	387	82	3	8	479
	Mean	147	150	67	364	107	2	10	482
NDO 2904-7	6.8	84	137	189	410	46	8	7	471
	8.7	79	129	183	390	40	9	9	448
	12.0	57	104	220	381	24	12	14	430
	Mean	73	123	197	394	37	10	10	450

Effect of Seedpiece Size on Performance of Three Potato Varieties

K.A. Rykbost[1], K.A. Locke[2], and J. Maxwell[1]

Introduction

Observations of commercial cut seed lots over several years have shown a lack of uniformity in seedpiece size within and between lots, and a tendency for local growers to use smaller seed size than is generally recommended. A preliminary study in 1994 showed a significant improvement in yield and economic returns when seedpiece size in Russet Burbank was increased from 0.75 to 1.75 ounces/seedpiece. Out of seven commercial seed lots evaluated, over 40 percent of seedpieces were less than 1.5 ounces in four lots. Only one seed lot had more than 60 percent of seedpieces in the range of 1.5 to 2.5 ounces. The study was expanded in 1995 to include Russet Norkotah and Century Russet varieties, and to evaluate more commercial cut seed lots.

Procedures

Forty to 50 pound samples of 12 cut seed lots were obtained from commercial potato growers during the 1995 planting season. Each lot was sorted to seedpiece sizes of: <1.0 oz.; 1.0 to 1.5 oz.; 1.5 to 2.0 oz.; 2.0 to 2.5 oz.; and >2.5 oz. The weight and number of seedpieces in each size fraction was recorded. Seed evaluated included six Russet Burbank and six Russet Norkotah lots. Mechanical and hand cutting methods were equally represented in the samples.

Seed tubers of Russet Burbank, Russet Norkotah, and Century Russet varieties were individually sized to 3, 5, 7, 9, or 11 ounces (within 1/4 ounce) to obtain appropriate size from four-cut pieces to plant four replications of one-row plots with 3/4, 1-1/4, 1-3/4, 2-1/4, and 2-3/4 ounce seedpieces. Russet Burbank plots were 30 hills/plot at 12-inch seed spacing. Russet Norkotah and Century Russet plots were 42 hills/plot at 8.7-inch seed spacing. Eight (Russet Burbank) or 11 (Russet Norkotah or Century Russet) tubers were used for each plot with two bud-end pieces discarded in each case. This ensured uniform numbers of bud-end and stem-end pieces for all plots.

All seed was cut on June 1 and planted in 32-inch rows on June 13. Plots were arranged in a split-plot design with variety as the main plot and seedpiece size as split-plots. Standard cultural practices were followed as described for variety trials (page 95). Vines were desiccated with Diquat on September 26. Potatoes were harvested with a one-row, digger-bagger on October 10. All tubers from each plot were graded to USDA standards on November 3.

Emergence data were recorded on July 5, July 7, and July 17. Stem numbers were counted on 10 consecutive plants in each plot on July 31. Economic interpretations of results were based on the following assumptions:

[1] Superintendent/Professor and Biological Sciences Research Technician III, respectively, Klamath Experiment Station, Klamath Falls, OR.
[2] Klamath County Cooperative Extension Agent, Klamath Falls, OR.

Acknowledgment: Partial funding from the Oregon Potato Commission and the cooperation of potato growers in providing samples of cut seed for evaluation is appreciated.

Effect of Seedpiece Size on Performance of Three Potato Varieties

1. Seed costs, including cutting and treating - $12/cwt.
2. 17,424 seedpieces/acre based on 10-inch spacing in 36-inch rows.
3. Crop values: Bs and culls - $1.00/cwt; No.2s - $4.00/cwt; No.1s - $5.00/cwt; 4 to 8-ounce No.1s - $12.00/cwt; 8 to 12-ounce No.1s - $10.00/cwt, > 12-ounce.
4. Yield of commercial seed lots would be proportional to ratio of seed sizes and experimental yields for comparable seed sizes.
5. Seed costs for commercial seed lots based on average weight of seed pieces in each size fraction.

Results and Discussion

Emergence data were recorded at 22, 24, and 34 days after planting, and stem numbers were determined 48 days after planting (Table 1). Small seedpieces delayed emergence and reduced stem numbers in all varieties. Russet Burbank emerged several days earlier than the other varieties. Final stands were similar regardless of seedpiece size. Stem numbers in Russet Burbank were slightly higher than in 1994 when the range was from 1.63 for 3/4-ounce to 2.73 stems/plant for 2-3/4-ounce seedpieces.

Effects of seedpiece size on yield, grade, and tuber size distribution were large and consistent for Russet Burbank and Century Russet (Table 2). Each incremental increase in seed size up to 2-1/4 ounces resulted in increased yield of No.1s. The 2-3/4-ounce size resulted in increased yield of No.2s and culls in Russet Burbank and reduced tuber size in Century Russet, with no advantage in yield of No.1s for either variety. Effects of seed size on Russet Norkotah were much different. No.1 yields declined slightly as seed size was increased from 3/4 to 1-3/4 ounces. The two largest sizes produced slightly higher No.1 yields. The lack of response to seedpiece size in Russet Norkotah was probably due to severe early dying in this variety. Vines were senescing by mid-August, irrespective of seedpiece size. A different seed source was used for Russet Norkotah in this study than in all other trials at KES. While yields for Russet Norkotah were very low in the seed size experiment, Russet Norkotah produced excellent yields in a seed spacing study and in several variety trials. The data obtained from Russet Norkotah in this study is probably of little value.

Effects of seedpiece size on Russet Burbank in the 1994 study, and two-year means for Russet Burbank are shown for comparison purposes (Table 3). While yields were over 100 cwt/acre higher in 1994, the effects of seedpiece size on yield were greater in the shorter growing season experienced in 1995. In 1994, the optimum seed size was 1-3/4 ounces. In 1995, increasing seed size to 2-1/4 ounces resulted in higher yields of tubers over 12 ounces. Averaged over both years, Russet Burbank produced similar total No.1 yields at 1-3/4 and 2-1/4 ounces. The further increase in seed size to 2-3/4 ounces resulted in a reduction in tuber size with fewer 12 ounce tubers and more Bs and small No.1s.

Effects of seedpiece size on economic returns were substantial for Russet Burbank and Century Russet (Table 2). Using yield component values listed above, gross crop values increased by over $1,000/acre for Russet Burbank and $1,900/acre for Century Russet in response to increasing seedpiece size

Effect of Seedpiece Size on Performance of Three Potato Varieties

from 3/4 to 2-1/4 ounces in 1995. The increase in seed costs associated with these differences in seed size would be about $200/acre for Russet Burbank planted at 10-inch spacing in 36-inch rows, and $250/acre for Century Russet planted at 8-inch spacing in 36-inch rows, assuming seed costs of $12/cwt. When the same component prices are applied to the Russet Burbank data from 1994 and two-year means are calculated, gross crop values are approximately 2,500, 3,000, 3,500, 3,500, and $3,200/acre for 3/4, 1-1/4, 1-3/4, 2-1/4, and 2-3/4 ounce seedpieces, respectively.

The 12 commercial seed lots examined had a wide range in seedpiece size distribution (Table 4). These lots included both hand and machine cutting methods. Averaged over all lots, about 50 percent of the seedpieces were within the desirable range of 1-1/2 to 2-1/2 ounces on a number basis. Only two lots had 60 percent of seedpieces in this size range. Seedpieces under 1-1/2 ounces accounted for about 36 percent, and over 2-1/2 ounces about 13 percent. There were no apparent trends for different cutting practices for the two varieties, or between cutting methods.

Seed use for the commercial lots evaluated was calculated based on the average weight of seedpieces in each size class, assuming no skips or doubles occurred (Table 4). The range among seed lots was from 15.4 cwt/acre to 27.6 cwt/acre for 10-inch seed spacing in 36-inch rows. At a seed cost of $12/cwt, the range in seed costs was from a low of $185/acre to a high of $331/acre.

Gross crop values were estimated for the commercial Russet Burbank seed lots. These are based on the percent of each seedpiece size fraction, two-year mean yields observed for that fraction in Russet Burbank, and values assigned for yield components (Table 4). The estimates show a range of $260/acre in gross crop value among seed lots. After subtracting seed costs, lot No.5 is estimated to return $172/acre more than lot No.4.

The return for any hypothetical seed size distribution can be estimated. For example, a seed lot with 10 percent each at 1-1/4 and 2-3/4 ounces, and 40 percent each at 1-3/4 and 2-1/4 ounces, would produce a gross return of $3,428/acre. The seed cost for this lot would be $260/acre, leaving a return after seed costs of $3,167/acre. Since the Russet Norkotah data was influenced by factors other than seedpiece size, no attempt was made to estimate economic returns for commercial lots of this variety.

The results observed for Century Russet suggest that seedpiece size is probably an important factor in determining performance in healthy potato crops of any variety. In varieties with few or poorly distributed eyes, including Century Russet and Shepody, seedpieces with no eyes (blind seed) are an additional concern and yield limiting factor.

Conclusions

Eighteen commercial cut seed lots evaluated over two seasons were found lacking in uniformity in seedpiece size. A high percentage of seedpieces were less than 1.5 ounces in most of these lots. Yields, grade, and tuber size distribution were significantly affected by seedpiece size in replicated experiments conducted with Russet Burbank over two years and with Century Russet in 1995. Yield of U.S. No.1s increased by over 40 percent when seedpiece size was increased from 3/4 to 2-1/4 ounces in Russet Burbank. For Century Russet, the increase in No.1 yield over this

Effect of Seedpiece Size on Performance of Three Potato Varieties

seedpiece size range was 70 percent. These findings suggest considerable room for improved yields in commercial potato crops by better quality control in seed cutting operations. They also demonstrate the need to use uniform seedpiece size in research efforts.

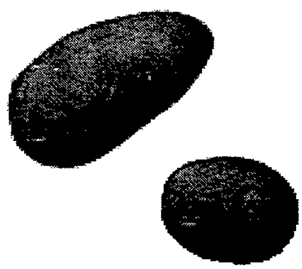

Table 1. Effect of seedpiece size on percent emergence at 22, 24, and 34 days after planting, and stem numbers 48 days after planting of Russet Burbank, Russet Norkotah, and Century Russet potatoes grown at Klamath Falls, OR, 1995.

Variety	Seed size	Emergence 7/5	Emergence 7/7	Emergence 7/17	Stems/plant 7/31
	oz	%	%	%	
R. Burbank	3/4	82	89	97	1.90
	1 - 1/4	97	100	100	2.45
	1 - 3/4	96	99	100	2.65
	2 - 1/4	96	97	97	3.05
	2 - 3/4	100	100	100	3.23
	Mean	94	97	99	2.66
R. Norkotah	3/4	46	71	96	2.08
	1 - 1/4	62	81	95	2.63
	1 - 3/4	70	83	96	3.00
	2 - 1/4	79	89	98	3.28
	2 - 3/4	74	85	97	3.40
	Mean	66	82	96	2.88
Century R.	3/4	38	54	90	2.15
	1 - 1/4	54	70	96	2.73
	1 - 3/4	76	88	99	3.48
	2 - 1/4	79	92	98	3.65
	2 - 3/4	79	88	98	3.73
	Mean	65	78	96	3.15

Table 2. Effect of seedpiece size on yield, grade, tuber size distribution, and gross value at Russet Burbank, Russet Norkotah, and Century Russet potatoes grown at Klamath Falls, OR, 1995.

Variety	Seed size	Yield U.S. No. 1s 4 - 8 oz	Yield U.S. No. 1s 8 - 12 oz	Yield U.S. No. 1s >12 oz	Yield U.S. No. 1s Total	Yield Bs	Yield No. 2s	Yield Culls	Yield Total	Gross Value
	oz	cwt/A								$/A
R. Burbank	3/4	76	109	50	234	21	17	25	297	1883
	1 - 1/4	102	124	49	275	29	14	26	344	2136
	1 - 3/4	126	146	60	331	35	5	9	380	2495
	2 - 1/4	148	144	99	390	46	16	16	467	2927
	2 - 3/4	138	136	23	296	43	25	55	419	2263
R. Norkotah	3/4	79	96	48	222	20	3	9	254	1692
	1 - 1/4	102	92	32	225	42	10	11	287	1660
	1 - 3/4	106	74	33	213	44	6	13	276	1505
	2 - 1/4	97	105	45	246	35	7	18	306	1865
	2 - 3/4	113	94	40	247	44	3	4	298	1768
Century R.	3/4	65	143	141	349	19	10	8	385	2871
	1 - 1/4	114	229	133	476	46	4	5	530	3871
	1 - 3/4	160	232	117	509	42	6	20	576	3888
	2 - 1/4	164	278	159	600	44	6	9	659	4774
	2 - 3/4	240	233	127	600	59	10	13	682	4394
Seed size effect										
	3/4	73	116	80	268	20	10	14	312	2149
	1 - 1/4	106	148	71	325	39	9	14	387	2555
	1 - 3/4	131	151	70	351	40	6	14	411	2629
	2 - 1/4	136	176	101	412	41	10	14	477	3189
	2 - 3/4	164	154	63	381	49	13	24	466	2808
	Mean	122	149	77	348	38	9	16	410	2666
	CV (%)	17	20	47	14	44	95	86	10	15
	LSD (0.05)	17	25	30	41	14	NS	NS	36	334
Variety main effect										
R. Burbank		118	132	56	305	35	15	26	381	2341
R. Norkotah		99	92	40	231	37	6	11	284	1698
Century R.		148	223	135	507	42	7	11	566	3960
	CV (%)	19	19	86	17	41	173	36	18	18
	LSD (0.05)	18	23	51	46	NS	NS	5	58	365
	Sign of Interaction[1]	**	**	NS	**	NS	NS	**	**	**

[1/] Level of statistical significance for interaction between variety and seed size: NS - not significant; ** - significant at 1 percent level.

Table 3. Effects of seedpiece size on yield, grade, and tuber size distribution of Russet Burbank potatoes grown at Klamath Falls, OR in 1994, and two-year means for 1994 and 1995.

Seed size	Yield U.S. No. 1s				Yield			
	4 - 8 oz	8 - 12 oz	>12 oz	Total	Bs	No. 2s	Culls	Total
oz	cwt/A							
				1994				
3/4	145	108	65	318	31	25	18	391
1 - 1/4	204	138	77	419	43	36	5	503
1 - 3/4	199	154	90	442	55	49	5	551
2 - 1/4	233	108	68	408	61	52	11	531
2 - 3/4	293	109	50	452	79	40	6	577
Mean	215	123	70	408	54	40	9	510
LSD (0.05)	38	42	33	63	20	23	NS	80
				Two-year mean				
3/4	111	108	58	277	26	21	22	346
1 - 1/4	153	131	53	337	36	25	16	414
1 - 3/4	163	150	75	388	45	27	7	467
2 - 1/4	190	126	84	400	54	34	13	501
2 - 3/4	216	122	37	374	61	33	30	498
Mean	167	127	61	355	44	28	18	445

Table 4. Seed lot size distribution and estimated seed use, costs, and economic returns for commercial seed lots evaluated at Klamath Falls, OR, 1995.

No.	Variety	Seedpiece size <1.0 oz	1 - 1.5 oz	1.5 - 2 oz	2 - 2.5 oz	>2.5 oz	Seed use[1]	Seed cost[2]	Gross return[3]	Net return[4]
		% (number basis)					cwt/A	$/A		
1	R. Burbank	19.9	30.2	33.0	14.8	2.1	16.7	200	3170	2970
2	R. Burbank	3.9	17.3	29.0	29.8	20.0	22.4	269	3315	3046
3	R. Burbank	13.2	34.4	35.9	13.9	2.6	17.0	204	3211	3007
4	R. Burbank	24.2	24.3	23.3	13.8	14.4	17.8	214	3111	2897
5	R. Burbank	0	5.1	24.0	39.8	31.1	25.2	302	3371	3069
6	R. Burbank	8.7	30.4	40.9	16.6	3.4	18.0	216	3272	3056
	Mean	11.7	23.6	31.0	21.4	12.3	19.5	234	3242	3008
7	R. Norkotah	30.9	24.2	23.3	14.0	7.6	15.4	185		
8	R. Norkotah	21.9	30.2	32.3	12.3	3.3	16.1	193		
9	R. Norkotah	19.7	29.2	29.5	15.0	6.6	17.0	204		
10	R. Norkotah	0	2.6	19.5	32.2	45.7	27.6	331		
11	R. Norkotah	4.5	25.0	35.9	24.4	10.2	19.8	238		
12	R. Norkotah	4.5	34.3	38.6	18.3	4.3	17.9	215		
	Mean	13.6	24.3	29.8	19.4	12.9	19.0	228		

1/ Based on 10-inch spacing in 36-inch row and seed size distribution by weight and number assuming no doubles or skips

2/ Based on seed use calculation and $12/cwt seed price.

3/ Based on yield, grade, and economic returns from replicated experiments in 1994 and 1995.

4/ Gross return less seed costs.

1995 Evaluation of the Herbicide Matrix on Russet Norkotah Potatoes at Klamath Falls, Oregon

K.A. Rykbost[1] and K.Locke[2]

Introduction

Preliminary evaluation has shown Matrix (25 percent rimsulfuron evaluated as E9636), alone or in combination with low rates of Lexone, to be a promising alternative to metribuzin products for post-emergence broadleaf weed control in potato crops. This is a particularly promising management tool for varieties that are gaining importance in western production areas, but are moderately to highly sensitive to metribuzin injury. The Shepody variety that has become dominant in the Treasure Valley and important in the Columbia Basin, is highly sensitive to metribuzin injury. Atlantic and most red-skinned varieties are also metribuzin-sensitive. A study was conducted at the Klamath Experiment Station (KES) in 1995, to further evaluate Matrix for post-emergence weed control in Russet Norkotah potatoes.

Procedures

Russet Norkotah potatoes were planted on June 13 in a field cropped with spring barley in 1994. Seed was spaced at 9 inches in 32-inch rows. Fertilizer was banded on both sides of seed furrows at 730 lb/acre of 16-8-8-14 S. Additional nitrogen fertilizer was applied at 30 lb N/acre as solution 32 with a conventional ground sprayer on June 21. Individual plot boundaries were established on June 22 to accommodate 8 treatments of 4-row, 22-foot plots with four replications. Eptam, at 3.0 lbs a.i./acre, was applied with a backpack sprayer to plots with treatment numbers 5-8 on June 22, and incorporated immediately by two passes with a rolling cultivator.

Intended herbicide treatments included Matrix at 0.0156, 0.0234, 0.0313 and 0.0468 lb ai/acre with a non-ionic surfactant at 0.25 percent by volume on four treatments at ground cracking. Three treatments that received Eptam were to be followed by Matrix plus Lexone at two Lexone rates, or by Lexone alone at 0.75 lb a.i./acre, applied at layby. The fourth treatment with Eptam was to serve as the control treatment.

Matrix was applied to treatments 1-4 with a backpack sprayer on the morning of July 13. Weather conditions at time of application were calm and clear. Air temperature was approximately 55 °F at the time of application, with a high of 72 °F and daily minimums of 35 and 48 °F on July 13 and 14, respectively. Soil conditions were moist following precipitation measured at 0.20 inches from mid-day rain on July 12. Soil temperatures at the 4-inch depth were 58 to 63 °F on July 13. All weather data were recorded at the KES weather station located approximately 1,000 feet from the trial site.

Standard cultural practices were followed for disease control. Total irrigation for the season was about 16 inches, applied with solid-set sprinklers at 40x48-foot spacing. Weed control efficacy was rated on July 21.

[1] Superintendent/Professor, Klamath Experiment Station, Klamath Falls, OR.
[2] Klamath County Cooperative Extension Agent, Klamath Falls, OR.

Acknowledgments: Partial funding for the study from the Oregon Potato Commission and the E.I. duPont de Nemours and Co., Inc., is gratefully recognized.

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Percent of weeds present that appeared to be effectively controlled were recorded for redroot pigweed and hairy nightshade on each plot. Filaree and mallow control was scored where these weeds were present. Vines were desiccated with Diquat applied at 0.25 lb ai/acre on September 21.

Plants and tubers were removed, by hand, from 2-foot borders between plots in the center two rows on September 28. All remaining tubers were harvested from the center two rows of each plot with a one-row, digger-bagger on October 4, and stored until grading was done on November 1. Tubers were graded to USDA standards, with separation of U.S. No.1s into sizes of 4-12, and over 12 ounces. Yield and grade data were analyzed statistically using MSUSTAT software.

Matrix was also used at approximately 0.0234 lb ai/acre on potatoes in another field at KES in 1995. The field included over 5,000 single-hill, first generation red-skinned breeding selections, advanced red-skinned breeding selections, several named red-skinned varieties, Shepody, and Russet Norkotah. Advanced selections and Shepody were planted on June 20. Russet Norkotah and single-hill, red-skinned selections were planted on June 13. Eptam was applied to the entire field on June 21 at 3.0 lb ai/acre. Emergence was very erratic in the single-hill selections, which were planted using mini-tubers produced in greenhouse culture. Mini-tuber seed size ranged from about 2 to 7 gms. These selections were spaced 36 inches apart in 32-inch rows.

Matrix was applied at 0.0234 lb ai/acre with 0.25 percent by volume R-11 surfactant with a conventional ground sprayer on August 2. Weather conditions were clear skies, calm, and 75 °F. Potato plants ranged from just emerged to near row closure. Weeds ranged from lambsquarter and redroot pigweed nearly 12 inches tall to nightshade and mallow plants over 8 inches in diameter. Minor populations of shepherds purse, filaree, Indian lovegrass, and kochia were also present but plants were quite small.

Results and Discussion

Planting was delayed until one month past normal by wet soil conditions. Additional rainfall of 1.04 inches was recorded at KES in the 24 hours following planting of this trial. These conditions led to some loss of stand due to seed decay, and uneven emergence of plants. The ground cracking timing varied by several days. When Matrix was applied on July 13, potato plants ranged from just emerging to plants 4 inches high. Weed size varied from cotyledon stage to 4-leaf stage or beyond. Weed pressure was relatively light throughout the study area.

Layby treatments were not applied as both investigators were out of town during the period these treatments should have been made. As a result, treatment comparisons can only be made between the four rates of Matrix and an Eptam control. Efficacy ratings for redroot pigweed, hairy nightshade, filaree, and mallow are presented in Table 1. All Matrix treatments provided complete control of these species. Some pigweed and nightshade escapes were observed in each of the four Eptam treatments. The data for Eptam control represents an average for the four treatments that received pre-emergence Eptam applications. No evidence of injury to potato foliage was observed in any of the treatments.

Yield data, by grade, are presented in Tables 2 and 3. Table 2 shows yields for all

1995 Evaluation of the Herbicide Matrix on Russet Norkotah Potatoes at Klamath Falls, Oregon

eight treatments, even though numbers 5-8 were identical. The statistical analysis presented in this table was done using all eight treatments. In Table 3, statistical analysis only included the four Matrix treatments and treatment number 8.

The post-emergence application of Matrix provided excellent control of the weed species present at the trial site, while pre-emergence application of 3.0 lb ai/acre of Eptam did not give complete control of redroot pigweed or hairy nightshade (Table 1). Yield and grade data show a significantly higher yield of 4-12 ounce U.S. No.1s for the 2.0 and 3.0 ounce/acre Matrix treatments than for all Eptam treatments whether analyzed using all treatments or only one Eptam treatment. No significant differences were found for any of the other yield parameters, although Matrix at 2.0 ounces/acre produced numerically higher total and total U.S. No.1 yields than all other treatments. The data suggest application of Eptam may produce some degree of crop injury.

Weed control has been difficult to achieve in the single-hill red-skinned selections in previous years because of the inability to use metribuzin products and the low plant density. Significant hand weeding has been necessary in these plots in each year since 1988. Matrix provided very satisfactory weed control, eliminating the need for hand weeding except for a few of the largest pigweed and lambsquarter plants. Most of the escapes were stunted and deformed, and did not achieve 50 percent of normal size by mid-September. Excellent control of nightshade and mallow was observed. There was no evidence of foliage injury to any of the many red-skinned breeding selections or Shepody.

While circumstances did not allow evaluation of the combination of Matrix with Lexone, this combination has been evaluated previously at KES in trials with the Shepody variety. Preliminary findings indicated that the product was more effective in controlling nightshade than metribuzin, and crop injury was minor, except when application was made in a near-frost situation.

The decision by E.I. du Pont de Nemours and Co., Inc. to market the product, Matrix, without adding Lexone, appears to be the correct decision for the industry. The growing acreage of metribuzin-sensitive varieties will be best served by this product without adding Lexone. Matrix will be a very important addition to the arsenal of weapons for weed control in the northwest.

Table 1. Effect of herbicide treatments on four weed species in potatoes at the Klamath Experiment Station, Klamath Falls, OR, 1995.

Treatment				Efficacy rating July 21			
No.	Product	Rate	Date	Pigweed	Nightshade	Filaree	Mallow
		lb ai/A		%			
3	Matrix	0.0156	7/13	100	100	100	100
1	Matrix	0.0234	7/13	100	100	100	100
4	Matrx	0.0313	7/13	100	100	100	100
2	Matrix	0.0468	7/13	100	100	100	100
5 - 8	Eptam	3.5	6/22	88	90	100	100

Table 2. Effect of herbicide treatments on yield, grade, and size distribution of Russet Norkotah potatoes at the Klamath Experiment Station, Klamath Falls, OR, 1995.

Treatment			Yield U.S. No. 1s			Yield			
No.	Product	Rate	4 - 12 oz	>12 oz	Total	Bs	No. 2s	Culls	Total
		lb ai/A	cwt/A						
3	Matrix	0.0156	216	121	337	24	6	12	379
1	Matrix	0.0234	212	117	329	32	3	23	387
4	Matrix	0.0313	248	127	375	34	5	13	427
2	Matrix	0.0468	249	94	343	26	8	14	391
5	Eptam	3.5	189	135	324	26	7	17	374
6	Eptam	3.5	180	135	315	28	8	15	366
7	Eptam	3.5	211	99	310	28	2	12	352
8	Eptam	3.5	201	103	304	26	3	14	347
Mean			213	116	330	28	5	15	378
CV (%)			12	29	13	38	91	51	12
LSD (0.05)			38	NS	NS	NS	NS	NS	NS

Table 3. Effect of herbicide treatments on yield, grade, and size distribution of Russet Norkotah potatoes at the Klamath Experiment Station, Klamath Falls, OR, 1995.

Treatment			Yield U.S. No. 1s			Yield			
No.	Product	Rate	4 - 12 oz	>12 oz	Total	Bs	No. 2s	Culls	Total
		lb ai/A	cwt/A						
3	Matrix	0.0156	216	121	337	24	6	12	379
1	Matrix	0.0234	212	117	329	32	3	23	387
4	Matrix	0.0313	248	127	375	34	5	13	427
2	Matrix	0.0468	249	94	343	26	8	14	391
8	Eptam	3.5	201	103	304	26	3	14	347
Mean			225	112	337	29	5	15	386
CV (%)			11	27	12	38	91	51	12
LSD (0.05)			36	NS	NS	NS	NS	NS	NS