1991 Crop Research

Klamath Agricultural Experiment Station

in cooperation with

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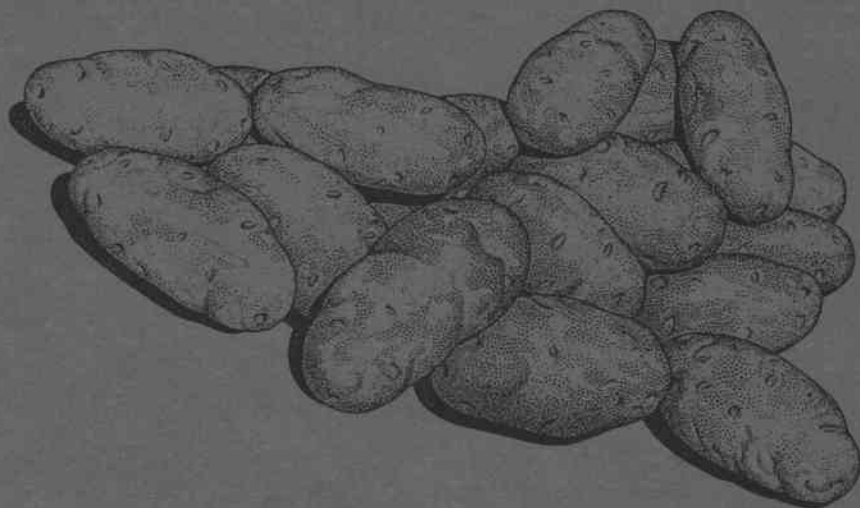

Special Report 895
June 1992

Agricultural Experiment Station
Oregon State University, Corvallis

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INTRODUCTION

The Klamath Experiment Station (KES) staff are pleased to present the annual report on KES research programs conducted in 1991. This is the fifth in a current series of special reports dating back to 1987. We hope our readers will glean useful information from the findings of research efforts in cereals, forages, potatoes, and sugarbeets. Comments and suggestions that will help us better fulfill our mission are welcome.

Our audience will note that many of the KES programs are cooperative efforts involving research personnel from the Oregon State University (OSU) campus, from University of California (UC) Davis, and from institutions in other states. We believe that teamwork is vital to the success of programs at KES, allowing us to make contributions to agriculture, not just in the Klamath Basin, but in other areas of Oregon and the region. This cooperation is also important to our efforts to secure extramural funding for specific research projects.

I take this opportunity to recognize the personnel from other OSU units, from UC Davis, and from other institutions, who are major contributors to KES research projects. Their contributions are, and will continue to be, deeply appreciated.

Oregon State University:

Dr. Peter Ballerstedt,	Department of Crop and Soil Science
Mr. Mylen Bohle,	Crook County Cooperative Extension Agent
Dr. Neil Christensen,	Department of Crop and Soil Science
Dr. David Hannaway,	Department of Crop and Soil Science
Dr. Patrick Hayes,	Department of Crop and Soil Science
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Mr. Steven James,	Central Oregon Agricultural Research Center

University of California, Davis:

Dr. Harry Carlson,	Intermountain Research and Extension Center
Mr. Don Lancaster,	Cooperative Extension Director, Modoc County
Mr. Steve Orloff,	Farm Advisor, Cooperative Extension, Siskiyou County
Dr. Ron Voss,	Department of Vegetable Crops

USDA - ARS, Aberdeen, Idaho:

Dr. Joseph Pavek,	Potato Genetics

North Dakota State University:

Dr. Robert Johansen,	Department of Horticulture and Forestry

Klamath County deserves recognition as a major partner with Oregon State University in the support and operation of the KES since its establishment more than 50 years ago. Klamath County owns the land and buildings at KES, contributed major resources to recent renovations and upgrading of facilities, and provides two full-time employees to current staffing. We hope this relationship can survive the effects of reduced county revenues resulting from declining timber sales receipts.

Finally, I thank the KES staff for their efforts and dedication in completing 1991 research projects and several years of facility upgrades, and KES Advisory Board members for their counsel and support.

Ken Rykbost, Superintendent
KLAMATH EXPERIMENT STATION

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Weather and Crop Summary, 1991

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

Weather conditions play a major role in determining the yield and quality of crops grown in the high-desert climate of the Klamath Basin. The Klamath Basin typically receives approximately 12 inches of precipitation annually, and at over 4,000 feet elevation, often experiences crop damaging frosts. Currently, the region is experiencing several years of below normal precipitation, In 1991, the moisture deficit resulted in reduced water deliveries to a significant acreage serviced by irrigation projects supplied from Gerber Reservoir and Clear Lake. At mid-winter, the prospects for replenishing depleted water storage supplies were not encouraging. While short-term weather phenomenae are important in explaining crop performance, the long-term impact of the present dry cycle is a factor to be considered in crop selection and management for the future.

An official weather station is maintained at Kingsley Field, one-half mile east of the KES. It is at 4,090 feet elevation, 42°10′ N latitude and 121°45′ W longitude. KES also maintains limited weather observation capabilities. Data from the two stations are very consistent with the exception that daily minimum temperatures are usually 1 to 3°F lower at KES. Climatological Data, Oregon, published by the National Oceanic and Atmospheric Administration, provided the data base for a portion of weather records (Tables 1 through 3). KES data were used to replace missing observations and as the base for all weather data for 1989 through 1991.

The 1991 growing season was characterized by low temperatures with frequent frosts through May and June, near normal temperatures in July and August, and unusually high temperatures in September and October. Significant rainfall in early May was the end of a series of late-winter and early-spring storms that provided some relief from a very dry fall and winter. The remainder of the season from late May through October, was one of the driest growing seasons on record in the Klamath Falls area. The frost-free season at the KES site extended from June 20 to September 21, 93 days.

Weather records are summarized on a weekly basis from April 1 through October 27 (Tables 1-3). This period approximates the local field activity season from earliest planting of crops to completion of harvest. Average data for the 12-year period from 1979 through 1990 are presented for comparison with 1991 data. This period includes several years with relatively warm temperatures compared to long-term means for Klamath Falls.

Air temperature data (Table 1) show a very clear and consistent three-phase seasonal trend. April, May, and June experienced temperatures approximately 4°F below the 12-year mean. July and August temperatures were very close to the 12-year average. September and October experienced unusually warm weather. While the mean temperature for the 30-week period was identical in 1991 and for the 12-year period from 1979 to 1990, the 1991 season was far from average in temperature distribution.

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

Crop production in the Klamath Basin is strongly influenced by late spring frosts. Weather records since 1979 (Table 2) show a risk of frost through the last week of June. Frost pockets in southern areas of the basin typically experience low temperatures several degrees below minimum temperatures recorded at Kingsley Field or KES. This suggests some risk of frost in the area for all but about four weeks from mid-July to mid-August. In 1991, frosts were experienced at KES on 14 days in May and 6 days in June. Lows of 24°F were recorded on May 3, May 9, and May 19. A low of 27°F occurred on June 14. Frosts were much more frequent in April, May, and June in 1991 than in the previous 12-year period (Table 2).

Temperatures were unusually high in September and October. Daily highs exceeded 80°F on 20 days in September and 14 days in October. Long term daily high temperature records were set or equalled on four dates in October, 1991. September temperatures equalled the record as the warmest September since records began in 1949.

In 1991, precipitation during the 30-week period from April through October was 82 percent of the average for the previous 12 years (Table 3). Two-thirds of this was received in April and May. No rainfall occurred between August 22 and October 24. The 1991 total annual precipitation recorded at Kingsley Field was 9.72 inches, representing 81 percent of the 42-year average of 11.98 inches.

The cold spring weather resulted in low yields and poor quality in the first cutting of alfalfa. Virtually all of the first cutting in the region was frost damaged and yields were about 50 percent of normal. Second and third cuttings produced typical yields and excellent quality in those areas with adequate irrigation supplies. Pasture production was reduced by cool conditions early. Areas with adequate water supplies maintained good production into late fall.

Potato crops were slow to develop in May and June. Frost protection with solid-set sprinklers avoided any serious injury, but crops were about two weeks behind normal development by the end of June. High temperatures during the remainder of the season allowed some recovery from the slow start. In general, yields were lower than normal and tuber size was somewhat smaller in the Russet Burbank crop. Heat sprouting, was a common problem observed in August. High temperatures in the fall will probably result in early sprouting of untreated crops in storage. Loss of tuber firmness, observed in a number of experimental lines, was attributed to high temperatures at harvest and in early storage.

Sugarbeet early development was also slowed by the cool spring. Frost injury affected stands in fields that were dry in critical periods of low temperatures during May. However, relatively few fields were replanted. Timely irrigation prevented serious stand loss due to frost injury. Weed competition was enhanced by weather conditions and presented a more serious problem than frost injury in many cases. Flea beetle injury was noted in several fields. No serious disease problems were experienced in the sugarbeet crop. While weather conditions in the spring contributed to lower yields than in the 1990 crop, the relatively warm fall and late harvest resulted in very high sugar contents. Several fields approached 20 percent sugar content and the average content for the area was 18.5 percent sugar.

Cereal crops under irrigation produced good yields and quality. Dryland crops were poor due to the lack of rain at critical periods. Russian wheat aphids were more prevalent than in previous years and presented a significant problem in stressed crops grown under dryland conditions. Grain maturity was delayed somewhat by the lack of early frosts. Excellent harvesting conditions through October provided adequate time to complete harvest.

Although Klamath Falls weather records indicate near normal precipitation for the period from 1986 through 1990, watersheds that supply Clear Lake, Gerber Reservoir, and Klamath Lake have experienced below normal snow cover in recent winters. Gerber Reservoir and Clear Lake were drawn down to minimum storage levels in 1991. Precipitation in 1992 during January, February, and March has been about 30 percent of normal. Limited water supplies could have a major impact on agricultural production in the Klamath Basin in 1992.

Table 1. Weekly average maximum, minimum, and mean temperatures for 1991 and the 12-year period from 1979 to 1990, and the accumulated departure of 1991 weekly means from the 12-year average at Klamath Falls, OR.

		1979-1990 Weekly average			1991 Weekly average			1991 Accumulated
Weekly period		Max	Min	Mean	Max	Min	Mean	departure[1]
		°F						
April	1- 7	54	29	42	60	31	45	+ 3
	8-14	59	30	45	53	25	39	- 3
	15-21	61	33	47	53	29	41	- 9
	22-28	59	33	46	54	29	42	-13
	29- 5	62	34	48	62	31	47	-14
May	6-12	61	34	48	56	33	44	-18
	13-19	67	36	51	55	33	44	-25
	20-26	69	40	55	68	34	51	-29
	27- 2	68	41	55	64	33	48	-36
June	3- 9	70	42	56	69	37	53	-39
	10-16	74	43	59	74	38	56	-42
	17-23	76	46	61	69	36	53	-50
	24-30	79	47	63	66	42	54	-59
July	1- 7	78	46	62	88	57	73	-48
	8-14	81	48	65	85	50	68	-45
	15-21	83	50	67	78	49	64	-48
	22-28	85	50	67	86	52	69	-46
	29- 4	85	48	67	89	49	69	-44
Aug.	5-11	87	50	69	79	48	63	-50
	12-18	83	47	65	85	48	66	-49
	19-25	80	47	64	88	47	68	-46
	26- 1	79	44	62	79	42	61	-47
Sept.	2- 8	80	44	62	86	46	66	-43
	9-15	76	40	58	78	38	58	-43
	16-22	71	38	55	86	43	64	-34
	23-29	70	38	54	83	41	62	-26
	30- 6	72	36	54	83	38	61	-19
Oct.	7-13	68	34	50	82	40	61	- 8
	14-20	62	30	46	77	34	55	+ 1
	21-27	61	32	47	55	31	43	- 3
Mean		72	40	56	73	39	56	

1/ Accumulated difference in mean weekly temperature between 1991 and the 12-year period from 1979 - 1990.

Table 2. Weekly minimum temperatures and percent of days with frost for 1991 and the 12-year period from 1979 to 1990 at Klamath Falls, OR.

Weekly period		Weekly minimum		Frost days/week	
		12-year	1991	12-year	1991
		°F		%	
April	1- 7	11	22	76	57
	8-14	17	15	68	86
	15-21	17	19	48	71
	22-28	21	21	52	71
	29- 5	22	19	35	57
May	6-12	23	24	50	57
	13-19	19	24	37	57
	20-26	24	26	17	29
	27- 2	27	28	18	57
June	3- 9	28	29	6	14
	10-16	29	27	4	29
	17-23	33	30	0	43
	24-30	31	34	0	0
July	1- 7	33	45	0	0
	8-14	35	40	0	0
	15-21	36	45	0	0
	22-28	40	47	0	0
	29- 4	39	43	0	0
Aug.	5-11	37	42	0	0
	12-18	37	42	0	0
	19-25	36	41	0	0
	26- 1	32	38	1	0
Sept.	2- 8	31	32	1	14
	9-15	29	33	10	0
	16-22	26	28	15	14
	23-29	26	36	20	0
	30- 6	20	33	24	0
Oct.	7-13	18	34	35	0
	14-20	18	28	68	43
	21-27	20	25	58	57

Table 3. Weekly and accumulated precipitation for 1991 and the 12-year period from 1979 to 1990 at Klamath Falls, OR.

Weekly period		1979-1990 Weekly	1979-1990 Accumulated	1991 Weekly	1991 Accumulated
		---------- Precipitation, inches	----------		
April	1- 7	.13	.13	.26	.26
	8-14	.11	.24	.02	.28
	15-21	.17	.41	.40	.68
	22-28	.29	.70	.29	.97
	29- 5	.16	.86	.07	1.04
May	6-12	.16	1.02	.06	1.10
	13-19	.13	1.15	1.26	2.36
	20-26	.24	1.39	.01	2.37
	27- 2	.28	1.67	.19	2.56
June	3- 9	.23	1.90	.01	2.57
	10-16	.14	2.04	.00	2.57
	17-23	.06	2.10	.04	2.61
	24-30	.09	2.19	.23	2.84
July	1- 7	.03	2.22	.00	2.84
	8-14	.02	2.24	.00	2.84
	15-21	.17	2.41	.34	3.18
	22-28	.05	2.46	.00	3.18
	29- 4	.08	2.54	.00	3.18
Aug.	5-11	.06	2.60	.02	3.20
	12-18	.06	2.66	.10	3.30
	19-25	.15	2.81	.11	3.41
	26- 1	.19	3.00	.00	3.41
Sept.	2- 8	.10	3.10	.00	3.41
	9-15	.12	3.22	.00	3.41
	16-22	.49	3.71	.00	3.41
	23-29	.20	3.91	.00	3.41
	30- 6	.06	3.97	.00	3.41
Oct.	7-13	.18	4.15	.00	3.41
	14-20	.07	4.22	.00	3.41
	21-27	.38	4.60	.37	3.78

Official Sugarbeet Variety Trials

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

INTRODUCTION

The California Beet Growers' Association (CBGA) Seed Committee determines which cultivars may be planted in each district served by the Association. Decisions are based on the performance of varieties in officially sanctioned trials, the severity of various diseases in a district, and varietal response to major diseases. The University of California Intermountain Research and Extension Center at Tulelake (IREC) and the Klamath Experiment Station (KES) conducted official variety evaluation trials in 1991 on behalf of the CBGA.

METHODS

KES

The trial site soil was a Hosely Sandy Loam. Previous crops were potatoes in 1990, barley in 1989, and several years of alfalfa. Soil analysis has shown a high level of potassium, low to medium phosphorous, organic matter content of approximately 0.5 percent, and a soil pH of 7.5 to 8.5 at the site. High soluble salt content occurs in portions of the field, but not in the location of this trial.

The field was plowed on April 1. Gypsum at 1.0 T/A (ton/acre) and 16-16-16 analysis fertilizer at 320 lbs/A were broadcast and harrow-incorporated on April 15. The seedbed was firmly compacted with a brillion roller on May 2. Twenty-four varieties were planted (May 3) in a randomized complete block design with four replications on. Seed was planted at approximately 0.5 inch depth at 8 to 12 seeds/foot with a hand-operated planet-junior type planter in 22-inch rows. Individual plots were two rows, 15 feet long.

Betamix herbicide (1.3 lbs ai/gal) was applied at 2.0, 3.0, and 4.0 pints/A on May 23, May 29, and June 3, respectively. Hand weeding was needed to control escapes, primarily Filaree. A flea beetle infestation was effectively controlled with Sevin applied at 1.5 pints/A on May 29. Stands were hand-thinned to approximately 8-inch plant spacing on June 10. Nitrogen, at 80 lbs N/A (solution 32), was applied with a conventional ground sprayer and incorporated with sprinkler irrigation on July 2. Irrigation, supplied with solid-set sprinklers, totalled 20.2 inches for the season. Rainfall from planting to harvest was 2.4 inches.

1/ Superintendent/Associate Professor and Assistant Professor, respectively, Klamath Experiment Station, Klamath Falls, OR.
2/ Superintendent/Farm Advisor, University of California Intermountain Research and Extension Center, Tulelake, CA.

Acknowledgments: Financial support for these studies from the CBGA, American Crystal Sugar Company, Betaseed Inc., Hilleshög Inc., Holly Sugar Corporation, Seedex Inc., and Spreckels Sugar Company Inc. is gratefully recognized. Appreciation is also expressed to Holly Sugar Corporation for providing laboratory analysis of sugar content.

Beet tops were removed with a flail chopper immediately prior to harvest. Beets were hand-harvested on October 15. All beets from both rows of each plot were counted and weighed. All beets from one row were analyzed for percent sucrose, nitrate-N content, and tare by Holly Sugar Corporation. Yield, sugar content, and beet population data were statistically analyzed using MSU Stat software.

IREC

The trial was established on Tulebasin Fine Silty Loam soil with approximately 12 percent stable organic matter content. This is a very fertile site capable of producing high yielding field and vegetable crops. Soil reaction is near neutral. The previous crop history was fallow with fall oat cover in 1990 and potatoes in 1989.

Field preparation consisted of primary tillage with a roto-harrow preceded by a broadcast application of 200 lbs/A of 16-20-0 and 400 lbs/A of 21-0-0. Beets were seeded into raised 24-inch wide beds on April 27 using a research adapted small plot cone planter. Seeding rates were adjusted for seed size so that 95,000 seeds/A were sown for all varieties evaluated. Planting depth was approximately 0.5 inches. Individual plots were three rows 25 feet long. The trial was arranged in a randomized complete block design with four replications.

A postemergence application of Betamix herbicide at 5½ pints/A was made on June 1. Weeds not controlled were removed by hand on June 6. The trial area was treated with Seven at 2 pints/A for control of flea beetles on May 24 and May 31, and for armyworm control on July 17. Elemental sulfur was applied at 12 lbs/A on August 21 and September 5 for control of powdery mildew.

The trial area was irrigated with solid set sprinklers until July 7 and by furrow flooding through the remainder of the season. A total of 3.5 acre feet of water was applied for the season through irrigation and rainfall. Stands were hand-thinned on June 25 to approximately 7-inch spacing.

On October 21 beets from the center 18 feet of the center row were dug and topped by hand, counted, and weighed. All harvested beets from each plot were sent to Holly Sugar Corporation for percent sucrose, nitrate-N, and tare determinations.

RESULTS AND DISCUSSION

Crop Establishment:

KES

Poor emergence occurred in selections 90N 146-012 and 90N 163-028. All other selections achieved stands of 3 to 8 plants per foot of row with uniform emergence. Plant stands after thinning ranged from approximately 33,000 to 39,000 plants/A (Table 1) on selections other than 90N 146-012 (18,800 plants/A) and 90N 163-028 (25,700 plants/A).

Plant vigor was rated on a scale of 1 (worst) to 5 (best) on May 30 (Table 1). Selections showing the best early season vigor were ACH 870332, ACH 177, WS 62, Beta 1996, and ACH 191. Poor vigor was noted for 90N 146-012 and 90N 163-028.

IREC

The modified seeder planted weighed amounts of seed in each plot; however, seed distribution was systematically clumped at approximately 12-inch intervals in the row. Final plant populations fell below the target stand of 35,000 plants/A in many plots due to poor crop emergence and clumping of seed by the planter. Prethinning populations ranged from a low of 15,100 plants/A for 90N 163-028 to a high of 55,000 plants/A for H 90695 (Table 1).

Plant vigor was rated on the 1 to 5 scale used at KES on May 28. Exceptionally good vigor was noted for H 90695 and poor vigor was observed in 90N 163-028, H 90801, and 90N 146-012 (Table 1).

Summary Across Locations

Minimum air temperatures below 32° F were recorded at the KES weather station on 12 days in May and 4 days in June. The lowest temperature observed was 24° F, which occurred on May 3, May 9, and May 19. Tulelake experienced lows of 26, 25, and 33° F on these dates. The May 9 frost coincided with emergence at IREC and probably accounts for a portion of the stand loss. Emergence at KES occurred during a period of less cold stress and frosts were not a factor in crop establishment.

The poor performance of 90N 146-012 and 90N 163-028 at both locations indicates a weakness in seed quality or in adaptation. While several selections exhibited better than average seedling vigor they were not the same selections at both locations. The H 90695 selection was clearly superior to all others at IREC, but below average in vigor at KES. Those selections with the best vigor at KES were average at IREC.

Overall, crop establishment and early development was quite good at both locations in a year when air temperatures were several degrees below long-term means throughout May and June. Trials at both locations were maintained relatively free of weeds and pests. With the exception of stand variability at IREC, crop performance was largely a reflection of varietal response to soil and climatic factors.

Yield and Sugar Production:

KES

Beet yields at KES ranged from 20.9 to 26.5 tons/A (Table 2). Six entries, including the two standards, Monohikari and HH 55, exceeded 25.5 tons/A. None of the selections that exhibited superior early season vigor were among the six with the highest yields. H 90695, which had the best early vigor at IREC, achieved the lowest yield of all entries at KES. Poor stands in 90N 146-012 and 90N 163-023 did not seriously impact yields. With 58 percent and 80 percent of population means for the trial, respectively, yields were 94 percent of the mean yield for the trial.

Sugar content ranged from 15.7 percent to 17.8 percent at KES. Low sugar content was noted for 90N 146-012, 90N 163-028, SX 1, HH 55, ACH 203, and HH 50. The low sugar content in 90N 146-012 and 90N 163-028 was partially due to large beet size related to poor stands. Sugar content was lower than typical levels observed in commercial crops in 1991, but very similar to results obtained at IREC.

Total sugar production at KES ranged from 70.4 cwt/A for 90N 146-012 to 89.9 cwt/A for Monohikari (Table 2). H 89719 and SX 1401 ranked second and third behind Monohikari in sugar production. High sugar yields for Monohikari were consistent with results observed in two other trials at KES in 1991 and in a 12-entry variety trial in 1990.

IREC

Beet yields were significantly higher at IREC than at KES, but were also more variable, due in part to stand variability. Low yields were observed in H 90801, ACH 177, Monohikari, HH 55, and 9BG 6272 (Table 2). HH 50, ACH 203, ACH 199, and SX 1 achieved the highest yields at IREC. As was noted for KES, the entries rated high in early season vigor, H 90695 and WS 41, were not among the top yielding selections.

Sugar content was similar to percentages observed at KES. Low sugar content was noted for HH 55, ACH 203, SS 502, Monohikari, and H 90801 at IREC (Table 2). WS 26, Beta 1996, and 9BG 6276 achieved the highest percent sugar.

Total sugar production was approximately 20 cwt/A higher at IREC than at KES. HH 50, 9BG 6276, ACH 199, and SX 1 were among the varieties with the highest sugar yields. The lowest sugar production was observed in H 90801, HH 55, and Monohikari. Sugar yields were significantly different between these high and low yielding groups.

Summary Across Locations

Higher yields at IREC are probably largely due to a two-week longer growing season at IREC. The trial was planted one week earlier and harvested one week later at IREC. Results from planting date experiments at both locations suggest that the earlier planting date would account for at least 50 percent of the difference in yields and sugar production.

Variety performance was clearly influenced by location in many cases. Monohikari was among the top selections at KES but one of the poorest at IREC, while the reverse was true for HH 50. Three selections, SX 1, H 89719, and 9BG 6276, performed quite well at both locations.

The effects of plant population on yield and sugar production were undoubtedly a factor in variety performance at IREC. However, the relationship between population and yield, over a wide range of plant populations, does not appear to be as important as might be expected. Results from both variety trials and planting date experiments at two locations in 1991 have shown that stands as low as 50 percent of target populations are capable of achieving over 90 percent of yields at target stands. In fact, results suggest that target stands of 35,000 plants/A may be too high for this short-season area. Some of the smaller beets recovered in hand-harvested trials would be lost in commercial harvests. Lower populations would result in fewer small beets.

Conclusion

The IREC results must be interpreted with caution due to low and variable populations. However, the data suggest that HH 55 and Monohikari are not appropriate selections for organic soils. Both selections were low in yield and sugar content at populations near the average for this trial. Six selections achieved significantly higher total sugar production than either HH 55 or Monohikari.

In contrast, Monohikari achieved the highest sugar production of all entries in the KES trial. It was also ranked first in a second trial with 12 entries in 1991 and in a 12-entry trial in 1990. HH 55 has consistently produced relatively high beet yields but low sugar content at KES. In consideration of the high transportation costs this is a serious limitation for HH 55. Susceptibility to curly top virus will be a limitation for Monohikari if this disease becomes a problem in the future.

Several of the entries in this study performed well at both locations. The top seven in total sugar production include H 89719, 9BG 6276, SX 1, HH 50, ACH 203, ACH 199, and SS 502. These seven entries should be included in 1992 trials for further evaluation. Low sugar content detracted from excellent beet yields in SX 1, ACH 203, and SS 502. Other entries worthy of further evaluation include 9G 6915, Beta 1996, WS 26, and SX 1401.

Table 1. Plant vigor and populations for 24 varieties in official sugarbeet variety trials at Klamath Falls, OR and Tulelake, CA, 1991.

Selection	Vigor rating[1] KES	Vigor rating[1] IREC	Population KES 6/11	Population KES 10/15	Population IREC 6/25	Population IREC 10/21
			-------- 1000 plants/A			--------
H 89719	2.25	2.75	34.2	34.1	46.7	22.1
H 90695	2.25	4.75	34.5	32.9	65.0	28.1
H 90801	2.25	1.25	34.9	33.1	22.7	12.7
SS 502	2.25	2.25	38.5	33.7	38.8	21.2
9BG 6276	2.25	2.00	34.5	34.7	38.5	26.9
9BG 6272	2.75	2.50	39.2	37.8	43.2	22.1
Beta 1996	3.50	2.50	39.9	36.3	38.8	22.1
9G 6915	2.75	2.25	38.0	33.1	23.8	18.1
WS 26	3.00	2.75	35.6	34.2	44.5	24.8
WS 41	2.00	3.35	39.0	37.2	55.4	27.2
WS 62	3.75	2.50	39.2	35.0	41.7	20.0
WS 91	3.25	2.75	35.2	32.7	57.6	28.1
HH 55	2.50	2.50	36.8	33.1	42.0	20.0
HH 50	2.75	2.00	38.7	34.6	28.5	20.0
90N 146-012	1.75	1.50	18.8	19.2	22.7	16.6
90N 163-028	1.50	1.00	25.7	26.7	15.1	13.9
ACH 177	4.00	2.75	38.7	34.1	39.2	19.4
ACH 191	3.50	2.00	38.7	35.3	36.9	18.2
ACH 199	2.75	3.00	39.7	34.7	48.2	24.8
ACH 203	3.25	3.00	36.8	34.4	45.2	22.7
ACH 870332	4.25	2.75	38.3	33.3	34.1	18.8
Monohikari	2.50	2.75	37.1	33.5	38.7	22.4
SX 1	2.50	3.00	35.4	33.1	37.2	23.0
SX 1401	2.25	3.00	32.8	29.9	44.3	23.9
Mean	2.74	2.53	35.8	33.2	39.5	21.5
CV (%)	19.1	28.7	9.9	10.0	21.3	18.8
LSD (.05)	0.74	1.03	5.0	4.70	11.8	5.70

1/ Vigor rating scale - 1.0 = worst, 5.0 = best

Table 2. Yield, percent sugar, and total sugar production for 24 varieties in official sugarbeet variety trials at Klamath Falls, OR and Tulelake, CA, 1991.

Selection	Beet Yield			Sugar Content			Total Sugar Production		
	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean
	----- tons/A -----			------- % --------			------- cwt/A --------		
H 89719	25.9	32.8	29.3	17.2	17.0	17.1	89.5	111.6	100.6
H 90695	20.9	28.5	24.7	17.5	16.8	17.1	73.1	95.5	84.3
H 90801	24.8	22.2	23.5	16.9	16.6	16.7	83.5	72.8	78.1
SS 502	24.5	33.1	28.8	17.3	16.4	16.8	84.6	108.7	96.7
9BG 6276	24.9	32.5	28.7	17.2	17.8	17.5	85.3	115.7	100.5
9BG 6272	24.5	27.8	26.1	17.6	17.5	17.6	86.3	97.5	91.9
Beta 1996	21.4	30.9	26.1	17.5	18.1	17.8	74.7	111.7	93.2
9G 6915	24.2	31.0	27.6	17.7	17.3	17.5	85.5	107.0	96.3
WS 26	22.2	30.0	26.1	17.6	18.2	17.9	78.2	109.3	93.8
WS 41	22.3	30.2	26.2	17.6	17.2	17.4	78.3	103.3	90.8
WS 62	23.5	29.3	26.4	17.2	16.9	17.1	80.8	98.9	89.8
WS 91	22.1	28.3	25.2	17.8	17.4	17.6	78.5	98.4	88.4
HH 55	25.7	27.8	26.8	16.5	15.8	16.1	84.4	87.7	86.0
HH 50	22.5	34.5	28.5	16.7	17.4	17.1	74.8	120.6	97.7
90N 146-012	22.3	30.9	26.6	15.7	17.1	16.4	70.4	105.3	87.8
90N 163-028	22.4	31.1	26.7	16.8	16.7	16.8	75.3	103.8	89.5
ACH 177	22.8	26.5	24.6	17.8	17.4	17.6	80.7	92.5	86.6
ACH 191	24.8	29.0	26.9	17.1	16.9	17.0	84.9	97.8	91.3
ACH 199	22.4	33.4	27.9	17.4	17.3	17.4	77.8	115.6	96.7
ACH 203	25.6	33.8	29.7	16.3	16.4	16.4	83.5	110.8	97.1
ACH 870332	23.2	31.2	27.2	17.1	16.8	17.0	79.4	105.1	92.2
Monohikari	25.9	26.9	26.4	17.4	16.6	17.0	89.9	89.3	89.6
SX 1	26.5	33.4	30.0	15.8	16.9	16.3	83.3	113.6	98.4
SX 1401	25.7	29.4	27.5	16.9	17.1	17.0	87.2	100.4	93.8
Mean	23.8	30.2	27.0	17.1	17.1	17.1	81.2	103.0	92.1
CV (%)	9.1	14.6	12.8	6.1	4.5	5.7	10.8	14.8	13.8
LSD (.05)	3.1	6.2	3.4	1.5	1.1	1.0	12.4	21.5	12.6

Proprietary Sugarbeet Variety Trial

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

INTRODUCTION

Individual sugarbeet seed companies were limited to four or five entries in official trials conducted at Tulelake, CA and Klamath Falls, OR on behalf of the California Beet Growers' Association, Ltd. Hilleshög Mono-hy Inc. supported a second variety trial at KES in 1991 to evaluate 10 of their proprietary selections in a comparison with the standard varieties HH 55 and Monohikari.

METHODS

The trial site soil was a Hosely Sandy Loam. Previous crops were barley in 1989 and 1990 and several years of alfalfa prior to 1989. The field was plowed April 1. Gypsum at 1.0 tons/A and 16-16-16 analysis fertilizer at 320 lbs/A were broadcast and harrow-incorporated on April 15. The seedbed was firmly compacted with a brillion roller on May 2. Twelve varieties were planted in a randomized complete block design with four replications on May 3. Seed was planted at approximately 0.5-inch depth at 8 to 12 seeds per foot with a hand-operated planet-junior type planter in 22-inch rows. Individual plots were two rows, 15 feet long.

Betamix herbicide (1.3 lbs ai/gal) was applied at 2.0, 3.0, and 4.0 pints/A on May 23, May 29, and June 3, respectively. Hand weeding was needed to control escapes, primarily filaree. Sevin was applied at 1.5 pints/A on May 29 to control a flea beetle infestation. Stands were hand-thinned on June 10 to approximately 8-inch plant spacing. Nitrogen, at 80 lbs N/A was applied as solution 32 with a conventional ground sprayer and incorporated with sprinkler irrigation on July 2. Irrigation, supplied with solid set sprinklers, totalled 20.2 inches for the season. Through the higher water use period of July and August irrigation was applied twice weekly. Rainfall from May 1 through harvest totalled 2.4 inches.

Beet tops were removed by hand and beets were hand harvested on October 15. Border plants between plots were discarded leaving a harvested plot size of two rows, 13.5 feet long. All beets from both rows were counted and weighed. All beets from one row were analyzed for sugar content by Hilleshög Mono-hy laboratory personnel.

RESULTS AND DISCUSSION

Emergence occurred on May 13, ten days after planting. All selections emerged uniformly with 5 to 8 plants per foot of row. Plant vigor was rated on a scale of 1 (worst) to 5 (best) on May 30 (Table 1). All selections exhibited quite good vigor and uniform plant size. Selections 9 and 8 were rated slightly better than others but differences were minor. Plant stands after thinning were very uniform at approximately 36,000 plants/A.

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

Early plant development was slowed by unseasonably cool weather through May and June. Average air temperatures at Klamath Falls were consistently 4° F below long-term means for the period. Frosts occurred on 12 days in May and 4 days in June. A minimum temperature of 24° F on May 19 had no apparent adverse effects on beet seedlings. However, the cool weather through June slowed early season plant development compared to crop progress observed in a 1990 variety trial.

Weather during July and August was typical for the area and crop development was rapid with no apparent stress. Unseasonably warm temperatures in September and early October resulted in vigorous growth up to harvest. No damaging frosts were experienced.

Beet yields were approximately 4 tons/A higher for the standard varieties Monohikari and HH 55 in this trial than in the larger variety trial. In part the difference was due to use of a tare factor in the official variety trial. In most samples the tare to account for soil and crown trim was approximately 10 percent. With this adjustment, yields for the standards were within 1 ton/A of those observed in the official variety trial.

Entries 7 and 9 achieved yields equivalent to those for Monohikari and HH 55 (Table 1). Significantly lower yields were observed in entries 8, 4, 10, and 5. Entry 2 was also included in the other variety trial at Klamath Falls. Its yield in that trial was 2.4 tons/A less than Monohikari.

Beet sugar content was higher in this experiment than in the official trial by 1.5, 0.9, and 1.7 percent, respectively, for Monohikari, HH 55, and entry 2. This difference is probably related to previous crop history and a higher residual soil nitrogen content in the official trial which followed a potato crop in 1990. Beet petiole nitrate levels were higher in early August and early September in trials that followed a potato crop than those grown after two years of barley.

High sugar content was observed in entries 4, 5, 8, and 10. However, the sugar content was not high enough to offset low yields for these entries. Entries 9 and 7 ranked second and third below Monohikari in total sugar production (Table 1). All other selections, including HH 55, were significantly lower than Monohikari in sugar yield.

Entries 4, 8, and 10 may be too low in yield to justify further evaluation locally. All other selections performed well enough that additional testing should be considered.

CONCLUSIONS

Several of the proprietary selections performed well enough to justify further testing in this region. Comparing results of this trial with the official variety trial at Klamath Falls, entries 7 and 9 would be ranked in the top five selections evaluated in 1991. In view of the poor performance of HH 55 and Monohikari in the Tulelake trial in 1991, it may be appropriate to evaluate several of these lines on an organic soil site.

Table 1. Plant vigor, population, yield, sugar content, and total sugar production of sugarbeet varieties at Klamath Falls, OR, 1991.

Selection	Vigor Rating	Population 6/11	Population 10/15	Beet Yield	Sugar Content	Sugar Yield
		1000 plants/A		T/A	-- % --	cwt/A
Monohikari	3.0	35.2	35.0	30.8	18.9	112.2
HH 55	3.4	35.6	35.9	29.7	17.4	99.4
1	3.3	36.6	37.0	28.5	17.9	98.6
2	3.5	35.6	34.8	28.5	18.0	98.9
3	3.5	34.6	34.3	28.4	17.8	98.2
4	3.1	35.8	34.3	24.7	18.9	89.7
5	3.6	35.0	34.3	27.1	18.8	98.7
6	3.3	35.8	35.2	28.9	17.6	98.0
7	3.0	36.0	38.3	31.0	17.7	105.6
8	3.8	37.4	35.9	24.4	19.4	91.6
9	4.3	35.6	34.8	30.1	18.3	105.9
10	3.1	37.4	38.1	25.1	19.2	93.0
Mean	3.4	35.9	35.7	28.1	18.3	99.2
CV (%)	---	--	--	2.5	2.6	7.5
LSD (.05)	---	--	--	2.9	0.7	10.3

Effects of Planting Date and Cultivar on Performance of Sugarbeets in the Klamath Basin

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

INTRODUCTION

A short growing season with a high risk of frost through mid-June potentially restricts yield and sugar content of sugarbeet crops grown in the Klamath/Tulelake Basin. In 1990, approximately 20 percent of commercial beets in the area were replanted due to frost damage. However, crops that are not injured during the vulnerable stage at or just prior to emergence, withstood relatively low temperatures subsequently with minimum damage.

With a short season, a yield advantage to early established beets is expected; but, harsh weather conditions early in the spring may make establishment of early crops difficult. Sugarbeet date of planting experiments were conducted on the Intermountain Research and Extension Center (IREC) and on the Klamath Experiment Station (KES) to evaluate the relationships between planting date, stand establishment, cultivar, and sugar yield.

PROCEDURES

Trials at both stations were conducted as randomized complete block experiments with four replications. Planting dates were assigned to main plots and two varieties, HH55 and Monohikari were randomly assigned to subplots. Six planting dates (April 18, April 26, May 3, May 10, May 20, and May 28) were evaluated in the KES study and eight planting dates were evaluated in the IREC test (April 3, April 10, April 18, April 25, May 3, May 8, May 22, and May 29).

At KES, main-plots were four rows, 32 feet long. Beds were formed on a 32-inch spacing with a two-row, assisted-feed potato planter. A starter fertilizer was banded at 4-inch depth on both sides of rows at 320 lbs/A of 16-16-16. Beds were formed and fertilizer applied on April 18, for April 18 and April 26 plantings; May 2, for May 3 and May 10 plantings; and May 15, for May 20 and May 28 plantings. Beds were firmly compacted with a brillion roller immediately after being formed. Preceding crops were; potatoes, barley, and several years of alfalfa. The field was plowed April 1 and gypsum was broadcast at 1.0 ton/A and incorporated with a harrow on April 15.

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Acknowledgment: Partial funding for these studies by the California Beet Growers' Association and the Oregon Center for Applied Agricultural Research is gratefully recognized.

The cultivars HH55 and Monohikari were randomly assigned to 16-foot split-plots within main-plots. Seed was planted at one-half inch depth with a hand operated planet-junior type planter. Due to seed size differences, seeding rates were approximately 12 seeds per foot for HH55 and 7 seeds per foot for Monohikari.

Betamix herbicide was uniformly applied to the entire KES experimental area at 2.0, 3.0, and 4.0 pints/A on May 23, May 29, and June 3, respectively. Hand weeding was necessary to control filaree, which escaped on all planting dates, and late emerging broadleaf weeds, which were most prevalent in the last two planting dates. An early infestation of flea beetles was controlled with Sevin, applied at 1.5 pints/A on May 29. Supplemental nitrogen at 80 lbs N/A (solution 32) was uniformly applied with a ground sprayer on July 2 and incorporated with sprinkler irrigation.

Uniform irrigation with solid-set sprinklers commenced on May 3, with light irrigation applied as needed, to supplement rainfall during crop establishment. During July and August, irrigation was applied twice weekly. Plant stands were hand-thinned with a goal of 6-inch plant spacing. Thinning dates ranged from June 8 for the April 18 planting date to June 28 for the May 28 planting date. Tops were removed with a flail chopper immediately prior to harvest on October 17, 1991. Beets were hand-harvested from the center two rows of each plot. Weights and number of beets were recorded separately for each row. All beets from one row were analyzed for tare and sugar content.

In the IREC test, variety subplot size was three 24-inch rows by 25 feet and planting date main plots were three rows by 50 feet. Planting was accomplished with a three-row experimental seeder using a measured seeding rate of approximately 4 seeds per foot of row for both varieties. Unfortunately the planter tended to place seeds in clumps resulting in several seeds being placed close together at 12-inch increments down the row. Difficult seedling emergence conditions and the clumped seed distribution led to less than optimum stands following hand thinning.

Prior to planting, the field was broadcast fertilized with 200 lb/A of 16-0-0 and 400 lbs of 21-0-0. The field was then disked and bedded into 24-inch rows. The previous crop was summer fallow with a full cover crop of oats.

Beginning April 10, the test area was irrigated through solid-set sprinklers as required for germination and emergence of beets in each planting date. On July 5, after all plantings had been established, the experiment was switched to furrow irrigation. Plants were thinned to no more than one plant every 6 inches approximately 5 weeks after planting. The trial area was treated with a broadcast application of Betamix herbicide at 5 1/2 pints/A on June 1, 1991. All remaining weeds were removed by hand thinning. The beets in the center 12 feet of the center row were hand harvested from each plot on October 21, 1991. Harvested beets were counted and weighed and sent to Holly Sugar in Hamilton City for tare and sugar percentage analysis.

RESULTS AND DISCUSSION

The yield and sugar production results for the Tulelake study are presented in Table 1, and the Klamath results are summarized in Table 2. These data are displayed graphically in Figures 1-3.

Beet Yield:

The yield of harvestable beets generally declined as planting date was delayed. At KES, this decline was linear over the planting dates evaluated. Beginning with the first planting date of April 18, yield declined an average of 1.26 tons/A for each week planting was delayed. The yield results with Monohikari and HH55 were very similar across all planting dates at KES.

At IREC, the yield response to planting date was more variable. The highest yields were attained with the April 10 planting date. Yields generally declined with plantings after April 10 but recovered somewhat when beets were planted on May 8 or later. Regression analysis was used to calculate the average loss in yield with each weeks delay in planting. The result of 0.35 tons/A lost per week delay at Tulelake was much lower than the 1.26 tons/A lost each week in the Klamath study. At IREC, Monohikari averaged 1.1 tons/A greater beet production than HH55.

Sugar Content:

The sugar content of harvested beets in the KES study averaged 16.4 percent and was generally not affected by the date of planting. The overall average sugar content was higher at Tulelake, 17.6 percent, and sugar percentages generally increased as planting dates were delayed. These differing trends in sugar percentage results are difficult to explain, but perhaps a partial explanation may be found in the way the two trials were fertilized and managed. All of the preplant fertilizer in the IREC study was applied broadcast and incorporated on March 22. The trial was then sprinkler irrigated regularly to maintain ideal soil moisture content for each planting date. On July 5, the IREC trial was switched to furrow irrigation with heavy water applications made every other week. Thus in the IREC trial it is possible that preplant nitrogen was lost by repeated irrigation prior to the planting of the later planting dates. Also higher late season flood applications in the IREC trial could have further reduced fertilizer availability. Thus at IREC, the increase in sugar content with later planting may have been a response to lower fertilizer nitrogen availability late in the season. On the other hand at KES, pre-plant starter fertilizer was applied just days prior to each planting and the nitrogen was added uniformly across all planting dates on July 2. The KES trial may have also been slightly over fertilized with nitrogen across all planting dates as evidenced by the generally low sugar percentages relative to the IREC trial.

Differences in plant populations and row widths between the two studies may also have added to the confusion over sugar response. The trial at KES was planted on 32-inch rows while the study at Tulelake used 24-inch rows. Also, established plant populations at KES were high and uniform across planting dates, while at Tulelake plant stands were below optimum, particularly in the earlier planted plots. Thus varying plant populations and competition between beets may have contributed to the observed divergences in sugar percentage response between the two studies.

In each planting, in both studies, the percentage sugar was significantly higher in the Monohikari variety than in HH55. Over all planting dates Monohikari averaged 1.0 percent higher sugar content than HH55 at Klamath and 0.9 percent higher at Tulelake.

Total Sugar:

Total sugar produced is the simple product between the beet tonnage harvested and the percentage of sugar in the beets. Total sugar also forms the basis for payment to the grower. At KES, sugar percentages were relatively constant across planting dates while yields declined with each planting delay, so the total sugar produced also declined with delayed planting. The decline in total sugar averaged 0.22 tons/A per week delay in planting past April 18. The total sugar results in the Tulelake study were complicated by rising sugar percentages with planting delays and by rebounding beet yields for the last three plant dates. As a result, total sugar production was good at IREC with both early and late planting dates. Total sugar production averaged near or over 5 tons/A on all planting dates except April 25 and May 3. The highest total sugar production resulted from the April 10 planting.

Monohikari produced more sugar at both locations. Averaged over all planting dates, total sugar production was higher for Monohikari by 0.43 tons/A at IREC and 0.28 tons/A at KES. At IREC, total sugar was highest for Monohikari at each planting date. At KES, Monohikari produced more sugar than HH55 on all planting dates except May 20.

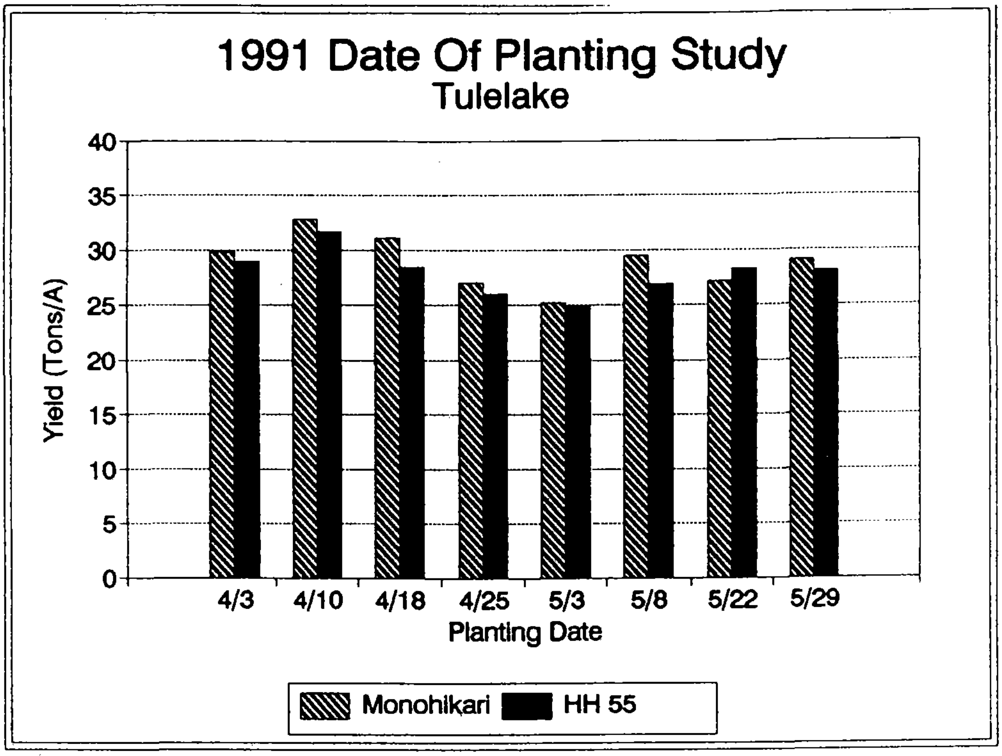
Table 1. Yield and sugar content of sugarbeets with varied planting dates - Intermountain Research & Extension Center.

Planting Date	Yield			Sugar			Total Sugar		
	Monohikari	HH55	Average	Monohikari	HH55	Average	Monohikari	HH55	Average
	---------- ton/A ----------			------------ % ------------			---------- ton/A ----------		
April 03, 1991	29.8	28.9	29.3	17.4	16.8	17.1	5.19	4.86	5.02
April 10, 1991	32.8	31.6	32.2	17.6	16.7	17.2	5.77	5.27	5.52
April 18, 1991	31.1	28.4	29.8	17.4	17.1	17.3	5.41	4.86	5.14
April 25, 1991	27.0	26.0	26.5	17.8	17.4	17.6	4.79	4.53	4.66
May 03, 1991	25.2	24.8	25.0	18.8	17.1	17.9	4.72	4.23	4.47
May 08, 1991	29.4	26.8	28.1	18.7	17.6	18.1	5.48	4.69	5.09
May 22, 1991	27.1	28.2	27.6	18.5	17.3	17.9	5.01	4.86	4.93
May 29, 1991	29.0	28.0	28.5	18.4	17.6	18.0	5.35	4.95	5.15
MEAN	28.9	27.8	28.4	18.1	17.2	17.6	5.21	4.78	5.00
CV%			10.4			4.5			10.2
LSD (0.05)			2.2			0.71			0.49

Table 2. Yield and sugar content of sugarbeets with varied planting dates - Klamath Experiment Station.

Planting Date	Yield			Sugar			Total Sugar		
	Monohikari	HH55	Average	Monohikari	HH55	Average	Monohikari	HH55	Average
	---------- ton/A ----------			------------ % ------------			---------- ton/A ----------		
April 18, 1991	33.3	34.6	33.9	17.1	16.0	16.5	5.70	5.53	5.61
April 28, 1991	30.6	32.8	31.7	17.7	15.8	16.8	5.41	5.19	5.30
May 03, 1991	32.9	29.4	31.2	16.4	15.7	16.0	5.38	4.63	5.01
May 10, 1991	30.7	29.9	30.3	16.8	16.2	16.5	5.14	4.84	4.99
May 20, 1991	27.3	28.5	27.9	16.6	16.2	16.4	4.52	4.59	4.55
May 28, 1991	26.5	26.8	26.6	16.9	15.7	16.3	4.49	4.20	4.34
MEAN	30.2	30.3	30.3	16.9	15.9	16.4	5.11	4.83	4.98
CV%			7.8			5.5			6.4
LSD (0.05)			2.1			NS			0.47

Figure 1. Effect of planting dates on beet yields in 1991 at the Intermountain Research and Extension Center (Tulelake, CA) and the Klamath Experiment Station (Klamath Falls, OR).



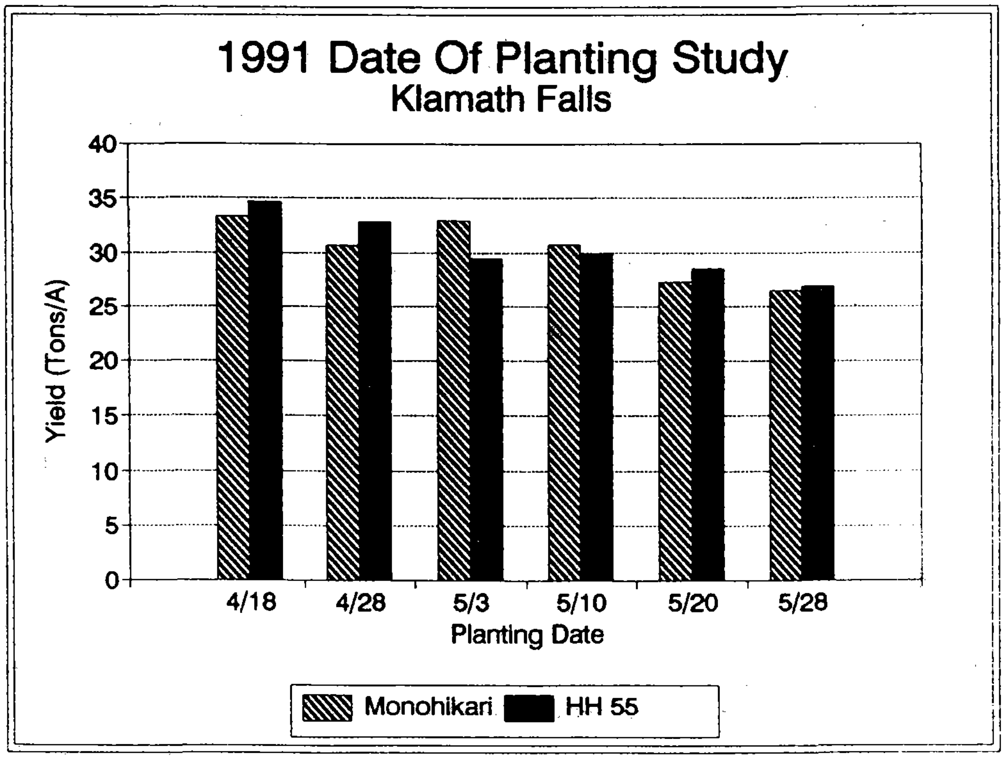
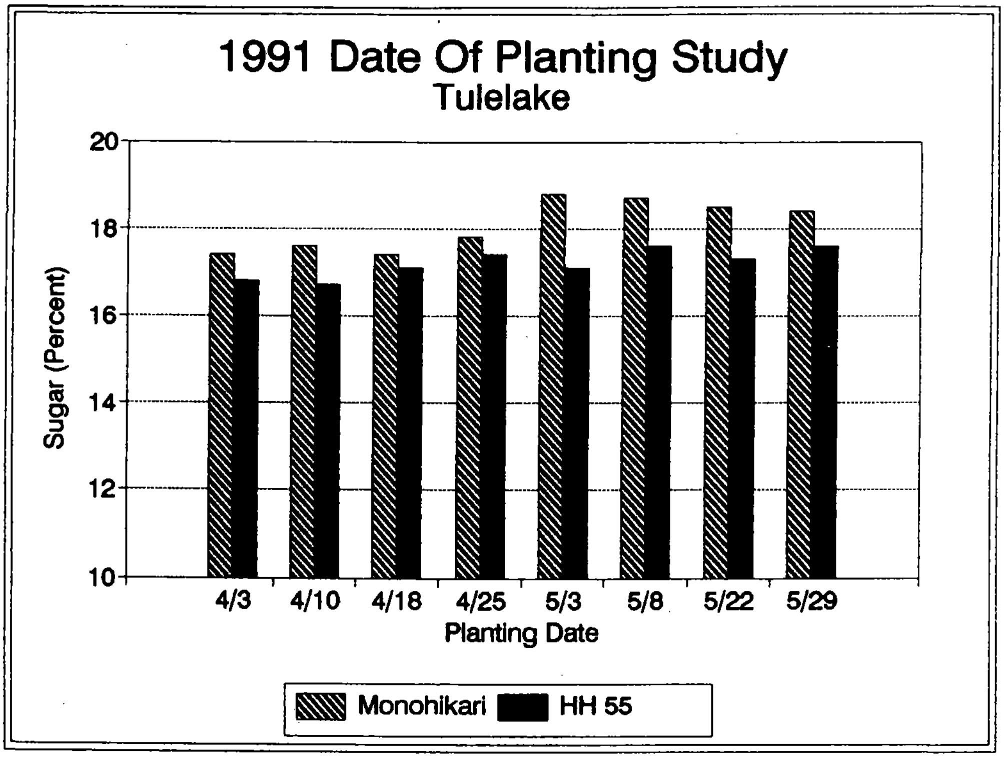


Figure 2. Effect of planting dates on beet sugar percentage in 1991 at the Intermountain Research and Extension Center (Tulelake, CA) and at the Klamath Experiment Station (Klamath Falls, OR).



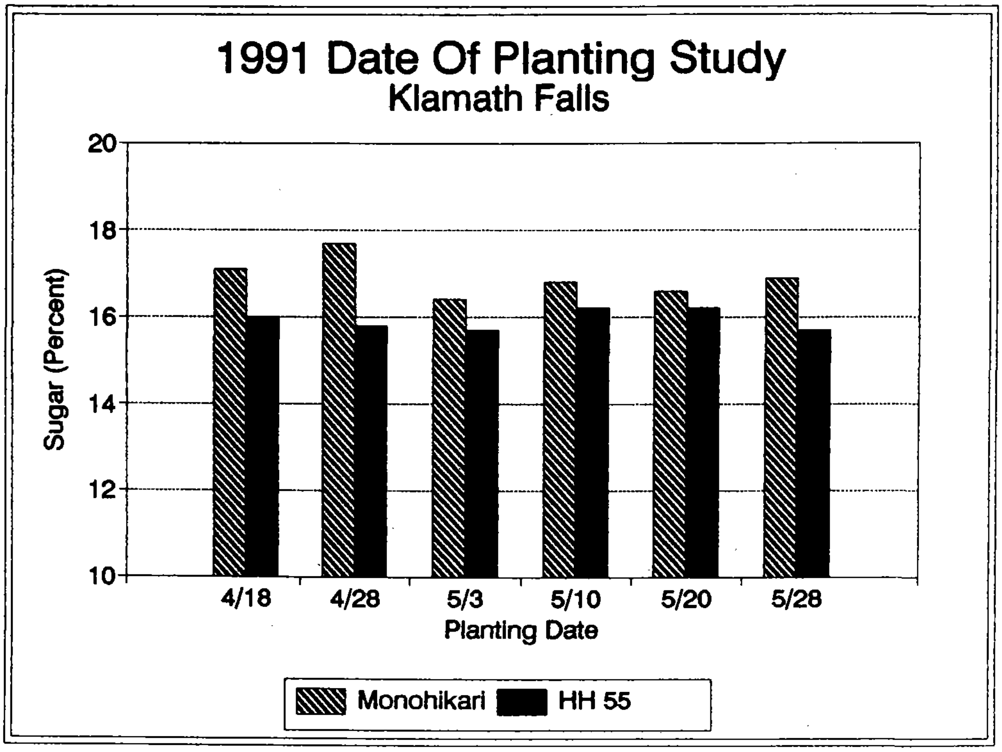
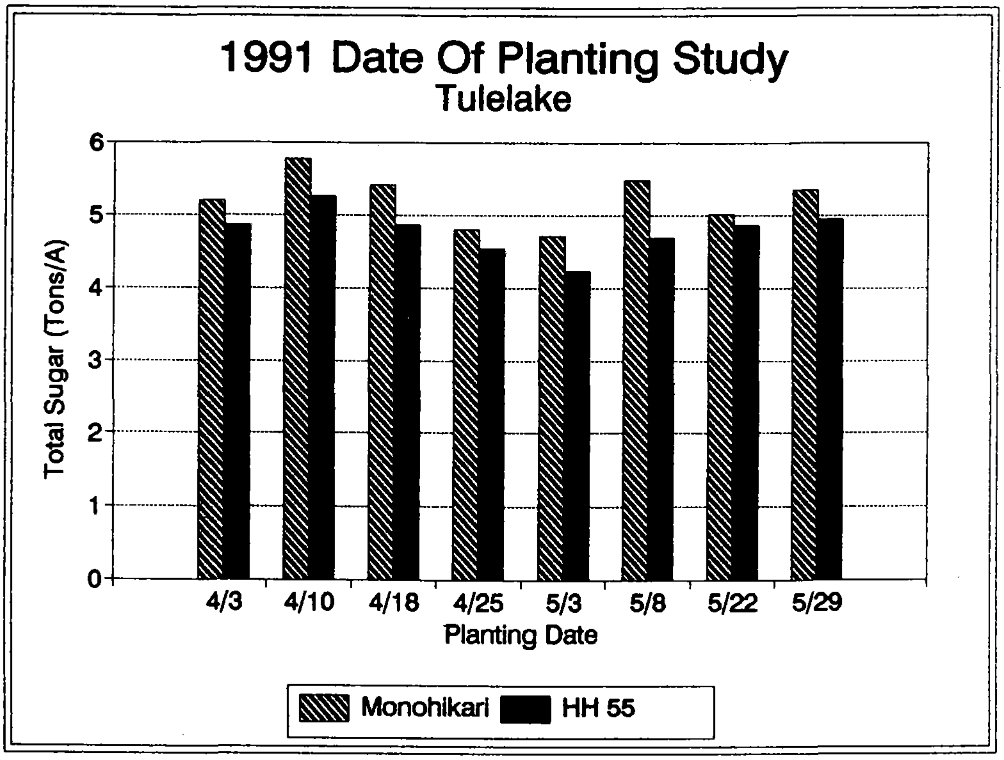
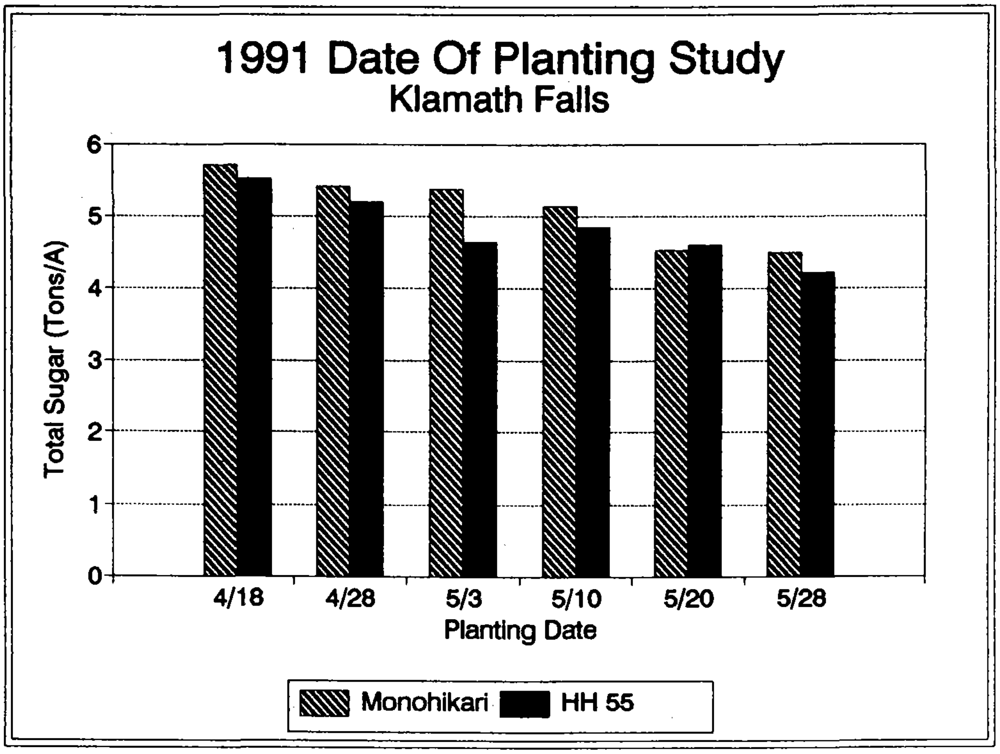


Figure 3. Effect of planting dates on total sugar production in 1991 at the Intermountain Research and Extension Center (Tulelake, CA) and at the Klamath Experiment Station (Klamath Falls, OR).





Sugarbeet Fertility

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

INTRODUCTION

Petiole analyses from several commercial sugarbeet crops in 1990 indicated a general trend of deficient levels of sulfur and calcium. Deficiencies in several minor elements were also observed with zinc, copper, and boron being borderline or deficient in every case. Experience with cereals has shown that banding an acidifying fertilizer has improved availability of micronutrients and grain yields on Klamath Basin soils. Gypsum is commonly used in local potato crops for improving soil tilth and also for nutritional benefits. A preliminary study was established at KES in 1991 to evaluate the response of sugarbeets to broadcast vs. banded starter fertilizer and gypsum.

METHODS

Soil conditions are described in the report on the official variety trial. Previous crops at this site were barley in 1989 and 1990 preceded by several years of alfalfa. The field was plowed on April 1. The experiment was a split-plot design with six replications. Main-plots were four 32-inch rows 32 feet long. Starter fertilizer (320 lbs/A of 16-16-16) was broadcast and harrow-incorporated on April 15, or banded at 4-inch depth on both sides of rows at the time of bed formation on May 2. Split-plots were 16-foot sections of eight rows with no gypsum or 1.0 T/A of gypsum broadcast and harrow-incorporated on April 15. Beds were firmly compacted with a brillion roller.

HH55 seed was planted at one-half inch depth with a hand-operated planet-junior type planter at approximately 12 seeds per foot on May 3. Beets were hand-thinned to a 6-inch spacing on June 7. Cultural practices were the same as described for other sugarbeet experiments.

Petiole samples were taken from each plot on August 2 and September 4. Beets were topped with a flail chopper and harvested on October 17. The number and weight of all beets from the center two rows of each plot were recorded. All beets from one row were analyzed for tare and sugar content.

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

Acknowledgment: Financial support of this study by the Oregon Center for Applied Agricultural Research and the California Beet Growers' Association is gratefully recognized.

RESULTS AND DISCUSSION

Treatments imposed had no visible effects on canopy development or crop health and minimal effects on sugarbeet production. Petiole analysis showed slightly higher nitrate nitrogen levels in beets with banded starter fertilizer (Table 1). Differences were not statistically significant. The application of 1.0 tons/A of agricultural gypsum did not affect petiole content of calcium, sulfur, or other nutrients.

Plant populations were very uniform throughout the experiment and close to the target population of 35,000 beets/A (Table 2). Beet yields were 0.7 tons/A higher when starter fertilizer was banded. This difference was not statistically significant. Fertilization method did not affect sugar content. The application of gypsum had no effect on beet yields but appeared to depress sugar content slightly.

The 30 tons/A yields were nearly identical to yields achieved by HH55 in the planting date study for May 3 planting. However, sugar content averaged 1.3 percent higher in this study. Previous cropping and fertilization history are believed to be the reason for this discrepancy. The planting date study followed a potato crop in 1990 while the fertility study followed a grain crop which received less fertilizer in 1990. Petiole nitrate nitrogen contents were higher at both sampling dates in beets grown following potatoes. High nitrate nitrogen levels late in the season are known to depress sugar contents.

Petiole nitrogen levels were higher than recommended for all beets sampled at KES in early September. Beet sugar contents from KES trials were consistently lower than in local commercial crops. The nitrogen fertilization program in all trials; 50 lbs N/A preplant and 80 lbs N/A applied in early July, was apparently excessive. Additional research is required to evaluate yield and sugar content responses to nitrogen fertilization on mineral soils in the Klamath Basin.

CONCLUSION

Growers have been using petiole analysis services as a tool to establish appropriate fertilization practices for this important new crop. Laboratories providing this service do not have locally derived calibration data to correlate petiole nutrient levels to crop performance. Critical or sufficiency range nutrient levels are being presented based on crops grown in other regions and soil types.

A comparison of petiole nutrient levels observed in this study with critical levels provided by Western Laboratories, Inc. (Parma, Idaho), suggests beets in this study were deficient in sulfur, calcium, magnesium, zinc, and copper. Samples from numerous commercial fields have been similarly diagnosed. The lack of petiole sulfur and calcium level responses to the application of gypsum, and the high beet yields achieved in this study, suggest the interpretation of petiole nutrient levels may not be appropriate for beets produced in the Klamath Basin.

Table 1. Effects of broadcast versus banded starter fertilizer and gypsum on petiole nutrient levels in HH55 sugarbeets, Klamath Experiment Station, OR, 1991.

Treatments		Petiole nutrient content								
Starter Fertilizer	Gypsum	NO_3-N	P	K	S	Ca	Mg	Mn	Zn	Cu
	tons/A	ppm	%					ppm		
		August 2								
Treatment Main Effects:										
Broadcast	---	7,600	0.28	3.6	0.09	0.27	0.22	31	9	3
Banded	---	9,200	0.29	3.8	0.10	0.27	0.23	43	10	3
----	0	8,400	0.29	3.6	0.09	0.27	0.22	36	9	3
----	1.0	8,500	0.28	3.8	0.10	0.27	0.23	39	10	3
		September 4								
Treatment Main Effects:										
Broadcast	---	4,000	0.14	3.1	0.10	0.30	0.25	36	9	3
Banded	---	5,000	0.20	2.7	0.11	0.27	0.24	38	9	3
----	0	4,800	0.17	2.8	0.10	0.28	0.24	35	9	3
----	1.0	4,300	0.17	3.0	0.11	0.28	0.25	39	9	3
Critical level[1]		7,600	0.22	2.5	0.20	0.40	0.30	27	17	5

1/ As reported by Western Laboratories, Inc. for crop status in early August.

Table 2. Effects of broadcast versus banded starter fertilizer and gypsum on beet yield, sugar content, and sugar yield of HH55 sugarbeets, Klamath Experiment Station, OR, 1991.

Treatment					
Fertilizer method	Gypsum	Beet population	Beet yield	Sugar content	Sugar yield
	tons/A	plants/A	tons/A	%	cwt/A
Broadcast	0	32,800	29.1	17.21	100
Broadcast	1.0	33,200	29.9	17.08	102
Banded	0	33,800	30.6	17.32	111
Banded	1.0	33,500	29.8	16.89	101
Treatment main effects:					
Broadcast	---	33,000	29.5	17.15	101
Banded	---	33,700	30.2	17.11	106
----	0	33,300	29.9	17.27	106
----	1.0	33,300	29.9	16.99	102

Red-Skinned Potato Variety Development, 1991

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

INTRODUCTION

Interest in red-skinned potatoes for both fresh and seed markets has increased in the Klamath Basin and in several areas in the western states. Red LaSoda remains as the predominant red variety grown for seed in the Klamath Basin and for fresh markets in Kern County, California. Red LaSoda produces high yields but is light in color, particularly after storage, has a high percentage of large tubers, and has deep eyes.

Northwestern potato variety development programs concentrate efforts on russet-skinned selections with processing potential. The search for superior red-skinned varieties adapted to the Klamath Basin was initiated at KES in 1988. Objectives of the two-pronged program are to: 1) evaluate named and released varieties and advanced selections under local conditions; and 2) screen progeny from red-skinned crosses to select one or more new cultivars specifically adapted to the Klamath Basin and other areas in the western states.

I. SINGLE-HILL SEEDLING SCREENING

Procedures

The North Dakota State University potato breeding program provided 5,016 first-generation mini-tubers from 37 crosses. Preselection on the basis of skin color, firmness, degree of sprouting, shape, and size of min-tubers reduced the number of clones planted to 3,177. The average weight of mini-tubers planted varied by families from approximately 2 to 8 grams.

All red-skinned selection trials were located in a field taken out of long-term alfalfa production in 1990. The soil was fumigated with Telone II applied at 20 gpa in August 1990. Clones were planted in 36-inch rows at 36-inch in-row spacing with an assisted-feed, two-row planter on May 22. Fertilizer included 600 lbs/A of 16-16-16 banded at planting and 50 lbs N/A applied as solution 32 on May 31. Weed control was achieved with Eptam applied at 3.5 lbs ai/A on May 31 and supplemental hand weeding. Aldicarb, at 3.0 lbs ai/A, was banded in the seed furrow at planting. Additional disease and pest control practices included aerial applications of Monitor on July 20

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Acknowledgment: The North Dakota University potato breeding program provides all tuber families for single-hill, first-generation screening. The program is partially funded by the Oregon Potato Commission, the Cooperative State Research Service (CSRS), and the Agricultural Research Service (ARS).

and August 10, Ridomil on July 10, and Kocide on July 20, August 10, and September 4, all at labelled rates. Vines were desiccated with Diquat applied with a conventional ground sprayer at 1 pt/A on September 2. A total of 18 inches of irrigation water was applied with solid set sprinklers.

Results and Discussion

Emergence and early plant development was delayed by cool weather through June. Plant vigor was clearly influenced by the size of mini-tubers planted. The best vigor occurred in families with larger average seed size. Final plant stands (Table 1) exceeded 90 percent in most families. High temperatures in July and August resulted in a significant incidence of heat sprouting and chain tuberization. Excessive vine growth and tuber skinning at harvest in some clones was probably enhanced by high residual soil nitrogen following a long-term alfalfa rotation.

Tuber families were dug with a two-row digger on September 23. A total of 170 clones were selected in the field and stored under typical seed storage conditions. On January 7 all clones were displayed and reselected. Skin color, dormancy, tuber firmness, shape, eye depth, and freedom from fusarium dry rot, common scab, and rhizoctonia were considered in evaluating clones. Forty selections were retained for further evaluation. The most successful parents in the crosses were 1196-2R (16 clones) and 2225-1R (15 clones).

Five tubers from each clone selected on January 7 were eye-indexed for virus infection. Virus-free lines will be planted in 12-hill plots at KES in 1992.

II. SECOND GENERATION SEEDLING SCREENING

Procedures

Fifty single-hill selections from 1990 were eye-indexed and grown in a greenhouse for disease evaluations. Forty-eight virus-free clones were planted in 12-hill plots on May 22. Seed pieces were spaced at 9 inches in 36-inch rows with 18-inch spacing between units. Cultural practices, timing of harvest, and selection procedures were as described for single-hill plots.

Results and Discussion

Emergence was uniform in most clones. Plant vigor was much better than in single-hill clones. Plant type and vigor were observed at several growth stages. One selection was removed due to a variety mix, and another due to virus infection. At harvest, 20 clones were retained for storage evaluation (Table 2). Tubers were displayed on January 7 and 10 clones were selected for further evaluation.

Thirty tubers of the 10 clones retained have been eye-indexed and greenhouse tested for virus diseases. Virus-free material will be planted in 50-hill plots at KES in 1992. Five tubers will be supplied to Powell Butte for seed increase. Seed will also be supplied for observational trials at Tulelake and Bakersfield, California in cooperation with UC Davis personnel.

III. THIRD-GENERATION SEEDLING SCREENING

Procedures

Thirteen clones selected from single-hills in 1989 were eye-indexed and greenhouse tested for virus diseases. Five virus-free tubers were supplied to Powell Butte for seed increase. Seed was also provided to UC Davis personnel for observational trials at Tulelake and Bakersfield. Virus-free material was used to plant 50-hill plots at KES on May 22. Seed was spaced at 9 inches in 36-inch rows. Cultural practices were as described for single-hill plots.

Results and Discussion

Plant stands exceeded 90 percent in all clones. Two lines were discarded on the basis of poor plant type. Plant type, canopy vigor, and plant maturity characteristics were noted during the growing season. Several selections maintained vigorous canopy growth until tops were desiccated. Tubers exhibited moderate skinning during harvest at KES. Selections were not made at harvest. All clones were stored for evaluation on January 7.

Based on performance at KES, selections 2438-6, 2469-1, 2686-4, 2686-6, and 3314-2 appeared to be worthy of further evaluation (Table 3). However, in consideration of performance at Powell Butte, Oregon, and Tulelake and Bakersfield, California, the additional selections 2438-7, 2438-9, and 2686-10 were retained. Seed production at Powell Butte from five tubers ranged from 40 to 80 lbs. Clone 2438-6 achieved an exceptional yield, while 2686-6 was outstanding in appearance. Six out of eight selections retained were derived from crosses with Redsen and 1196-2R.

Thirty tubers of the eight selections were eye-indexed and greenhouse tested for virus diseases. Virus-free material will be planted in 100-hill plots at KES in 1992. Seed from Powell Butte will be used for observational trials in the Willamette Valley and in Tulelake and Bakersfield, California. The selections will also be included in a replicated yield trial at KES in 1992, with seed derived from KES stocks.

IV. FOURTH-GENERATION SEEDLING SCREENING

Procedures

Six clones selected from single hills in 1988 were eye-indexed and greenhouse tested for virus diseases. Fifteen virus-free tubers were supplied to Powell Butte for seed increase. Seed was also provided to UC Davis personnel for observational trials at Tulelake and Bakersfield, California. Virus-free material was used to plant 100-hill plots at KES on May 22. Seed pieces were spaced at 9 inches in 36 inch rows. Cultural practices were as described for single-hill plots. Tubers were harvested with a one-row digger-bagger on September 20.

Results and Discussion

Plants remained vigorous until vine desiccation in all clones. High residual soil nitrogen levels following long-term alfalfa probably accounted for excessive vine growth. Tuber skinning was more severe than in other red seedlings, due in part to harvest method.

Based on performance at KES, two selections; 3503-2 and 3573-5, appeared suitable for further testing (Table 4). However, the clones all performed well at Bakersfield, California and five of six were selected at Tulelake. Therefore, all six clones will be reevaluated in 1992. Seed production at Powell Butte ranged from 150 to 200 lbs per selection from 15 tubers.

Sixty tubers from each clone were eye-indexed and greenhouse tested for virus diseases. Disease-free material will be used for replicated yield trials at Tulelake and Bakersfield, California. Seed from Powell Butte will be used for replicated yield trials in the Willamette Valley and at KES.

V. ADVANCED RED VARIETY TRIAL

Procedures

Four named varieties, two advanced selections, and five fourth-generation selections from the KES program were planted at KES in a randomized complete block design with four replications on May 21. Individual plots were two rows, 25 feet long. Seed pieces were spaced 8.7 inches apart in 32-inch rows, resulting in 70-hill plots. Fertilizer included 600 lbs/A of 16-16-16 banded at planting and 50 lbs N/A applied as solution 32 on June 5. Eptam was applied at 3.5 lbs ai/A and incorporated with a rolling cultivator on May 31. Di-Syston was applied in the seed furrow at 3.0 lbs ai/A. Other cultural practices were as described for single-hill red-skinned selections. All seed was hand-cut, treated with thiophanate-methyl, and suberized 10 days prior to planting. A total of 16 inches of irrigation water was applied with solid-set sprinklers during the season. Vines were desiccated with 1 pt/A of diquat, applied on September 2.

Tubers were harvested with a one-row, digger-bagger on September 24. Field weights were determined for all tubers from both rows of each plot. Approximately 100-pound samples from each plot were stored until October 23 and graded according to USDA standards. Tuber appearance ratings were scored on a 1 (worst) to 5 (best) scale for tuber skinning, eye depth, shape uniformity, and skin color.

Results and Discussion

Plant stands were excellent in most selections (Table 5). NDTX9-1068-11R was the only selection to exhibit a modest stand problem. The standard varieties produced typical vine development patterns. Sangre was slow to emerge with poor vigor early and a later canopy closure. Dark Red Norland had the best early season vigor and the earliest maturity. Redsen main-tained good canopy vigor in this trial. In previous years Redsen has been severely injured by metribuzin, which was not applied to this trial. NDTX9-1068-11R maintained a strong canopy late in the season and was later in maturity than most of the selections. This is undoubtedly an important factor in persistent problems of skinning damage and storage diseases that have delayed the release of this selection. Four out of five NDO selections exhibited later maturity than the four standard varieties. Skinning damage was moderate in all of them, and most severe in NDO 3573-5.

Tuber appearance scores were lowest in all categories for Red LaSoda. ND 2224-5R received the highest appearance ratings with Sangre and Dark Red Norland only slightly lower. All NDO selections were scored higher than Red LaSoda on eye depth and skin color, two serious limitations for this variety.

Tuber yields and size distribution varied widely between selections. NDO 3573-3 achieved a significantly higher yield of No. 1s than all other selections but had excessive size. ND 2224-5R and Dark Red Norland had the best size distribution for red market requirements but also had the lowest yields. NDO 3503-5 produced the best combination of yield and size. Excluding 14-ounce tubers, all NDO selections compared favorably with Red LaSoda in yields. Similar conclusions were drawn from observational trials at Bakersfield, California.

Standard red-skinned varieties have been evaluated at KES over the past four years. Red LaSoda has consistently produced high yields with a high percentage of tubers over 10 ounces. Deep eyes, a light color after storage for several weeks, and the tendency for large tubers detract significantly from the performance of Red LaSoda. Sangre, while producing lower total yield, has shown higher yields of the more desirable smaller tubers, better color out of storage, and excellent storage characteristics. Dark Red Norland also produces a high percentage of small tubers and much better skin color than Red LaSoda, with shallow eyes. If tuber appearance is an important quality objective, both Sangre and Dark Red Norland offer significant advantages over Red LaSoda.

Redsen and NDTX9-1068-11R produce very attractive tubers. Redsen is extremely susceptible to metribuzin injury which has seriously reduced yields in previous trials. Both selections are also very susceptible to harvest damage and subsequent storage disease losses. In view of these considerations, Redsen and NDTX9-1068-11R are not recommended for local production.

ND 2224-5R is being considered for official release in the near future. This selection was rated very highly in appearance in both 1991 KES and 1990 Tulelake trials. Yields have been modest, but with a high percentage of small tubers. This selection is currently being evaluated in the western regional program.

KES selections from the North Dakota breeding program were included in a replicated yield trial for the first time in 1991. Relatively high yields were achieved by all of the five NDO selections evaluated. These selections will be evaluated at multiple locations in Oregon and California in 1992. Preliminary observations at Bakersfield, California and good seed production at Powell Butte suggest that these selections may be promising prospects for the future.

CONCLUSIONS

Replicated experiments at KES have identified Sangre and Dark Red Norland as viable alternatives to Red LaSoda for local fresh market production. Both varieties have consistently produced more attractive tubers and equivalent yields of the most desirable tuber size, compared to Red LaSoda. However, local seed production of red-skinned varieties continues to be dominated by Red LaSoda, produced mainly for Kern County, California.

Results of the KES red-skinned variety selection program are very encouraging. A combination of preplant selection of mini-tubers for single-hill production, and post-storage evaluation of field selections has significantly improved the quality of lines retained, while reducing land requirements and labor investment in the program. All of the fourth-year selections were considered worthy of further evaluation by a grower selection group in Kern County, California. Five out of six of these selections were included in a replicated yield trial at KES in 1991. All of them produced yields equal to or higher than Red LaSoda yields. Several third-generation selections from 1989 single-hills have better appearance than any of the fourth-generation lines. Yield data will be obtained in 1992.

Over four years, this program has screened approximately 16,000 clones from 87 crosses. Fourteen selections will be evaluated at multiple locations in 1992. Two or more selections will probably be advanced to the western regional program in 1993. The probability of releasing a quality red-skinned variety with good yield potential appears high at this stage in the program.

Table 1. First-year red-skinned seedling screening, Klamath Experiment Station, OR. 1991.

Clone	Parentage	Clones provided	Clones planted	Stand	Number selected Sept 23	Jan 7
				- % -		
NDO 4226	Reddale x 2050-1R	145	81	99	10	4
NDO 4227	Reddale x 2225-1R	191	100	92	6	1
NDO 4228	Reddale x 3048-2R	154	87	95	3	0
NDO 4229	Reddale x 3261-5R	67	37	97	1	0
NDO 4231	Ruby Red x 1196-2R	128	67	90	5	1
NDO 4232	Ruby Red x 1618-13R	84	43	95	2	2
NDO 4235	Sangre x Norland	248	127	96	0	0
NDO 4236	Sangre x 2225-1R	66	35	80	1	0
NDO 4251	La 12-59 x Norland	177	100	96	5	0
NDO 4252	La 12-59 x Reddale	131	87	98	7	1
NDO 4253	La 12-59 x 1562-4R	128	83	95	3	1
NDO 4254	La 12-59 x 2050-1R	121	86	100	6	1
NDO 4265	NDT7-3406-4R x 1618-13R	28	15	87	0	0
NDO 4267	NDTX9-1068-11R x Norland	117	69	96	6	1
NDO 4269	NDTX9-1068-11R x La 12-59	35	35	97	4	0
NDO 4270	NDTX9-1068-11R x 1618-13R	53	43	93	2	1
NDO 4271	NDTX9-1068-11R x 2050-1R	59	48	94	2	0
NDO 4289	860-2 x NDTX9-1068-11R	157	31	77	0	0
NDO 4297	1196-2R x Ruby Red	63	23	87	1	1
NDO 4298	1196-2R x La 12-59	84	60	97	6	1
NDO 4299	1196-2R x 1618-13R	150	107	90	8	1
NDO 4300	1196-2R x 2225-1R	242	165	92	18	6
NDO 4305	1562-4R x 1196-2R	142	93	94	5	2
NDO 4306	1562-4R x 2225-1R	105	78	88	2	0
NDO 4308	1618-13R x Norland	65	41	95	1	0
NDO 4309	1618-13R x Reddale	169	100	91	5	1
NDO 4313	1618-13R x 2225-1R	238	130	95	11	2
NDO 4323	1871-3R x La 12-59	187	162	92	7	2
NDO 4325	1871-3R x 3630-17R	202	180	98	13	0
NDO 4331	2050-1R x Ruby Red	143	91	95	2	1
NDO 4332	2050-1R x La 12-59	94	70	97	2	1
NDO 4333	2050-1R x NDTX9-1068-11R	149	118	97	5	3
NDO 4334	2050-1R x 1196-2R	151	99	97	4	0
NDO 4339	2224-5R x 1196-2R	172	120	98	3	0
NDO 4341	2225-1R x 1196-2R	251	147	88	10	4
NDO 4342	2225-1R x 1618-13R	209	146	79	3	1
NDO 4343	2225-1R x 2050-1R	111	73	82	4	1
	Total	5016	3177		170	40

Table 2. Second-year red-skinned seedling screening, Klamath Experiment Station, OR. 1991.

Family No.	Parentage	Clones planted 1990	Clones selected 1990	Clones planted 1991	Clones selected 1991 Sept 23	Jan 7
NDO 3839	1382-6R x Mn 12945	143	2	2	1	0
NDO 3846	1408-8R x 3048-2R	169	8	7	4	3
NDO 3849	1660 IB-8R x 1196-2R	204	6	6	3	1
NDO 3892	2390-2R x 1196-2R	88	1	1	1	0
NDO 3991	Reddale x 1618-13R	233	6	6	2	1
NDO 3994	Redsen x La 12-59	136	4	4	1	1
NDO 4001	Ruby Red x 1618-13R	158	3	3	2	1
NDO 4006	Sangre x 1618-13R	131	3	3	0	0
NDO 4009	Viking x 2225-1R	109	2	2	0	0
NDO 4026	La 12-59 x 1618-13R	158	2	2	1	0
NDO 4030	Mn 12945 x 3049-1R	175	5	5	3	2
NDO 4031	Mn 13035 x 1618-13R	239	3	3	1	1
NDO 4035	Mn 13053 x 3170-2R	171	1	1	1	0
NDO 4056	1408-8R x Reddale	36	1	1	0	0
NDO 4057	1408-8R x Sangre	78	2	2	0	0
	Total	2228	49	48	20	10

Table 3. Third-year red-skinned seedling screening, Klamath Experiment Station, OR. 1991.

Family No.	Parentage	Clones planted 1989	Clones selected 1989	Clones planted 1990	Clones selected 1990	Clones planted 1991	Clones selected 1991
NDO 2438	Redsen x 1196-2R	266	11	10	4	4	3
NDO 2469	Viking x 1196-2R	281	6	5	1	1	1
NDO 2686	1196-2R x Redsen	225	10	10	4	4	3
NDO 3314	W806R x 2050-1R	82	2	2	1	1	1
NDO 3531	NDTX9-1068-11R x 2496-5R	248	6	5	1	1	0
NDO 3686	2428-2R x 2745-3R	144	3	2	1	1	0
NDO 3756	Red LaSoda x 2224-5R	132	1	1	1	1	0
	Total	1378	39	35	13	13	8

Table 4. Fourth-year red-skinned seedling screening, Klamath Experiment Station, OR. 1991.

Family No.	Parentage	Clones planted 1988	Clones planted 1989	Clones planted 1990	Clones planted 1991	Clones selected 1991 KES	Clones selected 1991 Calif
NDO 3432	Erik x NDTX9-1068-11R	160	3	1	1	0	1
NDO 3503	La12-59 x NDTX9-1068-11R	220	11	5	2	1	2
NDO 3504	La12-59 x 1196-2R	130	4	1	1	0	1
NDO 3573	1196-2R x La12-59	150	5	3	2	1	2
	Total	660	23	10	6	2	6

Table 5. Vine and tuber characteristics of red-skinned selections, Klamath Experiment Station, OR. 1991.

	Vine characteristics				Tuber characteristics[3]				
	Stand	Vigor[1]		Maturity[2]	Skinning	Eye	Shape	Skin	Overall
Selection	%	6/24	8/29	8/29	damage	depth	uniformity	color	appearance
Red LaSoda	96	3.5	2.5	1.5	3.5	2.0	2.0	2.0	2.4
Sangre	93	2.0	2.8	2.0	4.8	4.0	3.8	4.0	4.0
Dark Red Norland	98	3.8	2.0	1.1	4.5	4.0	4.0	3.5	4.0
Redsen	95	3.8	3.0	2.0	3.8	3.8	3.3	3.3	3.5
NDTX9-1068-11R	84	2.3	4.0	3.0	3.0	4.0	2.8	4.0	3.5
ND2224-5R	90	2.5	2.3	1.8	4.0	5.0	4.0	4.5	4.4
NDO 3432-3	89	3.0	4.3	3.0	2.8	3.0	2.0	4.0	2.9
NDO 3503-2	97	3.3	4.3	4.0	2.5	4.0	3.0	3.5	3.3
NDO 3503-5	94	3.3	3.3	2.0	2.8	2.8	2.8	2.8	2.8
NDO 3573-3	95	3.3	3.8	3.1	2.5	2.3	2.8	3.5	2.8
NDO 3573-5	95	3.5	3.5	2.8	2.0	3.0	3.3	3.5	2.9

1/ Vine vigor rating: 1 - small, weak plant; 5 - large, strong plant.
2/ Vine maturity rating: 1 - dead leaves and stems; 5 - lush, healthy plant.
3/ Tuber ratings: Skinning: 1 - severe; 5 - none
Eye depth: 1 - deep; 5 - shallow
Shape, color, appearance: 1 - worst; 5 - best.

Table 6. Yield and specific gravity of red-skinned selections, Klamath Experiment Station, OR. 1991.

	Yield U.S. No. 1s					Yield				Specific
Selection	4-6 oz	6-10 oz	10-14 oz	>14 oz	Total	Bs	#2s	Culls	Total	Gravity
	cwt/A									
Red LaSoda	100	147	96	40	383	53	12	17	465	1.070
Sangre	118	129	54	13	314	83	5	4	406	1.071
Dark Red Norland	121	143	20	2	286	77	2	10	375	1.062
Redsen	95	154	109	20	378	47	6	12	442	1.069
NDTX9-1068-11R	98	151	104	74	429	40	9	33	511	1.074
ND2224-5R	123	113	18	5	259	77	1	1	338	1.069
NDO 3432-3	95	134	109	51	389	46	15	23	473	1.072
NDO 3503-2	96	153	94	25	368	55	8	19	450	1.089
NDO 3503-5	140	178	65	29	412	71	3	10	495	1.077
NDO 3573-3	81	156	187	103	527	25	8	20	580	1.069
NDO 3573-5	121	161	90	27	399	64	3	4	470	1.075
Average	108	147	86	36	377	58	7	14	455	1.073
CV (%)	18	20	37	49	15	28	82	81	13	0.200
LSD (.05)	29	43	46	25	83	24	8	16	85	0.003

Potato Variety Screening Trials

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INTRODUCTION

The Oregon potato variety development program screened more than 60,000 seedling tubers in 1991. Single-hill screening is conducted at Powell Butte and Ontario. KES participates in the evaluation of selections in the third generation and beyond in preliminary, statewide, and regional trials. Selections are screened in a preliminary trial for one year at four locations. Lines advanced are evaluated for up to three years in the statewide trial at four locations. Surviving selections with processing potential are evaluated more intensively at three locations in tri-state trials for two years. The final stage of formal evaluation is regional trials conducted at 11 locations in 7 western states. Graduates of the three-year regional trials usually undergo one or two years of commercial scale evaluation prior to official naming and release. Consequently, selections are typically evaluated for 12 to 14 years prior to release.

From the preliminary trial forward more than 50 characteristics are monitored across multiple locations. Yield potential, while very important, is only one of many characteristics considered in decisions regarding disposition of lines evaluated. Data presented in this report is limited to less than one-half of the observations recorded on individual selections.

PROCEDURES

All variety screening trials were conducted in randomized complete block experimental designs. Trial areas were fumigated with Telone II at 20 gpa on October 17, 1990. Di-Syston was applied in the seed furrow at 3.0 lbs ai/A. Monitor was applied aerially at 0.75 lbs ai/A on July 19 and August 10. Herbicides included Eptam, applied at 3.5 lbs ai/A and incorporated with a rolling cultivator on May 31, and metribuzin, applied aerially at 0.3 lbs ai/A on July 10. Standard foliar fungicides were applied aerially at labelled rates on July 10, July 19, August 10, and September 4. Vines were desiccated with diquat, applied with a conventional ground sprayer at 1.0 pt/A on September 6. Vines were shredded with a rotobeater prior to harvest.

All trials were conducted in a two-year rotation of potatoes and spring cereal grains. Gypsum was applied at 1.0 ton/A before secondary tillage. Fertilizer included 600 lbs/A of 16-16-16, banded on both sides of rows at planting and 50 lbs N/A applied as solution 32 on May 31. Crops received approximately 20 inches of irrigation water during the growing season. Irrigation was applied twice weekly with solid-set sprinklers on a 40-foot x 48-foot spacing to replenish 60 to 90 percent of pan evaporation, depending on plant growth stage.

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Acknowledgments: Partial funding for variety development by the Oregon Potato Commission, the CSRS, and ARS is gratefully recognized.

All seed was hand cut, treated with thiophanate-methyl fungicide, and suberized at least 10 days prior to planting. Potatoes were planted with a two-row assisted feed planter with 32-inch row spacing. Seed spacing in the row was 8.7 inches for all trials. Plant stands were monitored in all trials on June 11, June 18, and June 24. Vine vigor ratings were recorded on June 24. Vine maturity ratings were made on September 5.

Potatoes were harvested with a one-row digger-bagger. Samples were tagged and stored until grading was done in late October. Specific gravity was determined by the weight-in-air, weight-in-water method using a 10-pound sample of U.S. No. 1s in the 6- to 12-ounce size fraction. Internal defects were observed by cutting 10 of the largest tubers from each plot. U.S. No. 1 yields were not adjusted for surface blemishes such as scab, elephant hide, or rhizoctonia, or for internal defects such as hollow-heart, brown center, or internal brown spot. Statistical analyses of data were performed using MSU Stat software. Additional procedural details are provided in the description of individual trials.

Preliminary Yield Trial

Five standard varieties and 79 numbered selections were planted in 20-hill plots with two replications on May 16. Potatoes were harvested on September 27. All tubers were saved for grading.

Oregon Statewide Trial

Five standard varieties and 41 numbered selections were planted on May 20. Single-row, 30-hill plots were replicated four times. Potatoes were harvested on September 26. Total weights were determined in the field. Sixty-pound samples were saved for grading.

Western Regional Trial

The trial included five standard varieties and 16 numbered selections. Single-row, 30-hill plots with four replications were planted on May 16. Potatoes were harvested on September 25. All tubers were weighed in the field. Sixty-pound samples were saved for grading.

RESULTS AND DISCUSSION

Preliminary Yield Trial

Early crop development was delayed in all trials by cool weather through the end of June. Plant stands were excellent in all selections (Table 1) but canopy development was about 10 days behind normal by July 1. A rapid transition to high temperatures during the first week of July resulted in the development of heat sprouts in many selections. High temperatures persisted through harvest. Tuber set was below normal in standard varieties as evidenced by low yields of tubers under 4 ounces (Table 2). Tuber quality was generally quite good, however, with relatively low percentages of second growth, growth cracks, misshaped tubers, and internal defects. With the exception of hollow heart in very large tubers of some selections, internal tuber disorders were minimal. No root-knot nematode or corky ringspot infections were detected in any of the selections.

Tuber skin development was abnormal in many of the russetted selections. Heavy and coarse netting was consistently noted in Russet Burbank, which typically exhibits a medium net. Elephant hide occurred in several selections with heavy netting characteristics.

The standard russet varieties produced lower total yields, lower yields of tubers under 4 ounces, and lower yields of tubers over 12 ounces than in 1990. Relatively low specific gravity (Table 1) may be an indication of delayed crop maturity or crop stress resulting from extended periods of high temperature.

Russet Burbank produced 100 cwt/A less total yield and 60 cwt/A less yield of No. 1s than in a similar trial in 1990. Lemhi, Norgold, and Norkotah were slightly higher than Russet Burbank in yield of No. 1s. Yield variability between selections was very large. Fifteen selections exceeded Russet Burbank in yield of No. 1s by more than 50 percent. The top five selections at KES in yield of No. 1s were A08555-201, A083155-4, A083141-5, A79341-3, and A084022-108.

Performance of selections varied widely between trial locations. Russet Burbank yield of No. 1s ranked 60th at KES but 26th or better at Hermiston, Powell Butte, and Ontario. Conversely, the A08555-201 selection was ranked 1st at KES and no better than 30th at other locations. Averaged over four locations the top five KES selections were ranked 17, 12, 5, 4, and 6, respectively, in yield of No. 1s.

A total of nineteen selections were retained for testing in the 1992 state-wide trial. These included 12 of the top 14 in yield of No. 1s at KES. Several exhibited excellent processing quality but others are clearly unsuited for processing. Culinary quality evaluations at KES revealed undesirable flavor in two selections retained; A084022-108, and A08515-201. It will be interesting to see if these undesirable flaws are detected again in 1992.

Oregon Statewide Trial

Crop development was delayed as observed in the preliminary trial (Table 3). Plant stands were good to excellent. A heavy and coarse skin texture was noted in many of the russetted selections. Yields of standard varieties were considerably lower in this trial than in the preliminary trial (Table 4). A four-day delay in planting and larger plot size with more replications probably accounts for a portion of the yield differences. Yields were about 85 percent of those observed in the preliminary trial for Russet Burbank, Lemhi, and Norgold. Norkotah performance was very poor. Norkotah has historically produced better yields than Russet Burbank at KES.

Entry numbers 6 through 14 are advanced selections being evaluated in tri-state, regional, or commercial testing. Entries 15 through 19 were in the state-wide trial for the second year. All other entries were in this trial for the first time in 1991. Several of the advanced selections performed well at KES and other locations. Century Russet achieved the highest yield at KES but ranked 12th at Hermiston and 18th at Ontario and Powell Butte. A74212-1E ranked 4th at KES and 3rd averaged over four locations. This early selection of Century Russet will be evaluated in the regional trial in 1992. C008014-1 and A082611-7 have completed three years of regional evaluation and are being evaluated commercially. Neither of these selections performed well at KES in this trial. A082283-1 has been discarded due to serious blackspot susceptibility but will be used as a breeding parent because it has resistance to corky ringspot caused by tobacco rattle virus. A082281-1 was also dropped from the regional trial in 1991. A083037-10 produced relatively high yields at all locations and will be retained in the regional trial in 1992. C0083008-1 is also being retained for regional evaluation. ND02904-7 was advanced from the tri-state trial to the 1992 regional trial.

Outstanding yields were observed at all locations for A085165-1 and A085031-7, ranking 1 and 2, respectively, in yields of No. 1s over four locations. Both selections produced high yields in 1990 trials. A085165-1 has excellent appearance and is considered a fresh market selection. A085031-7 has processing potential and will be entered in the 1992 tri-state trial. Five additional selections were retained for the 1992 statewide trial. None of these were particularly outstanding at KES. Culinary tests indicated a flavor problem in C0086149-4. C0086107-1 is a very attractive red-skinned selection that will be evaluated in a red-skinned variety trial at KES in 1992.

Western Regional Trial

Plant emergence and early crop development was similar to results in preliminary and statewide trials (Table 5). C081082-1 had very poor stands and low yields at all locations. All other lines achieved good stands at KES. Century Russet was included in the trial inadvertently. It was intended that the early selection, A74212-1E, would be evaluated. As a result of a seed labelling error, all project cooperators received Century Russet instead of A74212-1E seed.

Russet Burbank and Lemhi achieved yields equivalent to those observed in the preliminary trial (Table 6). Norkotah produced low yields in the regional trial, as was observed in the statewide trial. Shepody, grown in an adjacent field which was not treated with metribuzin, produced over 300 cwt/A of No. 1s. The yields of Shepody and ND2224-5R observed in this trial were clearly influenced by metribuzin injury.

Century Russet achieved the highest yield of No. 1s at KES and averaged over 11 locations in 7 states. A083037-10 was second highest at KES and across all locations. The red-skinned A82705-1 produced a high yield at KES but tuber size was excessively large for red markets. KES was the only location where A82705-1 achieved significantly higher yield than Red LaSoda.

Century Russet, AC7869-17, and A082611-7 have completed three years of evaluation in the regional trial and are being evaluated in commercial production. A082283-1, AC81198-11, ND671-4 RUSS, and C081082-1 have been discarded. ND1538-1 RUSS is being considered for naming and release by North Dakota. The other selections will be retained in the regional trial for 1992.

CONCLUSIONS

A number of attractive russetted selections were identified at each trial level. Many of them are superior to Russet Burbank and other standards in yield, dry matter content, fry color, and other internal tuber quality characteristics. The Oregon potato variety development program has developed several selections which appear to be good candidates for release. This program will continue in its present format. Increased emphasis on disease resistance screening is planned in anticipation of future losses of pesticides presently being relied on for suppression of disease and pest problems.

Table 1. Performance of entries in the Preliminary Yield Trial, Klamath Experiment Station, OR. 1991.

Entry No.	Selection	Stand	Vigor rating[1]	Maturity rating[2]	Specific gravity	H.H.[3]	Comments[4]
		- % -				- % -	
1	Russet Burbank	100	3.5	2.0	1.082	0	Rough
2	Lemhi	93	2.0	2.0	1.084	20	Coarse
3	Norgold	93	3.5	1.0	1.071	25	Small
4	Norkotah	100	4.5	1.0	1.074	5	Nice
5	Norchip	100	4.5	2.2	1.076	0	Small
6	NDO 3675-1	93	3.0	1.8	1.069	10	
7	A088011-10	100	3.0	1.5	1.078	0	Light YF
8	A088011-11	100	4.0	2.0	1.079	0	EH, rough
9	A088011-12	98	3.5	2.0	1.070	5	Rough, ugly
10	A088011-13	95	3.5	1.5	1.073	5	Coarse
11	A086097-1	85	3.5	1.0	1.080	5	Fair, YF
12	A086097-3	100	4.0	1.0	1.071	10	
13	A085130-1	85	1.5	2.0	1.079	40	EH, ugly
14	A085027-5	98	2.0	2.5	1.079	40	EH, rough
15	A083202-5	95	3.0	2.0	1.079	40	Poor
16	A083202-6	98	2.5	1.8	1.075	0	
17	*A083200-2	100	3.5	3.5	1.077	5	YF, skinning
18	A083184-1	100	3.5	3.0	1.089	50	Crooked
19	A083155-2	90	2.5	2.5	1.079	60	Coarse
20	*A083155-4	95	3.5	2.0	1.090	30	Heavy net
21	*A083155-5	98	3.5	2.5	1.084	5	Coarse, EH
22	*A083142-3	95	3.0	2.5	1.076	10	Heavy net
23	*A083141-5	88	3.5	2.5	1.088	15	Flat, folded
24	A083177-4	100	3.5	3.3	1.080	35	Rough
25	A083116-2	93	3.5	4.0	1.085	0	EH, IPS
26	A083113-1	100	4.0	2.3	1.088	5	Crooked
27	*A083113-4	85	3.0	3.0	1.083	25	Coarse
28	A083103-2	98	3.0	2.5	1.078	0	Crooked
29	A083103-5	100	3.0	1.0	1.078	0	Fair
30	A083103-6	98	2.5	1.3	1.077	15	Poor
31	A083103-10	100	2.5	3.0	1.071	15	Coarse
32	A083100-2	88	3.0	1.0	1.068	0	Flat, folded
33	A083096-1	100	3.5	1.3	1.072	0	Small
34	A083096-3	93	3.0	1.5	1.067	20	Coarse
35	A083039-1	100	4.0	1.0	1.080	0	Small
36	A083011-12	93	4.0	2.8	1.084	20	GC, light YF
37	A083010-4	100	4.0	2.0	1.079	0	Heavy net, flat
38	A083002-1	100	2.0	3.5	1.085	0	EH, GC
39	A080203-11	93	3.0	1.5	1.076	15	Too round
40	*A080191-7	95	3.0	3.5	1.088	20	Fair
41	A080044-1	100	4.0	3.0	1.077	5	Fair
42	A078018-1	98	3.0	3.8	1.087	25	
43	A078018-2	83	2.0	3.5	1.083	25	IPS, heavy net
44	A079053-7	95	2.5	3.0	1.071	45	Heavy net, soft
45	*A080004-2	98	3.5	3.0	1.080	20	Coarse

Table 1. Performance of entries in the Preliminary Yield Trial, Klamath Experiment Station, OR. 1991. (contd)

Entry No.	Selection	Stand	Vigor rating[1]	Maturity rating[2]	Specific gravity	H.H.[3]	Comments[4]
		- % -				- % -	
46	*A080093-3	100	3.0	3.0	1.079	35	Fair
47	A080175-1	93	3.5	1.0	1.075	0	Heavy net
48	A083072-3	100	2.0	2.5	1.078	0	GC
49	A083072-5	95	3.0	2.5	1.076	0	Rough
50	A083176-1	100	3.5	2.0	1.065	0	
51	*A083258-7	100	3.5	1.5	1.078	0	Fair
52	*A083171-5	100	2.0	2.5	1.073	5	Fair, YF
53	*A083011-15	98	3.5	2.0	1.082	0	
54	*A084022-108	98	3.5	3.0	1.087	0	Fair
55	*A084023-118	100	3.0	2.0	1.076	25	Fair
56	A084038-105	100	3.0	2.5	1.098	35	
57	A084275-105	90	1.5	3.0	1.080	45	Rough
58	A083107-103	95	3.0	3.5	1.081	5	Skinning
59	*A79341-3	100	4.0	2.0	1.087	15	Coarse
60	A084738-177	100	2.5	2.5	1.080	0	Flat, smooth, YF
61	A085042-103	98	2.5	2.5	1.087	0	Nice
62	A085330-107	100	3.5	3.0	1.086	0	EH, ugly
63	A085341-103	93	2.0	3.0	1.083	25	Coarse, GC
64	207-2	100	3.5	3.5	1.085	10	EH, small
65	*A080202-214	95	3.5	2.0	1.086	0	Too round
66	A083221-202	100	2.5	2.0	1.081	5	Poor
67	ND02725-3	98	2.5	2.0	1.067	0	EH, heavy net
68	ND03826-2	88	3.0	1.0	1.066	15	EH, ugly
69	A081784-201	98	2.0	3.5	1.075	0	
70	A084515-201	100	3.0	3.0	1.080	10	Coarse, YF
71	A08514-205	100	3.5	3.0	1.077	0	Light net, small
72	*A08515-201	100	3.5	2.5	1.076	0	Rough
73	A08518-201	95	3.0	3.5	1.085	55	Light net
74	A08518-205	98	3.5	3.0	1.081	0	Small
75	*A08555-201	98	2.5	3.0	1.086	5	Red eyes, YF
76	A085182-201	93	4.0	2.5	1.081	20	EH
77	A087102-203	100	3.0	2.5	1.083	35	Rough
78	A087103-203	100	3.5	1.5	1.079	0	Small
79	A087105-201	98	3.0	3.5	1.084	75	Coarse, IPS
80	A087126-206	100	4.0	3.0	1.092	15	
81	A087126-207	95	3.5	1.5	1.080	0	Too round
82	*A087458-202	98	4.0	3.5	1.091	0	Light net
83	A087458-208	98	3.5	3.5	1.090	0	Light net
84	A087458-210	98	4.0	2.0	1.079	5	
	Average	96	3.2	2.4	1.080	13	

1/ Vigor rating: (1 - small, weak; 5 - large robust)
2/ Maturity rating: (1 - dead; 5 - green, lush)
3/ H.H.: Hollow heart - percent in 10 largest tubers/sample
4/ Comments: EH - elephant hide; GC - growth cracks; IPS - internal purple spots; YF - yellow flesh.
* Advanced to the Statewide Trial for 1992

Table 2. Tuber yield by grade for entries in the Preliminary Yield Trial, Klamath Experiment Station, OR. 1991.

Entry No.	Selection	Yield U.S. No. 1s 4-12 oz	>12 oz	Total	Rank		Yield Bs	2s	Total	Rank
		-------- cwt/A	-------			%	---- cwt/A	----		
1	Russet Burbank	301	22	323	60	75	34	34	427	59
2	Lemhi	230	118	348	53	86	9	23	404	64
3	Norgold	336	0	336	58	87	29	0	383	70
4	Norkotah	347	41	388	37	84	62	5	459	51
5	Norchip	344	0	344	54	70	106	15	485	42
6	NDO 3675-1	207	160	367	44	78	15	48	470	48
7	A088011-10	290	84	374	41	77	66	29	483	45
8	A088011-11	184	14	198	84	68	50	14	287	81
9	A088011-12	191	97	288	70	59	10	84	482	46
10	A088011-13	186	28	214	81	77	42	6	275	84
11	A086097-1	298	13	311	62	70	108	0	439	56
12	A086097-3	273	71	344	55	84	43	7	405	63
13	A085130-1	240	24	264	75	72	24	43	365	73
14	A085027-5	299	152	451	21	84	14	36	534	26
15	A083202-5	301	67	368	43	69	132	20	529	28
16	A083202-6	308	16	324	59	81	55	15	400	66
17	*A083200-2	398	113	511	14	79	43	38	645	9
18	A083184-1	368	74	442	23	76	28	30	580	17
19	A083155-2	269	199	468	18	76	6	66	611	11
20	*A083155-4	441	159	600	2	81	64	10	733	2
21	*A083155-5	369	149	518	10	79	68	43	658	7
22	*A083142-3	360	171	531	8	91	32	0	582	16
23	*A083141-5	382	195	577	3	87	39	32	652	5
24	A083177-4	328	101	429	27	83	31	0	515	33
25	A083116-2	242	166	408	32	73	34	81	558	20
26	A083113-1	337	157	494	15	82	28	53	599	14
27	*A083113-4	193	225	418	29	82	11	23	506	37
28	A083103-2	299	91	390	36	75	76	12	515	34
29	A083103-5	263	32	295	66	83	45	6	354	74
30	A083103-6	449	79	528	9	90	17	22	583	15
31	A083103-10	276	88	364	47	84	34	16	429	57
32	A083100-2	358	30	388	38	82	54	16	472	47
33	A083096-1	292	46	338	57	74	102	2	451	52
34	A083096-3	244	48	292	35	79	35	28	369	72
35	A083039-1	285	6	291	69	73	96	0	398	67
36	A083011-12	326	93	419	28	76	50	59	551	22
37	A083010-4	325	33	358	49	72	101	10	497	38
38	A083002-1	277	38	315	61	62	83	54	506	36
39	A080203-11	264	10	274	74	80	65	0	341	76
40	*A080191-7	441	113	554	6	85	38	0	646	8
41	A080044-1	408	53	461	19	85	39	6	538	25
42	A078018-1	323	58	381	39	81	31	17	467	49
43	A078018-2	200	166	366	45	92	19	22	396	68
44	A079053-7	338	38	376	40	77	21	25	483	44
45	*A080004-2	347	167	514	13	84	38	25	610	13

Table 2. Tuber yield by grade for entries in the Preliminary Yield Trial, Klamath Experiment Station, OR. 1991. (contd)

Entry No.	Selection	Yield U.S. No. 1s 4-12 oz	>12 oz	Total	Rank		Yield Bs	2s	Total	Rank
		-------- cwt/A		-------		%	---- cwt/A		----	
46	*A080093-3	326	77	403	33	70	116	23	570	19
47	A080175-1	188	12	200	83	71	67	0	280	83
48	A083072-3	182	36	218	79	69	49	20	313	78
49	A083072-5	238	48	286	71	71	47	43	402	65
50	A083176-1	273	20	293	67	66	106	10	442	54
51	*A083258-7	371	89	460	20	88	27	13	521	29
52	*A083171-5	329	37	366	46	82	72	3	446	53
53	*A083011-15	339	13	352	51	72	105	20	487	41
54	*A084022-108	280	278	558	5	87	28	9	640	10
55	*A084023-118	384	87	471	16	85	46	3	550	23
56	A084038-105	225	21	246	77	70	64	23	351	75
57	A084275-105	347	85	432	25	75	40	54	572	18
58	A083107-103	373	59	432	26	77	86	7	555	21
59	*A79341-3	316	248	564	4	85	16	12	656	6
60	A084738-177	287	159	446	22	85	22	3	521	30
61	A085042-103	327	28	355	50	85	23	20	417	60
62	A085330-107	289	55	344	56	74	45	37	461	50
63	A085341-103	265	148	413	30	76	20	62	541	24
64	207-2	292	0	292	68	59	167	6	488	40
65	*A080202-214	409	30	439	24	84	52	18	519	31
66	A083221-202	209	10	219	78	70	52	22	310	79
67	ND02725-3	207	6	213	82	75	50	10	283	82
68	ND03826-2	205	10	215	80	70	64	8	306	80
69	A081784-201	229	71	300	64	80	11	22	371	71
70	A084515-201	235	318	553	7	81	26	61	681	4
71	A08514-205	276	0	276	73	82	60	0	335	77
72	*A08515-201	215	301	516	11	65	16	132	783	1
73	A08518-201	268	38	306	63	73	67	25	417	61
74	A08518-205	259	0	259	76	60	146	0	428	58
75	*A08555-201	513	137	650	1	91	52	0	711	3
76	A085182-201	277	0	277	72	68	77	21	406	62
77	A087102-203	374	39	413	31	84	71	0	489	39
78	A087103-203	283	15	298	65	75	78	3	394	69
79	A087105-201	264	206	470	17	88	4	34	532	27
80	A087126-206	335	15	350	52	67	91	47	517	32
81	A087126-207	297	62	359	48	81	74	3	439	55
82	*A087458-202	326	189	515	12	84	24	29	611	12
83	A087458-208	369	0	369	42	72	96	0	508	35
84	A087458-210	378	25	403	34	83	59	0	484	43
	Average	301	80	381	--	78	53	22	486	--

* Advanced to the Statewide Trial for 1992.

Table 3. Performance of entries in the Oregon Statewide Trial, Klamath Experiment Station, OR. 1991.

Entry No.	Selection	Stand	Vigor rating[1]	Maturity rating[2]	Specific gravity	H.H.[3]	Comments[4]
		- % -				- % -	
1	Russet Burbank	99	3.0	2.1	1.083	5	Rough
2	Lemhi	96	2.5	2.3	1.083	23	Coarse
3	Norgold	96	3.5	1.3	1.072	5	Small
4	Norkotah	96	2.8	1.3	1.070	23	Nice
5	Norchip	88	2.8	1.8	1.075	5	
6	*A74212-1E	98	2.3	2.6	1.078	0	Skinning
7	*Century Russet	95	2.5	4.5	1.078	0	Skinning
8	*C008014-1	88	2.3	2.8	1.077	10	Coarse
9	A082283-1	98	2.8	3.8	1.087	33	Rough, ugly
10	*A082611-7	92	2.5	2.5	1.088	5	Pointy
11	*C0083008-1	93	2.3	3.1	1.089	13	Fair
12	*A083037-10	91	2.5	2.8	1.079	20	Flat, coarse
13	A082281-1	94	2.0	2.5	1.082	18	EH, Fair
14	*ND02904-7	98	3.3	2.0	1.067	5	Coarse, EH
15	A085010-1	80	2.3	3.1	1.084	58	Nice, heavy net
16	*A085031-7	97	3.3	3.5	1.078	23	Flat, ugly
17	A085066-2	98	3.5	1.3	1.072	28	Coarse
18	*A085165-1	94	2.0	2.6	1.076	10	Fair
19	A085165-2	96	2.8	2.6	1.080	28	Fair
20	A082260-4	80	2.3	1.0	1.070	13	Too round
21	A085257-4	98	3.0	4.0	1.080	13	Misshapen
22	ND02955-6	94	3.3	1.5	1.069	10	Small
23	ND02667-12	99	3.0	1.6	1.069	13	EH
24	C0086222-3	98	2.5	2.1	1.069	0	Misshapen
25	C0086149-3	95	2.5	2.6	1.070	0	Big
26	*C0086149-4	87	2.5	2.8	1.078	35	Heavy net
27	*C0086107-1	98	2.0	1.5	1.073	0	Pretty
28	C0086106-1	95	2.5	2.0	1.076	0	
29	C0086058-1	98	3.0	2.0	1.073	13	Skinned, ugly
30	*C0086042-2	97	3.3	3.0	1.072	8	Flat
31	A086107-1	98	2.8	3.5	1.081	0	Ugly
32	A086097-6	96	2.8	3.3	1.084	33	Coarse
33	A086078-3	100	3.0	3.3	1.083	48	EH, ugly
34	A086058-4	86	1.8	2.4	1.070	3	EH
35	A086057-5	98	2.3	1.6	1.073	3	Coarse
36	A086049-1	93	1.8	4.0	1.084	10	Fair
37	A086034-1	86	1.5	1.5	1.072	15	EH
38	A086030-3	100	3.3	2.4	1.086	13	Poor
39	*A086026-1	98	2.3	2.5	1.090	8	Rough
40	*A086022-2	99	3.3	4.0	1.093	3	Crooked
41	*A086011-3	95	2.5	3.0	1.084	38	Coarse, skinned
42	*A085018-6	98	2.8	2.1	1.084	3	Poor
43	A084508-11	97	2.3	3.0	1.080	10	Fair
44	A083202-2	98	2.0	2.8	1.079	3	
45	A083026-202	99	2.3	2.4	1.078	45	Small
46	*A083221-204	99	2.8	2.1	1.072	8	Fair
	Average	95	2.6	2.5	1.078	14	
	CV (%)	--	---	---	0.3	--	
	LSD (.05)	--	---	---	0.004	--	

1/ Vigor rating: (1 - small, weak; 5 - large robust)
2/ Maturity rating: (1 - dead; 5 - green, lush)
3/ H.H.: Hollow heart - percent in 10 largest tubers/sample
4/ Comments: EH - elephant hide; GC - growth cracks; IPS - internal purple spots; YF - yellow flesh.
* Advanced to the Statewide Trial for 1992

Table 4. Tuber yield by grade for entries in the Statewide Trial, Klamath Experiment Station, OR. 1991.

Entry No.	Selection	Yield U.S. No. 1s					Yield			
		4-12 oz	>12 oz	Total	Rank		Bs	2s	Total	Rank
		-------- cwt/A --------				%	---- cwt/A ----			
1	Russet Burbank	263	19	282	33	73	39	33	382	30
2	Lemhi	251	30	281	35	82	25	17	340	38
3	Norgold	264	9	273	38	78	67	5	347	36
4	Norkotah	208	20	228	42	84	30	4	270	43
5	Norchip	266	16	282	34	77	45	15	363	33
6	*A74212-1E	320	122	442	4	87	25	13	503	5
7	*Century Russet	290	214	504	1	88	15	13	568	1
8	*C008014-1	244	34	278	36	79	21	13	350	35
9	A082283-1	289	58	347	18	65	30	94	532	3
10	*A082611-7	252	38	290	31	75	45	29	385	28
11	*C0083008-1	245	105	350	15	82	29	20	422	16
12	*A083037-10	270	146	416	5	82	18	35	503	6
13	A082281-1	289	109	398	8	88	21	16	448	10
14	*ND02904-7	263	66	329	22	86	30	16	382	31
15	A085010-1	229	111	340	19	83	14	23	408	20
16	*A085031-7	343	108	451	3	79	32	44	567	2
17	A085066-2	274	83	357	13	89	18	5	398	23
18	*A085165-1	289	163	452	2	90	17	9	498	7
19	A085165-2	291	66	357	14	84	32	13	421	17
20	A082260-4	169	5	174	45	77	41	2	224	46
21	A085257-4	235	86	321	25	72	16	56	442	12
22	ND02955-6	145	2	147	46	61	80	2	238	45
23	ND02667-12	315	15	330	20	81	59	10	405	21
24	C0086222-3	256	36	292	29	80	55	6	361	34
25	C0086149-3	308	56	364	11	84	33	9	431	15
26	*C0086149-4	275	100	375	10	86	29	12	434	14
27	*C0086107-1	267	22	289	32	84	43	2	341	37
28	C0086106-1	305	25	330	21	83	43	2	394	24
29	C0086058-1	290	16	306	28	78	46	18	392	25
30	*C0086042-2	369	46	415	6	82	43	15	505	4
31	A086107-1	292	58	350	16	74	18	59	472	8
32	A086097-6	248	113	361	12	88	18	14	410	19
33	A086078-3	303	26	329	23	81	39	14	402	22
34	A086058-4	212	94	306	27	83	15	17	368	32
35	A086057-5	200	72	272	39	88	6	10	308	41
36	A086049-1	313	97	710	7	92	11	9	441	13
37	A086034-1	178	40	218	44	85	14	9	256	44
38	A086030-3	283	36	319	26	83	44	4	383	29
39	*A086026-1	214	56	270	40	82	19	26	327	40
40	*A086022-2	301	49	350	17	74	11	69	472	9
41	*A086011-3	308	80	388	9	86	20	14	447	11
42	*A085018-6	227	12	239	41	61	89	30	389	27
43	A084508-11	249	26	275	37	81	27	20	338	39
44	A083202-2	291	36	327	24	78	29	25	417	18
45	A083026-202	281	10	291	30	74	83	7	391	26
46	*A083221-204	204	17	221	43	78	37	9	283	42
	Average	265	60	325	--	81	33	19	399	--
	CV (%)	19	53	20	--	--	32	63	17	--
	LSD (.05)	70	45	89	--	--	15	17	96	--

* Retained for further evaluation.

Table 5. Performance of entries in the Western Regional Trial, Klamath Experiment Station, OR. 1991.

Selection	Stand 6/11	Stand 6/24	Vine vigor rating	Vine maturity rating	Specific gravity	H.H.
	---- % ----					-%-
Russet Burbank	89	98	3.0	2.3	1.084	5
Lemhi	50	99	3.3	2.3	1.083	75
Norkotah	93	98	4.3	1.1	1.072	23
Shepody	54	93	2.3	2.3	1.075	0
Red LaSoda	78	99	4.0	1.1	1.066	23
Century Russet	49	100	2.8	4.5	1.079	3
AC7869-17	54	98	3.0	2.5	1.082	8
AC81198-11	16	94	2.0	2.5	1.082	3
A082283-1	52	93	2.5	3.0	1.084	25
A082611-7	70	99	3.3	2.4	1.088	10
*C082142-4	8	95	2.0	2.5	1.081	15
*C0083008-1	67	95	2.8	2.5	1.089	15
ND 671-4 RUSS	37	99	2.5	2.0	1.066	23
ND 1538-1 RUSS	64	98	3.3	1.6	1.070	5
ND 2224-5R	44	89	2.3	1.0	1.066	0
*ATX6-84378-1 RUSS	53	94	3.5	2.3	1.076	63
*A81473-2	16	96	2.0	4.0	1.086	0
*A82119-3	62	95	3.3	3.5	1.083	45
*A083037-10	72	97	3.0	3.0	1.080	23
*A82705-1R	16	95	2.3	2.8	1.069	0
C081082-1	31	69	1.5	1.1	1.072	0
Average	51	95	2.8	2.4	1.078	17
CV (%)	--	--	---	---	0.3	--
LSD (.05)	--	--	---	---	0.004	--

* Retained for further testing in the Western Regional Trial.

Table 6. Tuber yield by grade for entries in the Western Regional Trial, Klamath Experiment Station, OR. 1991.

Selection	Yield U.S. No. 1s			Yield			
	4-12 oz	>12 oz	Total	Bs	No. 2s	Culls	Total
	cwt/A						
Russet Burbank	307	32	339	62	31	35	467
Lemhi	278	62	340	43	4	8	395
Norkotah	242	25	267	94	0	2	363
Shepody	124	8	132	22	35	5	194
Red LaSoda	291	42	333	65	8	7	413
Century Russet	288	274	562	31	24	22	639
AC7869-17	243	60	303	50	19	9	381
AC81198-11	261	42	303	73	28	32	436
A082283-1	288	77	365	45	111	25	546
A082611-7	256	17	273	103	11	21	398
*C082142-4	253	123	376	25	22	21	444
*C0083008-1	259	101	360	36	14	6	416
ND 671-4 RUSS	211	3	214	96	1	12	323
ND 1538-1 RUSS	225	20	245	109	15	15	384
ND 2224-5R	106	0	106	112	1	7	226
*ATX6-84378-1 RUSS	167	246	413	13	16	57	499
*A81473-2	280	138	418	26	7	18	469
*A82119-3	314	54	368	60	20	5	453
*A083037-10	384	165	549	42	2	6	618
*A82705-1R	412	129	541	47	6	6	599
C081082-1	138	12	150	27	3	5	186
Average	254	77	331	56	19	15	421
CV (%)	21	45	18	28	100	109	15
LSD (.05)	75	49	85	23	27	23	92

* Retained for further testing in the Western Regional Trial.

Cultural Management of New Potato Varieties

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

INTRODUCTION

Russet Burbank has declined from 79 percent of the acreage in Oregon in 1988 to 62 percent in 1991. In Washington, the change during the same period was from 79 percent to 69 percent. Idaho experienced a decline from 97 percent Russet Burbank to 90 percent. The major varieties with increased acreage are Shepody, Russet Norkotah, and Frontier Russet which accounted for 7, 4, and 2 percent of northwest production in 1991, respectively. Several other new varieties have established niches as growers seek new marketing opportunities.

Most of the new varieties require different cultural management than Russet Burbank to achieve optimum performance. Studies were initiated at KES in 1987 to evaluate the response of new varieties and advanced selections to nitrogen fertilizer rates and plant populations. These management factors affect yield, tuber size distribution, and to some extent physiological disorders. Six named varieties and four advanced selections were evaluated in two experiments in 1991.

PROCEDURES

Ten varieties or advanced selections were evaluated in two separate experiments. Split-plot designs were employed with four replications. Standard management practices were used for weed control, disease and pest management, and irrigation (see page 41).

The variety by seed spacing experiment was planted on May 20. Main-plot treatments were seed spacings of 6.8, 8.7, or 12.0 inches in 32-inch rows. Individual plots were two rows, 30 feet long. Fertilizer included 600 lbs/A of 16-16-16 banded at planting and 50 lbs N/A applied as solution 32 and incorporated with a rolling cultivator on May 31. Vines were desiccated with diquat applied at 1.0 pint/A on September 14, and potatoes were harvested on October 1. Field weights were determined for all tubers from both rows. Approximately 120-pound samples from each plot were stored and graded to USDA standards in late October. Internal tuber quality was evaluated by cutting 10 large tubers from each plot. Specific gravity was determined by the weight-in-air, weight-in-water method using 10-pound samples of No. 1 tubers in the 6- to 10-ounce size fraction.

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Acknowledgment: Studies were funded in part by the Oregon Potato Commission and the CSRS.

The variety by nitrogen rate experiment was planted at a uniform seed spacing of 8.7 inches on May 21. Plots were four rows, 30 feet long. Main-plot treatments were nitrogen rates of 130, 160, or 190 lbs N/A, achieved by supplementing 800 lbs/A of 16-16-16 banded at planting with 0, 30, or 60 lbs N/A applied on May 31. Vines were desiccated on September 14 and potatoes were harvested on October 2. Total field weights were determined for all tubers from the center two rows. Approximately 120-pound samples were stored and graded as above in late October.

RESULTS AND DISCUSSION

Variety response to seed spacing, 1991:

All selections achieved uniform emergence and final stands in excess of 90 percent. Early senescence was observed in Russet Norkotah, HiLite Russet, Frontier Russet, and ND 1538-1. All other selections maintained good canopy vigor until vines were desiccated. Crop development was slowed by cool weather in May and June. Under the weather conditions experienced, several varieties produced lower yields and smaller tubers than in previous years. However, Century Russet and A74212-1E achieved exceptionally high yields with a high percentage of large tubers.

Seed spacing responses varied between selections (Table 1). The interaction between variety and seed spacing was statistically significant at the 5 percent probability level for 4- to 6-ounce, over 10-ounce, and total No. 1 yields. Averaged over all varieties, seed spacing significantly influenced tuber size distribution but not total yield or total No. 1 yield.

Century Russet and A74212-1E achieved maximum yields and excellent size for fresh market packing at the highest plant population. Both selections produced excessive tuber size at 8.7- and 12-inch spacing. Both selections are highly susceptible to tuber damage due to light skins and large size.

The optimum seed spacing for Gemchip, ND 1538-1, and CO08014-1 was 8.7 inches. Each of these selections experienced a decline in yield of No. 1s when spacing was increased to 12 inches. ND 1538-1 was included in this trial for the first time in 1991. It is expected to be released under patent by North Dakota State University in the near future.

Frontier Russet was clearly favored by the 12-inch spacing under 1991 conditions. It was the only variety that produced maximum yield at the lowest plant population. A large increase in the yield of 10-ounce tubers occurred from 8.7- to 12-inch spacing.

Considering the price advantage for large tubers that make count cartons, Russet Burbank, Russet Nugget, HiLite Russet, and Russet Norkotah all produced optimum yields at 12-inch spacing. While total No. 1 yields were similar at 8.7- and 12-inch spacing, all gained in the yield of large tubers at the lower population.

Effects of seed spacing on tuber quality were minimal. Specific gravity of tubers in the 6- to 10-ounce size fraction was not affected. Hollow-heart was limited to very large tubers and increased in frequency at wider seed spacings in HiLite Russet, Frontier Russet, and Gemchip. Very little hollow-heart was observed in ND 1538-1, Century Russet, A74212-1E, or Russet Burbank.

Variety response to nitrogen rates, 1991:

Plant development, stands, and variety performance were very similar to conditions observed in the seed spacing trial. Nitrogen rate did not significantly affect any of the parameters evaluated when averaged over varieties (Table 2). The interaction between nitrogen rate and variety was significant at the 5 percent probability level for 6- to 10-ounce yield and total yield of No. 1s, indicating varietal differences in nitrogen response.

Russet Norkotah and Russet Nugget were not affected by nitrogen rate. Yields and size distribution were similar at all rates. The 130 lb N/A rate was optimum for both selections. Frontier Russet and ND 1538-1 also achieved optimum yields and size at 130 lbs N/A. Higher N rates reduced tuber size and total No. 1 yields in these selections.

C008014-1 and Century Russet produced maximum yields at 160 lbs N/A. Yield differences between rates were quite small for C008014-1. Century Russet produced approximately 50 cwt/A more No. 1s at the intermediate nitrogen rate than at higher or lower rates, and with a better tuber size distribution.

HiLite Russet, Gemchip, A74212-1E, and Russet Burbank all produced maximum yields of No. 1s at 190 lbs N/A. The largest yield response was observed in A74212-1E.

Effects of nitrogen rates on specific gravity were small in most varieties. Only HiLite Russet and Frontier Russet followed expected trends of declining specific gravity in response to increased nitrogen rates. No consistent response in yield of No. 2s or culls occurred. Hollow-heart was observed in 15 percent of all tubers inspected. The highest incidence was found in Gemchip (31 percent), Frontier Russet (23 percent), and Russet Nugget (23 percent). Hollow-heart incidence declined from 18 percent at 130 lbs N/A to 15 percent at 160 lbs N/A and 11 percent at 190 lbs N/A. This trend has been observed in prior years. No other influences of nitrogen rate on tuber quality were observed.

Multi-year response to seed spacing:

Trials have been conducted in the same format since 1988. A minimum of three years of data have been collected on nine varieties, with four years of data available for Russet Norkotah. The most recent data is summarized (Table 3). Slight changes in data for Russet Norkotah, Century Russet, and Shepody, compared with multi-year summaries presented in last year's report on these studies, is due to updating with the most recent data obtained under a single experimental design.

The statistical analysis of multi-year summaries was performed independently for each variety. Variety by year comparisons are not possible since not all varieties were planted each year. Data were analyzed as a split-plot design with years as main plots and seed spacing as split-plot treatments.

The interaction between year and seed spacing was not statistically significant for any variety for total yield, total yield of No. 1s, yield over 10 ounces, or yield of No. 2s. Therefore, yields are presented as averages over years, by variety. Seed spacing significantly affected tuber size distribution in at least two yield components in each variety (Table 3). The general trend was increasing yield of large tubers and reduced yield of Bs and 4- to 6-ounce tubers as seed spacing increased. Effects on yields of No. 2s and total yield were relatively small in most cases.

Russet Norkotah was the only variety that produced maximum yield of No. 1s at 12-inch spacing. The large increase in yield of 10-ounce tubers from 8.7- to 12-inch spacing results in a higher percentage of count cartons for fresh market use, and greater economic returns for the crop. In combination with reduced seed costs at lower plant populations, the 12-inch spacing is clearly optimum for Russet Norkotah grown for fresh market use based on these trials. Norkotah has a tendency to produce very large tubers. Crops grown for seed would need to be spaced closer to avoid excessive size.

HiLite Russet and Frontier Russet produced slightly lower total No. 1s at 12-inch spacing than at the 8.7-inch spacing. However, for fresh market use the increased yield of large tubers at 12-inch spacing, combined with lower seed costs, favor the 12-inch spacing. Frontier Russet has also exhibited a tendency for production of very large tubers. For seed production Frontier should be spaced at 8.7 inches or less in 32-inch rows. For fresh market production both varieties may perform best at an intermediate spacing between 8.7 and 12 inches.

Ranger Russet and Sierra achieved maximum yields at the 8.7-inch spacing. Ranger Russet produces an undesirable tuber type in very large tubers. The 8.7-inch spacing appears to be optimum for both varieties for fresh market or seed production.

Century Russet and Shepody produced low tuber sets and excessive tuber size. Shepody is prone to hollow-heart in very large tubers. Century Russet was very susceptible to skinning and bruising damage in large tubers. Both varieties also have few and poorly distributed eyes. Tubers in excess of 10 ounces are considered undesirable for seed. The optimum seed spacing appears to be 6.8 inches for both varieties. A closer spacing may be required for seed production.

Tuber size criterion for chipping potatoes are not the same as requirements for fresh market or french fry use. Tubers over 4 inches in diameter are highly undesirable. Both Atlantic and Gemchip produced excessive size at 12-inch spacing. Hollow-heart was quite commonly observed in large tubers of both varieties. The appropriate spacings for chip production were 6.8 inches for Atlantic and 8.7 inches for Gemchip. Closer spacings may be required for seed production.

Russet Burbank was not included in these trials prior to 1991. However, earlier experiments at KES and many years of commercial production experience have established an appropriate seed spacing of 12 inches in 32-inch rows or 10.5 inches in 36-inch rows under Klamath Basin conditions. The same spacing is commonly used for fresh market or seed production for Russet Burbank.

Multi-year response to nitrogen rates:

Data analyses were conducted using the statistical format described for seed spacing response over years. Effects of nitrogen rates on yields and tuber size distribution were generally small or non-significant. The interaction between year and nitrogen rate was statistically significant for total yield of No. 1s for Russet Norkotah and Ranger Russet, but not for any of the other varieties.

In three years out of four, Russet Norkotah achieved maximum yield at the lowest nitrogen rate. In 1988, early dying seriously reduced yields of Russet Norkotah at 130 and 160 lbs N/A while the 190 lbs N/A rate maintained good crop vigor. Commercial experience with Russet Norkotah has consistently shown this variety to be prone to serious yield reductions when grown under high disease pressure or under other stresses. Averaged over four years, the 130 lbs N/A rate was optimum for Russet Norkotah (Table 4).

Ranger Russet achieved maximum yields at a different nitrogen rate each year. However, the three-year average data suggests an intermediate nitrogen rate is optimum. Other varieties were quite consistent in nitrogen response over years. Gemchip was the only variety that produced maximum yields at 190 lbs N/A. The intermediate rate was optimum for HiLite Russet, Frontier Russet, Century Russet, Shepody, and Atlantic. Sierra produced maximum yields at 130 lbs N/A.

Effects of nitrogen rate on yields of 4- to 6-ounce, 10-ounce, B size, and No. 2 tubers were not statistically significant for any of the varieties. Effects on specific gravity were minimal in most varieties. Hollow-heart was found to be slightly more prevalent at the lowest nitrogen rate but was not a serious problem in any of the varieties evaluated.

A three-year evaluation of Russet Burbank's response to fertilization rates was completed in 1990. The average yield of No. 1s was 314, 333, and 340 cwt/A at nitrogen rates of 120, 180, and 240 lbs/A, respectively. Clearly, most of the varieties evaluated in this study require less nitrogen fertilizer than Russet Burbank.

SUMMARY AND CONCLUSIONS

Data obtained over four years provide an extensive base for selecting appropriate plant populations and nitrogen rates for many of the new potato varieties of interest in the region. None of the varieties tested have achieved optimum performance at management levels appropriate for Russet Burbank.

Three-year summaries represent different years for different varieties. However, these data provide a good comparison of the yield potential for these varieties under local conditions. Several of the russetted varieties have consistently produced higher yields, with better tuber size, than Russet Burbank. Century Russet has produced outstanding yields and excellent size for fresh market use. Atlantic and Gemchip achieve good yields and acceptable quality for chip contracts. Additional new varieties and advanced selections will continue to be evaluated in this program.

Table 1. Effect of seed spacing on performance of ten potato selections, Klamath Experiment Station, OR. 1991.

Selection	Seed spacing	Yield U.S. No 1s 4-6 oz	Yield U.S. No 1s 6-10 oz	Yield U.S. No 1s >10 oz	Yield U.S. No 1s Total	Yield Bs	Yield No 2s	Yield Total	Specific Gravity
	inches	cwt/A							
R. Norkotah	6.8	142	124	33	299	105	11	422	1.070
	8.7	165	149	35	348	89	13	457	1.071
	12.0	128	161	42	331	70	18	425	1.070
HiLite R.	6.8	138	102	17	257	133	8	402	1.072
	8.7	148	145	23	316	92	4	416	1.071
	12.0	131	149	34	314	88	7	411	1.073
Frontier R.	6.8	143	155	35	333	108	13	463	1.078
	8.7	139	180	40	359	79	12	459	1.077
	12.0	107	165	104	376	57	24	471	1.078
ND 1538-1	6.8	148	156	58	362	96	24	487	1.072
	8.7	126	193	66	386	58	31	486	1.071
	12.0	93	151	73	317	45	32	410	1.072
C008014-1	6.8	128	206	140	474	45	31	566	1.080
	8.7	139	247	111	497	30	14	556	1.081
	12.0	90	190	132	412	23	28	481	1.078
Century R.	6.8	183	270	213	666	56	6	742	1.079
	8.7	92	264	265	621	27	24	700	1.081
	12.0	98	229	308	635	26	6	676	1.079
A74212-1E	6.8	155	273	227	655	51	15	735	1.078
	8.7	92	244	244	580	31	14	648	1.080
	12.0	94	225	279	598	32	22	664	1.078
R. Nugget	6.8	120	131	58	309	70	5	398	1.089
	8.7	118	163	47	328	56	9	416	1.088
	12.0	101	130	82	313	47	7	384	1.090
Gemchip	6.8	164	215	86	465	85	8	585	1.080
	8.7	160	285	81	526	60	10	623	1.082
	12.0	127	240	118	485	43	15	574	1.081
R. Burbank	6.8	161	124	20	306	105	17	446	1.086
	8.7	143	146	32	321	79	23	458	1.086
	12.0	115	156	47	318	56	31	419	1.086
Variety Main Effect (average of three spacings)									
R. Norkotah		145	145	37	326	88	14	435	1.071
HiLite R.		139	132	25	296	104	6	410	1.072
Frontier R.		130	167	60	356	81	16	464	1.078
ND 1538-1		122	167	66	355	66	29	461	1.072
C008014-1		119	214	128	461	33	24	534	1.080
Century R.		124	254	262	641	36	12	706	1.079
A74212-1E		114	247	250	611	38	17	682	1.078
R. Nugget		113	141	62	317	58	7	399	1.089
Gemchip		150	247	95	492	63	11	594	1.081
R. Burbank		140	142	33	315	80	24	441	1.086
CV (%)		19	18	23	10	20	64	9	0.300
LSD (.05)		20	27	19	34	11	9	37	0.003
Seed Spacing Main Effect (average of ten selections)									
	6.8	148	176	89	413	85	14	525	1.078
	8.7	132	202	95	428	60	15	522	1.079
	12.0	108	180	122	410	49	19	492	1.079
CV (%)		28	28	35	17	50	81	16	0.300
LSD (.05)		20	NS	19	NS	18	NS	NS	NS

Table 2. Effect of nitrogen rate on performance of ten potato selections. Klamath Experiment Station, OR. 1991.

Selection	N-Rate	Yield U.S. No 1s				Yield			Specific
		4-6 oz	6-10 oz	>10 oz	Total	Bs	No 2s	Total	gravity
	lbs/A	cwt/A							
R. Norkotah	130	123	169	43	335	76	22	450	1.068
	160	128	166	41	335	82	18	452	1.069
	190	123	164	41	328	87	13	438	1.067
HiLite R.	130	144	153	16	313	99	6	421	1.072
	160	138	151	17	306	96	8	417	1.069
	190	143	172	29	345	96	6	452	1.066
Frontier R.	130	120	195	63	378	66	20	478	1.081
	160	137	160	46	343	69	18	447	1.077
	190	109	188	49	346	72	25	455	1.074
ND 1538-1	130	86	209	94	389	42	29	470	1.073
	160	93	211	61	365	51	35	467	1.070
	190	93	210	75	378	42	39	477	1.078
C008014-1	130	94	238	136	468	26	39	547	1.080
	160	76	251	155	482	26	38	568	1.082
	190	98	219	152	469	27	33	558	1.078
Century R.	130	97	249	235	581	33	32	664	1.075
	160	110	328	198	636	33	25	705	1.082
	190	89	238	261	588	30	20	673	1.074
A74212-1E	130	94	242	243	579	21	17	637	1.080
	160	73	254	282	609	27	33	687	1.077
	190	113	290	238	641	36	25	710	1.078
R. Nugget	130	98	173	63	334	44	16	406	1.090
	160	97	168	48	313	38	12	380	1.085
	190	85	173	69	328	48	10	406	1.089
Gemchip	130	121	279	85	485	56	24	586	1.080
	160	107	287	130	525	41	24	613	1.075
	190	110	295	133	538	53	9	624	1.079
R. Burbank	130	137	183	39	359	81	26	474	1.088
	160	119	181	49	349	67	31	473	1.089
	190	109	205	58	372	78	28	492	1.090
Variety Main Effects (average of three N-rates)									
R. Norkotah		125	166	42	333	82	18	447	1.068
HiLite R.		142	159	21	321	97	7	430	1.069
Frontier R.		122	181	53	356	69	21	460	1.077
ND 1538-1		91	210	77	377	45	34	471	1.074
C008014-1		89	236	148	473	26	37	558	1.080
Century R.		99	272	231	602	32	26	681	1.077
A74212-1E		93	262	254	610	28	25	678	1.078
R. Nugget		93	171	60	325	43	13	397	1.088
Gemchip		113	287	116	516	50	19	608	1.078
R. Burbank		122	190	49	360	75	28	480	1.089
CV (%)		19	12	26	7	24	49	6	0.300
LSD (.05)		16	20	23	24	11	9	24	0.003
N-Rate Main Effects (average of ten selections)									
	130	111	209	102	422	54	23	513	1.079
	160	108	216	103	426	53	24	521	1.077
	190	107	215	111	433	57	21	529	1.077
CV (%)		31	7	30	5	38	44	7	0.200
LSD (.05)		NS	NS	NS	NS	NS	NS	NS	NS

Table 3. Multi-year summary of effects of seed spacing on yield, grade, and tuber size distribution of nine varieties, Klamath Experiment Station, OR.

Variety	Seed spacing	Yield U.S. No 1s 4-6 oz	Yield U.S. No 1s 6-10 oz	Yield U.S. No 1s >10 oz	Yield U.S. No 1s Total	Yield Bs	Yield No 2s	Yield Total
	inches	cwt/A						
R. Norkotah (4 years)	6.8	126 A[1]	161	90 B	377 B	79 A	20	489
	8.7	122 A	169	108 B	399 AB	65 B	20	504
	12.0	95 B	162	153 A	410 A	50 C	15	488
HiLite R. (3 years)	6.8	137 A	155 B	49 C	341 B	107 A	8 B	463
	8.7	120 B	184 A	70 B	374 A	77 B	12 AB	472
	12.0	99 C	159 B	95 A	354 AB	60 B	16 A	439
Frontier R. (3 years)	6.8	124 A	176	81 C	381	69 A	16	477
	8.7	110 A	167	121 B	398	54 B	17	480
	12.0	80 B	153	160 A	393	37 C	20	460
Ranger R. (3 years)	6.8	123 A	162 AB	93 B	378	80 A	79	570 AB
	8.7	110 A	179 A	126 AB	415	61 B	81	584 A
	12.0	76 B	143 B	163 A	382	46 C	86	547 B
Sierra (3 years)	6.8	118 AB	148 B	105	371 B	70	34 B	506
	8.7	124 A	195 A	98	417 A	63	29 B	531
	12.0	105 B	146 B	96	347 B	57	50 A	486
Century R. (3 years)	6.8	163 A	235 A	181 B	579	73 A	19	684 A
	8.7	125 B	208 AB	216 AB	550	61 A	24	654 AB
	12.0	118 B	192 B	250 A	559	40 B	18	631 B
Shepody (3 years)	6.8	77 A	128 AB	209	413 A	35 A	79	560 A
	8.7	77 A	138 A	202	417 A	33 A	56	543 AB
	12.0	53 B	96 B	205	353 B	21 B	70	490 B
Atlantic (3 years)	6.8	124 A	197 A	121 B	442 A	68 A	23	557 A
	8.7	122 A	189 A	114 B	425 AB	52 B	25	538 AB
	12.0	93 B	163 B	149 A	405 B	49 B	38	522 B
Gemchip (3 years)	6.8	151 A	234 A	123 B	508 AB	73 A	10 B	610 AB
	8.7	144 A	258 A	129 AB	530 A	55 B	17 AB	627 A
	12.0	107 B	205 B	169 A	481 B	36 C	24 A	575 B

1/ Figures in the same column, for one variety, followed only by a different letter are significantly different at the .05 level of probability according to the student's t test.

Table 4. Multi-year summary of effects of nitrogen rate on yield, grade, and tuber size distribution of nine varieties, Klamath Experiment Station, OR.

Variety	Nitrogen rate	Yield U.S. No 1s				Yield		
		4-6 oz	6-10 oz	>10 oz	Total	Bs	No 2s	Total
	lbs N/A	cwt/A						
R. Norkotah (4 years)	130	117 A[1]	174	93	384 A	60	19	477 A
	160	105 AB	156	84	345 B	69	17	447 B
	190	101 B	172	104	377 AB	67	13	467 AB
HiLite R. (3 years)	130	129	145 B	48	322	85	9	423
	160	113	172 A	61	346	80	11	443
	190	111	158 AB	67	336	75	8	427
Frontier R. (3 years)	130	91	164	100	355	55	31	456
	160	102	156	105	363	55	25	455
	190	105	164	91	360	58	27	455
Ranger R. (3 years)	130	94	158	123	375	53	86	538
	160	95	162	132	389	57	82	554
	190	96	166	122	384	57	80	547
Sierra (3 years)	130	92	157 A	104	353	51	43	466
	160	99	150 AB	84	333	62	36	458
	190	83	130 B	99	312	49	41	424
Century R. (3 years)	130	110	185 B	190	485	52	33	589
	160	102	227 A	197	526	44	21	609
	190	113	189 B	220	512	46	19	600
Shepody (3 years)	130	60	124 AB	170	354 AB	31	65	491
	160	56	136 A	195	387 A	28	55	507
	190	54	106 B	167	327 B	29	67	470
Atlantic (3 years)	130	107	150	100	357	68	29	485
	160	109	170	123	402	64	17	509
	190	106	153	111	370	68	25	491
Gemchip (3 years)	130	126	222 B	103	451 B	66 A	26	568
	160	113	246 A	134	493 A	57 AB	26	599
	190	120	250 A	135	505 A	55 B	19	601

1/ Figures in the same column, for one variety, followed only by a different letter are significantly different at the .05 level of probability according to the student's t test.

Effects of vine desiccants on A74212-1E

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

INTRODUCTION

A74212-1E is an earlier maturing selection of Century Russet. Century Russet has consistently been slow to develop vine and skin maturity following vine desiccation. Skinning damage has been a serious limitation for Century Russet, even with a delay of three weeks between vine desiccation and harvest. A74212-1E produces less vigorous vines which begin senescing at least 10 days earlier than Century Russet. This study evaluated vine maturity, yield and grade, and tuber skinning damage of A74212-1E in response to the standard desiccant, diquat, and an experimental product.

PROCEDURES

A74212-1E was planted at 8.7-inch spacing in 32-inch rows on May 16. Fertilizer included 600 lbs/A of 16-16-16 banded at planting and 50 lbs N/A applied as solution 32 on May 31. Cultural practices were similar to those described for other experiments (see page 41). Individual plots, 4 rows, 43-feet long, were established in a randomized complete block design with four replications in late August. Desiccation treatments (Table 1) were applied with a conventional ground sprayer using 26 gpa of solution at 30 psi with flat-fan nozzles.

Vine maturity ratings were visually estimated at 3, 9, and 21 days post-treatment. Potatoes were harvested from the center two rows of each plot on September 25 with a one-row, digger-bagger. Total weights were determined in the field. Approximately 120-pound samples from each plot were stored and graded to USDA standards on October 4. Skinning damage was estimated as the percent of tubers with more than 10 percent skin removed.

RESULTS AND DISCUSSION

Vines were beginning to show evidence of natural senescence when the first applications of desiccants were made. The first fall frost on September 21 effectively desiccated leaves on all plants, including those in untreated control plots. Diquat, applied in the evening, produced significantly more rapid leaf and stem death than a morning application of diquat or any of the C4243 treatments (Table 2). The 1-pint/A diquat application was as effective as 2-pints/A or split applications of 1 pint/A at a four-day interval. C4243 did not significantly enhance leaf or stem death compared with natural senescence of plants in untreated control plots except for stem death 21 days post-treatment.

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Acknowledgment: Partial funding for this study was provided by Uniroyal Chemical and the Oregon Potato Commission.

Tuber skinning damage was reduced by nearly 50 percent by evening applications of diquat compared with damage in control plots (Table 2). Variability between samples was high and differences were not statistically significant. However, the trends for skinning damage were consistent with treatment effects on vine maturity.

Tuber yields and size distribution were influenced slightly by desiccation treatments (Table 3). Diquat reduced yields and tuber size slightly compared with results observed in the control plots and in C4243-treated plots. Total yield of No. 1s was significantly higher in the control and p.m. treatment with C4243, than for the evening application of diquat at 2 pints/A. The split application of diquat produced the best combination of leaf and vine desiccation, reduced tuber skinning, and yields and size.

A74212-1E produced much higher yields in several other experiments in 1991. The major reason for lower yields in this study was the withdrawal of irrigation late in August to accommodate field entry for treatment applications. No further irrigation was applied. This provides some indication of potential yield reductions that could be anticipated in drought conditions when water deliveries would be curtailed in late August. A comparison with yields observed in seed spacing and nitrogen rate studies suggest a reduction in yield of No. 1s on the order of 30 percent.

CONCLUSION

A74212-1E experienced significant skinning damage when harvested three weeks after vine killing. Under similar conditions Russet Burbank seldom exhibits skinning damage. Diquat, applied in the evening, was effective in desiccating leaves and stems and substantially reduced tuber skinning damage, but at some sacrifice in yield. The experimental compound, C4243, was very slow acting in this study. It did hasten stem death and reduce tuber skinning slightly, but was clearly inferior to diquat.

Table 1. Vine desiccation treatments applied to A74212-1E, Klamath Experiment Station, OR, 1991.

Treatment code	Product	Rate	Time of day	Date	Adjuvant Product	Adjuvant Rate
Control	----	----	--	----	----	----
C 1 A	C4243	.063 #ai/A	a.m.	Sept. 3	Agridex	1 pt/100 gal
C 2 A	C4243	.125 #ai/A	a.m.	Sept. 3	Agridex	1 pt/100 gal
C 1 P	C4243	.063 #ai/A	p.m.	Sept. 2	Agridex	1 pt/100 gal
D 1 P	Diquat	1 pt/A	p.m.	Sept. 2	X77	12 oz/A
D 2 P	Diquat	2 pt/A	p.m.	Sept. 2	X77	12 oz/A
D 1+1 P	Diquat	1 pt/A	p.m.	Sept. 2	X77	12 oz/A
	+Diquat	1 pt/A	p.m.	Sept. 6	X77	12 oz/A
D 2 A	Diquat	2 pt/A	a.m.	Sept. 3	X77	12 oz/A

Table 2. Effect of vine desiccation treatments on leaf and stem death and tuber skinning ratings of A74212-1E, Klamath Experiment Station, OR, 1991.

Treatment Code	Leaf death Sept. 6	Leaf death Sept. 12	Leaf death Sept. 24	Stem death Sept. 6	Stem death Sept. 12	Stem death Sept. 24	Skinning
	%						
Control	0	35	89	0	21	48	38
C 1 A	15	48	95	4	28	70	30
C 2 A	18	56	99	5	26	78	26
C 1 P	11	45	96	3	23	68	30
D 1 P	65	70	98	16	36	84	20
D 2 P	65	75	100	16	36	86	16
D 1+1 P	65	83	99	18	46	89	21
D 2 A	29	51	89	6	29	58	30
CV (%)	28	19	6	32	26	20	40
LSD (.05)	17	17	8	4	12	21	NS

Table 3. Effect of vine desiccation treatments on yield and grade of A74212-1E, Klamath Experiment Station, OR, 1991.

Treatment Code	Yield U.S. No. 1s			Yield		
	4-10 oz	>10 oz	Total	Bs	No 2s	Total
	cwt/A					
Control	296	119	415	65	14	501
C 1 A	250	138	388	67	7	466
C 2 A	280	124	404	59	13	483
C 1 P	286	139	425	80	7	518
D 1 P	268	101	369	65	12	450
D 2 P	250	103	353	59	12	438
D 1+1 P	280	115	395	73	5	477
D 2 A	255	113	369	58	15	449
CV (%)	16	30	8	32	68	8
LSD (.05)	NS	NS	46	NS	NS	NS

Control of Nematodes and Related Diseases in Potatoes

K.A. Rykbost[1], R.E. Ingham[2], and J. Maxwell[1]

INTRODUCTION

Mineral soils in the Klamath Basin are infested to varying degrees with several nematode species that pose a serious threat for potato production. Prior to 1989, Telone II and aldicarb generally provided satisfactory and economical control of root-knot (*Meloidogyne chitwoodi*) and stubby-root nematodes (*Paratrichodorous teres*), respectively. Stubby-root nematodes vector tobacco rattle virus (TRV), causing tuber infections of corky ring-spot (CRS). With the loss of aldicarb, several growers in the Malin, Oregon area have abandoned potato production in fields with a history of stubby-root nematode infestations. Telone II use permits were withdrawn in California in early 1990. In 1991, over 2,000 acres of nematode infested fields were planted with alternate crops in the Tulelake area due to a lack of confidence in alternative control measures for root-knot nematodes. Eliminating potato production and control measures from infested fields is likely to result in increased nematode populations in these fields and an increased risk of infestations in surrounding areas.

Numerous studies have been conducted on mineral and organic soils in the Klamath Basin over many years to refine nematode control strategies. Recent research has led to significant improvements in root-knot nematode control with available chemicals through better placement and incorporation practices. A 1990 study at KES demonstrated satisfactory control of root-knot nematodes, but inadequate control of (CRS), with combinations of Telone II and ethoprop. This study was conducted in the Malin area to compare Telone II, ethoprop, and aldicarb, alone or in combinations, for efficacy on root-knot and stubby-root nematodes and CRS control.

PROCEDURES

Soil samples were obtained from two potential test sites in March 1991 and analyzed for nematode populations. The Prescott field, approximately 5 miles northwest of Malin, Oregon, was selected on the basis of higher populations of stubby-root nematodes. Plot areas were delineated and soil sampled on April 16. Individual plots were 20 feet wide and 50 feet long, arranged in a randomized complete block design with four replications. Soil samples represented 15 to 20 cores from 0- to 8- and 8- to 16-inch depths in each plot.

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2/ Associate Professor, Department of Botany and Plant Pathology, Oregon State University.

Acknowledgments: Partial funding of the project was provided by the Oregon Potato Commission, Oregon's Center for Applied Agricultural Research, Dow Chemical Company, and Rhone-Poulenc. Grower, Alan Prescott, provided the field site and crop care throughout the season.

Telone II treatments were applied at 20 gpa with conventional equipment at approximately 14-inch depth on a 12-inch shank spacing on April 22. Ethoprop (Mocap 6EC) treatments were applied with a conventional ground sprayer and immediately incorporated to a depth of 6 inches with a rotara on May 15. Russet Burbank potatoes were planted by the grower on May 25. Aldicarb (Temik 15G) treatments were banded on both sides of rows at 4 inches below seed depth with a continuous belt shank applicator on June 3. Standard commercial potato production practices were followed throughout the season. Irrigation was applied with solid-set sprinklers on a 30-foot by 50-foot spacing.

Mid-season soil samples were collected from each plot on July 10. Samples represented 15 to 20 cores per plot from 0- to 12-inch soil depth. Postharvest soil samples were collected from 0- to 8- and 8- to 16-inch soil depths on October 14. All soil samples were analyzed by personnel in the OSU Department of Botany and Plant Pathology.

Potatoes were harvested from 30-foot sections of the center two rows of each plot with a one-row digger-bagger on October 14. All tubers were stored under typical conditions and graded to USDA standards on October 22. Tubers exhibiting external blemish symptoms of root-knot nematode infections, regardless of size or grade, were included in a nematode blemish grade. Twenty-five tubers from each plot were cut longitudinally and inspected for CRS infections. No. 1 yields were not adjusted for CRS infections.

Two 25-tuber subsamples from each plot were saved for further evaluations and stored at KES at 40°F and 95 percent relative humidity. One set was delivered to Corvallis on October 29 and assayed for root-knot nematode and CRS infections in early November. The second set was delivered to Corvallis in late February and assayed in early March. All tubers were peeled with Daisy-Stripper peelers. Root-knot nematode infection sites were counted on individual tubers. Tubers were considered culls if six or more infection sites were present. CRS symptoms were evaluated by transverse slicing of tubers in 1/4-inch thick slices and inspection of individual slices for CRS arcs or diffuse spots. Tubers were scored as infected if one CRS infection site was observed in any of the slices.

RESULTS AND DISCUSSION

Pretreatment soil analysis revealed fairly consistent populations of stubby-root nematodes throughout the experimental area (Table 1). All individual plots were infested and the distribution between sample depths was quite uniform. Populations of root-knot nematodes were more varied. Approximately 50 percent of the samples were devoid of root-knot nematodes. Numbers were slightly higher in the 0- to 8-inch soil layer.

Few nematodes were detected in mid-season soil analysis (Table 1). Stubby-root nematodes were detected in 14 of 32 plots and root-knot nematodes were only found in three samples. Low populations of stubby-root nematodes, and the absence of root-knot nematodes in untreated control plots indicates that nematodes had either moved into plant roots or migrated to lower soil depths.

The analysis of postharvest soil samples presented a very different picture. Stubby-root nematode populations in control and ethoprop treated plots were similar to pretreatment levels (Table 1). Telone II, applied alone, appeared to reduce stubby-root populations to one-third of pretreatment levels. Aldicarb, alone or in combination with Telone II or ethoprop, and the combination of Telone II and ethoprop appeared to provide good control of stubby-root nematodes.

Postharvest populations of root-knot nematodes were very high in control and ethoprop or aldicarb treated plots (Table 1). Telone II provided excellent control of root-knot nematodes in three replications but high populations were observed at both soil depths in the fourth replication. High populations were detected in two replications of the ethoprop plus aldicarb treatment. Combinations of Telone II and ethoprop or aldicarb provided good control of root-knot nematodes.

Total yield of tubers was relatively consistent across all treatments (Table 2). Other recent studies in mineral soils in the Klamath Basin have shown significant populations of root-lesion (*Pratylenchous neglectus*) nematodes and yield responses to control of this nematode and associated early dying with various fumigation treatments. Soil analysis failed to detect root-lesion nematodes at the Prescott site. Early dying did not affect treatments differentially, if at all, in this study.

Yields of individual grades were highly variable, due to variability in the occurrence of nematode blemish between treatments and between replications within treatments. Tubers in two replications of the control treatment were 100 percent infected with root-knot nematodes. The other replications exhibited 0 and 6 percent nematode blemish. More than 10 percent blemish was observed in all replications of the aldicarb treatment and in three of four replications of both ethoprop treatments. The Telone II treatment replication that had high root-knot nematode populations in postharvest soil analysis exhibited a high incidence of tuber blemish. Approximately 20 percent blemish was observed in two replications of the combination treatment of aldicarb and ethoprop. No blemish was observed in the other replications of this treatment, or in any replications of the combinations of Telon II with aldicarb or ethoprop.

CRS infections observed in 25-tuber samples cut longitudinally at the time of grading were not well correlated with stubby-root nematode populations observed in October (Tables 1 and 2). CRS symptoms were found in 42 percent of control treatment tubers inspected. Infection rates were much lower in both ethoprop treatments, even though stubby-root nematode populations were higher than in control plots. Only 2 percent of Telon II treatment tubers exhibited CRS symptoms while stubby-root nematode populations were about the same as in control plots. No CRS infections were observed in any tubers from plots treated with aldicarb or the combination of Telone II and ethoprop.

Root-knot nematode infection levels were slightly higher when based on peeled tubers (Table 3). The largest discrepancy occurred in the ethoprop plus aldicarb treatment. Infection levels were 30 percent for peeled tubers versus 10 percent based on visual symptoms on intact tubers. The higher levels observed on peeled samples appear to be more in line with root-knot nematode populations at harvest (Table 1). Regardless of detection method, it is clear that under the conditions of this study satisfactory control of root-knot nematodes required a combination of Telone II and ethoprop or aldicarb. This contrasts with results obtained in a study at KES in 1990 where ethoprop at 12 lbs ai/A or Telone II at 15 gpa adequately controlled root-knot nematodes.

CRS infection levels were similar for both inspection methods (Table 3). All treatments except ethoprop at 9 lbs ai/A provided satisfactory control of CRS. These findings also contradict results observed in the 1990 study at KES. In that study, Telone II applied alone did not control CRS infections adequately. However, initial populations of stubby-root nematodes were higher in the study at KES than at the Malin site.

CONCLUSIONS

In a field with moderate populations of root-knot nematodes and stubby-root nematodes, combinations of Telone II and ethoprop or aldicarb were required to avoid serious tuber infections of root-knot nematodes and CRS. Compared with a 1990 study conducted at KES, root-knot nematodes were more difficult to control in this study. This may have been due to very warm conditions and an additional generation of nematodes produced in 1991. In contrast, CRS infections were more readily controlled in the 1991 study. Low tuber infection levels in plots with significant stubby-root nematodes could be due to a lack of TRV infection in a portion of the nematode population.

There was generally good agreement in levels of infection between the detection methods. Visual ratings of intact tubers found only slightly less tuber blemish than the more elaborate method based on counting tuber infection sites on peeled tubers. Likewise, inspection for CRS based on a single longitudinal cut detected similar levels to those based on multiple transverse slices from each tuber. The large difference in labor requirements between these methods would not be justified by results of this study. A simple evaluation of intact tubers for root-knot nematode infections and one longitudinal cut for CRS infections provided good estimations of infection levels.

The levels of infection did not increase with storage time for either root-knot nematodes or CRS. However, there may have been a significant change in tuber blemish symptom expression between the time of harvest and the eight day storage period prior to grading. No tuber blemish was observed by casual inspection of tubers at harvest. This could have serious implications for crops going for any use other than directly into processing. Further studies are planned to investigate the timing of tuber infection and symptom development.

Table 1. Effects of fumigation and nematicide treatments on populations of stubby-root and root-knot nematodes, Prescott site, Malin, 1991.

Treatment	Stubby-root April 16 0-8"	Stubby-root April 16 8-16"	Stubby-root July 10 0-12"	Stubby-root October 14 0-8"	Stubby-root October 14 8-16"	Root-knot April 16 0-8"	Root-knot April 16 8-16"	Root-knot July 10 0-12"	Root-knot October 14 0-8"	Root-knot October 14 8-16"
	nematodes/250 cc of soil									
Control	28	36	5	19	26	1	3	0	933	790
Ethoprop - 9#ai/A	41	56	1	36	86	14	5	2	916	1173
Ethoprop - 12#ai/A	34	52	7	27	61	1	10	8	645	570
Aldicarb - 3#ai/A	30	34	4	1	4	8	6	0	674	576
Telone II - 20 gal/A	63	66	2	21	21	9	13	0	138	147
Telone II - 20 gal/A + Ethoprop - 6#ai/A	20	20	0	0	1	5	1	0	3	4
Telone II - 20 gal/A + Aldicarb - 3#ai/A	21	25	1	1	0	38	16	0	11	1
Ethoprop - 9#ai/A + Aldicarb - 3#ai/A	67	47	0	1	2	1	11	1	416	258

Table 2. Effects of fumigation and nematicide treatments on yield, grade, nematode infections, and corky ringspot infections in Russet Burbank, Prescott Site, Malin, 1991.

Treatment	Total yield	Total #1 yield	Bs (<4oz) yield	Nematode blemish yield[2]	Root-knot infected[2]	Corky ringspot[3] infected
	cwt/A				--% of Total Yield--	
Control	335 B[1]	113 C	38 A	172 A	52 A	42 A
Ethoprop - 9#ai/A	352 AB	161 BC	61 A	126 AB	36 AB	13 AB
Ethoprop - 12#ai/A	360 AB	171 BC	67 A	120 AB	34 ABC	5 B
Aldicarb - 3#ai/A	332 B	122 C	42 A	164 A	49 A	0 B
Telone II - 20 gal/A	377 AB	215 AB	89 A	68 ABC	20 ABC	2 B
Telone II - 20 gal/A + Ethoprop - 6#ai/A	339 B	258 A	79 A	0 C	0 C	0 B
Telone II - 20 gal/A + Aldicarb - 3#ai/A	365 AB	253 AB	103 A	0 C	0 C	0 B
Ethoprop - 9#ai/A + Aldicarb - 3#ai/A	391 A	252 AB	91 A	39 BC	10 BC	0 B
CV (%)	10	20	56	90	93	268
LSD (.05)	51	85	NS	114	34	30

1/ Means in the same column not followed by the same letter are significantly different at the 5 percent probability level based on Student's t test.

2/ Based on visible external blemish.

3/ Based on inspection of 25 tubers/plot, cut longitudinally.

Table 3. Effects of method and time of tuber evaluation on the incidence of root-knot nematode and CRS infections in Russet Burbank grown in Malin, OR., 1991.

Treatment	Root-knot infections				CRS infections			
	Intact[1]	Peeled[2]			Cut[3]	Sliced[4]		
	10/91	11/91	3/92	Mean	10/91	11/91	3/92	Mean
	%							
Control	52	42	47	47	42	44	51	46
Ethoprop - 9#ai/A	36	45	41	41	13	21	23	19
Ethoprop - 12#ai/A	34	50	45	43	5	2	12	6
Aldicarb - 3#ai/A	49	73	56	59	0	5	4	3
Telone II - 20 gal/A	20	20	22	21	2	0	2	1
Telone II - 20 gal/A + Ethoprop - 6#ai/A	0	0	1	0	0	2	2	1
Telone II - 20 gal/A + Aldicarb - 3#ai/A	0	0	0	0	0	8	3	4
Ethoprop - 9#ai/A + Aldicarb - 3#ai/A	10	33	24	22	0	1	8	3
Mean	25	33	30	29	8	10	13	10

1/ Visible external blemish as percent by weight of the graded sample.

2/ The percent of tubers in a 25 tuber subsample with six or more infection sites.

3/ The percent of tubers in a 25 tuber subsample with one or more infection sites in a single longitudinal cut.

4/ The percent of tubers in a 25 tuber subsample with one or more infection sites in any of the 1/4-inch thick transverse slices.

Timothy Hay Variety Trial

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

INTRODUCTION

Timothy is a short-lived perennial forage grass that is in high demand for high quality hay. The development of specialty markets in the race horse industry has driven prices to levels that are in excess of alfalfa hay prices. There is an increasing interest in timothy hay in the Klamath Basin yet little variety yield data is available for prospective producers. This trial was established to compare the relative yield potential of various commercially available timothy varieties in the Klamath Basin.

PROCEDURES

Plots were established in August 1988. The trial consists of ten commercially available Timothy varieties arranged in a randomized complete block design with four replications. Soil samples from the plots were analyzed and appropriate fertilizer applied prior to planting. Seed was drilled to a depth of 1/4 inch or greater using a modified Kincaid drill at a rate of 4 lbs/A. Plots were 5 x 20 feet with a 3-foot alleyway. Water was supplied with a solid set sprinkler system. Plants were allowed to grow uncut through the first growing season. Three harvests were taken in 1989, 1990, and 1991 when plants started heading. Plots were harvested using a flail harvester with a 3-foot wide cutting head. All yields are reported on a dry weight basis.

RESULTS AND DISCUSSION

Establishment was poor due to deep planting. Timothy should be planted no deeper than 1/4 inch. It appears that seedling vigor of the various varieties was not the same since some varieties established much better than others in spite of the depth of planting.

Although Richmond had the highest yields in 1989, it was not an outstanding yielding variety in 1990 and was ranked fourth in 1991 (Table 1). Clair was the second highest yielding entry in 1989, the highest yielder in 1990, and was the second highest yielding variety in 1991, averaging 324 lbs/A more than Richmond over three years. Due to the importance of stand persistence in this crop, more emphasis should be placed on the second and third year yields.

There was little difference in digestibility, as measured by acid detergent fiber (ADF), between the entries in this trial. However, there were substantial differences in crude protein (CP) between varieties. Average CP value ranged from 7.6 to 10.4 percent. The two varieties with the highest CP were Basho and Climax, while Clair had the lowest value (Table 1). Forage quality evaluations were made on the second cutting in 1990.

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Continued testing is required to develop valid conclusions on the yield potential of these varieties in the Klamath Basin. However, the average yield across three years was in excess of four tons/A. At current market prices this yield would result in comparable or superior net profits/A to alfalfa hay.

Table 1. Summary of forage yield and quality of ten timothy hay varieties established in the fall of 1988 at the Klamath Experiment Station, OR.

Entry	Yield				Forage quality[1]	
					ADF	Protein
	1989	1990	1991	Avg.	---- 1990 ----	
	----------- lbs/A -----------				------ % -----	
Clair	11,920	9,331	11,925	11,059	40.1	7.6
Drummond	8,393	6,286	9,970	8,216	40.2	9.2
Timflor	9,838	6,980	11,983	9,600	41.6	8.7
Mariposa	10,970	7,122	10,484	9,525	40.4	8.3
Richmond	12,210	8,666	11,330	10,735	41.4	7.5
Bounty	9,085	6,980	9,972	8,679	39.3	10.0
Basho	7,805	8,379	11,388	9,191	39.4	10.4
Climax	8,042	8,155	10,654	8,950	40.2	10.4
Champ	9,816	6,525	10,801	9,047	40.0	8.5
Salvo	11,000	8,075	10,044	9,706	40.1	9.1
Mean:	9,908	7,648	10,855	9,470	40.3	9.0
LSD (0.05)	17,777	954	1,062		1.1	1.3
CV (%)	12	9	8		1.8	9.7

1/ Forage quality was determined on samples from the second cutting in 1990.

Pasture Grass Variety Trials

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 Alta tall fescue, released in the late 1940's. New cultivars developed since that time need to be assessed for adaptation to the Klamath Basin. The acquisition of new germplasm from forage breeding programs in New Zealand and Australia add further emphasis to the development of a forage variety screening program in the Klamath Basin.

Two variety trials were established in August, 1988 to examine the relative forage production of commercially available tall fescue and orchardgrass varieties. Another trial was established examining hybrids of bluebunch wheatgrass and quackgrass compared to a locally acquired selection of quackgrass. A substantial acreage of quackgrass is grown as hay or pasture in the Klamath Basin. The identification of a less weedy hybrid that is better adapted to both hay and pasture production could be very beneficial.

PROCEDURES

Trials were established on sandy mineral soil at the KES in August, 1988. All trials were 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. Orchardgrass was seeded at a rate of 15 lbs/A. Tall fescue varieties were seeded at 12 lbs/A. Quackgrass-bluebunch wheatgrass selections and crosses were seeded at a rate of 10 lbs/A. Plots were 5 x 20 feet with 3-foot wide alleyways. Plants were irrigated by solid set sprinklers.

The plants were allowed to grow uncut through the first growing season. Three harvests were taken in 1989, 1990, and 1991 when plants began to flower. Plots were harvested with a flail harvester. All yields are reported on a dry weight basis. Quality samples were collected from the second cutting in 1990 and analyzed for acid detergent fiber (ADF) and crude protein (CP).

RESULTS AND DISCUSSION

Tall Fescue

Tall fescue had the best seedling vigor of the grass species established in 1988. All varieties established well and tended to out-compete most weeds, with the notable exception of several mustard species. Average yield of tall

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fescue was higher than any other forage grass (Tables 1-3). It also appears that forage yield of this species is less dependent on N fertilization than orchardgrass. There was no significant difference in total forage yield between tall fescue cultivars in either 1989 or 1990. Tall fescue is the recommended grass species for irrigated pastures due to ease of establishment, forage production, weed suppression, and stand longevity. There was no difference in CP between tall fescue cultivars; however, ADF values of Tandem were lower than all other varieties.

Quackgrass-Bluebunch Wheatgrass

All entries in this trial established well. They showed lower seedling vigor than tall fescue but were more vigorous than orchardgrass varieties. The local selection of quackgrass was the lowest yielding entry in the trial (Table 2). RS MC87 was the highest yielding entry in 1989 and 1990, significantly exceeding yields of locally acquired quackgrass. However, in 1991 there were no significant differences between entries in this trial. Further testing is needed to confirm the adaptation of these new varieties to Klamath Basin dryland and irrigated sites; however, it is possible that RS MC87 will be a high-yielding variety for irrigated sites that also tolerates dryland conditions.

There was no difference in quality between entries in this trial. It is interesting to note that forage quality of all entries in this trial were superior to all timothy, tall fescue, and orchardgrass varieties tested at KES. Average ADF values were lower than improved species, indicating higher digestibility, and CP values were higher.

Orchardgrass Variety Trial

Although Orion produced significantly higher yields than all other entries in 1989, this trend did not continue in 1990 and 1991 (Table 3). The only entry with consistently high yields in all years was Latar. Wana, a variety introduced from New Zealand, produced significantly less forage than any other entry in the trial in 1990. By the end of the 1991 season there were few plants of this variety in the plots and yields represented the yield potential of invading Kentucky bluegrass.

There were slight, yet statistically significant, differences in forage quality between varieties. Latar, the highest yielding variety, had the highest ADF and lowest CP values.

Table 1. Summary of forage yield and quality of tall fescue varieties established in the fall of 1988 at the Klamath Experiment Station, OR.

Entry	Yield 1989	1990	1991	Avg.	Forage quality ADF	Protein
	lbs/A				%	
Fawn	14,750	7,460	7,956	10,055	40.9	9.5
Alta	14,640	7,520	7,497	9,886	40.9	8.8
Kentucky 31	16,100	7,430	8,104	10,545	39.4	9.7
Tandem	15,480	5,810	7,265	9,518	38.2	9.1
Festorina	14,430	6,660	7,789	9,626	39.6	9.7
Johnstone	14,280	7,490	7,887	9,886	39.4	9.7
Forager	15,520	8,350	7,776	10,549	40.4	9.6
Phytor	15,420	7,450	8,419	10,430	40.0	8.7
Mean:	15,080	7,270	7,837	10,062	39.9	9.4
LSD (0.05)	NS	NS	1,147			
CV (%)	8	18	10			

Table 2. Summary of forage yields and quality of two quackgrass - bluebunch wheatgrass hybrids and quackgrass lines established in the fall of 1988 at the Klamath Experiment Station, OR.

Entry	Yield 1989	1990	1991	Avg.	Forage quality ADF	CP
	lbs/A				%	
RS MC87	9,734	7,050	6,754	7,846	36.9	12.5
RS E87	8,263	6,657	7,409	7,443	37.1	13.5
RS Hoffman	8,572	7,003	6,562	7,379	36.3	13.7
Klamath Basin Selection	6,862	5,064	6,728	6,218	37.2	13.7
Mean	8,358	6,444	6,863	7,222	36.9	13.4
CV (%)	1,957	1,859	NS			
LSD (0.05)	15	18	13			

Table 3. Summary of forage yield and quality of ten orchardgrass varieties established in the fall of 1988 at the Klamath Experiment Station, OR.

Entry	Yield				1990 Forage quality	
	1989	1990	1991	Avg.	ADF	CP
	------------ lbs/A ------------				----- % -----	
Latar	11,740	9,302	8,993	10,012	42.4	9.5
Kara	9,277	7,180	5,233	7,230	41.6	10.1
Rancho	9,791	8,796	8,082	8,890	40.3	10.4
Able	8,751	7,150	7,424	7,775	39.8	11.0
Wana	8,421	5,874	5,802	6,699	39.0	13.3
Patomic	10,600	7,086	7,827	8,504	40.1	10.3
Benchmark	11,680	8,461	8,559	9,567	40.9	10.5
Comet	12,110	7,765	8,576	9,484	39.9	9.7
Orion	16,140	8,347	8,693	11,150	41.5	9.8
Crown	8,847	9,288	7,574	8,570	40.5	11.0
Mean:	10,740	7,925	7,676	8,788	40.6	10.6
LSD (0.05)	2,076	1,573	1,085		2.4	6.6
CV (%)	13	14	10		1.4	1.0

Spring Barley Variety Development at Klamath Falls

P.M. Hayes[1], R.L. Dovel[2], and G. Chilcote[2]

INTRODUCTION

Klamath Falls is the principal testing site for the spring barley component of the Oregon Barley Variety Development Program. The spring barley variety effort is based on the production of doubled haploids (DH) - a tissue culture technique that reduces variety development time in half - and introduction of advanced breeding lines from Idaho, Montana, and Washington. We are also involved in gene mapping activities that represent an application of biotechnology tools to real agricultural issues. During the 1991 season, experiments representing these various phases of the program were conducted at Klamath Falls, in cooperation with staff at the Klamath Experiment Station (KES).

PROGRAMS AND RESULTS

Doubled haploid breeding technology

Rationale: This experiment is designed to address issues of breeding strategy. The underlying question is: can the DH technique expedite selection gain in both narrow crosses (i.e. Harrington X Klages) and exotic crosses (i.e. Harrington X Vada and Klages X Vada)? The former cross defies early generation selection, as Harrington and Klages are phenotypically similar. The latter crosses generally produce such extreme variation that the progeny are not immediately useful in a variety development program.

Procedures: Sixty DH lines (20 from each cross combination) were randomly chosen from a large array of DH lines from each cross. Experimental materials were evaluated in five-replicate hill plots.

Results: Crop growth and development was reasonable. Sixteen percent of the DH lines, including lines from all pedigrees, were significantly higher yielding than the higher yielding parent (Klages). These lines will be advanced to conventional breeding plots.

Random mixtures of DH lines

Rationale: There is currently a good bit of enthusiasm over the use of mixtures instead of pure lines. Results in barley have not been as promising as in club wheats. Some concern has been voiced over the release of something as pure as a DH. To address these issues, we made random two-way mixtures of 20 DH lines from the DH progeny of Steptoe and Morex.

Procedures: The two-way mixtures, as well as the mixture of Steptoe and Morex and the 22 pure lines, were evaluated in a two-replicate experiment.

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2/ Assistant Professor and Research Technician, Respectively, Klamath Experiment Station, OR.

Acknowledgment: These experiments were conducted with the support of the Oregon Grains Commission.

Results: One mixture was significantly higher yielding than the pure line version of Morex. We are currently analyzing the performance of specific lines to see if they consistently do better in mixture combinations than would be expected. The yield benefits of mixing may not compensate for the additional trouble required to develop, maintain, and market mixtures.

The North American Barley Genome Mapping Project trial

Rationale: The NABGMP is directed at developing a barley gene map that is useful to plant breeders. This involves developing a map of 150 DH lines and simultaneously evaluating these 150 lines in field trials at 10 locations in the U.S. and Canada.

Procedures: 150 DH lines were evaluated using partial replication (50 lines replicated) in a randomized complete block design.

Results: There was tremendous variation for every agronomic character imaginable. A complete analysis of these data is in progress. An example of what gene mapping can do is shown in Figure 1. This data is from another mapping experiment directed at locating cold tolerance genes, but the principle is the same. The linkage map for chromosome 7 is given on the horizontal axis and the probability that there is a significant gene effect is given on the vertical axis. If the bars exceed LOD 3, then you can say with a high degree of confidence that there is a gene controlling the trait of interest in that region. For example, in the area of chromosome 7 between the gene markers mR and BCD265b there is a gene that has a significant effect on the cold tolerance of barley. This information can be used to move the cold tolerance gene into a spring barley with just a few crosses. Following conventional procedures, it would take a lifetime and a lot of luck to accomplish this.

Short row screening of doubled haploids

Rationale: There are many two-row doubled haploids in the pipeline. Some of these come from reasonable cross combinations. While the focus of the OGC-funded effort is on 6-rows, it seemed worthwhile to get a good look at this 2-row material.

Procedures: 1200 doubled haploids from various 2-row cross combinations were grown in short row observation plots. Based on a visual rating, 60 DH lines from each cross were chosen.

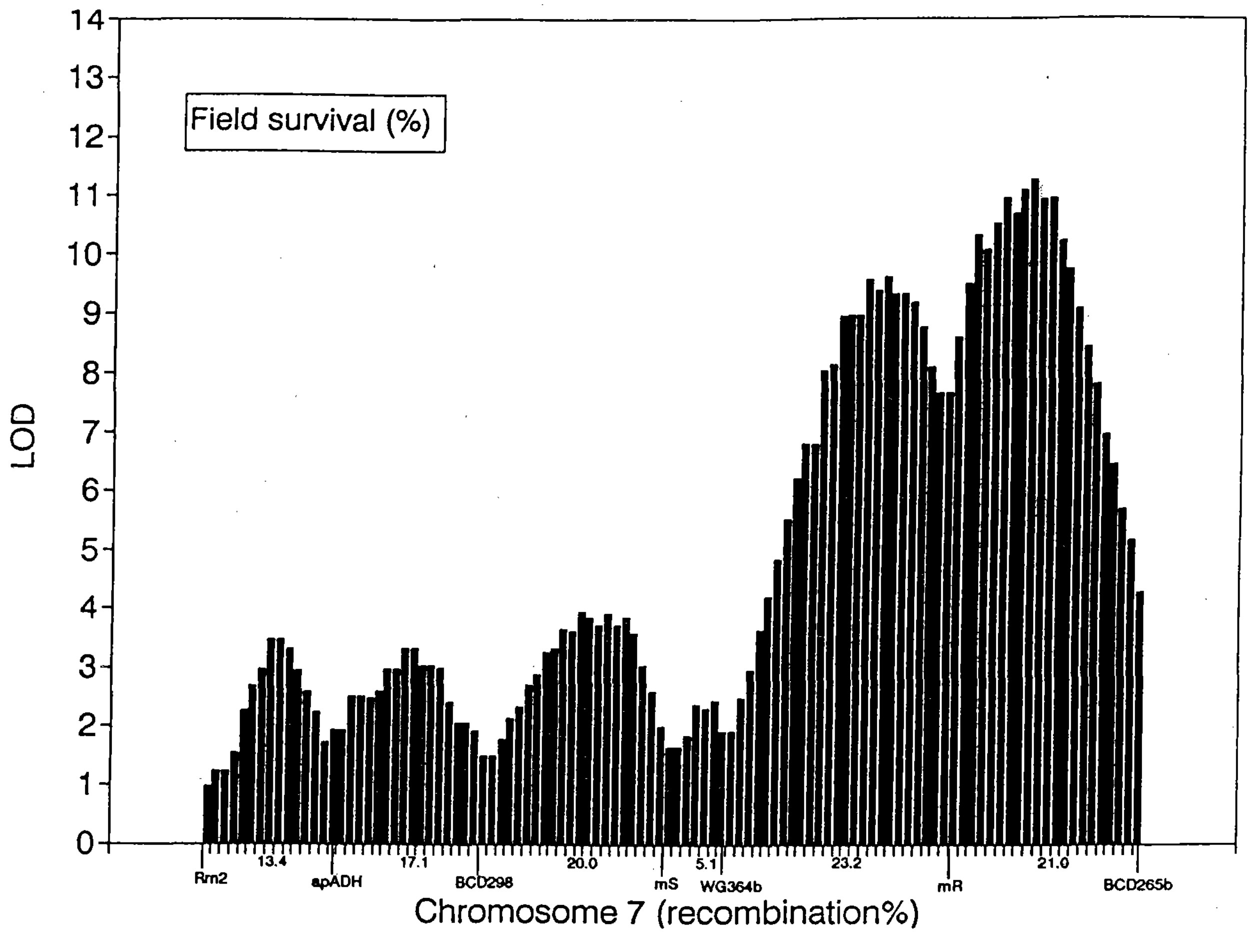
Results: Seventy-three lines made the cut and were submitted to the Cereal Crops Research Unit for complete malt analysis. Those showing malt and or protein potential will be advanced to full plot trials at Klamath Falls in 1992.

Variety testing and screening.

Rationale: Comprehensive data on new and upcoming varieties are needed for release and recommendations.

Procedures and Results: The results of these trials are summarized elsewhere in this publication. Across nurseries, ORS-2 looks like a winner. This short stature barley has excellent straw strength and good test weight. It is a smooth-awned white barley, and it could make an export grade of malt. What sort of premium, if any, would be paid remains to be seen. This variety does not represent a yield breakthrough beyond Gustoe, but it is a very competitive alternative. Foundation seed will be produced in 1993.

Figure 1. Quantitative trait loci for field survival mapped to chromosome 7 in a doubled haploid population derived from the cross of Dicktoo X Morex.



Spring Barley Variety Screening, 1991

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

INTRODUCTION

Barley variety trials planted at the Klamath Experiment Station (KES) in 1991 included: the Western Regional Spring Barley trial in cooperation with Western State plant breeders; the Intermountain Spring Barley trial in cooperation with University of California research and extension personnel; and a collection of new and promising lines from the Oregon State University barley breeding program. The trial in cooperation with OSU was planted at KES and at two sites 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. The off-station trials were on very deep, poorly drained, lake bottom soils with high organic matter content. These fields are cropped continuously in spring cereals. All plots at KES were sprinkler irrigated, while only one organic soil test site was irrigated.

All trials were arranged in a randomized complete block design with either three or four replications. Trials at the KES were planted between May 1 and 3. Plots at the irrigated organic soil site were planted on June 4 and the dry-land study was established on June 11. Seed was planted to a depth of one inch at a seeding rate of 100 lbs/A. All plots were fertilized with 100 lbs N, 60 lbs P_2O_5, and 44 lbs S/A at time of seeding. Plots measured 5 x 20 feet with a row spacing of six inches. At KES, Bromoxynil and MCPA were applied at labeled rates to control broadleaf weeds. Chemical weed control at organic soil sites was achieved using a mixture of 2,4-D and Banvel. Plots were harvested using a plot combine with a five foot wide head. Grain yield was recorded for all plots. Test weight, percent plumps, and percent thins were measured in only one replication.

RESULTS AND DISCUSSION

Western Regional Spring Barley Nursery

Barley yields at KES were above normal in 1991. Test weights were about average in most studies. The highest yielding entry was ORS 2 (Table 1). It was also a leading entry in 1990. Over a two-year period ORS 2 and ORS 3 were ranked first and second, respectively. ORS 2 yielded significantly more than Steptoe over the two-year period (Table 2). Although they are high yielding, these two lines had low test weights in 1990. Test weights were slightly

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

lower than the trial average in 1991 but still exceeded Steptoe. Good performance in trials on organic soil is also encouraging. The release of one of these lines as a feed barley is being considered.

Intermountain Spring Barley Variety Trial

Yields in the Intermountain Spring Barley Variety Trial were higher than in the past five years, averaging just over three tons/A. Test weights were also very high, averaging 55.7 lbs/bu. As in the Western Regional Trial, ORS 2 and ORS 3 were among the three leading varieties (Table 3). Yields of these two varieties were equivalent to Gustoe and Steptoe. Test weights of both ORS 2 and ORS 3 were slightly above the trial average and exceeded test weights of both Steptoe and Gustoe. These lines have only been in this trial for one year.

When averaged over a three-year period, Gustoe is the highest yielding line in this trial (Table 4). Other lines which show promise over a three-year period include, OSB 783063, a Westbred line (PH585-6), and Columbia. Identical trials were established on mineral soil at KES and on organic soil at Intermountain Research and Extension Center (IREC) at Tulelake, CA. Yields and relative ranking of varieties over a two or a three-year period were similar between the two sites (Table 5). One exception to this was PH 584-11. It performed much better at IREC (the top yielding variety over 3 years) than at KES (fifteenth over a 3-year period). The lower yields at KES do not appear to be valid, as PH 584-11 was the top yielding entry in the OSU Spring Barley Trial at KES.

OSU Spring Barley Variety Trials

The Westbred line Ph 254-11 was the highest yielding variety at KES, slightly exceeding four tons/A. However, it was not significantly higher than a number of proven or promising lines including Gustoe, ORS 2, and ORS 3 (Table 6). Test weights of all lines were good. PH 584-11 also performed well on organic soil but other varieties exceeded it at these sites. Colter, a newly released variety from Idaho formerly known as 79Ab10719-66LC, was the highest yielding entry at both the unirrigated and irrigated organic soil sites (Tables 7 & 8). It seems to do quite well in stress conditions and still have a high yield potential under favorable conditions. Test weights of this line remained high in spite of moisture stress at the unirrigated site. Due to better performance on the organic soil sites, Colter showed slightly better performance than PH 584-11 when averaged across all three sites (Table 7). Both ORS 2 and ORS 3 performed well on all three sites and averaged only slightly less than PH 584-11.

Table 1. 1991 Western Regional Spring Barley Nursery. Grain yield, test weight, percent thins, percent lodging, plant height, and heading date of spring barley varieties planted at the Klamath Experiment Station, OR.

Entry	Selection	Yield	Test Weight	Thins 6/64	Thins 5.5/64	Thins Pan	Lodge	Height	Heading date
		lbs/A	lbs/bu	%	%	%	- % -	inches	Julian days
1	Trebi	5890	50.0	90.4	6.0	3.6	58	37	188
2	Steptoe	6694	52.5	98.0	1.3	0.7	18	38	186
3	Klages	5450	56.0	94.9	3.5	1.6	28	37	191
4	Morex	4658	53.5	93.7	4.9	1.4	65	43	185
5	Excel	5504	55.0	97.1	2.1	0.8	10	41	186
6	Stark	6203	58.0	98.7	0.9	0.4	6	39	189
7	ORS 1	5800	57.5	98.2	1.2	0.6	0	31	191
8	ID 842974	5979	57.0	99.5	0.3	0.2	0	36	190
9	MT 851012	5277	56.5	97.3	1.7	1.1	43	40	189
10	MT 851195	5878	57.5	97.6	1.6	0.8	18	38	189
11	MT 860756	5458	57.0	99.2	0.5	0.2	8	35	189
12	ORS 6	5940	53.5	96.2	2.9	0.9	0	42	188
13	ORS 1209	6218	53.0	97.0	2.3	0.7	0	31	191
14	ORS 2	8012	53.5	96.5	2.7	0.8	0	31	189
15	ORS 3	6991	53.0	91.0	6.6	2.4	0	31	189
16	UT 1705	7186	52.0	97.9	1.7	0.4	0	39	183
17	WA 903584	5713	56.0	97.2	1.9	0.9	0	36	189
18	UT 1378	6363	52.5	96.0	2.6	1.4	0	34	188
19	WA 11163-86	7107	54.0	96.8	2.1	1.1	3	39	186
20	WA 11224-86	5577	53.0	97.6	1.7	0.7	8	44	189
21	BA 2B86-5113	6129	57.0	99.2	0.6	0.3	25	37	189
22	BA 2B86-5133	5665	56.0	99.4	0.4	0.2	8	37	186
23	BA B1603	5249	55.0	96.6	2.7	0.7	18	38	186
24	ID 86Ab2317	4911	56.5	99.6	0.3	0.1	0	39	189
25	UT 502355	6537	52.0	99.1	0.6	0.4	0	40	187
26	UT 2684	6441	51.0	96.7	2.6	0.7	0	40	182
27	PB 401	6672	54.0	97.4	2.1	0.5	5	42	188
	Mean	6056	54.5	97.0	2.1	0.9	12	38	188
	CV (%)	11.9					117.7	4.5	0.5
	LSD (0.05)	1013					19.4	2.4	1.4

Table 2. Summary of Western Regional Spring Barley Yields, 1990-1991. Grain yields of spring barley varieties planted at the Klamath Experiment Station, OR.

Entry	Selection	Yield 1991	Yield 1990	Yield Avg.	Rank
		------	lbs/A	-----	
1	ID 842974	5797	4940	5369	9
2	Morex	4658	5007	4833	12
3	MT 851012	5277	4065	4671	14
4	MT 851195	5878	5237	5558	7
5	MT 860756	5458	5261	5360	10
6	ORS 1	5800	5278	5539	8
7	ORS 2	8012	6849	7431	1
8	ORS 3	6991	6803	6897	2
9	ORS 1209	6218	6353	6286	5
10	Steptoe	6694	6364	6529	4
11	Trebi	5890	3762	4826	13
12	UT 1378	6363	5985	6174	6
13	UT 1705	7186	6358	6772	3
14	WA 903584	5713	4157	4935	11
15	BA 2B86-5113	6129			
16	BA 2B86-5133	5665			
17	BA B1603	5249			
18	Excel	5504			
19	ID 86Ab2317	4911			
20	Klages	5450			
21	PB 401	6672			
22	Stark	6203			
23	UT 2684	6441			
24	UT 502355	6537			
25	WA 11163-86	7107			
26	WA 11224-86	5577			
27	Whitford	4290			
	Mean	5988	5459	5799	
	CV (%)	11.9	18.0	15.4	
	LSD (0.05)	1013	1056	893	

Table 3. 1991 Intermountain Regional Spring Barley Trial. Grain yield, test weight, percent thins, percent lodging, plant height and heading date of spring barley varieties planted at the Klamath Experiment Station, OR.

Entry	Selection	Yield	Test Weight	Thins 6/64	Thins 5.5/64	Thins Pan	Lodge	Height	Heading date
		lbs/A	lbs/bu	%	%	%	- % -	inches	Julian days
1	Steptoe	7063	55.0	96.2	2.4	1.4	29	36	187
2	Klages	5465	57.0	97.2	1.8	1.0	23	35	190
3	Advance	6361	54.0	93.4	4.5	2.1	10	37	181
4	Gustoe	7423	54.0	97.8	1.8	0.4	0	30	189
5	Columbia	6925	54.0	98.7	0.9	0.4	0	31	191
6	ORSF 8405	6871	52.5	88.3	6.8	4.9	25	36	186
7	Teton	6767	55.0	94.3	3.5	2.2	3	36	187
8	Cougbar	6461	55.5	97.7	1.6	0.7	8	39	187
9	ORSM 8413	7124	57.0	89.6	47.0	3.4	0	31	189
10	ORSM 8424	7043	56.0	89.3	7.3	3.4	0	35	190
11	ORSF 8432	6551	60.0	97.5	1.6	0.8	0	31	189
12	PH584-11	6940	54.0	98.9	0.7	0.4	0	30	189
13	ORSM 8423	6444	55.0	85.5	10.2	4.3	0	33	190
14	Medalion	7643	57.0	91.9	6.5	1.5	0	32	189
15	B 1202	6170	57.0	98.3	1.0	0.7	0	35	189
16	Micah	6237	54.0	94.1	4.0	1.9	0	28	190
17	PH585-6	7455	53.0	97.0	2.4	0.6	0	31	188
18	MT 140523	6004	57.5	97.5	1.8	0.7	33	37	189
19	OSB 783063	7161	52.5	68.4	17.3	14.3	0	31	189
20	ORSM 8408	6163	56.0	95.3	2.9	1.8	8	35	189
21	ORS 1	6924	52.5	96.2	2.3	1.5	0	31	193
22	Crystal	5542	57.0	92.1	4.9	3.1	23	37	189
23	ORSF 8635	7430	56.0	84.2	11.5	4.3	0	33	189
24	ORSF 8435	7218	55.0	87.3	8.0	4.7	4	39	187
25	BA 4039	5448	57.0	97.0	1.7	1.3	8	36	189
26	MT 83533	6275	58.5	99.2	0.5	0.3	20	36	188
27	Harrington	5709	58.0	98.1	1.4	0.6	0	37	189
28	Excel (MN 52)	6218	58.0	97.4	2.0	0.6	11	40	187
29	WA 8771	5067	55.0	90.4	5.5	4.1	55	36	189
30	B 1603	6029	57.5	96.0	3.0	1.0	5	39	186
31	B 1215 (BA8529)	5790	57.0	95.7	2.9	1.4	10	38	189
32	BA 2601	6389	58.0	96.7	2.2	1.1	0	32	188
33	Camelot	6508	56.0	95.1	2.7	2.2	48	35	190
34	PB 107	5253	57.5	95.3	2.6	2.1	8	40	189
35	79Ab10719-66LC	6954	55.0	92.3	5.2	2.6	23	41	184
36	ORS 2	7562	56.0	93.0	5.0	2.0	0	31	189
37	ORS 3	7852	56.0	88.6	7.6	3.8	0	31	189
38	UT 1705	6523	53.0	89.6	6.9	3.4	23	39	181
39	TL83-359	4799	55.0	97.4	1.8	0.8	35	42	189
40	TL83-321	4455	55.0	84.5	8.3	7.2	63	37	189
41	TL83-347	5358	55.5	92.5	4.6	3.0	23	41	189
42	TL83-351	4820	56.0	96.0	2.2	1.8	46	39	188
43	TL83-335	4383	55.0	91.4	5.3	3.2	5	40	188
44	TL83-356	5587	56.0	98.3	1.1	0.6	13	39	189
45	TL83-714	5555	55.0	92.9	4.3	2.8	33	41	189
46	TL83-381	5310	54.0	73.7	13.7	12.6	35	36	188
47	TL83-361	5842	57.5	97.6	1.6	0.7	35	38	189
48	TL83-327	5116	54.0	89.2	7.9	2.9	0	39	189
	Mean	6254	55.7	93.1	4.4	2.5	14	6.0	188
	CV (%)	12.8				149.8	5.3	0.5	
	LSD (0.05)	1116				28.7	6.7	1.2	

Table 4. **Intermountain Regional Spring Barley Variety Trial Summary, 1989-1991.** Three-year summaries of spring barley varieties planted at the Klamath Experiment Station, OR.

Entry	Selection	Yield 1991	Yield 1990	Yield 1989	2-year Avg.		3-year Avg.	
		lbs/A				Rank	lbs/A	Rank
1	Advance	6361	6114	5046	6238	15	5840	13
2	B 1202	6170	4671	5218	5421	28	5353	20
3	Columbia	6925	6611	5740	6768	6	6425	4
4	Cougbar	6461	5200	5758	5831	21	5806	15
5	Crystal	5542	5976	5012	5759	22	5510	19
6	Gustoe	7243	7337	5473	7290	1	6684	1
7	Klages	5465	4311	4703	4888	30	4826	22
8	Micah	6237	5207	4346	5722	23	5263	21
9	ORS 1	6924	6371	5219	6648	9	6171	7
10	ORSF 8405	6871	6237	4911	6554	11	6006	10
11	ORSF 8432	6551	6365	4643	6458	12	5853	12
12	ORSF 8435	7218	5626	5739	6422	13	6194	6
13	ORSF 8635	7430	5829	4834	6630	10	6031	9
14	ORSM 8408	6163	5973	5309	6068	18	5815	14
15	ORSM 8413	7124	6641	4351	6883	5	6039	8
16	ORSM 8423	6444	6887	4552	6666	8	5961	11
17	ORSM 8424	7043	6293	5454	6668	7	6263	5
18	OSB 783063	7161	7403	5342	7282	2	6635	2
19	PH584-11	6940	5648	4652	6294	14	5747	16
20	PH585-6	7455	6694	5596	7075	3	6582	3
21	Steptoe	7063	5221	4473	6142	16	5586	18
22	Teton	6767	5416	4767	6092	17	5650	17
23	B 1215	5790	5525		5658	26		
24	B 1603	6029	4713		5371	29		
25	BA 4039	5448	6314		5881	20		
26	Excel	6218	4836		5527	27		
27	Harrington	5709	5679		5694	25		
28	Medalion	7643	6470		7057	4		
29	MT 140523	6004	5821		5913	19		
30	MT 83533	6275	5139		5707	24		
31	79Ab10719	6954						
32	Camelot	6508						
33	ORS 2	7562						
34	ORS 3	7852						
35	PB 107	5253						
36	TL83-321	4455						
37	TL83-327	5116						
38	TL83-335	4383						
39	TL83-347	5358						
40	TL83-351	4820						
41	TL83-356	5587						
42	TL83-359	4799						
43	TL83-361	5842						
44	TL83-381	5310						
45	TL83-714	5555						
46	UT 1705	6523						
47	WA 8771	5067						
	Mean	6247	5884	5052	6220		5920	
	CV (%)	13	15	17	13		13	
	LSD (0.05)	1116	1214	1197	783		634	

Table 5. Intermountain Regional Spring Barley Trial - three-year summary. Barley yields and relative rankings from the Klamath Experiment Station (KES) and the Intermountain Research and Extention Center (IREC).

Entry	Selection	2-Year Average Yield --- KES ---		--- IREC ---		3-Year Average Yield --- KES ---		--- IREC --	
		lbs/A	Rank	lbs/A	Rank	lbs/A	Rank	lbs/A	Rank
1	Advance	6238	15	5460	17	5840	12	5660	8
2	B 1202	5421	27	5220	18	5353	19	5300	17
3	Columbia	6768	6	6120	8	6425	4	5900	3
4	Cougbar	5831	21	5120	19	5806	14	5100	19
5	Crystal	5759	22	5020	22	5510	18	5000	20
6	Gustoe	7290	1	6400	2	6684	1	6520	2
7	Klages	4888	29	4500	28	4826	21	4580	21
8	Micah	5722	23	5800	13	5263	20	5400	16
9	ORS 1	6648	9	5640	16	6171	7	5700	7
10	ORSF 8432	6458	12	6000	11	5853	11	5780	6
11	ORSF 8435	6422	13	5660	15	6194	6	5660	10
12	ORSF 8635	6630	10	6120	7	6031	9	5580	13
13	ORSM 8408	6068	18	5120	20	5815	13	5180	18
14	ORSM 8413	6883	5	6180	4	6039	8	5780	5
15	ORSM 8423	6666	8	6120	6	5961	10	5460	15
16	ORSM 8424	6668	7	6060	10	6263	5	5600	11
17	OSB 783063	7282	2	6080	9	6635	2	5580	12
18	PH584-11	6294	14	6440	1	5747	15	6620	1
19	PH585-6	7075	3	6320	3	6582	3	5840	4
20	Steptoe	6142	16	5880	12	5586	17	5660	9
21	Teton	6092	17	5660	14	5650	16	5500	14
22	B 1603	5371	28	4180	29				
23	BA 4039	5881	20	4840	26				
24	Excel	5527	26	4780	27				
25	Harrington	5694	25	4960	23				
26	Medalion	7057	4	6180	5				
27	MT 140523	5913	19	4880	25				
28	MT 83533	5707	24	4920	24				
29	ORSF 8405	6554	11	5060	21				
	Mean:	6240		5542		5916		5590	
	CV (%)	13		13		13		12	
	LSD (0.05)	783		720		634		560	

Table 6. 1991 Irrigated Mineral Soil OSU Barley Variety Trial. Grain yield, test weight, percent thins, percent lodging, plant height and heading date of spring barley varieties planted in mineral soil at the Klamath Experiment Station, OR.

Entry	Selection	Yield	Test Weight	Thins 6/64	Thins 5.5/64	Thins Pan	Lodge	Height	Heading date
		lbs/A	lbs/bu	%	%	%	%	inches	Julian days
1	Bearpaw	5891	54.5	97.4	1.8	0.8	43	36	189
2	Crystal	6810	57.0	99.4	0.4	0.2	0	36	189
3	Gustoe	7977	52.0	98.6	1.1	0.3	0	27	189
4	Nupana	4063	60.0	98.3	1.2	0.5	65	34	189
5	Russell	7167	55.0	98.2	1.3	0.4	0	40	182
6	Shonkin	4631	61.5	93.2	5.1	1.7	18	38	189
7	Steptoe	6843	52.0	98.2	1.1	0.7	11	36	185
8	Wanupana	3759	57.0	95.8	2.6	1.6	50	33	189
9	Washonupana	4248	56.0	88.9	6.1	5.1	75	34	189
10	ORSM 8408	6710	58.5	99.0	0.9	0.2	0	38	189
11	ORS 1	6188	55.5	98.0	1.4	0.6	0	29	191
12	ORS 2	7661	52.5	97.5	1.9	0.6	0	32	189
13	ORS 3	7547	54.0	94.8	4.0	1.2	0	31	189
14	Columbia	7340	52.0	98.2	1.5	0.4	0	34	191
15	Klages	6339	56.0	98.2	1.2	0.6	14	36	190
16	Harrington	6903	56.0	99.3	0.4	0.2	0	37	189
17	Excel	6643	54.0	98.0	1.4	0.6	3	41	186
18	Morex	5817	54.0	96.6	2.6	0.8	41	42	186
19	MT 140523	6140	57.5	95.8	3.0	1.2	24	36	189
20	PH 584-11	8150	53.0	99.1	0.7	0.2	0	28	188
21	Colter	7254	51.0	96.5	2.5	0.9	0	40	185
22	WA 8771-78	5520	56.0	99.0	0.8	0.2	25	36	189
	Mean	6346	55.2	97.2	2.0	0.9	17	35	188
	CV (&)	10.3					117.0	5.9	0.3
	LSD (0.05)	923					27.6	7.5	0.9

Table 7. 1991 Unirrigated Organic Soil OSU Barley Variety Trial. Grain yield, test weight, and percent thins of spring barley varieties planted in organic soil in the Lower Klamath Lake, OR.

Entry	Selection	Yield	Test Weight	Thins 6/64	Thins 5.5/64	Thins Pan
		lbs/A	lbs/bu	--------	%	--------
1	Bearpaw	4026	52.0	95.4	3.0	1.6
2	Crystal	4203	49.0	81.8	12.9	5.2
3	Gustoe	5074	53.0	96.7	2.1	1.2
4	Nupana	2319	56.5	92.1	4.1	3.8
5	Russell	3638	53.5	96.6	2.1	1.3
6	Shonkin	1161	55.5	41.3	34.3	24.4
7	Steptoe	4124	51.5	96.7	1.8	1.4
8	Wanupana	1917	58.0	90.2	5.1	4.8
9	Washonupana	3207	57.0	82.2	5.8	12.0
10	ORSM 8408	3556	50.0	81.1	12.8	6.0
11	ORS 1	3449	49.5	88.4	7.0	4.5
12	ORS 2	4370	46.5	82.5	11.4	6.1
13	ORS 3	3357	44.0	91.8	5.1	3.1
14	Columbia	4096	43.5	94.4	3.1	2.5
15	Klages	3914	52.0	91.6	5.3	3.1
16	Harrington	3985	57.0	97.7	1.3	1.0
17	Excel	4837	50.5	94.6	3.4	2.0
18	Morex	4492	51.0	96.8	2.1	1.1
19	MT 140523	3536	48.5	67.8	22.3	9.9
20	PH 584-11	4291	53.0	97.8	1.3	0.9
21	Colter	5230	54.0	95.6	2.7	1.7
22	WA 8771-78	4075	56.0	97.9	1.3	0.7
	Mean	3766	51.9	88.7	6.8	4.5
	CV (%)	28.5				
	LSD (0.05)	1519				

Table 8. 1991 Irrigated Organic Soil OSU Barley Variety Trial. Grain yield, test weight, and percent thins of spring barley varieties planted in organic soil in the Lower Klamath Lake, OR.

Entry	Selection	Yield	Test Weight	Thins 6/64	Thins 5.5/64	Thins Pan
		lbs/A	lbs/bu	--------	%	--------
1	Bearpaw	4550	53.0	97.4	1.9	0.7
2	Crystal	4948	54.5	98.0	1.3	0.7
3	Gustoe	5906	51.5	99.1	0.7	0.2
4	Nupana	2593	52.5	96.1	2.3	1.7
5	Russell	5803	52.5	98.5	1.0	0.5
6	Shonkin	1795	54.0	65.3	22.7	12.0
7	Steptoe	5642	51.0	98.0	1.2	0.8
8	Wanupana	2158	52.0	94.9	2.8	2.3
9	Washonupana	2372	54.0	88.1	4.6	7.3
10	ORSM 8408	3919	47.0	92.0	5.3	2.6
11	ORS 1	4505	47.5	93.0	5.1	1.9
12	ORS 2	5908	51.5	93.7	4.3	2.0
13	ORS 3	5782	47.5	98.6	1.0	0.4
14	Columbia	5032	48.0	98.6	1.0	0.4
15	Klages	3962	50.0	95.6	3.3	1.2
16	Harrington	4493	51.0	97.5	1.7	0.8
17	Excel (MN 52)	5047	51.0	98.3	1.3	0.4
18	Morex	4848	52.5	98.8	1.0	0.3
19	MT 140523	4652	50.5	95.9	3.1	1.0
20	PH 584-11	5943	50.0	99.4	0.4	0.2
21	Colter	6132	52.0	97.1	1.9	1.0
22	WA 8771-78	4261	52.0	98.6	1.0	0.4
	Mean	4557	51.2	95.0	3.2	1.8
	CV (%)	12.2				
	LSD (0.05)	783				

Table 9. 1991 OSU Spring Barley Varieties - Observations of grain yield over 3 locations - Irrigated mineral soil (IMS), Unirrigated organic soil (UOS), Irrigated organic soil (IOS), OR.

Entry	Selection	IMS	UOS	IOS	Avg.	Rank
		-------	------- lbs/A	-------	-------	
1	79Ab10719-66LC	7254	5230	6132	6205	2
2	Bearpaw	5891	4026	4550	4822	13
3	Columbia	7340	4096	5032	5489	9
4	Crystal	6810	4203	4948	5320	10
5	Gustoe	7977	5074	5906	6319	1
6	Nupana	4063	2319	2593	2992	20
7	ORS 1	6188	3449	4505	4714	17
8	ORS 2	7661	4370	5908	5980	4
9	ORS 3	7547	3357	5782	5562	5
10	ORSM 8408	6710	3556	3919	4728	16
11	Russell	7167	3638	5803	5536	7
12	Shonkin	4631	1161	1795	2529	22
13	Steptoe	6843	4124	5642	5536	6
14	Wanupana	3759	1917	2158	2611	21
15	Washonupana	4248	3207	2372	3276	19
16	Excel	6643	4837	5047	5509	8
17	Harrington	6903	3985	4493	5127	11
18	Klages	6339	3914	3962	4738	15
19	Morex	5817	4492	4848	5052	12
20	MT 140523	6140	3536	4652	4776	14
21	PH 584-11	8150	4291	5943	6128	3
22	WA 8771-78	5520	4075	4261	4619	18
	Mean	6346	3766	4557	4889	
	CV (%)	10.3	28.5	12.2	12.8	
	LSD (0.05)	923	1519	783	982	

Spring Wheat Variety Screening in the Klamath Basin, 1991

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

INTRODUCTION

In 1991, spring wheat variety trials were conducted at the KES in cooperation with plant breeding and evaluation programs at Oregon State University, the Tulelake Field Station (University of California at Davis) and Western Region 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 included soft white (SW), hard white (HW), and hard red (HR) selections. In general there is little disease or insect pressure on small grains in the Klamath Basin. However, the introduction of the Russian wheat aphid could greatly alter that situation.

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 either three or four replications. Trials at the KES were planted between May 1 and 3. Seed was planted to a depth of one inch. The seeding rate for wheat trials was 80 lbs/A. All plots were fertilized with 100 lbs N, 60 lbs P_2O_5, and 44 lbs S/A at time of seeding. Plots measured 5 x 20 feet with a row spacing of six inches. Bromoxynil and MCPA were applied at labeled rates to control broadleaf weeds. Plots were harvested using a plot combine with a five foot wide head. Grain yield was recorded for all plots. Test weight was measured in only one replication.

RESULTS AND DISCUSSION

Western Regional Spring Wheat Nursery

Average yield in this trial was 5218 lbs/A, an increase of almost 500 lbs/A from the previous year. Test weight was also higher in 1991 than 1990 (63.0 and 57.1 lbs/bu, respectively. The highest yielding entry was a soft white line from Idaho (ID 409). However, it was not significantly higher than a number of lines including ID 420, a hard red line (Table 1). Averaged over two years, ID 420 is the highest yielding entry in the trial. Further evaluation of the quality of this line is necessary to determine if it meets

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

milling requirements of the industry. If quality is adequate, ID 420 would represent a substantial improvement over currently grown varieties. Penawawa, a soft white variety, is another outstanding variety in this trial. Averaged over a three-year period, it is the highest yielding entry.

Intermountain Spring Wheat Trial

Yields in the Intermountain Trial were comparable to those in the Western Regional Nursery. Test weights in the Intermountain Trial were very high, averaging 65 lbs/bu. The highest yielding entry in the trial was ID 266, a soft white variety (Table 3). It was not significantly higher than Blanca or Fieldwin, both soft white lines. The highest yielding hard red line in the trial was PH 684-23. When averaged over three years, ID 266, and Treasure are the two highest yielding lines (Table 4). However, they do not yield significantly higher than a number of released soft white wheat lines. The highest yielding hard red variety over the last three years is Westbred 926. However, Spillman is not significantly lower than Westbred 926. These two lines appear to have superior yield potential to Westbred 906R and Yecoro Rojo, which have historically been the standard varieties in the area. Two club wheat lines, UC 850 and UC 852, have been tested for two years at KES. UC 850 has produced yields comparable to moderate yielding hard red varieties, but lower than leading soft white varieties.

Intermountain Spring Wheat Variety Trials were planted over a three-year period at both KES and Intermountain Research and Extension Center (IREC) at Tulelake, CA. Unlike barley trials planted on the two sites, wheat yields and relative ranking of varieties were not similar between the two sites. Over a three-year period, yields at IREC were 36 percent higher than at KES and the ranking of varieties was quite different (Table 5). The highest yielding variety at IREC was Sterling, which ranked 11th at KES.

OSU Hard White Spring Wheat Variety Trial

The advent of HW wheat as a viable market class offers another option for producers in the Klamath Basin. This was the first year for this trial to be planted at KES. Two standard HR varieties were included for comparison as well as Klasic, the standard HW variety in California. Yields of several lines were promising; however, further testing is required before any conclusions as to the adaptation of these lines to the Klamath Basin can be made (Table 6).

OSU Hard Red Spring Wheat Variety Trial

Yields in this trial were average or slightly below normal and variability within entries was higher than would be desired, making mean separation difficult. Test weights in this trial were very high. No experimental line yielded more than Westbred 906R, the standard in this trial (Table 7).

Table 1. **1991 Western Regional Spring Wheat Nursery.** Observations of grain yield, test weight, lodging, plant height, and days to 50% heading of spring wheat varieties planted at the Klamath Experiment Station, OR.

Entry	Selection	Yield	Test Wt.	Lodge	Height	Heading date
		lbs/A	lbs/bu	- % -	inches	Julian days
1	McKay	4999	64.0	0	32	193
2	Federation	4285	62.0	0	42	193
3	Owens	5085	63.0	0	30	192
4	Penawawa	5652	63.5	0	30	193
5	Spillman	5234	60.5	0	33	193
6	Wakanz	5546	62.5	0	32	193
7	WA 7176	5246	61.5	0	31	193
8	WA 7496	4506	60.5	0	29	192
9	ID 367	5670	60.5	0	34	192
10	ID 420	5905	63.5	0	31	193
11	OR 487456	5531	65.5	0	27	191
12	OR 487457	4794	63.0	0	23	192
13	OR 487400	4873	64.0	0	32	192
14	Klasic	4841	63.5	0	29	190
15	Serra	4882	63.0	0	29	190
16	WA 7668	5425	62.5	0	48	193
17	OR 487462	5203	63.0	0	29	191
18	OR 484027	4751	64.0	0	32	192
19	OR 487380	4487	61.5	0	21	191
20	OR 487279	5374	64.0	0	28	190
21	OR 487453	5399	63.5	0	31	193
22	UC 784	4587	64.0	0	21	190
23	UC 786	5238	62.5	0	25	193
24	UC 785	4834	64.0	0	24	193
25	UT 1601	5357	63.0	0	30	193
26	UT 613945	5099	61.5	0	32	193
27	ID 392	5504	64.5	0	32	193
28	ID 408	5503	61.5	0	30	193
29	ID 409	6131	64.0	0	32	193
30	ID 412	5017	65.0	0	34	192
31	LEWIEM 4	5046	64.5	0	32	193
32	UT 1708	5267	62.5	0	37	193
33	UT 1711	5123	62.0	0	35	193
34	UT 1723	5411	63.0	0	39	193
35	UT 1736	4826	63.0	0	35	193
36	Sunstar 1	5018	64.5	0	31	190
37	OR 487249	5668	63.0	0	30	191
38	OR 487255	5005	64.5	0	31	190
39	OR 488403	5599	62.0	0	29	193
40	OR 487469	5467	64.0	0	31	190
41	OR 488189	4821	64.0	0	29	192
42	ID 377S	5953	64.0	0	33	191
43	ID 404	5561	64.5	0	31	193
44	ID 410	5357	62.5	0	31	193
45	ID 430	5715	63.5	0	34	193
	Mean	5218	63.0		31	192
	CV (%)	10.5			6.3	0.4
	LSD (0.05)	765			6.9	1.1

Table 2. Summary of Western Regional Spring Wheat Nursery, 1989-1991. Three-year summary of spring wheat planted at the Klamath Experiment Station, OR.

Entry	Selection	Class	Yield 1990	1989	1988	2-yr Avg	Rank	Yield 3-yr Avg	Rank
			-------------	lbs/A	--------------		Rank	-lbs/A-	Rank
1	ID 367	HR	5670	5215	4590	5443	4	5158	3
2	ID 420	HR	5905	5606	4801	5756	1	5437	2
3	McKay	HR	4999	5229	4514	5114	12	4914	7
4	OR 487400	HR	4873	4741	5201	4807	19	4938	6
5	OR 487456	HR	5531	3169	3468	4350	28	4056	13
6	OR 487475	HR	4794	5026	3884	4910	16	4568	9
7	Serra	HR	4882	4492	4325	4687	21	4566	10
8	Klasic	HW	4841	5285	4263	5063	13	4796	8
9	Federation	SW	4285	3830	4348	4058	29	4154	12
10	Owens	SW	5085	4757	5142	4921	15	4995	4
11	Penawawa	SW	5652	5236	5570	5444	3	5486	1
12	WA 7176	SW	5246	4520	5053	4883	17	4940	5
13	WA 7496	SW	4506	4667	4216	4587	24	4463	11
14	ID 412	HR	5017	3990		4504	26		
15	OR 487462	HR	5203	3635		4419	27		
16	UC 784	HR	4587	4497		4542	25		
17	UC 785	HR	4834	4491		4663	22		
18	UC 786	HR	5238	4520		4879	18		
19	UT 1601	HR	5357	4950		5154	9		
20	UT 613945	HR	5009	5421		5215	8		
21	WA 7668	HR	5425	5283		5354	5		
22	OR 487279	HW	5374	3924		4649	23		
23	OR 487380	HW	4487	3564		4026	30		
24	OR 487453	HW	5399	4905		5152	10		
25	ID 392	SW	5504	4541		5023	14		
26	ID 408	SW	5503	4974		5239	7		
27	ID 409	SW	6131	5094		5613	2		
28	LEWIEM 04	SW	5046	5230		5138	11		
29	OR 484027	SW	4751	4672		4712	20		
30	Wakanz	SW	5546	5145		5346	6		
31	ID 430	HR	5715						
32	OR 487469	HR	5467						
33	OR 488189	HR	4821						
34	Spillman	HR	5234						
35	Sunstar	HR	5018						
36	UT 1708	HR	5267						
37	UT 1711	HR	5123						
38	UT 1723	HR	5411						
39	UT 1736	HR	4826						
40	ID 377S	HW	5953						
41	OR 487249	HW	5668						
42	OR 487255	HW	5005						
43	OR 488403	HW	5599						
44	ID 404	SW	5561						
45	ID 410	SW	5357						
	Mean		5216	4687	4567	4922		4805	
	CV (%)		10.5	26.7	12.1	20.2		16.9	
	LSD (0.05)		766	1782	743	982		654	

Table 3. 1991 Intermountain Spring Wheat Nursery. Observations of grain yield, test weight, lodging, plant height, and days to 50% heading of spring wheat varieties planted at the Klamath Experiment Station, OR.

Entry	Selection	Yield	Test wt.	Lodge	Height	Heading date
		lbs/A	lbs/bu	- % -	inches	Julian days
1	Yecora Rojo	4548	66.0	0	23	189
2	Fieldwin	5921	66.0	0	35	195
3	Klasic	4679	66.0	0	24	189
4	Westbred 906R	4954	65.0	0	31	189
5	Blanca	6111	64.0	0	34	191
6	Edwall	5051	62.0	0	32	192
7	ORS 8413	5278	63.0	0	31	193
8	Serra	5239	65.5	0	31	189
9	Treasure	5638	65.0	0	31	193
10	ID 266	6643	65.5	3	33	191
11	Sterling	5836	65.0	0	34	192
12	Waduel	5102	66.0	0	34	190
13	Spillman	5264	65.0	0	33	189
14	Westbred 926	5225	65.0	0	32	190
15	Westbred Sprite	5314	65.0	1	31	190
16	ORS 8410	4698	66.0	0	31	192
17	UC 784	4854	66.0	0	23	189
18	UC 785	4710	66.0	0	24	192
19	UC 786	5023	65.0	0	25	193
20	UC 850	5152	65.0	0	30	193
21	UC 852	4723	65.5	0	29	192
22	Westbred Rambo	5174	63.0	8	33	193
23	ID 312	6015	66.0	0	33	190
24	W 2502	5040	63.0	0	32	190
25	OR 4870235	4559	66.0	0	30	190
26	OR 4870249	5159	65.0	0	29	190
27	OR 4870279	5594	66.0	0	30	189
28	ID 379	5322	65.0	0	33	192
29	ID 366	4821	64.0	23	33	191
30	Nomad	5168	65.5	0	30	191
31	Express	5327	65.5	0	28	190
32	Grandin	4117	65.0	0	33	191
33	Vance	4955	65.0	0	28	191
34	SDM-1	5311	65.0	0	31	190
35	TR 983-239	5105	66.5	0	34	189
36	PH 986-61	5743	65.5	0	30	189
37	PH 684-23	5611	65.0	0	32	192
38	ID 417	5759	66.5	0	31	189
39	OR 4874456	4619	66.0	0	29	189
40	Federation	4690	62.0	8	47	194
	Mean	5201	65.1	1	31	191
	CV (%)	10.1		763	4.8	0.6
	LSD (0.05)	735		11	2.1	1.5

Table 4. Summary of Intermountain Regional Spring Wheat Variety Trial, 1989-1991. Three-year summary of spring wheat planted at the Klamath Experiment Station, OR.

Entry	Selection	Class	Yield 1991	1990	1989	2-yr Avg		Yield 3-yr Avg	
			lbs/A				Rank	-lbs/A-	Rank
1	ORS 8410	HR	4698	5460	3692	5079	14	4617	10
2	Serra	HR	5239	3437	3323	4338	31	4000	19
3	Spillman	HR	5264	5285	4016	5275	10	4855	6
4	W 2502	HR	5040	4239	3347	4640	24	4209	17
5	Westbred 906R	HR	4954	4589	3283	4772	21	4275	15
6	Westbred 926	HR	5225	6073	3453	5649	1	4917	3
7	Westbred Rambo	HR	5174	4624	3629	4899	20	4476	13
8	Westbred Sprite	HR	5314	4533	3745	4924	19	4531	12
9	Yecora Rojo	HR	4548	4638	3173	4593	26	4120	18
10	Klasic	HW	4679	6141	3320	5410	3	4713	8
11	ORS 8413	HW	5278	5336	4040	5307	8	4885	5
12	Blanca	SW	6111	4215	4408	5163	12	4911	4
13	Edwall	SW	5051	4366	3879	4709	23	4432	14
14	Fieldwin	SW	5921	4772	3860	5347	4	4851	7
15	ID 266	SW	6643	4584	4098	5614	2	5108	1
16	ID 312	SW	6015	4155	3868	5085	13	4679	9
17	Sterling	SW	5836	4125	3791	4981	17	4584	11
18	Treasure	SW	5638	5034	4338	5336	5	5003	2
19	Waduel	SW	5102	3692	3904	4397	30	4233	16
20	UC 850	CLUB	5152	5397		5275	11		
21	UC 852	CLUB	4723	4523		4623	25		
22	Grandin	HR	4117	4353		4235	32		
23	ID 366	HR	4821	4168		4495	28		
24	Nomad	HR	5168	5447		5308	7		
25	UC 784	HR	4854	5031		4943	18		
26	UC 785	HR	4710	5446		5078	15		
27	UC 786	HR	5023	5585		5304	9		
28	Vance	HR	4955	4097		4526	27		
29	OR 4870235	HW	4559	4885		4722	22		
30	OR 4870249	HW	5159	3800		4480	29		
31	OR 4870279	HW	5594	5029		5312	6		
32	Federation	SW	4690	3459		4075	33		
33	ID 379	SW	5322	4702		5012	16		
34	Express	HR	5327						
35	OR 4874456	HR	4619						
36	PH 684-23	HR	5611						
37	PH 986-61	HR	5743						
38	TR 983-239	HR	5105						
39	ID 417	SW	5759						
40	SDM-1	--	5311						
	Mean		5201	4704	3746	4937		4600	
	CV (%)		10.1	27.9	18.6	20.6		18.4	
	LSD (0.05)		735	1855	727	1003		683	

Table 5. Three-year summary of yields from the Intermountain Spring Wheat Trial grown at the Klamath Experiment Station (KES) and the Intermountain Research and Extension Center (IREC) from 1989 to 1991.

Entry	Selection	Class	2-Year Average Yield				3-Year Average Yield			
			---- KES ---		--- IREC ---		---- KES ---		--- IREC ---	
			lbs/A	Rank	lbs/A	Rank	lbs/A	Rank	lbs/A	Rank
1	ORS 8410	HR	5079	14	5800	30	4617	10	5480	18
2	Serra	HR	4338	31	6480	17	4000	19	6360	8
3	Spillman	HR	5275	11	6360	22	4855	6	5840	17
4	W 2502	HR	4640	24	6680	12	4209	17	6460	7
5	Westbred 906R	HR	4772	21	6380	21	4275	15	6340	9
6	Westbred 926	HR	5649	1	6540	14	4917	3	6260	10
7	Westbred Rambo	HR	4899	20	6520	16	4476	13	5940	13
8	Westbred Sprite	HR	4924	19	5980	28	4531	12	5880	16
9	Yecora Rojo	HR	4593	26	6660	13	4120	18	6140	12
10	Klasic	HW	5410	3	7340	2	4713	8	6780	3
11	ORS 8413	HW	5307	8	6200	26	4885	5	5900	15
12	Blanca	SW	5163	12	6880	8	4911	4	6760	5
13	Edwall	SW	4709	23	5880	29	4432	14	5260	19
14	Fieldwin	SW	5347	4	7200	4	4851	7	6980	2
15	ID 266	SW	5614	2	7200	3	5108	1	6780	4
16	ID 312	SW	5085	13	7140	6	4679	9	6720	6
17	Sterling	SW	4981	17	7380	1	4584	11	7040	1
18	Treasure	SW	5336	5	6860	10	5003	2	6200	11
19	Waduel	SW	4397	30	6420	20	4233	16	5920	14
20	UC 850	CLUB	5275	10	6160	27				
21	UC 852	CLUB	4623	25	6320	23				
22	Grandin	HR	4235	32	5620	31				
23	ID 366	HR	4495	28	6520	15				
24	Nomad	HR	5308	7	6460	18				
25	UC 784	HR	4943	18	6420	19				
26	UC 785	HR	5078	15	6280	25				
27	UC 786	HR	5304	9	7160	5				
28	Vance	HR	4526	27	5100	32				
29	OR 4870235	HW	4722	22	6320	24				
30	OR 4870249	HW	4480	29	6700	11				
31	OR 4870279	HW	5312	6	7000	7				
32	ID 379	SW	5012	16	6880	9				
	Mean		4963		6526		4600		6265	
	CV (%)		20.6		7.9		18.4		10.1	
	LSD (0.05)		1003		500		683		500	

Table 6. 1991 OSU Hard White Spring Wheat Variety Trial. Observations of grain yield, test weight, lodging, plant height, and days to 50% heading of spring wheat varieties planted at the Klamath Experiment Station, OR.

Entry	**Selection**	**Yield**	**Test wt.**	**Lodge**	**Height**	**Heading date**
		lbs/A	**lbs/bu**	**- % -**	**inches**	**Julian days**
1	McKay (ID 167)	5430	65.0	0	32	193
2	Klasic	5024	65.0	0	28	191
3	ORS 8413	4884	64.0	0	29	193
4	OR 4870235	4970	67.0	0	30	191
5	OR 4870249	4766	65.0	0	27	190
6	OR 4870279	5278	64.5	0	29	191
7	OR 4870453	5037	64.0	0	28	193
8	4880376	5858	65.0	0	31	193
9	4880384	4279	65.0	0	28	193
10	Spillman	5425	64.0	0	32	192
11	4880351	4812	65.0	0	30	193
12	OR 4880388	5534	66.0	0	27	193
13	OR 4880391	4774	63.5	0	25	193
14	OR 4880392	5204	66.0	0	27	193
15	OR 4880403	5592	63.5	0	28	193
16	4880302	4517	65.0	0	28	193
17	4880358	5504	66.0	0	26	192
18	4895143	4879	65.0	0	30	193
19	4880536	5553	67.0	0	28	193
20	Kauz "S" (#1)	4983	66.0	0	26	193
21	Kauz "S" (#2)	4978	65.0	0	26	193
22	4870352	4565	65.0	0	29	193
23	4895198	3847	65.0	0	27	191
24	4880331	5523	66.0	0	27	191
25	4880353	5080	65.0	0	27	192
26	Westbred 906R	5424	65.0	0	30	190
27	Westbred 926	5654	64.0	0	33	190
28	Yecora Rojo	4378	65.0	0	20	189
	Mean	5063	65.1	0	28	192
	CV (%)	9.7			5.4	0.5
	LSD (0.05)	688			2.1	1.3

Table 7. 1991 OSU Hard Red Spring Wheat Variety Trial. Observations of grain yield, test weight, lodging, plant height, and days to 50% heading of spring wheat varieties planted at the Klamath Experiment Station, OR.

Entry	Selection	Yield	Test wt.	Lodge	Height	Heading date
		lbs/A	lbs/bu	%	inches	Julian days
1	McKay (ID 167)	4116	64.0	0	31	195
2	Westbred 906R	4827	64.0	0	30	191
3	Yecora Rojo	3853	65.0	0	21	191
4	Spillman	3965	63.5	0	30	193
5	ORS 8510	4137	65.5	0	31	193
6	OR 4870456	3994	66.0	0	29	193
7	OR 4870475	3810	63.0	0	23	193
8	OR 4870400	4561	65.0	0	31	196
9	OR 4870401	4389	66.0	0	31	196
10	OR 4870462	4372	66.0	0	28	193
11	4870469	4870	66.0	0	29	192
12	4870622	3775	60.0	0	29	195
13	OR 4880189	3899	65.0	0	28	193
14	OR 4880193	4293	66.0	0	31	196
15	OR 4880200	4341	66.0	0	26	193
16	OR 4880250	4616	65.0	0	28	196
17	OR 4880264	4712	65.0	0	31	196
18	4870410	4420	66.0	0	31	195
19	OR 4870355	4155	65.0	0	31	196
20	FCT'S'	4101	66.0	0	26	193
21	TUI'S'	4154	65.0	0	31	193
22	4895075	4001	66.0	0	28	194
23	4895078	3908	63.0	0	27	193
24	4895078	4333	62.5	0	26	192
25	4895105	4702	66.0	0	29	195
26	4870251	4186	62.0	0	28	193
27	4870251	4165	66.0	0	31	195
28	Westbred 926	4404	65.0	0	31	192
	Mean	4252	64.8	0	29	194
	CV (%)	17.9			6.2	0.5
	LSD (0.05)	1071			2.5	1.4

Oat Variety Screening in the Klamath Basin

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

INTRODUCTION

Variety trials were established in three locations in the Klamath Basin in 1991. A large trial (30 entries) was established at the KES in cooperation with regional testing programs (Uniform Northwestern States Oat Nursery). Two smaller trials (16 entries) were established on organic soil sites in the Lower 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. The off-station trials were on very deep, poorly drained, lake bottom soils with high organic matter content. All plots at KES were sprinkler irrigated, while only one organic soil test site was irrigated.

All trials were arranged in a randomized complete block design with either three or four replications. Trials at the KES were planted between May 2 and 6. Plots at the irrigated organic soil site were planted on June 4 and the dryland study was established on June 11. Seed was planted to a depth of one inch at a seeding rate of 100 lbs/A. All plots were fertilized with 100 lbs N, 60 lbs P_2O_5, and 44 lbs S/A at time of seeding. Plots measured 5 x 20 feet with a row spacing of six inches. At KES, Bromoxynil and MCPA were applied at labeled rates to control broadleaf weeds. Chemical weed control at the organic soil sites was achieved using a mixture of 2,4-D and Banvel. Plots were harvested using a plot combine with a five foot wide head. Grain yield was recorded for all plots. Test weight was measured in only one replication.

RESULTS AND DISCUSSION

Oat grain yields in the Northwestern Uniform Oat Nursery were higher in 1991 than in the two previous years (Table 1). The highest yielding entry in the trial in 1991 was 83Ab3250. It produced significantly higher yields than all entries except 81Ab5792 and 80Ab5807. These three varieties were the highest yielding entries when averaged over three years. The highest yielding

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

named variety in the trial over the last three years was Border. It produced significantly higher yields than Cayuse, the most commonly planted variety in the region.

Test weight is an important factor to consider when selecting an oat variety. The two entries with the highest test weights over a three-year period were Calibre and Trucker (Table 2). Unfortunately, these two varieties produced much lower yields than the majority of entries in the trial. Six other entries; Otana, Riel, 80Ab5807, Valley, 80Ab5322, and 83Ab3250, averaged above 40 lbs/bu over a three-year period. Of these, 80Ab5807, 80Ab5322, and 83Ab3250 were the highest yielding lines.

Lodging resistance must also be considered when selecting an oat variety. There were seven entries which showed no lodging over a three-year period (Table 3). Among these, only 83Ab3119 had grain yields similar to the three highest yielding lines. Test weight of 83Ab3119 (39.3) was also fairly good, ranking tenth when averaged over three years. Three high yielding lines, 80Ab5807, 80Ab5322, and 81Ab5792 all averaged less than 10 percent lodging. In all years, lodging in these lines was lower than in Cayuse. Lodging of the highest yielding entry in the trial, 83Ab3250, averaged 13 percent. In every year except 1989, lodging was lower in 83Ab3250 than in Cayuse.

The leading entries from the KES trial were also planted on two organic soil sites in 1990 and 1991. When averaged over two years and two locations, Monida was the highest yielding entry (Table 4). This is due to exceptionally high yields in 1991 at both sites. This variety has not historically been a high yielding line in the Klamath Basin. Entries not statistically different from Monida included Border, 82Ab3250, 82Ab248, and 80Ab5322. Test weights of all these lines were acceptable but slightly lower than Monida and 82Ab1178 (Table 5).

A number of experimental lines show promise for improving oat yield, test weight, and lodging resistance over commercially available varieties. Continued testing is needed to select from among these lines.

Table 1. Summary of Northwestern States Oat Nursery Yields, 1989-1991. Grain yields of spring oat varieties planted at the Klamath Experiment Station, OR.

Entry	Selection	Yield 1991	1990	1989	2-year Avg	Rank	3-year Avg	Rank
		------	lbs/A	-----	lbs/A		lbs/A	
1	80Ab5322	5980	4423	5071	5202	7	5158	5
2	80Ab5807	6464	4865	5172	5665	2	5500	3
3	81Ab5792	6119	5063	5605	5591	4	5596	2
4	82Ab1142	5798	3978	4889	4888	10	4888	10
5	82Ab1178	5856	4105	5379	4981	9	5113	7
6	82Ab248	5352	3801	5855	4577	13	5003	9
7	83Ab3119	5861	5429	5047	5645	3	5446	4
8	83Ab3250	6750	5242	5208	5996	1	5733	1
9	83Ab3725	5660	4897	4627	5279	6	5061	8
10	Appaloosa	4928	3530	4926	4229	18	4461	13
11	Border	5255	4390	5760	4823	11	5135	6
12	Calibre	3286	3836	4010	3561	24	3711	20
13	Cayuse	4548	4049	4765	4299	17	4454	14
14	Monida	4337	3779	5312	4058	21	4476	12
15	Ogle	5841	4267	3881	5054	8	4663	11
16	Otana	4052	3593	3859	3823	23	3835	19
17	Park	4466	3831	4210	4149	19	4169	17
18	Pennuda	3509	3228	2596	3369	25	3111	22
19	Riel	4660	3555	4041	4108	20	4085	18
20	Robert	5246	3589	4363	4418	16	4399	15
21	Trucker	4236	3414	3085	3825	22	3578	21
22	Valley	5661	3428	3774	4545	14	4288	16
23	86Ab1867	5242	5330		5286	5		
24	86Ab664	5946	3134		4540	15		
25	Minimax	5018	4479		4749	12		
26	87Ab5125	5779						
27	87Ab5932	4379						
28	ND 852017	4113						
29	ND 860416	4729						
30	Newdak	5535						
	Mean:	5154	4129	4611	4666		4630	
	LSD (0.05)	702	1309	750	758		586	
	CV (%)	12.4	22.2	15.9	16.4		15.7	

Table 2. Summary of Northwestern States Oat Nursery Test Weights, 1989-1991. Test weights of spring oat varieties planted at the Klamath Experiment Station, OR.

Entry	Selection	Test weight			2-year		3-year	
		1991	1990	1989	Avg	Rank	Avg	Rank
		-----	lbs/bu	-----	lbs/bu		lbs/bu	
1	Park	38.5	34.5	41.0	36.5	12	38.0	15
2	Cayuse	39.0	32.5	41.0	35.8	17	37.5	17
3	Otana	39.0	40.0	42.0	39.5	5	40.3	6
4	Appaloosa	39.0	27.0	40.0	33.0	23	35.3	21
5	Border	40.5	31.5	42.5	36.0	16	38.2	13
6	Monida	33.0	38.0	44.0	35.5	19	38.3	12
7	Ogle	38.0	34.0	39.0	36.0	15	37.0	18
8	Calibre	42.5	39.0	45.5	40.8	2	42.3	1
9	81Ab5792	40.0	32.5	42.0	36.3	14	38.2	14
10	Riel	40.5	37.0	43.0	38.8	8	40.2	7
11	80Ab5807	40.5	39.0	42.0	39.8	4	40.5	3
12	Valley	42.0	35.0	43.0	38.5	9	40.0	8
13	80Ab5322	40.0	38.0	43.5	39.0	7	40.5	4
14	82Ab248	40.0	31.5	44.0	35.8	18	38.5	11
15	82Ab1178	40.0	28.0	42.0	34.0	21	36.7	20
16	82Ab1142	38.0	31.0	42.0	34.5	20	37.0	19
17	Robert	40.0	32.5	41.0	36.3	13	37.8	16
18	Trucker	43.0	37.0	44.5	40.0	3	41.5	2
19	Minimax	37.0	27.0	41.0	32.0	24	35.0	22
20	83Ab3119	40.0	36.0	42.0	38.0	11	39.3	10
21	83Ab3250	39.0	40.0	42.0	39.5	6	40.3	5
22	83Ab3725	40.5	36.0	42.0	38.3	10	39.5	9
23	86Ab664	39.0	28.0		33.5		22	
24	86Ab1867	41.5	40.0		40.8		1	
25	Newdak	40.0						
26	ND 860416	38.5						
27	ND 852017	40.0						
28	87Ab5125	41.0						
29	Pennuda	43.0						
30	87Ab5932	41.0						
	Mean:	39.8	34.4	42.2	37.0		38.7	

Table 3. Summary of Northwestern States Oat Nursery Lodging, 1989-1991. Percent lodging of spring oat varieties planted at the Klamath Experiment Station, OR.

Entry	Selection	Lodging 1991	Lodging 1990	Lodging 1989	2-year Avg	2-year Rank	3-year Avg	3-year Rank
		-------	%	--------	%		%	
1	Park	70	53	2	62	23	42	21
2	Cayuse	33	35	0	34	20	23	17
3	Otana	90	45	37	68	24	57	22
4	Appaloosa	78	38	0	58	22	39	20
5	Border	28	23	0	26	16	17	14
6	Monida	53	35	7	44	21	32	19
7	Ogle	0	0	0	0	1	0	1
8	Calibre	18	48	0	33	18	22	15
9	81Ab5792	3	10	0	7	9	4	8
10	Riel	53	5	16	29	17	25	18
11	80Ab5807	0	15	0	8	10	5	9
12	Valley	0	0	0	0	1	0	1
13	80Ab5322	0	23	0	12	12	8	10
14	82Ab248	3	38	0	21	14	14	13
15	82Ab1178	0	0	0	0	1	0	1
16	82Ab1142	0	0	0	0	1	0	1
17	Robert	0	40	0	20	13	13	11
18	Trucker	25	40	0	33	18	22	15
19	Minimax	0	0	0	0	1	0	1
20	83Ab3119	0	0	0	0	1	0	1
21	83Ab3250	0	18	22	9	11	13	11
22	83Ab3725	0	0	0	0	1	0	1
23	86Ab664	3	38		21	14		
24	86Ab1867	0	5		3	8		
25	Newdak	5						
26	ND 860416	28						
27	ND 852017	33						
28	87Ab5125	5						
29	Pennuda	0						
30	87Ab5932	0						
	Mean:	18	21	4	20		15	

Table 4. **Summary of 1990 and 1991 oat grain yield (lbs/A)** at two organic soil sites in Klamath County, Oregon.

		Dryland		Irrigated		2 Locations Average		2-year	
Entry	**Selection**	**1990**	**1991**	**1990**	**1991**	**1990**	**1991**	**Avg**	**Rank**
		lbs/A							
1	Cayuse	3229	3970	2959	5465	3094	4718	3906	7
2	Monida	3723	5513	3077	5784	3400	5649	4524	1
3	Appaloosa	3193	3577	3457	4768	3325	4173	3749	12
4	Border	3312	4685	3830	5017	3571	4851	4211	3
5	Ogle	3563	3338	4043	4724	3803	4031	3917	6
6	Sierra	2701	3317	2367	4226	2534	3772	3153	15
7	80Ab988	4327	2948	3659	4391	3993	3670	3831	10
8	80Ab4725	3617	4367	2173	4700	2895	4534	3714	13
9	80Ab5322	3707	3302	4100	5033	3904	4168	4036	5
10	80Ab5807	3814	3741	2634	5390	3224	4566	3895	8
11	81Ab5792	3161	4333	2903	5108	3032	4721	3876	9
12	82Ab248	3692	3675	2959	5908	3326	4792	4059	4
13	82Ab1142	3699	3894	3065	4656	3382	4275	3829	11
14	82Ab1178	2830	2604	3432	4970	3131	3787	3459	14
15	82Ab3250	3692	4923	3215	5020	3454	4972	4213	2
16	Dane	2233	2497	2034	3250	2134	2874	2504	16
	Avg	3406	3793	3119	4901	3263	4347	3805	
	LSD (0.05)	801	1752	489	608	468	908	506	
	CV (%)	17	32	11	9	15	21	19	

Table 5. **Summary of 1990 and 1991 oat grain test weights for oats grown at two organic soil sites in Klamath County, Oregon.**

		Dryland		Irrigated		2 Locations Average		2-year	
Entry	**Selection**	**1990**	**1991**	**1990**	**1991**	**1990**	**1991**	**Avg**	**Rank**
		lbs/bu							
1	Cayuse	31.5	38.5	34.5	39.5	33.0	39.0	36.0	11
2	Monida	36.5	38.5	40.5	41.0	38.5	39.8	39.1	2
3	Appaloosa	33.5	35.0	34.5	36.0	34.0	35.5	34.8	15
4	Border	37.0	38.0	39.0	39.5	38.0	38.8	38.4	3
5	Ogle	33.0	39.0	35.0	40.0	34.0	39.5	36.8	9
6	Sierra	33.5	35.0	32.0	39.0	32.8	37.0	34.9	14
7	80Ab988	34.0	37.0	39.0	36.0	36.5	36.5	36.5	10
8	80Ab4725	35.0	37.5	32.0	37.0	33.5	37.3	35.4	13
9	80Ab5322	38.0	37.0	37.0	40.0	37.5	38.5	38.0	6
10	80Ab5807	36.5	38.0	37.0	39.5	36.8	38.8	37.8	7
11	81Ab5792	37.0	39.0	36.5	40.0	36.8	39.5	38.1	5
12	82Ab248	32.5	37.5	37.0	42.0	34.8	39.8	37.3	8
13	82Ab1142	37.0	33.0	37.0	36.5	37.0	34.8	35.9	12
14	82Ab1178	38.0	39.0	40.0	40.0	39.0	39.5	39.3	1
15	82Ab3250	35.5	38.0	39.0	41.0	37.3	39.5	38.4	4
16	Dane	31.0	36.0	31.5	36.0	31.3	36.0	33.6	16
	Avg	35.0	37.3	36.3	38.9	35.7	38.1	36.9	

Variety and N effects on Spring Wheat Yield and Quality

R.L. Dovel and H. Carlson[1]

INTRODUCTION

The Klamath Basin has a unique environment characterized by a short growing season and cool night temperatures. Many varieties that perform well throughout the rest of the state yield poorly in the Klamath Basin. The development and adoption by the milling industry of Klasic, a hard white spring wheat (HWSW) variety, has resulted in the development of an important and growing grain class. Klasic has repeatedly produced higher grain yields than Yecora Rojo, the most widely planted hard red spring wheat (HRSW) in the region; however, yield levels of Klasic are lower than several experimental lines of HWSW currently being tested. Grain quality of several of these lines looks quite promising; however, no information exists concerning management effects on grain quality or yield of these lines. Little information is available on the management of Klasic for yield or grain quality in the Klamath Basin. Since HWSW prices are dependent on quality (mainly protein content), research is needed to compare the yield potential and grain quality of Klasic and experimental HWSW lines to that of Yecora Rojo under a wide range of management conditions to determine the relative profitability of HWSW.

The greatest single management impact on grain quality is N fertilization. Increasing levels of N fertilization increase grain protein content. Research has shown that late season application of N can affect grain protein content more than preplant or early season N application. The application of 30 lbs N/A to Yecora Rojo at heading increased grain protein content from 12.8 to 14.5 percent in one study at Ontario. Addition of N in excess of 30 lbs N/A did not increase grain protein levels. Soil type may influence the effectiveness of late season N application in increasing grain protein concentration. Recent research using Yecora Rojo on lake-bottom soil in Siskiyou county indicates that late season N application may not be effective on organic soils.

It is evident in hard red winter wheat (HRWW) and HRSW that there is a significant difference between varieties in their ability to produce high quality grain at low soil N levels. Some varieties are much more sensitive to N management than others. It is reasonable to assume that the same variability exists between HWSW varieties. Comparing promising HWSW varieties under a number of N management systems would identify varieties in which grain quality is less sensitive to N fertilizer inputs, thus allowing lower N inputs while maintaining grain quality.

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Acknowledgment: Partial support of this study was provided by the California Wheat Commission.

It is desirable due to environmental and financial constraints to use a minimum of N fertilizer to achieve high grain yields with adequate quality. Nitrogen applied at heading has been shown to be incorporated primarily in the grain. Also a higher percentage of late applied N is recovered in the plant than preplant applied N. This has not been examined in the Intermountain Region and may not hold true on the organic soils in the area. Research is needed to develop N management systems to optimize grain yield, grain quality and N use efficiency on the two major soil types, mineral and organic, in the Klamath Basin.

PROCEDURES

Factorial experiments were established on an organic soil at the Intermountain Research and Extension Center (IREC) and a mineral soil at the Klamath Experiment Station (KES). The experiments were arranged in a split-split-plot design with four replications. Timing of N application was the sub-plot, variety was the sub-sub-plot and nitrogen fertilizer applied at 30, 70, 110, and 150 lbs N/A was the main plot. Nitrogen was applied either as a preplant or a split application. Preplant treatments received all fertilizer N broadcast prior to planting. Nitrogen was applied to plots receiving split applications as 0, 40, 80, and 120 lbs N/A prior to planting, followed by an additional 30 lbs N/A at heading.

Yecora Rojo, the most commonly planted HRSW in the region, was included in the study as a reference to assess relative white wheat production and quality responses to N management. The HWSW varieties in the study included Klasic and five promising experimental lines developed at OSU.

Soil samples were collected prior to and after application of preplant fertilizer. At harvest, grain yield and test weight were recorded. Grain protein contents were determined by infrared reflectance. Bulk samples of all four replications of the 30 lb N preplant and the 150 lb N split treatments were sent to the California Wheat Quality Laboratory for milling and baking quality analysis.

RESULTS

AGRONOMIC DATA - IREC

Varieties differed in all parameters measured at IREC. Fieldwin, a soft white variety, was the highest yielding variety in the trial, followed by Spillman, a recently released hard red variety (Table 1). Among the hard white varieties only Klasic and 4870249 had yields equivalent to Spillman. All other hard white lines yielded slightly less than Klasic. Among the hard white varieties only 4870235 had higher test weights than Klasic. Both 4870279 and 4870249 had test weights equivalent to Klasic and those of ORS 8413 were lower than Klasic. The two hard red varieties in the trial had grain protein contents significantly higher than any of the hard white entries. Among the hard white lines 4870235, 4870249, and 4870279 had grain protein contents higher than Klasic. Rate of N fertilization did not affect any parameter measured (Table 2). Timing of N application also had no effect on grain yield or major quality parameters (Table 3). Split N application resulted in a higher hardness index; however, this is not a dependable predictor of milling and baking quality. Grain yield and protein data from this location indicate that residual inorganic N and mineralization of organic nitrogen during the growing season provide adequate N to meet requirements for both optimal yields and grain protein levels.

AGRONOMIC DATA - KES

The highest yielding variety at KES was the soft white entry, Fieldwin. It produced significantly higher yields than all other entries except ORS 8413 (Table 4). ORS 8413 has historically been a very high yielding variety at KES, often matching or exceeding leading soft white varieties. Unfortunately, this variety has not met milling and baking quality standards to justify release as a bread wheat. The second highest yielding hard white wheat, 4870279, was not significantly different from ORS 8413 but lower yielding than Fieldwin. It produced yields significantly higher than all other hard white entries and both hard red varieties. All experimental lines had higher test weights than the commercially available hard red and hard white varieties (Table 4). Yecora rojo had the highest protein content in the trial. Both it and Spillman produced protein levels that were significantly higher than the hard white entries. Among the hard white entries, both 4870279 and 4870249 produced average protein levels significantly higher than Klasic. Grain yield increased as N fertilization increased from 30 to 110 lbs N/A but not from 110 to 150 lbs N/A (Table 5). Grain protein content increased with increasing levels of N fertilization throughout the entire range of fertility levels included in this study. In contrast, bushel weight declined with increasing N fertilization. On average, split N application resulted in a slight reduction in grain yield (0.14 tons/A) but a substantial increase in grain protein (0.5 percent)(Table 6). Thus split application resulted in decreasing N available for grain production by 30 lbs N/A compared to the preplant treatments.

QUALITY DATA

Results from the California Wheat Quality Laboratory indicate that four lines included in this trial have good milling and baking quality; 487029, Klasic, Yecora rojo, and Spillman. Grain protein content significantly affected baking quality. KES had higher grain protein content and as a result generally had higher baking quality than IREC (Table 7). The higher fertilizer rate resulted in higher baking quality at both locations. Only the two HRSW lines had acceptable quality at the low N rate at IREC. In contrast, baking quality of four entries was satisfactory and Klasic was excellent at the low N rate at KES.

CONCLUSIONS

Higher levels of N fertilization are required on mineral soils than on organic soils in the Klamath Basin to obtain optimal grain yield and protein content of both HRSW and HWSW varieties. Late season N fertilization significantly increases grain protein levels of both HRSW and HWSW varieties on mineral soil; but not on organic soils. Klasic yielded only one tenth of a ton more than 4870279 at IREC and had significantly lower grain protein content than the experimental line. This, combined with the superior performance of 4870279 at KES on mineral soil, indicates that this line has promise as a bread wheat variety in the Intermountain Region.

On mineral soils both 4870235 and 4870279 had acceptable quality for baking at the low fertilization rate. None of the HWSW lines produced acceptable baking quality in the low fertility regime on the organic soil site.

Table 1. Wheat variety development and grain yield at IREC averaged over nitrogen treatments. 1991.

Variety	Height	TKW*	Bushel weight	Yield	Protein	Hardness
	inches	- g -	lb/bu	T/A	- % -	
4870235	37	39.2	65.8	2.85	12.9	75.6
4870279	33	39.6	64.4	2.90	12.8	62.2
4870249	35	40.4	64.3	3.03	13.0	72.9
ORS 8413	34	34.5	62.6	2.88	12.5	78.3
Klasic	36	39.4	64.6	3.03	12.4	49.1
Fieldwin	40	34.7	63.7	3.26	11.5	7.3
Yecora Rojo	28	41.8	65.1	2.93	13.1	65.4
Spillman	39	42.0	62.6	3.04	13.3	78.4
LSD (0.05)	0.9	0.85	0.3	0.12	0.22	5.5

* Thousand kernel weight

Table 2. Effects of nitrogen rate on wheat development and grain yield at IREC averaged over varieties and application timing. 1991.

Nitrogen Rate	Height	TKW*	Bushel weight	Yield	Protein	Hardness
lbs/A	inches	- g -	lb/bu	T/A	- % -	
30	34	39.3	64.3	2.78	12.4	61.1
70	36	38.5	64.1	3.06	12.8	59.0
110	36	38.9	64.1	3.03	12.6	62.9
150	35	39.1	64.1	3.09	13.1	61.7
LSD (0.05)	NS	NS	NS	NS	NS	NS

* Thousand kernel weight

Table 3. Wheat variety development and grain yield at IREC averaged over nitrogen treatments. 1991.

Timing	Height	TKW*	Bushel weight	Yield	Protein	Hardness
	inches	-g-	lb/bu	T/A	- % -	
All Pre-plant	36	38.8	64.1	3.01	12.7	59.0
Split Application	35	39.1	64.1	2.97	12.7	63.3
LSD (0.05)	NS	NS	NS	NS	NS	2.2

* Thousand kernel weight

Table 4. Wheat variety development and grain yield at KES averaged over nitrogen treatments. 1991.

Variety	Heading days	Height	Bushel weight	Yield	Protein	Hardness
	Julian days	inches	lb/bu	T/A	- % -	
4870235	190	31	64.1	2.56	13.3	86.0
4870279	189	30	64.0	2.78	13.6	69.2
4870249	190	30	63.7	2.62	13.6	76.7
ORS 8413	192	31	64.0	2.85	12.9	90.2
Klasic	189	30	63.3	2.59	13.3	49.9
Fieldwin	196	36	63.6	2.94	11.9	19.7
Yecora Rojo	189	23	62.4	2.48	14.3	66.4
Spillman	191	34	63.0	2.53	13.9	87.2
LSD (0.05)	0.4	0.8	0.3	0.09	0.2	3.6

Table 5. Effect of nitrogen rate on wheat development and grain yield at KES averaged over varieties and application timing. 1991.

Nitrogen rate	Heading days	Height	Bushel weight	Yield	Protein	Hardness
lbs/A	Julian days	inches	lb/bu	T/A	- % -	
30	191	29	64.0	2.34	12.8	69.5
70	191	30	63.8	2.73	13.1	66.2
110	191	31	63.5	2.81	13.6	66.5
150	191	32	62.7	2.80	13.9	70.5
LSD (0.05)	NS	1.1	0.4	0.11	0.4	2.6

Table 6. Effect of pre-plant vs split N application on wheat development and grain yield at KES. 1991.

Timing	Heading days	Height	Bushel weight	Yield	Protein	Hardness
	Julian Days	inches	lb/bu	T/A	- % -	
All Pre-plant	191	31	63.4	2.74	13.1	68.8
Split Application	191	30	63.6	2.60	13.6	67.3
LSD (0.05)	NS	NS	NS	0.10	0.3	NS

Table 7. Nitrogen fertilization effects on baking quality of spring wheat lines at Intermountain Research and Extension Center (IREC) and the Klamath Experiment Station (KES). Samples from four replications were bulked for quality analysis. Nitrogen treatments were 30 lbs N/A at planting with no N applied at heading (30-0) and 120 lbs N/A at planting and 30 lbs N/A at heading.

	------ IREC -----		------ KES ------		
VARIETY	**30-0**	**120-30**	**30-0**	**120-30**	**AVG**[1]
4870235	2[3]	4	3	3	3
4870279	2	5	3	4	3.5
4870249	2	3	1	4	2.5
ORS 8413	2	3	2	3	2.5
KLASIC	2	4	5	5	4
YECORA ROJO	3	4	3	5	3.8
SPILLMAN	3	4	3	4	3.5
AVG[2]	2.3	3.9	2.9	4	

[1] Average for each entry across both locations and N treatments.
[2] Average baking quality for each N treatment and location.
[3] Baking quality rating of 3 or higher is considered acceptable.