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Crop Research in the Klamath Basin, 1992 Annual Report

Agricultural Experiment Station
Oregon State University

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Klamath Agricultural Experiment Station in cooperation with Klamath County

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INTRODUCTION

The Klamath Experiment Station (KES) presents the sixth in a current series of annual reports, summarizing KES research programs conducted in 1992. We take this opportunity to recognize personnel from other units in Oregon State University (OSU) and from other institutions who contribute to our research efforts in many ways.

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USDA-ARS, Aberdeen, Idaho:

Dr. Joseph Pavek,	Potato Genetics

North Dakota State University:

Dr. Robert Johansen,	Department of Horticulture and Forestry

We recognize and appreciate the financial support of our programs by grower organizations, industry, and federal grants. Reports of individual research programs include recognition of this support. As fiscal constraints at state and county levels cut into traditional sources of funding, industry support is becoming more important in maintaining our research programs.

The KES is also grateful for continuing support from the Klamath County Board of Commissioners. Two full-time employes are funded by the County. Klamath County owns the land and buildings, and has provided much of the funding for major facility improvements accomplished over the past five years at the KES.

Finally, I thank the staff for their continuing efforts and dedication in carrying on the KES programs and KES Advisory Board members for their counsel and support. As we work our way through the maze of state and county budget reductions, I hope we can maintain a similar level of support for agricultural research in the Klamath Basin and in Oregon.

Ken Rykbost, Superintendent
KLAMATH EXPERIMENT STATION

STAFF AT KES

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Weather and Crop Summary, 1992

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

Seven years of below normal precipitation in the Pacific Northwest had significant effects on Klamath Basin agriculture in 1992. Restrictions on water deliveries were imposed throughout the Klamath Project for the first time since the Bureau of Reclamation established the project. At the end of the irrigation season, Gerber and Clear Lake Reservoirs were at historic low levels, and Klamath Lake was at its lowest level since 1931. Although restrictions were partially the result of measures imposed to protect endangered sucker fish, they were mainly due to precipitation deficits. The winter of 1991-1992 was one of the driest on record. Total snowfall measured at Klamath Falls was less than 8 inches, about 15 percent of normal. Total precipitation for the six-month period from October 1991 through March 1992 was about 50 percent of normal for Klamath Falls.

The relatively warm and dry winter weather continued during the 1992 growing season. Many fields were irrigated before planting to provide adequate soil moisture for germination. In other cases, irrigation was applied as soon after planting as practical. Potato acreage was reduced 15 percent due to uncertainty over availability of late season irrigation supplies. Sugarbeet acreage was lower than that desired by the processors. Lack of stock water in rangelands resulted in early removal of cattle from private and public grazing lands. A portion of public leases in lower Klamath Lake and Tulelake areas were not let in 1992. Areas irrigated from Gerber Reservoir did not have water deliveries. Clear Lake deliveries were severely reduced, affecting over 25,000 acres. Wildlife refuges in the lower basin also experienced restricted water deliveries.

An official weather station is maintained at Kingsley Field, one-half mile east of the KES. It is at 4,090 feet elevation, 40°10′ N latitude, and 121°45′ W longitude. KES also maintains limited weather observation capabilities. Except for air temperatures being 1 to 3 °F lower at KES, data from the two stations are quite consistent in most observations. Climatological Data, Oregon, published by the National Oceanic and Atmospheric Administration, provided the data base for a portion of weather records (Tables 1-3). KES data were used to replace missing records and as the base for all weather data for 1989 through 1992. Weather records are summarized on a weekly basis from April 1 through October 27 (Tables 1-3). This 30-week period represents the majority of the local field activity season from early planting to harvest of most crops. Average data for the 13-year period from 1979 through 1991 are presented for comparison with 1992 data. This period includes several years with above long-term average temperatures.

Air temperatures averaged about 5 °F above 13-year means through April and May (Table 1). This was a sharp contrast to spring 1991 when temperatures were about 4 °F below the average. During the remainder of the 1992 growing season, temperatures

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

were similar to 13-year averages. The last spring frost occurred on May 21, and the first frost in the fall was observed on August 22, resulting in a frost-free period of 93 days. Frosts were less common in April and May and more frequent in September and October than in the previous 13 years (Table 2). Precipitation during the growing season was similar to averages for recent years (Table 3). No major storm events occurred during the season. A significant change in weather patterns was experienced in late fall. December received record snowfall (dating back to 1949 when local records began) and a new record for total snowfall for the winter was set (over 97 inches at Klamath Falls). This welcomed change has eased local and regional drought conditions for 1993.

Effects of 1992 weather conditions on crop performance were mixed. Cereal crops were planted early, developed rapidly under favorable temperatures, and avoided frost damage. Where water was adequate, excellent yields and quality were realized. Two pest problems caused serious losses in isolated areas. Russian wheat aphids were more abundant than in previous years, and infested fields at economic levels earlier in the season. As seen in previous years, the problem was most severe in late planted fields that were stressed for moisture. Infestations occurred in wheat, barley, and oat crops. A small acreage was treated for this pest and several fields experienced high losses. The wheatstem maggot also caused damage in crops in the lower Klamath Lake area. The area of infestation was less extensive than for the wheat aphid. Several fields were treated after damage was observed, but in general the treatments were too late. Early infestations of both pests were undoubtedly enhanced by warm spring conditions.

Forage crops were favored by the warm spring conditions. Alfalfa first cuttings were taken one to two weeks earlier than normal. However, water restrictions resulted in some second and third cuttings being sacrificed to maintain adequate water for row crops. Pasture and rangeland productivity was reduced significantly by water restrictions. As a result, cattle were moved to other areas, and in some cases herds were reduced.

Potatoes experienced several weather related problems in 1992. Seed piece decay occurred in cases where fresh cut seed was planted in very dry soil and irrigation was delayed by several days. Pink rot was observed in early maturing varieties harvested in early September. This may have resulted from excessive irrigation for frost protection in late August when vines of early varieties were senescing and water use was reduced. Conditions were further enhanced by very warm weather at the time of harvest. The warm season was favorable for root-knot nematodes. This resulted in high populations at the end of the season. Where these problems were avoided, potato yields and quality were generally good.

Sugarbeets produced similar yields to those obtained in 1991, with slightly lower sugar content. Flea beetle pressure was severe in early plantings. Moderate powdery mildew infections were observed in early September, but only a few crops required treatment. Harvest was completed in the first week of November. As in previous years, weed control was the most limiting factor in the crop. Several fields exceeded 28 tons/acre at 18 percent, or higher, sugar content, indicating an excellent potential for this crop in the future. While diseases were not serious in the Klamath Basin in 1992, severe losses from beet curly top virus occurred in a small field near Susanville, CA.

Table 1. Weekly average maximum, minimum, and mean air temperatures for 1992 and the 13-year period from 1979 to 1991, and the accumulated departure of 1992 weekly means from the 13-year average at Klamath Falls, OR.

Weekly Period		1979-1991 Weekly average Max	Min	Mean	1992 Weekly average Max	Min	Mean	1992 Accumulated departure[1]
		°F						
April	1-7	54	29	42	63	24	43	+ 1
	8-14	59	30	44	58	39	49	+ 6
	15-21	60	33	47	61	36	49	+ 8
	22-28	59	33	46	65	32	48	+10
	29-5	62	34	48	73	36	55	+17
May	6-12	61	34	48	80	40	60	+29
	13-19	66	36	51	73	39	58	+36
	20-26	69	39	54	79	42	60	+42
	27-2	68	40	54	81	49	65	+53
June	3-9	70	42	56	83	44	63	+60
	10-16	74	43	59	66	40	53	+54
	17-23	75	45	60	84	52	68	+62
	24-30	78	47	62	77	49	63	+63
July	1-7	79	45	62	71	45	58	+59
	8-14	81	48	65	80	46	63	+57
	15-21	83	50	67	86	51	69	+59
	22-28	85	50	67	83	48	66	+58
	29-4	85	48	67	92	49	71	+62
Aug.	5-11	86	50	68	85	49	67	+61
	12-18	83	47	65	94	56	75	+71
	19-25	81	47	65	80	42	61	+67
	26-1	79	44	62	83	35	59	+64
Sept.	2-8	80	44	62	70	39	55	+57
	9-15	76	40	58	76	39	58	+57
	16-22	72	38	55	81	38	60	+62
	23-29	71	38	55	76	34	55	+62
	30-6	73	36	55	70	39	55	+62
Oct.	7-13	69	34	55	76	29	53	+60
	14-20	63	30	47	67	26	47	+60
	21-27	61	32	47	67	33	50	+63
Mean		72	40	56	76	41	58	

[1]/ Accumulated difference in mean weekly temperature between 1992 and the 13-year period from 1979-1991.

Table 2. Weekly minimum air temperatures and percent of days with frost for 1992 and the 13-year period from 1979 to 1991 at Klamath Falls, OR.

Weekly Period		Weekly minimum 13-year	Weekly minimum 1992	Frost days/week 13-year	Frost days/week 1992
		°F		%	
April	1-7	11	15	75	100
	8-14	17	33	69	0
	15-21	17	27	50	29
	22-28	21	20	53	57
	29-5	19	22	37	14
May	6-12	23	30	51	14
	13-19	19	35	39	0
	20-26	24	27	18	14
	27-2	27	34	21	0
June	3-9	28	38	7	0
	10-16	27	35	6	0
	17-23	30	41	3	0
	24-30	31	40	0	0
July	1-7	33	42	0	0
	8-14	35	42	0	0
	15-21	36	43	0	0
	22-28	40	35	0	0
	29-4	39	44	0	0
Aug.	5-11	37	40	0	0
	12-18	37	52	0	0
	19-25	36	31	0	28
	26-1	32	38	1	0
Sept.	2-8	31	32	2	14
	9-15	29	24	9	28
	16-22	26	34	15	0
	23-29	26	27	18	43
	30-6	20	26	22	28
Oct.	7-13	18	24	32	86
	14-20	18	20	66	86
	21-27	20	29	58	57

Table 3. Weekly and accumulated precipitation for 1992 and the 13-year period from 1979 to 1991 at Klamath Falls, OR.

Weekly period		1979 - 1991		1992	
		Weekly	Accumulated	Weekly	Accumulated
		---------- Precipitation, inches	----------		
April	1-7	.14	.14	.00	.00
	8-14	.10	.24	.26	.26
	15-21	.19	.43	.48	.74
	22-28	.29	.72	.00	.74
	29-5	.15	.87	.03	.77
May	6-12	.15	1.02	.20	.97
	13-19	.22	1.24	.03	1.00
	20-26	.22	1.46	.07	1.07
	27-2	.27	1.73	.00	1.07
June	3-9	.21	1.94	.00	1.07
	10-16	.13	2.07	.05	1.12
	17-23	.06	2.13	.03	1.15
	24-30	.10	2.23	.28	1.43
July	1-7	.03	2.26	.65	2.08
	8-14	.02	2.28	.02	2.10
	15-21	.18	2.46	.00	2.10
	22-28	.05	2.51	.02	2.12
	29-4	.07	2.58	.00	2.12
Aug.	5-11	.06	2.64	.00	2.12
	12-18	.06	2.70	.04	2.16
	19-25	.15	2.85	.00	2.16
	26-1	.18	3.03	1.11	3.27
Sept.	2-8	.09	3.12	.10	3.37
	9-15	.11	3.23	.00	3.37
	16-22	.45	3.68	.00	3.37
	23-29	.18	3.86	.04	3.41
	30-6	.06	3.92	.22	3.63
Oct.	7-13	.17	4.09	.00	3.63
	14-20	.06	4.15	.00	3.63
	21-27	.38	4.53	.49	4.12

Red-Skinned Potato Variety Development, 1992

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

INTRODUCTION

Red-skinned potatoes are becoming more popular for specialty markets in the Pacific Northwest and are a major component of the California potato industry. Red LaSoda is the predominant red variety grown in the region. It produces high yields, but it has light skin color - particularly after storage, deep eyes, and tends toward large tuber size. Northwestern potato variety development programs have traditionally emphasized russet-skinned selections with processing potential. A systematic search for superior red-skinned varieties was initiated at KES in 1988. Progeny from red-skinned crosses from the North Dakota State University breeding program have been screened annually. In 1991 and 1992, seedlings from crosses in the USDA-ARS Aberdeen, Idaho breeding program were also screened at KES. First and second generation selections are screened at KES. Selections retained for the third year are evaluated in observational trials at Bakersfield, and Tulelake, California. In the fourth year, surviving selections are included in replicated yield trials at KES and in the Willamette Valley. At year six, material that has not been discarded will be advanced to regional trials in several western states.

I. SINGLE-HILL SEEDLING SCREENING

Procedures

The North Dakota State University potato breeding program provided 6,194 first-generation mini-tubers from 37 crosses. The USDA-ARS Aberdeen, Idaho program supplied 1,621 mini-tubers from six crosses. Tuber families were preselected on the basis of skin color, firmness, degree of sprouting, shape, and size, to reduce the number of clones planted to 3,897.

All red-skinned seedling screening trials were located in a field that was taken out of long-term alfalfa production in 1990 and cropped with barley in 1991. The field was

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[2]/ Extension Specialist, Vegetable Crops Department, University of California, Davis, CA.
[3]/ Extension Specialist, Department of Crop and Soil Science, Oregon State University, Corvallis, OR.

Acknowledgment: This program is partially funded by the Oregon Potato Commission, the Cooperative State Research Service (CSRS), and the Agricultural Research Service (ARS). The North Dakota State University and USDA-ARS Aberdeen potato breeding programs supply all tuber families for first-year screening.

fumigated with Telone II, applied at 20 gallons per acre (gpa) on November 15, 1991. The field was pre-irrigated with 1.5 inches prior to planting. Clones were planted at 36-inch spacing in 36-inch rows with a two-row, assisted-feed planter on May 21. Fertilizer included 600 pounds per acre (lb/A) of 16-16-16 banded at planting, and 40 lb N/A sprayed on as urea-ammonium nitrate (Soln. 32) and incorporated with a rolling cultivator on May 27. Eptam was applied at 3.5 lb ai (active ingredient)/A on May 27 with supplemental hand weeding. Aldicarb, at 3.0 lb ai/A, was applied in the seed furrow. Other disease and pest control practices included: Ridomil MZ58 applied aerially at 1.5 lb/A on July 8 and 2.0 lb/A on July 26; Monitor applied aerially at 1.0 lb ai/A on July 26; and Kocide applied aerially at 1 qt/A on August 22. Vines were desiccated with Diquat applied at 1 pt/A plus R-11 spreader activator at 1.5 pt/100 gallons, by a ground sprayer on September 5. A total of about 22 inches of irrigation was applied with solid-set sprinklers on a twice-weekly schedule.

Results and Discussion

Emergence and early plant development was favored by the warm spring conditions. Over 90 percent stands were obtained in all families with an average emergence of 96 percent. Only a few plants were removed for off-type canopy appearance. Many of the clones maintained vigorous growth until vines were desiccated. Tuber size was excessive in some of these clones, and skinning damage was common.

Tuber families were dug with a two-row digger on September 21. A total of 123 clones were selected at harvest and stored under typical seed storage conditions. On December 7, all selections were displayed and evaluated. Twenty-eight lines were retained for screening in 1993. Selection criteria at harvest included tuber numbers, tuber shape, skin color, and eye depth. Selection criteria after storage included these factors in addition to tuber firmness, dormancy, freedom from fusarium or other diseases, and general appearance when compared to standard red-skinned varieties stored under the same conditions. Five tubers from each clone were eye-indexed for virus testing. Virus-free lines will be planted in 12-hill plots at KES in 1993.

The selection percentage was very low compared to previous years. The high incidence of skinning damage was a major factor in rejecting clones after storage. However, skin color in the 1992 single-hill lines was inferior to that in many of the second and third generation lines from 12- and 50-hill plots. It is interesting to note that Redsen was not used as a parent in any of the North Dakota crosses (Table 1.). In previous years many of the selections that have been retained have Redsen as one parent. This variety produces excellent skin color in many of its progeny. None of the Idaho lines survived the post-storage evaluation.

II. SECOND GENERATION SEEDLING SCREENING

Procedures

Thirty-eight single-hill selections from 1991 were eye-indexed and grown in a greenhouse for disease evaluation. Thirty-six virus-free clones were planted in 12-hill plots on May 21. Seed pieces were spaced at 9 inches in 36-inch rows. Cultural practices, timing of harvest, and selection procedures and criteria were as described for single-hill plots.

Results and Discussion

Emergence, plant type, and canopy vigor were observed through the season. Seven selections were discarded on the basis of poor plant type and vigor. Thirteen clones were selected at harvest. Nine clones were advanced for further evaluation after the December screening (Table 2). Selection criteria included all factors considered for single-hill seedlings with emphasis at harvest on yield and uniformity of size and shape.

Thirty tubers of the nine clones retained were eye-indexed and greenhouse tested for virus diseases. Virus-free material will be planted in 50-hill plots at KES in 1993, and five tubers will be supplied to the seed increase program at Madras, Oregon. Seed will also be supplied for observational trials at Bakersfield, and Tulelake, California.

III. THIRD GENERATION SEEDLING SCREENING

Procedures

Nine selections from 1990 single-hill seedlings were planted in 50-hill plots at KES on May 21. Seed pieces were spaced at 9 inches in 36-inch rows. All cultural practices were as described for single-hill plots. Five of these selections and one additional clone from 1990 selections were planted in 12-hill or 27-hill observational plots at Bakersfield, and Tulelake, California. Standard local cultural practices were followed. Bakersfield trials were planted February 10 and harvested in early June. Tulelake trials were planted on May 6 and harvested on September 21. Seed of all 10 clones was increased at Madras, Oregon.

At each trial site, plant emergence, vine vigor, and vine maturity were noted. Selection criteria at harvest were as described for 12-hill plots. Larger plot size allowed greater emphasis on yield and tuber uniformity characteristics. At KES, evaluations after storage did not include clones NDO 3994-2 or NDO 4030-12. Both lines were selected at California sites, and they will be included in 1993 trials.

Results and Discussion

The NDO 4031-3 clone was discarded at KES on the basis of a poor vine type. All other clones were acceptable in this regard. All clones were rated as early to medium in vine maturity. NDO 3849-12 was rated highly at Bakersfield and Klamath Falls. This clone produced a high yield of relatively small tubers with excellent skin color, shallow eyes, and uniform shape. It is the most attractive clone in the group selected from 1990 single-hills. Seven of the lines will be evaluated further in 1993 (Table 3). Those with adequate seed supplies will be included in replicated yield trials in the Willamette Valley and at KES in 1993. Thirty tubers from five clones saved at KES have been eye-indexed and greenhouse tested. Seed of all clones is available for observational trials in 1993.

IV. ADVANCED RED-SKINNED VARIETY TRIALS

Procedures

Three standard red-skinned varieties, two advanced clones from other programs, and 13 advanced selections from the KES program were planted in a randomized complete block design with five replications at KES on May 18. Individual plots were one row, 25 feet long. Seed was hand cut to 1.5 to 2.0 ounces, treated with thiophanate-methyl (Tops 2.5), and suberized for 10 days before planting. Seed pieces were planted at 8.7-inch spacing in 32-inch rows with a two-row, assisted-feed planter. Di-syston was applied in the seed furrow at 3.0 lb ai/A. Other cultural practices were as described for single-hill seedlings (page 9), except aldicarb was not applied.

Tubers were harvested with a one-row digger-bagger on September 23. All tubers from each plot were graded according to USDA standards in late October. Tuber appearance ratings were scored for color, eye depth, shape, shape uniformity, and skinning. Specific gravity was determined by the weight-in-air, weight-in-water method on a 10-lb sample of 6- to 10-ounce U.S. No.1 tubers. Sub-samples of No.1 tubers in the same size range from one replication were stored until early December and evaluated for culinary quality for boiling, microwave baking, and oven baking preparation methods.

Trials at Corvallis and Sherwood, in the Willamette Valley, compared the same three standard red-skinned varieties with 13 advanced selections from the KES selection program. Both trials were randomized complete block designs with four replications of single-row, 25-foot plots. Seed pieces were spaced at 9 inches in 34-inch rows. Standard cultural practices were followed. Potatoes were planted in mid-May and harvested in early September.

Results and Discussion

KES

Crop establishment and early development was generally good. Slow emergence was noted for Sangre, NDO 2686-6, and NDO 3314-2 (Table 4). Final stands were over 90 percent for all selections. Tuber characteristics varied widely between selections. Red LaSoda and Sangre were light in skin color and had uneven tuber size distribution. Dark Red Norland also was light in color. The selections from 1988 single-hills all experienced skinning damage and uneven size with a tendency for large tubers and growth cracks (NDO 3432, 3503, 3504, and 3573 clones). Appearance ratings were much better for the selections from 1989 single-hill selections (NDO 2438, 2469, and 2686 clones). In general, similar observations were noted for both Willamette Valley trials and the observational trials in California locations. ND 2224-5R and COO86107-1 both produced more attractive tubers than any of the standards. Although detailed notes were not taken at the other locations, the selections NDO 2438-7, 2438-9, 2686-4, 2686-6, and 2686-10 were rated very highly for appearance at all locations. NDO 3314-2 was not as consistent at all locations, but rated better than standards in appearance. This selection was found to have a bitter flavor in all culinary tests at KES.

Yields and grade varied widely between selections. NDO 3573-3 was significantly higher in U.S. No.1 yield than all other selections (Table 5). However, tuber size was excessive. This selection also produced high yields at KES and in California in 1992, but again with excessive size. It was susceptible to tuber rot in the seed increase program in central Oregon. Other clones from the 1988 single-hill selections produced high yields with large tuber size and few Bs (tubers under 4 oz).

NDO 2438-9, 2686-10, and 3314-2 were low in total yield of U.S. No.1s, with a high yield of small tubers. These selections may be well suited to the market niche for baby reds, where yield is not a major factor due to very high prices. For more traditional red markets, the selections NDO 2438-7, 2469-1, 2686-4, and 2686-6 all appear to be worthy of further evaluation. NDO 2686-6 rated very high in all cooking tests at KES.

Willamette Valley

Both trials included all advanced KES selections, with the exception that the NDO 2438-6 selection replaced NDO 2438-7, which was grown in the KES trial. Yields were higher at Corvallis than at Sherwood for all selections (Table 6). Averaged over both locations, three selections, NDO 3573-3, 2438-6, and 2686-6, were equivalent to Red LaSoda in yield of No.1s. High yields of small tubers were found in NDO 3314-2 at both locations.

SUMMARY

Consistently outstanding appearance was noted for several KES red-skinned clones in third and fourth generation material evaluated at five locations. While the lines selected from single-hills in 1988 have shown high yield potential, none of them are as attractive as several selected in 1989 and 1990. All of the 1988 selections are being discarded. A similar trial format with replicated yield trials at KES and two Willamette Valley sites, and observational trials at Bakersfield, and Tulelake, California, is planned for 1993. Twelve selections will be included in the yield trials. It is expected that two or three lines will be advanced to formal regional trials in 1994. At that time, lines advanced will be submitted for propagation of disease-free tissue culture plantlets in the Oregon Foundation Seed Project. Concurrently, seed stocks for evaluation will be increased at the Central Oregon Agricultural Research Center at Madras. Limited seed will be available for commercial evaluation from that source by 1994.

Preliminary selection of seedlings from North Dakota and Idaho will continue at KES. Greenhouse testing of eye-indexed material has shown that material can be grown for up to three years at KES with very low virus-infection levels. This has allowed production of adequate seed supplies to provide material for observational trials in California at an early stage.

Several of the clones selected in the KES program are being used as parents for crosses at the USDA-ARS Aberdeen, Idaho and Colorado State University potato breeding programs. The first single-hill progeny from KES selections will be evaluated in 1993.

Table 1. First-year red-skinned seedling screening, Klamath Experiment Station, OR. 1992.

Clone	Parentage	Number of tubers	Number planted	Number plants	No. Selected Fall	No. Selected Winter
NDO 4271	NDTX9-1068-11R x 2050-1R	61	36	36	0	0
4577	Norland x La 12-59	191	100	96	7	1
4578	Norland x 1196-2R	190	130	128	5	2
4579	Norland x 1618-13R	76	50	50	2	0
4580	Norland x 2842-3R	151	98	97	7	2
4581	Norland x 3196-1R	164	108	106	3	0
4584	Reddale x La 12-59	201	130	118	1	0
4585	Reddale x NDTX9-1068-11R	90	66	61	0	0
4586	Reddale x 1196-2R	176	100	100	3	1
4587	Reddale x 1871-3R	164	100	98	0	0
4588	Reddale x 2050-1R	228	72	70	5	1
4589	Reddale x 2225-1R	271	92	90	1	0
4590	Reddale x 2842-3R	224	158	154	5	1
4591	Reddale x 3196-1R	188	134	122	3	1
4592	Reddale x 3198-1R	168	98	97	0	1
4602	Viking x NDTX9-1068-11R	57	34	34	1	1
4614	La 12-59 x 1871-3R	216	132	130	0	0
4615	La 12-59 x 2050-1R	300	220	211	7	3
4621	Minn 14309 x La 12-59	238	172	166	0	1
4625	Minn 14309 x 2842-3R	304	246	237	12	5
4628	NDTX9-1068-11R x Norland	90	38	37	1	0
4629	NDTX9-1068-11R x 2842-3R	62	46	38	1	0
4631	NDTX9-1068-11R x 3261-5R	44	30	29	0	0
4646	1196-2R x La 12-59	235	166	166	5	0
4651	1562-4R x Norland	218	132	121	1	0
4653	1562-4R x La 12-59	148	84	82	3	0
4654	1562-4R x 3312-3R (Pur.Fl.)	140	70	68	2	1
4655	1618-13R x La 12-59	187	65	65	5	0
4666	2225-1R x Norland	139	24	22	0	0
4674	2434-9R x La 12-59	101	26	26	0	0
4677	2467-8R x La 12-59	90	36	35	2	0
4699	2686-2R x Norland	213	32	32	0	0
4706	2842-3R x 2050-1R	141	54	54	3	1
4735	3048-2R x Norland	219	144	135	3	1
4742	3196-1R x La 12-59	234	160	151	9	3
4784	3574-5R x 2050-1R	117	100	98	5	2
4808	3805-1R x La 12-59	158	150	139	3	0
	<u>NDO TOTAL</u>	6,194	3,633	3,499	115	28
AO 83341	A78208-21 x Redsen	292	32	30	1	0
83350	Redsen x TXA218-7	341	60	59	1	0
83351	Redsen x Chieftan	135	32	11	1	0
83355	Bison x Redsen	194	40	39	2	0
83363	Red LaSoda x Redsen	322	50	50	2	0
83368	Red Pontiac x Redsen	337	50	49	1	0
	<u>AO TOTAL</u>	1,621	264	238	8	0

Table 2. Second-year red-skinned seedling screening, Klamath Experiment Station, OR. 1992.

Clone	Parentage	Number planted	Number selected Sept. 21	Dec. 7
NDO 4226	Reddale x 2050-1R	4	1	0
NDO 4231	Ruby Red x 1196-2R	1	1	0
NDO 4232	Ruby Red x 1618-13R	2	1	1
NDO 4252	La 12-59 x Reddale	1	0	0
NDO 4253	La 12-59 x 1562-4R	1	1	1
NDO 4254	La 12-59 x 2050-1R	1	0	0
NDO 4267	NDTX9-1068-11R x Norland	1	0	0
NDO 4270	NDTX9-1068-11R x 1618-13R	1	1	1
NDO 4297	1196-2R x Ruby Red	1	0	0
NDO 4298	1196-2R x La 12-59	1	1	1
NDO 4299	1196-2R x 1618-13R	1	0	0
NDO 4300	1196-2R x 2225-1R	5	2	2
NDO 4305	1562-4R x 1196-2R	2	1	0
NDO 4309	1618-13R x Reddale	1	0	0
NDO 4313	1618-13R x 2225-1R	2	1	0
NDO 4323	1871-3R x La 12-59	2	1	1
NDO 4331	2050-1R x Ruby Red	1	0	0
NDO 4332	2050-1R x La 12-59	1	0	0
NDO 4333	2050-1R x NDTX9-1068-11R	3	2	2
NDO 4341	2225-1R x 1196-2R	2	0	0
NDO 4342	2225-1R x 1618-13R	1	0	0
NDO 4343	2225-1R x 2050-1R	1	0	0
	Total	36	12	9

Table 3. Disposition of third- and fourth-year red-skinned seedlings at Klamath Falls, OR, and Bakersfield and Tulelake, CA. 1992.

Clone	Parentage	Disposition[1] Klamath Falls	Bakersfield	Tulelake
		Third-year Seedling		
NDO 3846-3	1408-8R x 3048-2R	R	N	N
NDO 3846-7	1408-8R x 3048-2R	R	N	N
NDO 3846-9	1408-8R x 3048-2R	R	N	N
NDO 3849-12	1660-IB-8R x 1196-2R	R	R	R
NDO 3991-5	Reddale x 1618-13R	D	N	N
NDO 3994-2	Redsen x La 12-59	D	R	R
NDO 4001-2	Ruby Red x 1618-13R	R	N	D
NDO 4030-6	Mn 12945 x 3049-1R	D	D	D
NDO 4030-12	Mn 12945 x 3049-1R	N	R	R
NDO 4031-3	Mn 13035 x 1618-13R	D	D	D
		Fourth-year Seedlings		
NDO 2438-6	Redsen x 1196-2R	N	R	R
NDO 2438-7	Redsen x 1196-2R	R	R	R
NDO 2438-9	Redsen x 1196-2R	R	R	R
NDO 2469-1	Viking x 1196-2R	R	D	R
NDO 2686-4	1196-2R x Redsen	R	R	R
NDO 2686-6	1196-2R x Redsen	R	R	R
NDO 2686-10	1196-2R x Redsen	R	R	R
NDO 3314-2	W806R x 2050-1R	D	D	R

[1]/ Disposition: R - retain for further evaluation
D - discard
N - not grown at location

Table 4. Plant and tuber characteristics of red-skinned varieties and advanced selections grown at Klamath Falls, OR. 1992.

Variety/	Percent	Vine	Appearance rating[2]				
Clone	Stand	vigor[1]	color	eyes	shape	uniform.	skin.
Red LaSoda	98	3.2	3.0	2.0	2.4	2.0	4.6
Sangre	62	2.0	2.8	4.2	2.0	3.0	4.4
D. R. Norland	98	3.6	3.2	4.8	2.0	2.8	4.8
ND 2224-5R	86	2.6	4.6	5.0	2.0	4.2	4.8
COO86107-1	94	2.6	4.8	5.0	2.0	3.6	4.0
NDO 3432-3	96	3.0	4.4	3.6	2.0	2.4	3.6
NDO 3503-2	92	3.2	4.0	4.0	2.0	2.4	3.0
NDO 3503-5	95	4.2	4.0	3.8	2.0	2.4	3.0
NDO 3504-3	99	3.2	4.0	4.0	2.0	2.2	2.2
NDO 3573-3	99	4.0	4.2	2.8	2.0	2.4	2.6
NDO 3573-5	95	3.2	5.0	3.8	2.0	2.8	2.8
NDO 2438-7	94	3.8	5.0	4.0	1.8	4.0	4.2
NDO 2438-9	91	3.0	4.2	5.0	1.0	4.0	3.6
NDO 2469-1	91	3.2	4.2	4.8	1.2	3.8	4.2
NDO 2686-4	92	4.0	4.4	5.0	1.2	4.0	4.2
NDO 2686-6	76	3.8	4.8	5.0	2.0	4.2	4.0
NDO 2686-10	86	3.4	4.8	5.0	1.0	4.6	3.8
NDO 3314-2	78	2.4	4.8	5.0	2.8	3.8	4.6

[1]/ Vine vigor: 1-small, weak; 5-large, rank
[2]/ Color: 1-pale to pink; 5-bright red
Eyes: 1-deep; 5-shallow
Shape: 1-round; 2-oval; 3-oblong
Uniformity: 1-poor; 5-excellent
Skinning: 1-severe; 5-none

Table 5. Yield and specific gravity of red-skinned varieties and advanced selections, Klamath Experiment Station, 1992.

Variety/ Selection	Yield U.S. No. 1's				Yield			Specific gravity
	4-6 oz.	6-10 oz.	>10 oz.	Total	B's	Culls	Total	
Red LaSoda	174	195	123	492	46	10	548	1.072
Sangre	148	171	123	442	38	8	488	1.068
Dark Red Norland	159	101	31	291	94	14	400	1.065
ND2224-5R	129	126	68	323	80	11	413	1.068
CO086107-1	147	206	100	453	33	29	515	1.079
NDO 3432-3	164	176	164	503	54	39	596	1.070
NDO 3503-2	117	183	164	464	48	21	533	1.078
NDO 3503-5	156	171	175	502	76	62	640	1.075
NDO 3504-3	165	166	150	480	66	67	613	1.071
NDO 3573-3	102	226	391	719	27	25	771	1.070
NDO 3573-5	166	194	118	479	69	43	592	1.070
NDO 2438-7	165	238	111	514	29	4	547	1.068
NDO 2438-9	137	109	30	275	105	11	391	1.061
NDO 2469-1	220	195	69	484	90	14	588	1.077
NDO 2686-4	185	185	64	435	55	27	518	1.070
NDO 2686-6	159	224	35	417	88	11	516	1.071
NDO 2686-10	141	111	17	269	127	20	396	1.063
NDO 3314-2	187	110	14	312	119	21	452	1.079
Mean	157	172	108	436	69	24	529	1.071
CV(%)	29	34	49	23	35	80	21	0.3
LSD(.05)	57	74	68	124	31	25	139	0.004

Table 6. Yield of red-skinned varieties and advanced selections, Corvallis and Sherwood, 1992.

Variety/ Selection	Corvallis				Sherwood				Avg. 2 locations			
	Total	No 1's	B's	Culls	Total	No 1's	B's	Culls	Total	No 1's	B's	Culls
Red LaSoda	541	437	35	69	396	310	35	51	469	374	35	60
Sangre	514	445	28	41	242	165	45	33	378	305	37	37
Dark Red Norland	505	386	89	30	321	222	84	16	413	304	87	23
NDO 3432-3	614	487	65	54	340	247	69	25	477	367	67	40
NDO 3503-2	383	314	27	43	376	311	54	12	380	313	41	27
NDO 3503-5	372	293	25	55	356	244	27	85	364	269	26	70
NDO 3504-3	535	286	46	204	380	290	38	52	458	288	42	128
NDO 3573-3	544	487	29	29	405	347	26	33	475	417	28	31
NDO 3573-5	507	338	55	114	407	351	43	13	457	345	49	64
NDO 2438-6	606	534	59	13	388	323	44	21	497	429	52	17
NDO 2438-9	435	350	70	15	366	298	64	3	401	324	67	9
NDO 2469-1	536	414	69	53	339	229	85	26	438	322	77	40
NDO 2686-4	402	336	61	5	335	272	54	9	369	304	58	7
NDO 2686-6	495	417	72	6	386	332	54	1	441	375	63	4
NDO 2686-10	537	379	77	81	352	259	76	17	445	319	77	49
NDO 3314-2	396	270	118	8	301	208	89	5	349	239	104	7
Mean	495	386	58	51	356	275	55	25	426	331	57	38
CV(%)	13	15	33	65	18	22	25	68	---	---	---	---
LSD(.05)	91	84	27	48	NS	87	21	24	---	---	---	---

Potato Variety Screening Trials, 1992

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

INTRODUCTION

The USDA-ARS potato genetics program at Aberdeen, Idaho, provides true potato seed to Oregon, annually. Over 50,000 tuberlings are produced in a greenhouse in Corvallis for field evaluations the following year. Preliminary screening in single-hills is done at Powell Butte and Ontario. Selections retained are evaluated in multiple-hills at Powell Butte and Hermiston in the third year. Surviving clones are further evaluated in the preliminary yield trials and advanced statewide trials conducted at Powell Butte, Ontario, Hermiston, and Klamath Falls. Promising lines are advanced to regional trials, conducted at 13 locations in seven states. KES participates in this final stage of formal evaluation of potential new potato varieties.

From the preliminary yield trial stage forward, over 50 characteristics are measured or observed for each selection. Yield, shape, size, appearance, and processing quality are key parameters considered at all stages of the selection and evaluation process. Advanced lines are screened for disease resistance, nutritional value, and culinary quality. This report on KES trials conducted within the statewide and regional program will emphasize yield parameters; however, the many other characteristics observed are carefully considered in decisions of promotion of clones through the evaluation program.

PROCEDURES

All variety screening trials were conducted in randomized complete block experimental designs. Trial areas were fumigated with Telone II applied at 20 gpa on November 15, 1991. Di-Syston was applied in the seed furrow at 3.0 lb ai/A. Monitor was applied aerially at 1.0 lb ai/A on July 26. Herbicides included Eptam, applied at 3.5 lb ai/A on May 27, and metribuzin, applied aerially at 0.5 lb ai/A on June 10. Standard fungicides were applied aerially at labelled rates on July 8, July 26, and August 22. Vines were desiccated with Diquat, applied with a conventional ground sprayer at 1.0 pt/A on September 10, and shredded with a rotobeater before 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 lb/A of 16-16-16, banded on both sides of rows at planting, and 50 lb N/A applied as Soln. 32 on May 27. Crops received about 24 inches of irrigation water during the season, applied twice weekly with solid-set sprinklers on a 40-foot by 48-foot spacing.

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All seed was hand cut, treated with thiophanate-methyl fungicide, and suberized at least 10 days before planting. Potatoes were planted with a two-row assisted-feed planter with 32-inch row spacing on May 18. Seed spacing was 8.7 inches in each trial. Plant stands were monitored on June 11 and June 18, vine vigor was evaluated on July 2, and vine maturity was rated on September 10. The preliminary yield trial included five standard varieties and 32 numbered selections in 20-hill plots with two replications. The statewide trial included five standard varieties and 36 numbered selections in single-row, 30-hill plots with four replications. Three standard varieties were compared with 15 numbered selections in single-row, 30-hill plots with four replications in the western regional trial.

Potatoes were harvested with a one-row digger-bagger on September 24 and 25. All tubers were saved and stored under typical commercial conditions until grading was done in late October. Specific gravity was determined on a 10-pound sample of U.S. No.1s by the weight-in-air, weight-in-water method. Internal defects were observed by cutting 10 large tubers, usually over 10 ounces, from each plot. Yields of No.1s were not adjusted for external blemishes such as scab, elephant hide, or rhizoctonia, or internal defects such as hollow-heart, brown center, or black spot bruises. For most selections, the incidence of these blemishes and defects was low. Approximately 10 pounds of 6-10 ounce U.S. No.1s were saved from one replication of each trial for culinary evaluations with French frying, boiling, oven baking, and microwave baking preparation methods. Culinary tests were conducted in late November and early December.

RESULTS AND DISCUSSION

As a result of very low precipitation in late winter and early spring, the soil was extremely dry by early May. Trial areas were irrigated before planting. Dry conditions in late May reduced the efficacy of Eptam. A metribuzin application was necessary in early June to control a serious weed infestation. The timing of application coincided with the emergence of potato plants. Susceptible varieties and numbered selections suffered injury to plants and loss of yield to varying degrees in each of these trials. Yield variability was higher than in most recent years in all trials.

Crop emergence and establishment was rapid under warm conditions in May and June. Canopy development was 10 days to two weeks earlier than normal through the first half of the season. Crop injury from a frost on August 23 was prevented by protection with irrigation. Late maturing selections maintained vigorous canopy growth until vines were desiccated in September. As a result of generally favorable growing season conditions, some of the selections in all trials produced very high yields. Very low yields for some entries were probably due to metribuzin injury.

Preliminary Yield Trial

Emergence exceeded 90 percent in most selections by 30 days after planting (Table 1). Stands were poor in Shepody and AO87197-3 but satisfactory in all others. Vine vigor was not well correlated with obvious metribuzin injury symptoms. Several selections that were apparently stunted did not exhibit chlorotic leaf symptoms. Few internal or external defects were found in potatoes from these trials.

Russet Burbank produced a high yield with an unusually low percent of off-grade tubers (Table 2). Its performance in all three trials was much better than in most years. Shepody yields were reduced by herbicide injury. The other standards; Lemhi, Norkotah, and Norchip, achieved good yields and size distribution. Norchip had a relatively high incidence of misshapen tubers. Specific gravity of standard varieties was a little higher than normally observed at KES.

Eight selections achieved higher No.1 yields than Russet Burbank at KES, and seven were also higher - averaged over four locations. Two chipping types; AO85419-5 and AO85436-1, ranked first and second in No.1 yield at KES and averaged over locations. AO85419-5 had high specific gravity but darker fry color than Norchip. AO85436-1 was high in specific gravity and equal to Norchip in fry color. The third and fourth highest No.1 yields averaged over locations occurred with AO84017-1 and AO84053-2. Neither selection was high enough in specific gravity for processing. AO84017-1 is the better candidate of the two for fresh market use. None of the selections were outstanding candidates for French fry use.

Culinary tests at KES did not detect any serious deficiencies in the eight selections that were promoted to the statewide trial. The highest overall score for boiling and baking tests among the standards and selections promoted for further evaluations was achieved by Russet Burbank. A sloughing problem was noted in the boiling test for AO85105-1.

__Oregon Statewide Trial__

All selections achieved acceptable stands (Table 3). Shepody and several numbered selections exhibited quite severe metribuzin injury. Other selections experienced yield reductions even though symptom expression was not as distinct. Specific gravity was lower in the standard varieties in this trial than in the preliminary yield trial. Hollow heart and other internal defects were infrequent and tubers were generally free from external defects.

Standard varieties produced lower yields than in the preliminary trial (Table 4). Russet Norkotah was an exception, with a higher No.1 yield than Russet Burbank. Several selections produced very high yields with a high percentage of No.1s. A74212-1E was second highest in No.1 yield at KES and highest at other locations. This selection has very consistently achieved outstanding yields at all locations. The late maturing variant of this selection, A74212-1L, was lower in yield by about 13 percent at all locations. Additional contrasts of these selections is presented in a separate report (pages 29-30). The decision has been made to discard A74212-1L and proceed with the release of A74212-1E as Century Russet.

AO83037-10 has produced very high yields at KES for several years. It is a heavily russetted, yellow-fleshed clone with large, coarse tubers. Yields have been high at all Oregon locations and in regional trials. The clone is being maintained for a third year of evaluation in the regional trial. AO82283-1 will be discarded due to a serious susceptibility to black spot bruising. This clone is also heavily russetted and yellow-fleshed, and has some tolerance to corky ringspot as reported in another section (pages 42-49). It may be used as a parent for breeding purposes.

AO82611-7 and COO83008-1 are both processing selections that have performed well in regional trials as well as in Oregon. Several processors are interested in one or both of these selections. Both are considered candidates for naming and release in the future. These selections are not as attractive for fresh market use as standard varieties presently in use.

NDO2904-7 is an early maturing fresh market line that was evaluated in the tri-state trials in 1992, and is promoted to the regional trial for 1993. AO85165-1 was promoted to the tri-state trial for evaluation as a fresh market line. It did not yield as well at other locations, but at KES it ranked third in No.1 yield in 1992 and second in 1991. Russet Norkotah is the male parent of both of these lines. COO86107-1 is an attractive red-skinned selection that was also included in the KES advanced red-skinned trial. It will be evaluated in Willamette Valley and KES advanced red trials in 1993. Five additional selections were retained for further evaluation in the statewide trials in 1993. None of these were particularly prominent in the KES trial.

Culinary tests at KES did not detect serious limitations in any of the lines in this trial that have been retained for further evaluations. As in the preliminary yield trial, Russet Burbank had the highest total score over boiling and baking tests, but several of the selections retained were close to Russet Burbank in scores for all tests.

Western Regional Trial

This trial was conducted at nine locations in six states as a late harvest trial, with an additional early harvest trial at five locations that included most of the same entries. Crop conditions at KES were as described for preliminary and statewide trials. Plant stands were good in all entries (Table 5). Metribuzin injury was less serious in this trial, and the variability in yields was less than in preliminary and statewide trials. Minimum external and internal tuber defects were observed, and most entries had a very low percentage of No. 2s and culls.

Lemhi and Russet Norkotah produced lower yields than in the statewide trial. Russet Burbank achieved about the same yield in this trial, with few off-grades. AO83037-10 had the highest yield at KES and was second to A74212-1E in No.1 yield across locations (Table 6). It will be evaluated in the regional trial for the third year in 1993. COO83008-1 completed three years in the regional trial and is being considered for release. At KES and across all locations, it achieved a higher No.1 yield than Russet Burbank. CO82142-4 has also been evaluated for three years in this trial. Yields of this fresh market line have been similar to Russet Burbank yields. Seed is being increased for commercial evaluations. Three selections; A8174-2, A81478-1, and AC75430-1 are being discarded from the program. All other lines have been retained for testing in the 1993 regional trials. Culinary quality was acceptable in all lines. A separate red-skinned trial will be established for 1993 and future years, and will be conducted at about eight locations with a significant interest in reds. The KES will coordinate this program.

Table 1. Performance of entries in the Preliminary Yield Trial, Klamath Experiment Station, OR. 1992.

Variety/ Selection	Percent stand	Vigor rating[1]	Vine maturity[2]	Specific gravity	Percent H.H.[3]	Comments[4]
Russet Burbank	100	2.5	3	1.089	5	nice
Lemhi	98	2.5	2	1.089	10	coarse
Shepody	80	1.5 S	3	1.085	0	rough
Norkotah	98	2.5	1	1.077	0	nice
Norchip	98	4.0	2	1.080	0	misshapes
AO84009-1	98	2.5	2.5	1.080	15	coarse, G.C.
*AO84017-1	98	4.0	2	1.073	0	coarse
*AO84053-2	88	2.5	2.5	1.077	5	coarse
AO84055-1	93	2.5	1	1.082	0	rough
AO85058-2	93	1.5	1	1.072	0	G.C.
AO85058-6	100	1.5	1	1.070	0	small, poor
AO85058-13	100	4.5	1	1.075	0	small
AO85058-14	98	4.5	1	1.077	0	nice, small
*AO85105-1	88	2.0	2	1.080	5	nice, pointy
AO85118-1	85	2.5	3.5	1.077	0	pointy
AO85141-1	100	2.0	2	1.085	20	nice
*AO85419-5	95	2.0	3	1.086	30	coarse
*AO85419-12	93	2.5 S	2.5	1.090	0	nice
AO85432-1	95	2.0	2	1.081	0	poor
*AO85436-1	100	3.5 S	2.5	1.078	0	skinning
AO85470-5	93	3.0	3	1.087	5	round
COO88150-1	90	2.5	1	1.073	0	small
AO87174-2	100	2.5	2	1.079	0	pointy
AO87197-2	88	2.5	2.5	1.084	55	
AO87197-3	73	2.0	2	1.075	15	
AO87197-8	95	3.0	2	1.082	0	G.C.
AO87199-2	98	2.0 S	1	1.077	5	poor
AO87199-4	95	3.0	2	1.085	0	poor
AO87243-1	95	3.0	2.5	1.083	0	round
AO87246-1	88	1.5 S	3.5	1.083	10	poor
AO87449-1	98	3.0	3	1.096	0	small, IPS
AO87450-1	100	2.5 S	2	1.085	0	heavy net
*COO88165-5	98	3.0	2.5	1.094	0	fair
*AO88114-2	98	2.0	2	1.082	10	flat
AO88135-2	100	2.5	2.5	1.075	0	fair, IPS
AO88135-3	98	2.5 S	1.5	1.077	0	pointy
AO88434-1	98	3.0	2	1.089	10	
Average	95	2.4	2.1	1.081	5	

[1]/ Vigor rating : (1 - small, weak; 5 - large, robust; S - metribuzin susceptible).
[2]/ Maturity rating: (1 - dead; 5 - rank).
[3]/ H.H.: Hollow-heart - percent in 10 large tubers/sample.
[4]/ Comments: G.C. - growth cracks; IPS - internal purple spots.
* Advanced to Statewide Trial for 1993.

Table 2. Tuber yield by grade for entries in the Preliminary Yield Trial, Klamath Experiment Station, OR. 1992.

Variety/ Selection	Yield U.S. No. 1s 4-12 oz	> 12 oz.	Total	Yield Bs	No. 2s	Culls	Total[2]
	----------	----------	cwt/A	----------	----------	----------	----------
Russet Burbank	371	101	472	109	7	1	589
Lemhi	324	226	550	23	40	6	619
Shepody	235	145	380	36	6	9	431
Norkotah	239	196	435	33	0	0	468
Norchip	376	84	460	35	61	21	577
AO84009-1	348	174	522	54	18	41	635
*AO84017-1	436	184	620	75	0	16	711
*AO84053-2	227	293	518	24	16	12	570
AO84055-1	282	28	310	105	56	3	474
AO85058-2	221	55	276	45	14	19	354
AO85058-6	145	0	145	114	0	1	260
AO85058-13	195	0	195	172	0	2	369
AO85058-14	263	5	268	113	3	1	385
*AO85105-1	300	65	365	109	0	10	484
AO85118-1	294	22	316	79	28	3	426
AO85141-1	343	53	396	68	0	1	465
*AO85419-5	299	337	636	26	3	1	666
*AO85419-12	400	145	545	66	0	7	618
AO85432-1	114	10	124	60	2	0	186
*AO85436-1	483	187	670	84	4	12	770
AO85470-5	332	134	466	56	0	14	536
AO88150-1	378	21	399	95	0	1	495
AO87174-2	337	23	360	112	12	2	486
AO87197-2	294	57	351	52	43	19	465
AO87197-3	289	130	419	38	20	7	484
AO87197-8	329	152	481	30	34	16	561
AO87199-2	256	40	296	66	11	11	384
AO87199-4	182	0	182	152	4	0	338
AO87243-1	369	31	400	115	0	0	515
AO87246-1	82	76	158	16	0	0	174
AO87449-1	361	10	371	142	3	2	518
AO87450-1	268	161	429	48	34	1	512
*COO88165-5	532	40	572	69	6	3	650
*AO88114-2	321	103	424	40	18	22	504
AO88135-2	332	58	390	70	6	0	466
AO88135-3	235	10	245	135	40	9	429
AO88434-1	387	9	396	99	9	3	507
Average	302	90	392	75	14	8	489

* Advanced to Statewide Trial for 1993

Table 3. Performance of entries in the Oregon Statewide Trial, Klamath Experiment Station, OR. 1992.

Variety/ Selection	Percent stand	Vigor rating[1]		Vine maturity[2]	Specific gravity	Percent H.H.[3]	Comments
Russet Burbank	99	4.5		2.8	1.085	15	
Lemhi	95	3.5		2.0	1.085	0	
Shepody	98	2.3	S	3.3	1.082	0	
Norkotah	97	3.5		1.8	1.071	0	nice
Norchip	97	4.5		1.8	1.076	0	
*A74212-1 E	98	3.8		2.8	1.075	3	
A74212-1L	98	2.8		4.3	1.074	0	skinning, rough
AO82283-1	88	3.5		3.3	1.082	0	coarse
*AO82611-7	93	3.3		2.3	1.085	5	rough, fair
*COO83008-1	96	3.3		3.3	1.083	3	flat, fair
AO83037-10	98	3.3		3.0	1.073	10	flat, ugly
*NDO2904-7	94	3.5		2.5	1.069	0	nice
AO85031-7	96	3.8		3.0	1.075	0	rough, ugly
*AO85165-1	95	2.8		3.5	1.072	5	fair
COO86149-4	91	3.3		2.8	1.078	8	heavy net, pointy
*COO86107-1	94	3.0	S	2.3	1.078	0	fair, skinning
*COO86042-2	96	3.8		2.8	1.069	5	fair
AO86026-1	99	3.5		2.8	1.091	3	nice, pointy
AO86022-2	95	3.0	S	3.8	1.088	0	heavy net
AO86011-3	93	2.5		3.3	1.082	0	skinning
AO85018-6	98	3.5		2.0	1.082	0	nice
*AO83221-204	95	3.5		2.0	1.072	33	skinning, fair
AO83200-2	98	2.5		2.5	1.072	0	fair
AO83155-4	95	3.8		2.8	1.087	3	growth cracks
AO83155-5	98	3.0		2.3	1.078	0	fair
AO83142-3	94	3.3		2.0	1.072	0	nice
*AO83141-5	93	2.8		2.8	1.084	10	nice, flat
*AO83113-4	98	2.5		2.8	1.077	0	coarse
AO80191-7	88	3.5		3.3	1.080	8	fair
AO80004-2	93	3.3	S	2.0	1.078	3	small, nice
AO83258-7	92	3.0		1.8	1.073	0	fair
AO83171-5	99	2.5		2.5	1.071	0	small, fair
AO83011-15	100	3.8		2.5	1.084	3	small
*AO84022-108	95	2.5	S	3.3	1.081	0	nice
AO84023-118	93	3.0	S	2.8	1.074	3	crooked
A79341-3	90	3.0	S	2.8	1.083	3	rough, ugly
AO80202-214	93	2.5		2.5	1.083	0	fair
AO8515-201	98	3.5		1.8	1.073	0	rough
AO8555-201	96	2.3		2.8	1.081	0	red splash
AO87458-202	96	3.5	S	3.8	1.090	5	
Siskiyou	96	2.0	S	4.8	1.091	5	skinning, poor
Average	95	3.2		2.8	1.079	3	

[1]/ Vigor rating : (1 - small, weak; 5 - large, robust; S - metribuzin susceptible).
[2]/ Maturity rating: (1 - dead; 5 - rank).
[3]/ H.H.: Hollow-heart - percent in 10 large tubers/sample.
* Advanced to Statewide Trial for 1993.

Table 4. Tuber yield by grade for entries in the Oregon Statewide Trial, Klamath Experiment Station, OR. 1992.

Variety/ Selection	Yield U.S. No. 1s			Yield			
	4-12 oz	> 12 oz.	Total	Bs	No. 2s	Culls	Total
	cwt/A						
Russet Burbank	382	23	405	116	35	24	580
Lemhi	382	105	487	63	24	2	576
Shepody	197	98	295	20	2	6	323
Norkotah	252	226	478	25	26	16	545
Norchip	361	34	395	92	35	17	539
*A74212-1 E	482	218	700	65	7	10	782
A74212-1L	331	281	612	34	9	11	666
AO82283-1	451	145	596	61	18	9	684
*AO82611-7	320	136	456	66	16	8	546
*COO83008-1	304	237	541	46	16	5	608
AO83037-10	471	240	711	39	16	11	777
*NDO2904-7	285	208	493	34	7	0	532
AO85031-7	355	232	587	45	52	30	714
*AO85165-1	444	249	693	54	10	11	768
COO86149-4	363	151	514	57	6	11	588
*COO86107-1	322	58	380	65	11	5	461
*COO86042-2	354	81	435	54	15	10	514
AO86026-1	345	85	430	56	11	2	499
AO86022-2	301	38	339	59	11	6	415
AO86011-3	335	47	382	53	20	10	465
AO85018-6	339	103	442	70	9	3	524
*AO83221-204	436	77	513	75	2	1	591
AO83200-2	379	228	607	57	29	6	699
AO83155-4	358	42	400	102	38	17	556
AO83155-5	345	195	540	50	14	4	608
AO83142-3	289	60	349	85	2	1	437
*AO83141-5	325	154	479	59	14	3	555
*AO83113-4	298	255	553	30	14	5	602
AO80191-7	390	84	474	69	3	4	550
AO80004-2	289	54	343	43	6	4	497
AO83258-7	311	98	409	33	17	4	461
AO83171-5	412	50	462	120	2	3	587
AO83011-15	310	24	334	97	0	1	432
*AO84022-108	360	88	448	46	14	10	519
AO84023-118	260	157	417	49	12	8	486
A79341-3	271	286	557	20	39	21	637
AO80202-214	406	115	521	56	4	2	583
AO8515-201	309	126	435	55	47	18	555
AO8555-201	329	58	387	92	12	5	496
AO87458-202	380	145	525	36	14	2	567
Siskiyou	257	145	402	29	9	1	441
Average	343	132	475	58	16	8	558
CV(%)	21	47	22	39	104	150	20
LSD(.05)	100	88	147	31	23	17	159

* Retained for further evaluation.

Table 5. Performance of entries in the Western Regional Potato Variety Trial, Klamath Experiment Station, OR. 1992.

Variety/ Selection	Percent stand	Vine vigor[1]	Vine maturity[2]	Specific gravity	Percent H.H.[3]
Russet Burbank	98	3.3	2.8	1.085	0
Lemhi	96	2.0	2.0	1.086	10
Norkotah	92	2.0	1.0	1.069	0
A74212-1E	96	2.0	2.5	1.074	0
COO83008-1	96	2.5	3.0	1.080	0
AO83037-10	94	3.0	3.0	1.074	5
NDO2904-7	93	2.3	2.0	1.071	3
A82119-3	94	2.8	3.0	1.079	5
A81473-2	93	2.5	2.8	1.078	0
NDTX8-731-1R	98	2.3	2.0	1.068	23
CO82142-4	86	1.8	2.5	1.076	5
ATX6-84378-1	85	2.3	3.0	1.077	8
A8174-2	100	1.8	1.0	1.068	3
AO84275-3	95	1.8	3.3	1.086	0
A81478-1	93	2.0	3.3	1.080	0
A8390-3	93	2.5	2.0	1.076	3
A81286-1	99	2.8	3.0	1.078	0
AC75430-1	99	2.8	2.0	1.084	10
Average	94	2.4	2.3	1.077	4

[1]/ Vine vigor: (1 - small, weak; 5 - large, robust)
[2]/ Vine maturity: (1 - dead; 5 - rank)
[3]/ H.H.: percent in 10 largest tubers/sample

Table 6. Tuber yield by grade for entries in the Western Regional Potato Variety Trial, Klamath Experiment Station, OR. 1992.

Variety/ Selection	Yield U.S. No. 1s 4-12 oz	> 12 oz.	Total	Yield Bs	No. 2s	Culls	Total
	cwt/A						
Russet Burbank	322	92	414	78	39	6	537
Lemhi	295	71	366	49	9	2	426
Norkotah	256	71	327	37	2	5	371
A74212-1E	406	111	517	45	6	7	575
COO83008-1	288	171	459	22	0	7	488
AO83037-10	464	204	668	28	10	1	707
NDO2904-7	247	148	395	20	6	1	422
A82119-3	299	143	442	37	10	9	498
A81473-2	292	261	553	21	20	2	596
NDTX8-731-1R	418	130	548	38	0	2	588
CO82142-4	300	143	443	30	13	7	493
ATX6-84378-1	120	395	515	4	33	29	581
A8174-2	258	56	314	44	10	11	379
AO84275-3	310	19	329	88	0	3	420
A81478-1	264	130	394	29	3	2	428
A8390-3	312	97	409	52	1	1	463
A81286-1	373	115	488	40	8	9	545
AC75430-1	333	136	469	44	6	3	522
Average	309	139	447	39	10	6	502
CV(%)	22	35	21	37	77	138	20
LSD(.05)	96	68	133	21	22	12	140

A Comparison of A74212-1 Seed Sources and Clonal Variants

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

INTRODUCTION

The Oregon potato variety development program has been evaluating two variants of A74212-1 for several years. A late maturing variant, (A74212-1L), has exhibited more indeterminate vine habit with profuse flowering, larger tuber size with a greater tendency for bulging eyes, and a serious susceptibility to skinning damage. This is thought to be the original clonal selection. An earlier maturing vine type was selected out of seed increase plots at Powell Butte in 1987. This line, (A74212-1E), appears to have a more determinate growth habit with less flowering, produces smaller, blockier tubers, and it is less prone to skinning damage during harvest. The two lines have been compared in statewide variety trials in Oregon since 1988.

Commercial production of A74212-1 seed began in Central Oregon in 1986. Seed produced from virus-free, tissue cultured plantlets became available through the Oregon Foundation Seed Project in 1987. Commercial seed production expanded to other states, including Colorado, Nebraska, and Wisconsin, in 1989 or 1990. Seed lots were also maintained by one or two Klamath County growers since 1987. It was thought that seed lots from the Oregon Foundation Seed Project were derived from A74212-1L. In 1991, the A74212-1L seed distributed to cooperators for western regional trials raised concerns about the identity of commercial seed lots in several states. A seed lot comparison was established at KES in 1992 to attempt to determine the clonal identity of several commercial seed lots in three states.

PROCEDURES

Seed lots of A74212-1E and A74212-1L were obtained from the Central Oregon Agricultural Research Center (COARC) at Powell Butte. Four commercial Oregon lots included nuclear (N), generation II (GII), and generation IV (GIV), obtained from a Klamath County seed grower (Klamath), and a commercial generation II (GII) lot from a Deschutes County grower (Deschutes). Colorado lots were obtained from the San Luis Valley Research Center (CO-SLV), and a commercial seed grower (CO-Grower). The other lots included a commercial source from Nebraska and a sample from Texas that originated from an unknown Colorado seed grower.

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

Acknowledgment: Partial funding of this study by the Oregon Potato Commission is gratefully recognized. The assistance of Oregon Seed Certification personnel in rating vine types is appreciated.

All seed lots were hand cut to 1.5- to 2.0-ounce seedpieces at KES, treated with thiophanate-methyl fungicide, and suberized at 50 °F and 95 percent relative humidity for 10 days before planting. Seed lots were planted with a two-row assisted-feed planter on May 18 in a randomized complete block design with four replications. Seed was spaced at 8.7 inches in 32-inch rows. Individual plots were single rows of 30 hills. Cultural practices are described on page 19. Vines were desiccated with Diquat applied at 1.0 pt/A on September 10. Potatoes were harvested with a one-row digger-bagger on September 25. All tubers were stored and graded in late November.

Vine type was rated, independently, as early, late, or mixed for each plot in mid-August by six seed certification or research personnel. The result was 24 observations for each seed source. Blind plot maps were used to secure the identity of seed sources. Tubers were graded to USDA standards. Forty U.S. No.1 tubers of 8 to 16 ounces from each plot were measured to determine the length to width ratio.

RESULTS AND DISCUSSION

Vine type differences between seed lots were clearly evident in mid-August. The COARC late clone and the Klamath GIV lot exhibited a distinctly late vine habit (Table 1). COARC early clone, Klamath N and GII lots, CO-SLV, CO-Grower, and Nebraska lots were early maturing vine types. Deschutes GII and Texas seed lots were more varied in vine type, but appeared to be early. Tuber length to width ratios were quite uniform for most seed lots. The Klamath GIV lot had a significantly higher ratio than several other lots. Differences between other lots were not significant.

Yield and tuber size distribution data did not provide a statistical basis for clonal identity (Table 2). The Klamath GIV lot produced the highest yield and percentage of tubers over 10 ounces, and the lowest yield and percentage of tubers under 6 ounces. The COARC early and late clones were nearly identical in yield and size distribution. The lowest yield and smallest tubers were observed for the Klamath N lot. In total, yield and size data suggest the Klamath GIV lot was different than several of the other seed lots, but all other lots were similar in tuber characteristics.

Early and late variants of A74212-1 have been compared in Oregon statewide trials conducted at Hermiston, Ontario, Powell Butte, and Klamath Falls in each year since 1988. Average yields of U.S. No.1, and under 4-ounce tubers over locations are shown for each year (Table 3). The early clone has produced a higher yield of No.1s four years out of five. Tuber size has been consistently smaller for the early selection. These results clearly show an advantage for the early variant.

The greatest commercial interest in A74212-1 has been in Texas. Seed for this production has been grown in Colorado and Nebraska. Results of seed lot comparisons suggest that this seed was the early maturing variant of A74212-1. In view of the relative performance of variants in Oregon trials; results of seed lot comparisons in this study; and the fact that commercial interest in Texas appears to have been based on the early variant; the late maturing variant should be discarded and the early clone pursued.

Table 1. Emergence, vine maturity ratings and tuber length to width ratios of ten A74212-1 seed lots grown at the Klamath Experiment Station. 1992.

Seed source	Percent Emergence	Vine Maturity[1]			Length/Width ratio
		Early	Late	Mixed	
COARC (E)	98	19	3	2	1.57
COARC (L)	97	5	14	5	1.63
Klamath (N)	98	18	4	2	1.49
Klamath (GII)	98	20	2	2	1.49
Klamath (GIV)	98	2	20	2	1.73
Deschutes (GII)	98	14	8	2	1.62
CO - Grower	98	23	0	1	1.60
CO - SLV	99	24	0	0	1.61
Texas	90	16	3	5	1.51
Nebraska	97	20	2	2	1.55
Average	97	---	---	--	1.58
CV(%)	---	---	---	--	5
LSD(.05)	---	---	---	--	0.13

[1]/ Vine maturity ratings - number of individual ratings out of 24 possible.

Table 2. Yield and grade of ten A74212-1 seed lots grown at the Klamath Experiment Station, OR. 1992.

Seed Source	Yield U.S. No. 1s 4-6 oz.	6-10 oz.	> 10 oz.	Total	Yield <4 oz.	No 2s	Culls	Total
	cwt/A							
COARC (E)	144	228	224	596	34	10	8	648
COARC (L)	154	238	218	609	27	13	8	658
Klamath (N)	258	204	78	540	89	14	2	645
Klamath (GII)	205	284	143	632	67	4	12	715
Klamath (GIV)	120	228	263	611	24	5	12	652
Deschutes (GII)	155	254	256	665	27	2	14	708
CO - Grower	162	255	253	670	45	12	6	733
CO - SLV	185	221	237	643	51	0	7	701
Texas	175	226	171	572	38	0	12	622
Nebraska	155	310	169	635	40	5	13	693
Average	171	245	201	617	44	6	9	677
CV(%)	25	21	30	10	44	160	98	9
LSD(.05)	63	NS	88	NS	29	NS	NS	NS

Table 3. Average tuber yield and size distribution of A74212-1E and A74212-1L in Oregon statewide trials at Hermiston, Powell Butte, Ontario, and Klamath Falls from 1988 to 1992.

	A74212-1E				A74212-1L			
	Yield U.S. No. 1s			Yield	Yield U.S. No. 1s			Yield
Year	4-10 oz.	>10 oz.	Total	Bs	4-10 oz.	>10 oz.	Total	Bs
	cwt/A							
1988	342	238	580	35	326	280	606	46
1989	310	207	517	33	183	281	465	23
1990	317	213	531	44	224	264	488	36
1991	363	146	509	30	258	205	463	28
1992[1]	368	259	627	50	285	260	545	37
Average	340	213	553	38	255	258	513	34

[1]/ No data obtained in Hermiston in 1992.

Evaluation of Post-Emergence Herbicides for Metribuzin-Sensitive Potato Varieties

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

INTRODUCTION

Control of late emerging broadleaf weeds in metribuzin-sensitive potato varieties, such as Shepody and several red-skinned cultivars, is a problem in commercial and research situations. If low metribuzin rates are applied, weed control may be unsatisfactory and yield losses may occur. Weed competition reduces yields and size when no herbicide is used for late emerging weeds. The objectives of this study were to evaluate an experimental post-emergence broadleaf herbicide and metribuzin and assess the effects of several weed suppression options on crop performance for the variety Shepody.

PROCEDURES

Shepody seed was planted at 8.7-inch spacing in 32-inch rows on May 18. Standard practices were followed for fertilizer, irrigation, disease, and pest control (see page 19). Eptam was applied at 3.5 lb ai/A on May 27. Four-row, 20-foot plots were established to accommodate eight treatments with four replications in a randomized complete block design. Herbicide treatments were applied with a backpack sprayer on June 25, when weeds were in the cotyledon to 1-2 true leaf stages. Potato plants were about 6 to 8 inches tall. Treatments included: untreated control; metribuzin (M) alone at 5.3 oz ai/A; Du Pont's E9636 (E) alone at 0.25, 0.38, and 0.50 oz ai/A; and combinations of 2.0 oz ai/A M plus 0.25 oz ai/A E, 3.0 oz ai/A M plus 0.38 oz ai/A E, and 4.0 oz ai/A M plus 0.50 oz ai/A E.

Visual ratings of weed control and crop injury were made at 2, 7, and 14 days after treatment. Crop injury was rated as the percent of plants with visible stunting or leaf chlorosis symptoms. Weed control ratings represented the percent of weeds of a given species that were wilted beyond recovery. The predominant weed species present were redroot pigweed, hairy nightshade, and Indian lovegrass.

Vines were desiccated with Diquat applied at 1.0 pt/A on September 5. Three plants were removed between plots to eliminate border effects before harvest. Potatoes were harvested with a one-row digger-bagger on September 24. All tubers from 18 feet of the center two rows of each plot were stored and graded to USDA standard grades in late October.

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

Acknowledgment: E.I. du Pont de Nemours and Co., Inc. provided the experimental herbicide E9636. Partial funding was provided by the Oregon Potato Commission.

RESULTS AND DISCUSSION

Crop injury was just evident two days after treatments were applied (Table 1). One week after applications, metribuzin injury increased with application rate while the E9636 product did not produce visible injury symptoms. Two weeks after application, foliar symptoms were slightly more evident in E9636 plots, and plants were growing out of metribuzin symptoms. No potato plant death occurred in any of the treatments. Some concern has been expressed about a synergistic interaction between E9636 and organophosphate insecticides. There was no evidence of any interaction between E9636 and Di-syston. Di-syston was applied in seed furrows at planting in this study.

Metribuzin produced more rapid desiccation of pigweed and lovegrass than E9636. Hairy nightshade was controlled about equally well by both products, alone or in combinations. At low application rates, the combination treatments were slightly less effective for all three species than E9636 applied alone, over the two-week observation period. All herbicide treatments provided excellent late season weed control.

Weed competition significantly reduced yield and tuber size in the control plots compared with all herbicide treatments except metribuzin applied alone (Table 2). Plant injury for metribuzin alone, and in the high rate combination, reduced yield and tuber size slightly, but not significantly, compared with other herbicide treatments. The yields were similar for all rates of E9636 and the two low-rate combination treatments.

In commercial practice, metribuzin is typically applied for late season weed control at 8 to 12 oz ai/A (0.50 to 0.75 lb ai/A). Locally, concern has been expressed about development of resistance to metribuzin in hairy nightshade if lower rates are used. Residual effects of metribuzin on cereal grain and sugarbeet crops have also occurred. The results of this study indicate that E9636 applied alone at 0.38 oz/A would provide acceptable late season weed control in potatoes with little or no reduction of crop yields. This product offers a solution to the problem of late season weed control in research trials where metribuzin-sensitive varieties are disadvantaged by the use of metribuzin. Further studies are needed to evaluate E9636 under a range of weed pressure situations. In particular, the efficacy of this product for control of kochia should be determined as this species is becoming a common problem in the Klamath Basin.

Table 1. Effects of postemergence herbicide treatments on percent crop injury and control of three weed species at 2, 7, and 14 days after treatment, Klamath Experiment Station, OR. 1992.

Treatment		Crop	Weed control[2]		
Herbicide	Rate	injury[1]	Pigweed	Hairy Nightshade	Indian Lovegrass
	oz ai/A	%	%	%	%
		2 days post treatment			
Control	----	0	0	0	0
M	5.3	3	88	0	70
E	0.25	3	0	0	0
E	0.38	3	1	0	0
E	0.50	3	0	0	0
M+E	2+0.25	3	68	1	30
M+E	3+0.38	3	78	0	60
M+E	4+0.50	3	73	0	50
		7 days post treatment			
Control	----	0	0	0	0
M	5.3	60	98	53	96
E	0.25	3	37	30	33
E	0.38	1	53	38	26
E	0.50	1	52	45	38
M+E	2+0.25	13	80	35	55
M+E	3+0.38	15	88	38	65
M+E	4+0.50	53	90	60	89
		14 days post treatment			
Control	----	0	0	0	0
M	5.3	14	91	89	94
E	0.25	3	90	95	75
E	0.38	8	98	98	88
E	0.50	8	100	100	90
M+E	2+0.25	8	73	75	64
M+E	3+0.38	2	68	70	70
M+E	4+0.50	9	95	95	93

[1]/ Crop injury - percent of plants with visible stunting or leaf chlorosis.
[2]/ Control - percent of weeds wilted beyond recovery.

Table 2. Effect of postemergence herbicide treatments on yield and grade of Shepody potatoes, Klamath Experiment Station, OR. 1992.

Treatment		Yield U.S. No 1s				Yield		
Product	**Rate**	**4-6 oz**	**6-10 oz**	**>10 oz**	**Total**	**Bs**	**No 2s**	**Total**
	oz ai/A	**cwt/A**						
Control	----	77	97	53	226	44	14	296
M	5.3	70	131	107	308	29	22	364
E	0.25	98	151	130	379	36	26	456
E	0.38	87	152	151	389	32	26	465
E	0.50	90	143	134	367	31	25	430
M+E	2.0+0.25	94	147	122	363	40	26	442
M+E	3.0+0.38	87	153	129	369	32	36	443
M+E	4.0+0.50	83	144	117	343	33	26	413
Average		86	140	118	343	34	25	414
CV(%)		27	19	28	17	24	45	16
LSD(.05)		NS	NS	49	84	NS	NS	94

Potato Cultivar Response to Seed Spacing and Nitrogen Fertilizer Rates

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

INTRODUCTION

The success of potato breeding and selection programs depends on the identification of superior selections, but also on the development of cultural management practices that allow new cultivars to realize their potential for yield and quality. In the western states, Russet Burbank remains the dominant variety. Cultural practices are well established for Russet Burbank, based on extensive experience and research. Russet Burbank requires relatively high fertilizer rates, careful water management, and low plant populations for optimum performance. Most new varieties will not achieve their genetic potential with cultural management practices appropriate for Russet Burbank. Evaluation of the response of new varieties and advanced selections to a range of plant populations and nitrogen fertilizer rates has been ongoing at the KES since 1987. In 1992, these studies included two promising advanced selections from the Oregon variety development program, a recent release from Colorado, Russet Nugget, and the current dominant varieties grown in the Klamath Basin, Russet Burbank and Russet Norkotah.

PROCEDURES

Selections were evaluated in two separate experiments. Split-plot experimental designs were employed with four replications. Standard management practices were used for weed control, disease and pest management, and irrigation (page 19). Potatoes were planted in both studies with a two-row assisted-feed planter on May 19. Vines were desiccated with diquat applied at 1.0 pt/A on September 10, and potatoes in both studies were harvested on September 29.

In the seed spacing experiment, main-plot treatments were spacings of 6.8, 8.7, or 12 inches in 32-inch rows. Individual plots were two rows, 30 feet long. Fertilizer included 600 lb/A of 16-16-16 banded at planting, and 50 lb N/A applied as soln. 32 and incorporated with a rolling cultivator on May 27. Potatoes were harvested with a one-row digger-bagger. 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 early November. Specific gravity was determined by the weight-in-air, weight-in-water method on 10-pound samples of No.1 tubers in the 6- to 10-ounce size fraction. Internal tuber quality was evaluated by cutting the 10 largest tubers from each plot.

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A uniform seed spacing of 8.7 inches was used in the variety by nitrogen rate study. Individual plots were four rows, 30 feet long. Main-plot treatments were nitrogen rates of 130, 160, or 190 lb N/A, achieved by supplementing 800 lb/A of 16-16-16 banded at planting, with 0, 30, or 60 lb N/A applied on May 27. All tubers from the center two rows were weighed in the field at harvest. Approximately 120-pound samples from each plot were stored and graded as above in early November.

RESULTS AND DISCUSSION

Response to seed spacing

Emergence was rapid and uniform in all varieties. Final stands exceeded 90 percent with most plots exceeding 95 percent emergence. Vines senesced in late August in Russet Norkotah and Russet Nugget, but remained vigorous in Russet Burbank, COO83008-1, and AO82611-7 until vines were desiccated.

Significant differences were found between varieties for all yield parameters and in specific gravity (Table 1). COO83008-1 and AO82611-7 were higher in total No.1 yield than the named varieties. Both selections produced a high percentage of tubers over 10 ounces with few off-grade tubers and very few internal defects. Russet Burbank had significantly more No.2 and cull (data not shown) tubers than all other selections. Second growth and growth cracks were common in Russet Burbank, and hollow heart was observed in 15 percent of tubers inspected. In contrast, less than 5 percent hollow heart was found in Russet Norkotah, and less than 2 percent of tubers examined were hollow in the other selections.

Russet Burbank and Russet Norkotah were similar in total No.1 yield. Russet Norkotah produced more large tubers and fewer off-grades than Russet Burbank. The low specific gravity for Russet Norkotah is typical. Russet Nugget was significantly lower in No.1 yield than all other selections. In the 1991 study, its yield was equal to Russet Burbank and Russet Norkotah yields.

The interaction between varieties and spacing was not statistically significant for any yield component. Specific gravity was not affected by plant populations. Lower plant populations (increased seed spacing) increased tuber size, but did not affect total or No.1 yield, averaged over all varieties. There were, however, minor differences in the response of individual varieties to seed spacing. Russet Nugget achieved maximum yield at the 6.8-inch spacing. Lower populations reduced its yield without compensating improvements in tuber size. In the 1991 study, Russet Nugget achieved optimum yield at the 8.7-inch spacing. In both years, the 12-inch spacing resulted in reduced yields.

Russet Norkotah achieved maximum No.1 and 10-ounce yields at 8.7-inch spacing, as in 1991. Increasing spacing to 12 inches reduced No.1 and total yields by about 30 cwt/A. Russet Burbank also produced the highest yield at 8.7-inch spacing in both 1991 and 1992. Increased yield of large tubers that command price premiums offset the slight yield reduction that results from increasing spacing to 12 inches for Russet Burbank.

COO83008-1 and AO82611-7 were included in these studies for the first time in 1992. Both selections are promising candidates for release as processing varieties. Both achieved maximum No.1 and 10-ounce yields at the 12-inch spacing. Effects of spacing on tuber size were more pronounced than in any of the other three varieties. Tuber size was not excessive for processing use in either selection, even at the 12-inch spacing.

Response to nitrogen rate

The only significant effects of N rate were an increased yield of 10-ounce tubers from 160 to 190 lb N/A, and reduced specific gravity from 130 to 160 lb N/A (Table 2). The interaction between N rate and variety was not significant for any of the parameters evaluated. However, varieties varied moderately in their response to the range of N rates. Russet Burbank had slightly increased yield and tuber size at 160 lb N/A than at 130 lb N/A, with no further improvement at the highest N rate. Russet Norkotah did not benefit from rates above the minimum. Maximum yields were achieved at the high N rate for Russet Nugget, COO83008-1, and AO82611-7. AO82611-7 and COO83008-1 experienced the greatest tuber size response to N rates.

Total No.1 yield was similar in both trials for Russet Norkotah. Average yields for other varieties were about 20 to 50 cwt/A higher in the N rate study. COO83008-1 and AO82611-7 were significantly higher in yield of No.1s than the named varieties. Russet Burbank was highest in total yield, but also had the highest yield of small and off-grade tubers. Specific gravity was consistent between trials for all varieties. Hollow-heart was observed in 12 percent of Russet Burbank tubers inspected, 7 percent of Russet Norkotah, and less than 2 percent in the other selections. Hollow-heart incidence was not influenced by N rate.

The absence of major effects of N rates on yield has been observed over several years with many different potato varieties. Russet Norkotah has been evaluated in this study for five years. Averaged over years, the 130 lb N/A rate has produced the highest total yield of No.1s and near maximum yield of 10-ounce tubers. In two years in this study, Russet Burbank appears to require 160 lb N/A, but shows little added benefit from an additional 30 lb N/A. A three year study, in which Russet Burbank was evaluated at N rates from 60 to 240 lb N/A, failed to demonstrate a response above 180 lb N/A.

Each year from 1988 to 1991, this study included 10 varieties or selections. None of the yield components have shown a significant response to N rate in any year when averaged over varieties. On several occasions, significant interactions between varieties and N rate have been observed, however. Several selections have consistently required more N fertilizer than others to achieve optimum yield and size. Others have not responded to rates over 130 lb N/A, which is well below typical commercial practices on mineral soils in the Klamath Basin. Findings suggest that commercial N fertilizer application rates for potatoes could be reduced with little effect on crop performance, and perhaps improved yields in some varieties.

Table 1. Effect of seed spacing on performance of five potato selections, Klamath Experiment Station, 1992.

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							
Russet Burbank	6.8	191	119	62	372	85	32	554	1.083
	8.7	204	144	72	420	89	30	588	1.086
	12.0	172	123	102	397	64	37	536	1.084
Russet Norkotah	6.8	179	130	119	429	57	17	523	1.070
	8.7	153	144	143	440	46	4	501	1.072
	12.0	119	152	139	410	37	8	469	1.073
Russet Nugget	6.8	137	128	113	378	53	6	449	1.087
	8.7	120	113	110	343	55	4	417	1.087
	12.0	87	98	131	316	35	11	383	1.084
COO83008-1	6.8	122	153	140	415	47	5	486	1.087
	8.7	113	153	194	460	33	5	521	1.089
	12.0	102	128	244	474	17	9	513	1.088
AO82611-7	6.8	179	163	122	464	72	5	557	1.081
	8.7	166	153	133	452	71	11	555	1.084
	12.0	140	145	201	486	44	4	555	1.084
Variety Main Effect (average of three spacings)									
Russet Burbank		189	129	78	396	79	33	559	1.085
Russet Norkotah		150	142	134	426	47	10	498	1.072
Russet Nugget		115	113	118	346	48	7	416	1.086
COO83008-1		112	145	193	450	32	6	507	1.088
AO82611-7		162	154	152	467	62	1	556	1.083
CV(%)		16	20	28	11	32	78	9	1
LSD(.05)		20	22	32	39	14	8	38	0.003
Seed Spacing Main Effect (average of five selections)									
	6.8	161	139	111	411	63	13	514	1.082
	8.7	151	142	130	423	59	11	516	1.084
	12.0	124	129	164	417	39	14	491	1.082
CV(%)		16	14	23	8	13	26	6	1
LSD(.05)		18	NS	24	NS	6	3	NS	NS

Table 2. Effect of nitrogen rate on performance of five potato selections, Klamath Experiment Station, 1992.

Variety/ Selection	N-Rate	Yield U.S. No. 1s 4-6 oz.	6-10 oz.	>10 oz.	Total	Yield Bs	No. 2s	Total	Specific gravity
	lb N/A	cwt/A							
Russet Burbank	130	193	143	91	427	93	36	607	1.087
	160	188	162	112	461	70	41	618	1.083
	190	176	166	114	456	77	20	595	1.082
Russet Norkotah	130	135	170	129	434	56	14	526	1.074
	160	138	166	100	403	73	5	492	1.070
	190	123	162	144	428	53	7	509	1.071
Russet Nugget	130	132	124	142	398	54	15	483	1.089
	160	138	131	128	399	56	9	477	1.086
	190	139	138	135	412	55	4	487	1.086
COO83008-1	130	120	182	169	471	30	7	519	1.089
	160	130	181	203	514	30	5	559	1.089
	190	121	169	235	525	27	1	566	1.085
AO82611-7	130	185	182	123	490	76	16	591	1.082
	160	174	157	136	467	79	8	567	1.081
	190	139	170	201	510	56	20	606	1.080
Variety Main Effect (average of three N-rates)									
Russet Burbank		185	157	106	448	80	32	607	1.084
Russet Norkotah		132	166	124	422	61	9	509	1.072
Russet Nugget		136	131	135	403	55	9	482	1.087
COO83008-1		124	177	202	503	29	5	548	1.088
AO82611-7		166	170	153	489	70	15	588	1.081
CV(%)		15	14	23	6	24	59	5	1
LSD(.05)		18	19	27	23	12	7	25	0.002
N-Rate Main Effect (average of five selections)									
	130	153	160	131	444	62	18	545	1.084
	160	153	159	136	449	61	14	543	1.082
	190	139	161	166	466	54	10	553	1.081
CV(%)		15	17	19	7	18	59	6	1
LSD(.05)		NS	NS	21	NS	NS	NS	NS	0.002

Control of Nematodes and Related Diseases in Potatoes

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

INTRODUCTION

Root-knot (Meloidogyne chitwoodi) and stubby-root nematodes (trichodorus spp.) continue to present problems to the potato industry in the Pacific Northwest and in the Klamath Basin. A significant acreage on the California side of the Klamath Basin has been abandoned for potato production due to the loss of Telone products and serious infestations of root-knot nematodes. The incidence of corky ringspot disease (CRS), caused by tobacco rattle virus (TRV) and vectored by stubby-root nematodes, is increasing in the northwest since the withdrawal of the most effective control measure for the stubby-root nematode, aldicarb. Several hundred acres of sandy soils in the northern portion of the Klamath Basin have been taken out of potato production due to concerns for CRS.

New control options must be developed to prevent a continuing decline in potato production in the area. Previous research at the University of California Intermountain Research and Extension Center (IREC) indicated that early harvest and early maturing varieties offered promise as a means of reducing root-knot nematode infections. Recent research at KES has shown reasonably good control of both root-knot nematodes and CRS with a combination of Telone II (1-3, dichloropropene) and Mocap (ethoprop). Questions remain about the timing of tuber infection and the development of symptoms of surface blemish from root-knot nematodes, and CRS from TRV infections.

Varietal tolerance or resistance to nematodes and related diseases is an important goal of variety development programs. Preliminary evaluations have indicated that one selection from the Oregon program, AO82283-1, may have some degree of resistance to CRS. Experience with A74212-1 at the KES has shown this selection is very susceptible to CRS infection. This study was undertaken to compare these selections with the commonly grown varieties, Russet Burbank and Russet Norkotah, in untreated culture and with a combination treatment of Telone II and Mocap. Sequential harvests and evaluation of tubers after storage were used to more clearly determine the timing of tuber infections and symptom expression.

Immuno-blot serological testing of potato and weed plant tissues was evaluated as a diagnostic tool for the detection of TRV. This aspect of the study was abandoned for lack of technical support in the region, and it will not be discussed in this report.

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PROCEDURES

The KES field selected for the study has a history of potato infections with both CRS and root-knot nematodes. In a 1990 experiment conducted on this site, infection levels in untreated control plots exceeded 80 percent nematode blemish and 60 percent CRS. Spring barley was grown on the site in 1991.

Composite soil samples, representing 16 cores each from 0- to 8- and 8- to 16-inch depths, were collected from nine quadrants within the experimental area before treatments were applied in early April 1992. Treated and untreated plots in each replication were sampled in early July and after harvest in early October. Root-knot and stubby-root nematode populations were determined by personnel in the OSU Department of Botany and Plant Pathology.

The experiment was a split-plot design with four replications. Main-plots were two 32-inch rows, 160 feet long, of four varieties. Split-plots were eight rows, 90 feet long, untreated, or treated with Telone II and Mocap. Telone II was shanked in at 16-inch depth on 18-inch spacing, at a rate of 20 gpa, with a V-ripper on April 6. The soil surface was packed with a Brillion roller immediately after application. The field was plowed to a depth of 12 inches on April 30. Mocap was applied to treated plots in a 6EC liquid formulation at 12 lb ai/A with a conventional ground sprayer and immediately incorporated to 6 to 8 inches with a disc on May 12.

Potatoes were planted in 32-inch rows with a two-row assisted-feed planter on May 20. A74212-1 seed was spaced at 8.7 inches and other varieties at 12 inches. No systemic insecticide was applied in seed furrows at planting. Fertilizer included 800 lb/A of 16-16-16 banded at planting and 50 lb N/A applied as soln. 32 and incorporated with a rolling cultivator on May 27. Herbicides used included Eptam, applied at 3.5 lb ai/A on May 27, and metribuzin applied aerially at 0.5 lb ai/A on June 10. Irrigation was applied twice weekly with solid-set sprinklers, totalling 24 inches for the season. Cultural practices for control of aphids and fungal diseases are described on page 9.

Sequential harvests occurred on August 12, August 26, and September 9. Four plants were harvested by hand from each plot. Ten-tuber sub-samples were inspected for external root-knot nematode blemish and cut into four sections to inspect cut surfaces for CRS symptoms. A second 10-tuber sub-sample from each plot was stored at 55 to 60 °F and inspected after 21 days for blemish and CRS symptoms. Vines were desiccated with Diquat on September 10. Final harvest on September 30 included two rows, 40 feet long from each plot. Tubers were harvested with a one-row digger-bagger. Field weights were recorded for all tubers at harvest. Approximately 120-pound samples were stored at 50 °F until grading on October 2. Tubers showing external nematode blemish were classified as blemish, regardless of size or other characteristics. Unblemished tubers were graded to USDA standard grades.

Two 25-tuber sub-samples were randomly selected from representative grades from each plot for internal inspection for CRS symptoms. One sample was examined by cutting tubers into four sections and inspecting all eight cut surfaces on October 2. The second sample was stored at approximately 45 °F and 90 percent relative humidity, and cut and inspected on December 23. On October 2, any evidence of either necrotic arcs or diffuse spots was recorded as positive for CRS. On December 23, CRS symptoms were further classified as arcs (with or without diffuse spots) at levels of less than 20 percent, or more than 20 percent necrotic discoloration of the cut surface area. When no arcs were observed, CRS diffuse spots were recorded at 1 to 5 or more than 5/tuber. The statistical analyses of all data reported in percents were performed using the arcsine transformation for proportions.

RESULTS AND DISCUSSION

Analyses of soil collected before treatments showed average populations of 10 root-knot and 30 stubby-root nematodes/250 cc of soil. Higher populations of both species were observed in the 8- to 16-inch samples than in the surface 8 inches of soil. Mid-season soil analyses detected root-knot nematodes in only one untreated plot. None were found in treated plots. Stubby-root nematodes were present at less than 10/250 cc of soil in all of the untreated plots, but were not found in any treated plots. Post-harvest populations were over 800 root-knot nematodes/250 cc of soil in untreated plots and 1/250 cc in treated plots. Stubby-root populations were 24 and 5/250 cc of soil in untreated and treated plots, respectively.

Final harvest yields are presented (Table 1), based on grading procedures as described. Yield of No.1s were not adjusted to account for internal CRS infections. Gnarly tubers were badly misshapen, a condition known to be associated with CRS infection. Many tubers included in the blemish category also exhibited the gnarly condition. Russet Burbank had the highest incidence of gnarly tubers. A very high percent of gnarly tubers examined were severely infected with CRS arcs and diffuse spots. Russet Norkotah and A74212-1 had about 40 percent as many gnarly tubers as Russet Burbank in untreated plots, while AO82283-1 did not develop the misshapen condition. Gnarly tubers were not found in potatoes from plots treated with Telone II and Mocap.

The highest incidence of nematode blemish occurred in Russet Norkotah, which was 53 percent infected in untreated plots. Russet Burbank had 34 percent blemish in untreated plots. Blemished tubers accounted for 20 percent and 13 percent of total yield in untreated AO82283-1 and A74212-1, respectively. The combination treatment provided good control of tuber blemish in all varieties.

The timing of CRS tuber infections is evident from observations from sequential harvests (Table 2). On August 12, the initial sampling date, most tubers were under 4 ounces and 2 inches in diameter. At this stage, Russet Burbank had CRS symptoms in 30 percent, and A74212-1 in 10 percent of tubers examined from untreated plots. After three weeks in storage, a much higher incidence of CRS was found in all varieties. The TRV infection apparently occurred before August 12, but CRS symptom development required additional time. While CRS symptoms increased in subsequent harvests, it is not clear whether this increase was due to additional infection with TRV or further CRS symptom development from early TRV infections. A post-storage comparison of infections in untreated plots for September 9 and September 30 harvests, shows little change for any variety. This suggests most TRV infections had occurred by early September. Treatment significantly reduced, and seemed to delay, CRS infection. This response is consistent with reduced populations of stubby-root nematodes observed in treated plots. Significant differences were observed in CRS infection levels between varieties at each sampling date. Russet Burbank and A74212-1 infection levels were about three times as high as levels in Russet Norkotah and AO82283-1.

Visible external tuber blemish due to root-knot nematode infection was not extensive until early September in varieties other than Russet Burbank (Table 3). Symptoms did not increase after storage. Variability between plots was quite high and varietal differences were not significant for either of the first two sequential harvests. September 30 harvest data provide the best evaluation of varietal susceptibility due to the larger sample size. In general, root-knot nematode infections occurred later than TRV infections and CRS symptom development. Russet Burbank was the exception to this. Telone II and Mocap provided good control of nematode blemish in all varieties.

Distinctions in CRS symptoms and severity showed that A74212-1 had the most severe CRS symptoms, with numerous and extensive arcs (Table 4). Russet Burbank tubers also had arcs, but less necrotic discoloration. Diffuse spots accounted for more CRS infections in Russet Burbank, and a majority of tubers with spots had more than 5 spots/tuber. Russet Norkotah and AO82283-1 tubers had very few CRS arcs. Most of the infected tubers of both varieties had a few diffuse spots that were often less distinct than spots observed in Russet Burbank and A74212-1 tubers. The low incidence and mild symptoms of CRS in tubers from treated plots would probably not cause rejection for fresh or processing markets, except for A74212-1. CRS infections in all varieties in untreated culture were sufficient to prevent marketing of these crops for fresh or processing use.

The study confirms the efficacy of the combination of Telone II and Mocap for control of both root-knot nematodes and CRS in mineral soils with moderate nematode populations. None of the varieties evaluated are sufficiently tolerant of both nematode related problems for production in untreated soils infested with both species. However, the results suggest that Russet Norkotah and AO82283-1 are less susceptible to CRS than Russet Burbank, while A74212-1 should be avoided in any field with a CRS history. Under 1992 conditions, which favored high populations of nematodes, early harvest was not a viable control strategy, particularly for CRS, as late August represents the earliest feasible harvest period for early maturing varieties under local conditions.

Table 1. Effect of fumigation and nematicide treatment and variety on yield and grade of potatoes, Klamath Experiment Station, OR. 1992.

Treatment[1]	Variety/Selection	Yield						
		No. 1s	Bs	No. 2s	Culls	Blemish	Gnarly	Total
		cwt/A						
Untreated	Russet Burbank	128	28	6	15	138	95	409
	Russet Norkotah	111	23	7	3	205	39	388
	A74212-1	352	44	19	16	67	37	535
	AO82283-1	302	25	23	16	90	1	457
Treated	Russet Burbank	258	98	24	17	0	0	397
	Russet Norkotah	348	37	24	9	6	0	425
	A74212-1	486	67	2	3	2	0	560
	AO82283-1	385	39	20	22	0	0	466
Variety Main Effect:								
	Russet Burbank	193	63	15	16	69	47	403
	Russet Norkotah	229	30	16	6	106	19	406
	A74212-1	419	56	10	10	35	19	548
	AO82283-1	343	32	21	19	45	1	461
	CV(%)	33	25	107	83	78	110	14
	LSD(.05)	111	13	NS	NS	NS	27	69
Treatment Main Effect:								
Untreated		223	30	13	13	125	43	447
Treated		369	60	17	13	2	0	462
CV(%)		30	42	83	71	144	138	10
P-Value[2]		***	***	NS	NS	**	**	NS

[1]/ Treatment included Telone II at 20 gpa, 4/6/92 and Mocap at 12 lb ai/A, 5/12/92

[2]/ Difference between means is designated as significant at P = .01 (**), P = .001 (***), or not significant (NS).

Table 2. Effect of fumigation and nematicide, variety, and time of harvest on the incidence of CRS infection of potatoes at harvest and after storage, Klamath Experiment Station, OR. 1992.

Treatment	Variety/Selection	CRS infection 8/12	8/26	9/9	9/30
		-----------------	%	-----------------	
			at harvest		
Untreated	Russet Burbank	30	50	58	87
	Russet Norkotah	3	15	30	22
	A74212-1	10	50	88	74
	AO82283-1	3	10	13	25
Treated	Russet Burbank	0	0	3	1
	Russet Norkotah	0	0	5	0
	A74212-1	0	15	35	11
	AO82283-1	0	3	0	0
Variety Main Effect[1]:					
	Russet Burbank	15 A	25 A	31 B	44 A
	Russet Norkotah	2 B	8 B	18 BC	11 B
	A74212-1	5 AB	33 A	62 A	43 A
	AO82283-1	2 B	7 B	7 C	13 B
Treatment Main Effect:					
Untreated		12 A	31 A	47 A	52 A
Treated		0 B	5 B	11 B	3 B
			after storage		
Untreated	Russet Burbank	58	75	68	78
	Russet Norkotah	25	28	38	22
	A74212-1	55	70	83	85
	AO82283-1	15	45	18	21
Treated	Russet Burbank	0	3	25	5
	Russet Norkotah	0	0	3	2
	A74212-1	3	15	33	18
	AO82283-1	0	5	10	1
Variety Main Effect[1]:					
	Russet Burbank	29 A	39 A	47 A	42 A
	Russet Norkotah	13 AB	14 B	21 B	12 B
	A74212-1	29 A	43 A	58 A	52 A
	AO82283-1	8 B	25 AB	14 B	11 B
Treatment Main Effect:					
Untreated		38 A	55 A	52 A	52 A
Treated		1 B	5 B	18 B	7 B

[1]/ Means within a column and main effect not followed by the same letter are significantly different at P = .05.

Table 3. Effect of fumigation and nematicide, variety, and time of harvest on the incidence of tuber blemish at harvest and after storage, Klamath Experiment Station, OR. 1992.

Treatment	Variety/Selection	Tuber blemish 8/12	8/26	9/9	9/30
		%			
			at harvest		
Untreated	Russet Burbank	30	10	43	34
	Russet Norkotah	3	5	23	53
	A74212-1	3	0	10	13
	AO82283-1	5	0	10	20
Treated	Russet Burbank	0	0	0	0
	Russet Norkotah	0	0	0	1
	A74212-1	10	0	0	0
	AO82283-1	0	0	0	0
Variety Main Effect:					
	Russet Burbank	15	5	22	17 AB
	Russet Norkotah	2	3	12	27 A
	A74212-1	7	0	5	7 B
	AO82283-1	3	0	5	10 AB
Treatment Main Effect:					
Untreated		10	4 A	22 A	30 A
Treated		3	0 B	0 B	0 B
			after storage		
Untreated	Russet Burbank	25	30	53	
	Russet Norkotah	0	0	25	
	A74212-1	8	0	18	
	AO82283-1	3	0	23	
Treated	Russet Burbank	0	0	5	
	Russet Norkotah	0	5	3	
	A74212-1	0	0	3	
	AO82283-1	0	0	0	
Variety Main Effect:					
	Russet Burbank	13	15	29	
	Russet Norkotah	0	3	14	
	A74212-1	4	0	11	
	AO82283-1	2	0	12	
Treatment Main Effect:					
Untreated		9	8	30 A	
Treated		0	1	3 B	

Table 4. Effect of fumigation and nematicide treatment, and variety on type and severity of CRS infections in tubers harvested September 30 and inspected December 23, Klamath Experiment Station, OR. 1992.

Treatment	Variety/Selection	Total CRS	Arcs ± Spots <20%[2]	Arcs ± Spots >20%	Diffuse Spots Only 1-5	Diffuse Spots Only >5
		% of tubers in 25 tuber sample				
Untreated	Russet Burbank	78	20	0	20	38
	Russet Norkotah	22	2	0	19	1
	A74212-1	85	29	16	18	22
	AO82283-1	21	1	0	18	2
Treated	Russet Burbank	5	1	0	3	1
	Russet Norkotah	2	1	0	1	0
	A74212-1	18	5	2	9	2
	AO82283-1	1	0	0	1	0
Variety Main Effect[1]:						
	Russet Burbank	42 A	11 AB	0 B	11	20 A
	Russet Norkotah	12 B	2 B	0 B	10	0 B
	A74212-1	52 A	17 A	9 A	14	12 A
	AO82283-1	11 B	1 B	0 B	9	1 B
Treatment Main Effect:						
Untreated		52 A	13 A	4	19 A	16 A
Treated		7 B	2 B	0	4 B	1 B

[1]/ means within one column not followed by the same letter are significantly different at the 5 percent probability level according to student's t.

[2]/ percent of cut surface area affected by necrotic discoloration caused by CRS.

Nematode Resistance Screening Trial for Potato Selections

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

INTRODUCTION

The loss of chemical control measures for root-knot nematodes (*Meloidogyne chitwoodi*) and corky ringspot (CRS), caused by tobacco rattle virus (TRV) and vectored by stubby-root nematodes (*trichodorus spp.*), increases the urgency for identification of alternative control measures for nematodes. Varietal resistance to nematodes and related diseases is a goal of potato breeding and selection programs in the northwest. A screening trial was established at the KES in 1992 to evaluate root-knot nematode and CRS tolerance or resistance for several named varieties, and advanced selections from the western regional variety development program.

PROCEDURES

The study was conducted in a field with a history of root-knot nematode blemish and CRS infections in potatoes. No fumigation or nematicide treatments were applied at the site since 1990. The preceeding crop was spring barley. The experimental design was a randomized complete block with two replications. Twenty-four varieties or advanced selections were planted in 26-hill plots with an adjacent row of Russet Burbank in each plot. Seed was planted at 8.7-inch spacing in 32-inch rows with a two-row assisted-feed planter on May 21. All cultural practices were the same as described in the preceeding report (page 43).

Composite soil samples from each replication were collected from 0- to 8- and 8- to 16-inch depths on April 6 and July 9. Post-harvest samples were taken at 0- to 12- and 12- to 24-inch depths on October 1. Soil samples were assayed for root-knot and stubby-root nematodes by OSU Department of Botany and Plant Pathology personnel.

Vines were desiccated with Diquat applied at 1.0 pt/A on September 10. Potatoes were harvested from both rows of each plot with a one-row digger-bagger on September 30. All tubers were saved for grading and stored under conditions as previously described (pages 43-44). Grading procedures for initial and final evaluations, on November 5 and December 23, respectively, duplicated procedures described previously (page 44). Due to the use of only two replications, a limitation imposed by seed availability, statistical analyses were not performed on any of the data.

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RESULTS AND DISCUSSION

Analyses of early spring soil samples did not detect root-knot nematodes in the top 16 inches at this site. Stubby-root nematode populations were 1/250 cc of soil at 0 to 8 inches and 25/250 cc at 8 to 16 inches. In July, root-knot nematodes were not found in the surface layer, but were detected at populations of 5/250 cc of soil at 8 to 16 inches. Stubby-root populations were 1/250 and 4/250 cc of soil at 0 to 8 and 8 to 16 inches, respectively. Post-harvest populations, uniformly distributed in the top 24 inches, included approximately 300 root-knot and 25 stubby-root nematodes/250 cc of soil.

Yield and grade data compare individual selections with the adjacent Russet Burbank standard (Table 1). Most of the selections produced total yields within 15 percent of Russet Burbank yields. Yields of No.1s were adjusted to exclude tubers with root-knot nematode blemish, but did not exclude CRS infections. The incidence of tuber blemish varied from 9 to 100 percent in Russet Burbank, averaging 52 percent. This variability was probably a function of the variability of nematode populations within the trial area. Selections with much less blemish than adjacent Russet Burbank plots included Russet Nugget, NDO 2904-7, A81473-2, ATX6 84378-1, and A8390-3.

The incidence of CRS was very high in all selections and in Russet Burbank. Yield of culls included misshapen tubers that represent effects of TRV on tuber development. This accounted for a substantial portion of the crop in several Russet Burbank lots that were not high in tuber blemish. Selections with a high incidence of misshapen tubers included Russet Nugget, A81473-2, and ATX6 84378-1. Many tubers with nematode blemish were also misshapen due to TRV infections, but are not included in the cull yield component.

Type and severity of CRS symptoms were identified in the December evaluation of samples (Table 2). Total CRS infection, measured as the percent of 50 tubers examined, is shown for each selection, and the adjacent Russet Burbank sample for November 5 and December 23 inspections. A slightly lower incidence of CRS was observed in the December evaluation for Russet Burbank and most of the selections. As noted in the previous section (page 45), CRS symptoms varied in type and severity. Russet Norkotah and AO82283-1 had the fewest arcs, and a majority of infected tubers had less than six diffuse spots. Red LaSoda, Dark Red Norland, ND 2224-5R, A74212-1, NDO 2904-7, and A8174-2 had CRS arcs in over 50 percent of tubers.

Under moderate populations of root-knot and stubby-root nematodes, selections included in this study showed varying levels of blemish and CRS infections. In fields where only one of the nematode species occurs, these results indicate that one or more selections are less affected than Russet Burbank. When both root-knot nematodes and TRV infected stubby-root nematodes are present, none of these selections offer a satisfactory alternative to chemical control.

Table 1. Yield, root-knot nematode blemish, and corky ringspot (CRS) incidence in 24 potato selections, relative to Russet Burbank (RB), Klamath Experiment Station, OR. 1992.

Variety/ Selection	Total yield	Yield No.1s		Yield culls		Blemish		CRS	
		Entry	R.B.	Entry	R.B.	Entry	R.B.	Entry	R.B.
	% R.B.	---------------------- % of Total				----------------------		%-50 Tubers	
Lemhi	101	7	14	10	9	82	71	68	90
Russet Norkotah	100	20	9	4	15	71	67	58	90
Russet Nugget	75	52	25	23	15	12	43	92	94
Red LaSoda	125	17	23	0	20	78	47	80	90
Sangre	101	52	23	14	48	23	21	76	100
Dark Red Norland	94	0	0	0	0	100	100	96	100
ND2224-5R	87	13	7	6	7	67	83	86	94
AO82283-1	114	53	35	18	13	22	30	64	74
AO82611-7	98	37	34	18	37	35	9	89	86
A74212-1E	96	38	20	20	11	35	52	96	94
COO83008-1	104	36	21	17	14	41	46	100	98
AO83037-10	101	34	17	2	13	63	61	66	82
NDO2904-7	101	59	17	17	13	15	61	78	82
A82119-3	98	28	19	8	22	56	46	78	92
A81473-2	93	54	29	36	31	0	22	58	94
NDTX8 731-1R	115	37	37	7	19	50	30	84	84
CO82142-4	87	28	0	5	0	64	100	74	68
ATX6 84378-1	114	65	37	25	19	9	23	72	84
A8174-2	51	9	16	16	22	73	56	100	96
AO84275-3	111	39	22	10	12	40	53	76	98
A81478-1	75	52	28	14	15	28	51	66	82
A8390-3	96	50	16	21	24	19	56	84	100
A81286-1	104	22	18	33	18	36	58	74	88
AC75430-1	104	27	10	2	10	69	72	52	88
Average	98	35	20	14	17	45	52	78	90

Table 2. Corky ringspot (CRS) infection and types and severity of CRS symptoms for 24 potato selections, relative to Russet Burbank (RB), Klamath Experiment Station, OR. 1992.

Variety/ Selection	Total CRS Symptoms November 5 Entry	R.B.	Total CRS Symptoms December 23 Entry	R.B.	Symptom Type and Severity Arcs ± Spots <20%	>20%	Symptom Type and Severity Diffuse Spots 1-5	>5
	% of 50 tubers							
Lemhi	68	90	54	84	12	0	24	18
Russet Norkotah	58	90	50	78	2	0	46	2
Russet Nugget	92	94	82	98	14	0	20	48
Red LaSoda	80	90	74	80	58	0	10	6
Sangre	76	100	82	90	8	0	44	30
Dark Red Norland	96	100	90	92	86	0	0	4
ND2224-5R	86	94	84	88	54	0	20	10
AO82283-1	64	74	34	66	0	0	22	12
AO82611-7	89	86	78	70	18	0	30	30
A74212-1E	96	94	98	74	54	8	10	26
COO83008-1	100	98	98	92	30	8	6	54
AO83037-10	66	82	86	68	42	0	14	30
NDO2904-7	78	82	78	74	54	0	0	24
A82119-3	78	92	64	86	22	0	30	12
A81473-2	58	94	50	90	14	0	24	12
NDTX8 731-1R	84	84	76	86	48	0	20	8
CO82142-4	74	68	68	86	28	0	24	16
ATX6 84378-1	72	84	46	78	16	0	22	8
A8174-2	100	96	100	76	62	24	0	14
AO84275-3	76	98	60	88	22	0	34	4
A81478-1	66	82	56	78	10	0	22	24
A8390-3	84	100	80	94	30	0	26	24
A81286-1	74	88	52	80	26	0	24	2
AC75430-1	52	88	52	84	12	0	22	18
Average	78		71		28	2	23	18
R.B. Average		90		83	31	0	20	32

Sugarbeet Variety Trials

K.A. Rykbost[1], H.L. Carlson[2], R.L. Dovel[1], and J. Schmierer[3]

INTRODUCTION

The California Beet Grower's 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. In 1992, official variety trials were conducted at the Klamath Experiment Station (KES) in Klamath Falls, at the Intermountain Research and Extension Center (IREC) in Tulelake, and at Honey Lake Valley (HLV) in Susanville. Additional KES and IREC trials evaluated experimental lines from several seed companies.

PROCEDURES

I. OFFICIAL VARIETY TRIALS

KES

The trial site was a Hosely sandy loam soil that was planted to spring barley the three previous years. The field was fumigated with Telone II, shanked in at 20 gallons per acre (gpa) on November 15, 1991. Spring tillage included plowing on April 2, and disking and packing on April 20. Soil analysis has shown a high level of potassium, low to medium phosphorus, soil organic matter content of approximately 0.5 percent, and a soil reaction of about 7.5 at the site. Gypsum was broadcast at 1.0 ton/A, and fertilizer was broadcast at 50 lb/A of N, P_2O_5, and K_2O before disking. The seedbed was firmly packed with a Brillion roller.

Sixteen varieties were planted in a randomized complete block design with four replications on April 23. Seed was planted at a depth of 0.5 inches at 8 to 12 seeds/foot with a hand operated Planet-Junior type planter in 22-inch rows.

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Individual plots were two rows, 15 feet long. Two border rows were planted on both sides of the experiment and 5-foot borders were used on end plots. Stands were hand thinned to 8-inch spacing on May 30. A flea beetle infestation was controlled with carbaryl applied at 1.0 lb ai/A on May 5, and 0.5 lb ai/A on May 30. Weed control was achieved with Betamix applied at 0.3 lb ai/A on May 12 and May 19, followed by hand weeding as necessary to control escapes, primarily redstem filaree and hairy nightshade. Supplemental nitrogen was applied at 50 lb N/A as Soln. 32 and incorporated with irrigation on June 23. Irrigation was applied with solid-set sprinklers on a 40 x 40-foot spacing. Total irrigation water and rainfall for the season was approximately 26 inches.

Beet tops were removed with a flail chopper immediately prior to harvest. Beets were hand harvested on October 9. All beets from both rows of each plot were weighed and counted. All beets from one row were analyzed for percent sucrose by the Holly Sugar Corporation. Crop values were calculated for each plot based on beet yield and price/ton for beets at the observed sugar content, as determined by terms of the Holly Sugar Corporation contract. The price/ton is described by the equation: Price/ton = -15.4 + (3.517 X % sugar) for a selling price of $24.00/cwt. Yield, sugar content, total sugar production, and gross crop value were statistically analyzed using MSU Stat software.

IREC

The trial was established on Tulebasin fine silty loam soil with approximately 12 percent organic matter content. The soil is highly fertile and near neutral in reaction. The previous crop was spring barley. Field preparation consisted of primary tillage with a roto-harrow preceded by broadcast application of 88 lbs N/A. Beets were seeded into raised 24-inch wide beds using a research adapted small plot cone planter on April 24. Seeding rates were adjusted for seed size to achieve a uniform seeding rate of 95,000 seeds/A for all varieties. Planting depth was approximately 0.25 inches. Individual plots were three rows, 50 feet long, arranged in a randomized complete block design with four replications.

Postemergence applications of Betamix herbicide were made at 0.2 and 0.15 lb ai/A rates on May 15 and June 2, respectively. Insect control was achieved with applications of 0.5 lb ai/A of carbaryl on May 8, May 14, June 11, and July 17. Powdery mildew control measures included applications of 0.5 lb/A of Bayleton on August 28 and 10 lb/A of elemental sulphur on September 9. Stands were hand-thinned to final plant spacings of approximately 7 inches on June 4. The trial area was irrigated with solid-set sprinklers. Total irrigation applied, including pre-plant irrigation, was approximately 42 inches.

Beets were harvested with a modified one-row harvester on October 19. All beets from 45 feet of the center plot row were weighed and counted. Samples of 10 beets/plot were analyzed for sucrose content by the Holly Sugar Corporation.

HLV

The trial site was a sandy loam soil at 4,200 feet elevation. Double-row beds, 14 x 26 inches, were formed preplant. Fertilizer included 32 lb N/A and 40 lb P_2O_5/A banded preplant, and 50 lb N/A broadcast applied on June 25 and July 9. Twenty-two varieties were planted in two-row plots with four replications in a completely randomized block design on May 14.

Weed control measures included Betamix applied at 0.5 lb ai/A on June 10, Betamix at 0.5 lb ai/A and Nortron at 0.375 lb ai/A applied on June 16, and hand weeding as necessary. Stands were hand thinned to 8-inch spacing on June 24. Irrigation was applied with solid-set sprinklers. Beets were evaluated for curly top virus infection as a percent of plants infected on July 30, and by degree of severity on August 11. All beets from each plot were harvested, weighed, and counted on October 12 and 13. Fifteen beets/plot were analyzed for sucrose content by the Holly Sugar Corporation.

II. EXPERIMENTAL VARIETY TRIALS

KES

Details of trial methods and cultural management were as described for the commercial variety trial. This trial included 32 entries. Beets were planted on April 24 and harvested on October 12.

IREC

Details of trial methods, cultural management, and time of planting and harvest are as reported for the commercial variety trial at IREC.

RESULTS AND DISCUSSION

I. COMMERCIAL VARIETY TRIAL

Crops established well under relatively favorable spring conditions. Emergence occurred uniformly approximately 10 days after planting. Frosts were recorded at KES on only three dates in May. Minimum air temperatures of 22, 30, and 27 °F occurred on May 1, 12, and 21, respectively. No frosts occurred in June. Minor flea beetle damage at both KES and IREC did not seriously affect crops. Trials at IREC were influenced by powdery mildew invasion in late August. Mild symptoms were observed at KES; however, control measures were not needed or applied. Plant populations after thinning were very uniform at approximately 33,000 and 35,000 plants/A at KES and IREC, respectively. Early season vigor ratings were made at both KES and IREC. Significant differences were not observed.

Beet yields, percent sugar, total sugar production, and gross crop value are presented for KES and IREC (Table 1). Average yields were similar and high at both locations. Yields were also quite similar between varieties. Yield differences were not statistically significant at IREC and barely so at KES. Sugar content was also high at both locations and similar to levels observed in commercial crops in the area. Sugar content differences between varieties were significant at KES, but not at IREC. Total sugar production ranged from 5.5 to 6.6 ton/A at KES and from 5.7 to 6.7 ton/A at IREC. Statistical significance was observed between varieties at both locations. Gross crop value is the best indication of variety performance as this parameter considers the premium for high sugar content. Significant differences between varieties in gross crop value were observed at both locations. SX-1 and Beta 1996 achieved the highest crop values at KES. KW 316 and KW 6000 were highest in crop value at IREC.

As in previous trials, variety performance was different between locations. At KES, the highest sugar production and crop value was observed in SX-1, Beta 1996, and Monohikari. At IREC, the highest three entries in total sugar production and crop value were KW 316, KW 6000, and ACH 199. At both locations, all entries produced excellent crops and they seem reasonably well adapted to local conditions in a relatively disease-free environment.

The trial at HLV was severely affected by curly top virus. The percent of plants showing curly top symptoms on July 30 ranged from less than 1 to 73 percent (Table 2). The severity of symptoms was rated from 2.4 to 7.9 on a scale of 1=no injury to 10=plant death, on August 11. Curly top infections resulted in severe yield reductions in about one-third of the varieties. The highest yields were about 75 percent of average yields at KES and IREC. Sugar content was not different between varieties and was slightly lower than levels observed at KES and IREC.

The occurrence of curly top virus in the HLV trial offers the first opportunity to observe reactions of locally grown varieties to this serious disease problem. Clearly, the most commonly grown varieties in the district, Monohikari, Beta 1996, SX-1, and HH 55, as well as several others, were seriously affected by the disease. However, a number of entries demonstrated good curly top resistance. Several of these, including ACH 191, ACH 203, HH 50, and SS 502 have been evaluated over four location-years, or more, locally, and have demonstrated good performance. Curly top virus has not posed a serious threat in the Tulelake and Klamath Basins to date. The results of 1992 trials provide the basis for avoiding serious crop losses in the future. The industry will undoubtedly shift a greater portion of the crop to those varieties that have demonstrated good yield potential and resistance to the virus.

Most of the entries in the 1992 commercial variety trial have been included in previous trials at KES and IREC. Six entries have been evaluated at KES over three years (Table 3). Monohikari has consistently produced high yields and high sugar content on mineral soils at KES and in commercial fields. HH 55, ACH 191, ACH 203, and Beta 1996 have produced only slightly lower total sugar over three years. The best combination of disease resistance, percent sugar, and total sugar production for the six varieties is close between ACH 191 and ACH 203.

Twelve of the entries in the 1992 commercial trials have been evaluated over four location-years at KES and IREC (Table 4). The best performance for organic soils (IREC) has been achieved by HH 50 and ACH 199. Both of these varieties demonstrated good curly top resistance in the HLV trial. Differences between years were significant for all parameters. Location effects were significant except for sugar content. Variety differences were only found in sugar content. Interactions between year, location, and variety were highly significant in sugar yield and gross crop value (Table 4).

II. EXPERIMENTAL VARIETY TRIALS

Conditions and performance in these trials were generally very similar to those in the commercial trials. One entry, 90-84-C65-06, had a severe stand loss in the KES trial that resulted in a low yield. With that exception, most entries achieved excellent yields, high sugar content, and high total sugar production (Table 5). The location effect was statistically significant for percent sugar at $p=0.05$ probability, but not for beet yield, total sugar production, or gross crop value. Several of the entries that were evaluated in the district for the first time appear to be good candidates for commercial production for the future. As in all trials at KES, Monohikari and HH 55 produced top sugar yields. Several new entries rose to the top at IREC.

An additional variety trial, conducted at KES only, evaluated 14 proprietary lines and the standards, HH 55 and Monohikari. Trial format, cultural practices, and crop performance were as described for other KES trials. Sugar analyses were performed in a Hilleshog-Monohy laboratory. Beet yields and sugar production were similar to results observed in other trials at KES (Table 6). The higher sugar contents, and hence higher crop values, in this trial are probably the result of differences in laboratory procedures. Several of the selections were equal to Monohikari in sugar production and crop value.

Table 1. Yield, percent sugar, total sugar production, and gross crop value for 16 varieties in commercial sugarbeet variety trials at Klamath Falls, OR (KES) and Tulelake, CA (IREC), 1992.

Variety/ Selection	Beet Yield			Sugar Content			Total Sugar Production			Gross Crop Value		
	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean
	----- tons/A -----			-------- % --------			------- tons/A -------			------ $/A -------		
ACH 191	31.6	32.4	32.0	19.6	18.2	18.9	6.17	5.90	6.04	1681	1575	1628
ACH 199	29.3	33.3	31.3	18.8	18.8	18.8	5.50	6.27	5.89	1483	1692	1587
ACH 203	32.9	31.4	32.2	19.1	18.2	18.7	6.28	5.71	6.00	1703	1526	1615
ACH 304	31.6	31.2	31.4	19.2	18.7	19.0	6.05	5.83	5.94	1640	1571	1605
Beta 1996	33.7	32.5	33.1	19.0	18.6	18.8	6.41	6.05	6.23	1734	1628	1681
KW 316	32.2	35.6	33.9	19.3	18.9	19.1	6.21	6.73	6.47	1687	1814	1751
KW 6000	32.9	34.1	33.5	18.7	18.6	18.7	6.15	6.34	6.25	1659	1704	1681
WS 26	33.5	32.9	33.2	18.9	18.1	18.5	6.33	5.96	6.15	1711	1589	1650
WS 62	31.7	33.8	32.8	18.7	18.5	18.6	5.92	6.24	6.08	1595	1675	1635
WS 91	31.4	33.7	32.6	18.9	17.8	18.4	5.93	5.99	5.96	1604	1586	1595
5892	31.9	32.5	32.2	18.3	18.1	18.2	5.84	5.87	5.86	1560	1564	1562
HH 50	32.6	32.5	32.6	18.2	18.6	18.4	5.95	6.03	5.99	1589	1621	1605
HH 55	34.5	34.7	34.6	18.2	18.1	18.2	6.29	6.27	6.28	1680	1670	1675
Monohikari	33.1	31.4	32.3	19.1	18.7	18.9	6.34	5.86	6.10	1717	1579	1648
SX-1	34.9	31.1	33.0	18.9	18.6	18.8	6.59	5.80	6.20	1778	1557	1668
SS 502	31.3	31.7	31.5	17.8	18.1	18.0	5.74	5.75	5.75	1477	1534	1506
Mean	32.4	32.8	32.6	18.8	18.4	18.6	6.10	6.04	6.07	1644	1618	1631
CV(%)	5	6	5	3	3	3	5	6	5	5	6	6
LSD(0.05)	2.2	NS	1.8	0.8	NS	0.6	0.43	0.52	0.34	126	147	96

Table 2. 1992 Sugarbeet Variety Performance at Honey Lake Valley (Susanville), CA.

Selection/ Variety	Curly Top Virus Infection Plants	Curly Top Virus Infection Severity[1]	Sugar Content	Beet Yield	Sugar Yield	Gross Crop Value
	- % -		- % -	tons/A	tons/A	$/A
ACH 191	15.9	2.4	17.8	24.8	4.37	1171
ACH 199	5.1	3.4	18.5	24.1	4.40	1197
ACH 203	0.8	3.4	17.7	25.9	4.60	1213
ACH 304	4.4	3.4	17.8	22.2	3.92	1048
Beta 1996	45.1	7.4	18.3	8.8	1.60	431
KW 316	70.6	7.8	18.7	6.9	1.30	347
KW 6000	66.8	8.1	18.2	7.7	1.40	374
WS 26	22.2	3.8	18.0	21.8	3.92	1044
WS 62	3.8	4.8	18.2	20.4	3.71	992
WS 91	6.7	4.8	18.5	21.5	3.98	1068
5892	30.3	4.4	18.1	21.9	3.96	1057
HH 50	5.9	4.8	17.7	25.2	4.45	1181
HH 55	43.1	6.3	17.4	16.2	2.82	742
HH 39	4.3	4.0	16.9	24.3	4.11	1070
HH 45	13.5	5.1	17.4	18.9	3.27	866
Monohikari	73.1	7.9	17.9	6.4	1.15	304
SX-1	62.8	7.8	17.8	6.5	1.17	307
SS 502	3.7	4.0	16.9	24.5	4.06	1079
H 89719	5.6	4.0	18.0	21.5	3.85	1030
H 91249	4.4	4.6	18.2	21.9	4.00	1065
HM A16	44.1	6.5	17.6	14.4	2.54	670
HM 7006	73.1	7.0	18.5	10.6	1.98	526
Mean	27.5	5.3	17.9	18.0	3.21	854
CV (%)	55	22	5	19	17	--
LSD (0.05)	21.5	1.7	NS	4.7	7.6	--

[1]/ Severity rating scale: 1 - no injury, 10 - plant death.

Table 3. Three-year summary of performance of six sugarbeet varieties at Klamath Falls, OR, 1990-1992.

Variety	Beet Yield		Sugar Content		Sugar Production		Gross Crop Value	
	tons/A	Rank	%	Rank	tons/A	Rank	$/A	Rank
HH 50	26.1	6	17.3	5	4.52	6	1187	6
HH 55	28.6	2	17.0	6	4.86	4	1270	5
Beta 1996	27.3	4	18.0	2	4.91	3	1308	2
Monohikari	28.9	1	18.1	1	5.29	1	1395	1
ACH 191	26.9	5	18.0	3	4.84	5	1289	4
ACH 203	28.2	3	17.5	4	4.94	2	1301	3

Table 4. Two-year summary of performance of 12 sugarbeet varieties at Klamath Falls, OR (KES) and Tulelake, CA (IREC) in 1991 and 1992.

Selection/	Beet Yield			Sugar Content			Sugar Yield			Gross Crop Value		
Variety	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean
	----- Tons/A ----			--------- % --------			----- Tons/A -----			------ $/A ------		
HH 50	27.6	33.5	30.5	17.5	18.0	17.7	4.83	6.03	5.44	1280	1605	1442
HH 55	30.1	31.3	30.6	17.4	17.0	17.3	5.34	5.32	5.33	1288	1522	1405
Beta 1996	27.6	31.7	29.6	18.3	18.4	18.3	5.05	5.82	5.45	1359	1559	1459
Monohikari	29.5	29.2	29.3	18.3	17.7	18.0	5.40	5.17	5.29	1450	1368	1409
SX-1	30.7	32.3	31.5	17.4	17.8	17.5	5.34	5.74	5.56	1418	1514	1465
ACH 191	28.2	30.7	29.5	18.4	17.6	17.9	5.09	5.40	5.30	1396	1424	1410
ACH 199	25.9	33.4	29.6	18.1	18.1	18.1	4.69	6.05	5.36	1254	1605	1429
ACH 203	29.3	32.6	30.9	17.7	17.63	17.5	5.19	5.63	5.43	1389	1477	1433
WS 26	27.9	31.5	29.7	18.3	18.2	18.2	5.14	5.72	5.42	1372	1525	1448
WS 62	27.6	31.6	29.6	18.0	17.7	17.8	4.97	5.59	5.29	1327	1485	1406
WS 91	26.8	31.0	28.9	18.4	17.6	18.0	4.93	5.46	5.19	1322	1441	1381
SS 502	28.4	32.4	30.1	17.6	17.3	17.4	4.94	5.60	5.29	1295	1468	1381
Mean	28.1	31.8	30.0	17.9	17.8	17.8	5.06	5.66	5.36	1345	1499	1422
LSD (0.05)	--	--	1.9	--	--	0.6	--	--	NS	--	--	NS
Significance:[1]												
Year			**			**			**			**
Location			**			NS			**			**
Year x Location			**			*			**			**
Entry			NS			**			NS			NS
Year x Entry			*			*			NS			NS
Location x Entry			*			NS			NS			NS
Year x Location x Entry			NS			NS			**			**

[1] Significance levels: NS - not significant at P = 0.05; * - significant at P = 0.05; ** - significant at P = 0.01.

Table 5. Yield, sugar content, total sugar production, and gross crop value for 32 experimental sugarbeet varieties at Klamath Falls, OR (KES) and Tulelake, CA (IREC) in 1992.

Selection/ Variety	Beet Yield			Sugar Content			Sugar Yield			Gross Crop Value		
	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean
	----- Tons/A ----			-------- % -------			----- Tons/A -----			------ $/A ------		
ACH 305	29.0	29.5	29.2	19.4	19.4	19.4	5.63	5.72	5.68	1533	1560	1546
ACH 89-222	27.7	30.4	29.1	19.5	19.3	19.4	5.41	5.86	5.64	1478	1594	1536
ACH 89-320	30.6	32.7	31.7	18.6	19.4	19.0	5.69	6.34	6.01	1528	1727	1628
ACH 86-35	27.6	29.4	28.5	18.7	19.4	19.0	5.14	5.71	5.42	1384	1553	1468
ACH 890229	31.3	34.6	32.9	19.2	19.4	19.3	6.01	6.72	6.36	1632	1829	1730
ACH 9000520	31.7	32.4	32.0	18.6	18.5	18.5	5.87	5.98	5.93	1580	1606	1593
ACH 9000428	32.6	31.6	32.1	18.8	19.3	19.0	6.13	6.09	6.11	1652	1655	1653
9G 6915	31.9	32.0	32.0	17.9	19.3	18.6	5.71	6.17	5.94	1518	1676	1597
9BG 6276	34.2	33.6	33.9	18.8	18.8	18.8	6.41	6.31	6.36	1728	1702	1715
9BG 6272	31.2	32.6	31.9	18.6	18.7	18.6	5.80	6.09	5.95	1559	1639	1599
Beta 8422	31.8	34.1	33.0	18.6	18.8	18.7	5.90	18.7	6.16	1585	1733	1659
Beta 2010	27.8	28.2	28.0	18.9	19.7	19.3	5.27	5.56	5.41	1426	1521	1473
KW 1479	32.6	32.1	32.4	18.8	19.1	19.0	6.13	6.14	6.14	1655	1665	1660
9BG 6393	31.8	31.5	31.7	19.2	19.5	19.3	6.08	6.13	6.11	1649	1671	1660
HM WS-870	31.4	32.6	32.0	18.1	18.3	18.2	5.67	5.96	5.81	1509	1596	1552
HM A16	31.3	31.9	31.6	18.5	18.6	18.6	5.79	5.93	5.86	1554	1595	1574
HM 7006	34.4	34.5	34.5	19.1	18.7	18.9	6.56	6.44	6.50	1778	1733	1755
HH 55	36.7	33.8	35.2	18.0	18.0	18.0	6.60	6.09	6.34	1754	1621	1688
HH 86	31.1	28.9	30.0	18.9	18.8	18.9	5.88	5.44	5.66	1591	1469	1530
HH 88	34.1	34.3	34.2	18.7	18.9	18.8	6.39	6.47	6.43	1721	1747	1734
90-84-C65-06	19.4	30.5	25.0	17.6	18.7	18.2	3.42	5.71	4.56	901	1540	1220
91 N 187-02	29.9	32.5	31.2	18.4	18.7	18.5	5.49	6.08	5.79	1470	1638	1554
90 C 148-02	29.1	31.2	30.3	18.3	19.2	18.7	5.31	5.99	5.67	1419	1637	1528
90 C 148-031	32.4	34.0	33.2	18.4	17.6	18.0	5.97	6.00	5.99	1599	1587	1593
Monohikari	34.7	34.2	34.2	18.8	19.1	19.0	6.54	6.52	6.53	1766	1764	1765
SX-1401	29.8	31.5	30.6	18.8	18.5	18.7	5.60	5.83	5.72	1511	1566	1539
SX-1402	34.0	35.8	34.9	17.9	18.4	18.1	6.06	6.57	6.31	1609	1758	1684
H 90446	34.1	33.1	33.6	17.9	18.7	18.3	6.10	6.17	6.13	1620	1659	1640
H 89719	32.1	32.5	32.3	18.1	18.3	18.2	5.81	5.94	5.87	1550	1588	1569
H 90451	31.2	34.0	32.6	19.1	19.1	19.1	5.94	6.47	6.20	1611	1752	1681
H 91480	32.6	34.7	33.7	18.3	18.0	18.2	5.97	6.24	6.11	1598	1660	1629
H 91249	30.1	35.3	32.7	16.9	18.4	17.6	5.08	6.48	5.78	1325	1736	1530
Mean	31.2	32.5	31.9	18.5	18.8	18.7	5.79	6.11	5.95	1556	1649	1603
CV (%)	7	7	7	4	2	3	8	7	7	8	7	7
LSD (0.05)	3.0	3.2	2.2	1.0	0.5	0.6	0.61	0.58	0.42	176	156	117

Table 6. Yield, sugar content, total sugar production, and gross crop value of Hilleshög-Monohy sugarbeet varieties at Klamath Falls, 1992.

Selection/ Variety	Beet yield	Sugar content	Total Sugar production	Gross crop value
	tons/A	- % -	tons/A	- $/A -
HH 55	31.8	19.5	6.21	1693
Monohikari	34.6	19.7	6.81	1862
1	33.8	19.7	6.66	1820
2	27.8	19.8	5.51	1510
3	30.4	19.4	5.88	1601
4	35.2	19.4	6.84	1862
5	28.7	19.9	5.70	1562
6	28.0	19.2	5.37	1457
7	27.6	19.5	5.39	1469
8	31.7	19.7	6.24	1707
9	30.0	20.1	6.01	1653
10	31.0	20.0	6.19	1699
11	31.9	20.1	6.41	1765
12	32.2	20.2	6.50	1792
13	35.1	19.1	6.70	1817
14	34.6	19.0	6.56	1776
Mean	31.5	19.6	6.19	1690
CV (%)	5	2	5	5
LSD (0.05)	2.1	0.6	0.42	117

Optimum Sugarbeet Planting Dates in the Klamath Basin

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

INTRODUCTION

Because yields are limited by a short growing season in the Klamath Basin, early season planting should be desirable to maximize crop growing days. Unfortunately, early planting during the basin's harsh early spring weather also increases the chances of poor stand establishment with the possible need for replanting. More information is needed on the trade-offs between early planting risks and the loss of yield with delayed planting dates. Accordingly, a sugarbeet planting date study was initiated in 1991 at the Intermountain Research and Extension Center (IREC) in Tulelake and at the Klamath Experiment Station (KES) in Klamath Falls. The objective was to establish optimum dates for planting sugarbeets in the Klamath Basin. Although the two sites are only 35 miles apart, they represent the diversity of soil types and climatic conditions that occur in the basin. The soil at IREC is a rich lake bottom silty clay loam with 10 percent organic matter. The soil at KES is a fine sandy loam with less than 1 percent organic matter. Minimum daily air temperatures at IREC are often 5 to 10 °F cooler than recorded at KES.

PROCEDURES

Studies at both locations were conducted as randomized complete block split-plot experiments with planting dates assigned to main plots and two varieties, Monohikari and HH 55, randomly assigned to sub-plots. Treatments were replicated six times at IREC and four times at KES.

IREC

Nine planting dates were evaluated; April 8, April 15, April 29, May 6, May 13, May 20, May 27, June 3, and June 10. A planting was made on April 24 but the stand was lost due to weather conditions. Affected plots were replanted as the June 10 planting. Main plots were three 24-inch rows, 90 feet long, subdivided into two 45-foot sub-plots of two varieties. All plots were planted on raised, 24-inch beds. Plots were individually fertilized at planting with 175 lb/A of 12-12-12 fertilizer, side-dressed in beds.

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The preceding crop was barley. Plots were irrigated as required through solid-set sprinklers. Frequent irrigations were applied to accommodate plant emergence for the various planting dates. A season total of 43 acre-inches of irrigation was applied to the trial area. Following plant establishment, beet seedlings were thinned to 7-inch spacing in the row (approximately 35,000 plants/A). Weed control was achieved by multiple applications of Betamix herbicide at 0.20 lb ai/A. Carbaryl insecticide was used as needed to control insect injury to beet seedlings. Powdery mildew was controlled with applications of Bayleton at 0.50 lb ai/A on August 28 and 10 lb/A sulfur applied on September 9. Beets were harvested on October 21 with a modified single-row digger with a weighing scale. Yields were recorded and analyzed from the center 40 feet of the center row of each sub-plot.

KES

Planting dates at KES were April 8, April 17, April 28, May 7, May 18, and May 29. Main plots were four rows 40 feet long, split into two 20-foot sub-plots (varieties). Beds were formed with 32-inch row spacing with a two-row potato planter. Fertilizer was banded at 320 lb/A of 16-16-16 as beds were formed for the first two plantings on April 7, and for remaining plantings on April 27. Seed was planted with a Planet-Junior type hand planter at a rate of 10 to 12 seeds/foot of row. Frequent irrigation was supplied with solid-set sprinklers during stand establishment. Beets were irrigated with a season total of 22 acre-inches. Supplemental nitrogen was applied at 50 lb N/A and incorporated with irrigation on June 23.

The trial area was cropped with barley during the two preceding years. Telone II was applied at 20 gpa in November 1991. Weed control was achieved with two applications of Betamix at 0.30 lb ai/A and hand weeding as necessary. Carbaryl was applied at 0.50 lb ai/A on April 28, May 5, and May 30 to control insects. Beets in individual planting dates were hand thinned approximately 30 days after planting to achieve 6-inch in-row spacing, or populations of about 35,000 plants/A. Beets from the center 18 feet of the center two rows were harvested by hand on October 13. Beets from both rows were counted and weighed. Sub-samples of 15 beets from one row in each plot were analyzed for sugar content by Holly Sugar Corporation.

Crop values were calculated for each plot based on beet yield and price/ton for beets at the observed sugar content, as described by terms of the Holly Sugar Corporation contract. The price/ton is described by the equation: Price/ton = -15.4 + (3.517 X percent sugar) for a selling price of $24.00/cwt.

RESULTS AND DISCUSSION

At IREC, 1992 beet yields were similar for April planting dates, peaked at the May 6 planting date, and declined significantly at each later date through June 3 (Table 1). Yield differences between varieties were not significant. Monohikari yielded less than HH 55 in seven of nine planting dates. Sugar content was not affected by planting date. Monohikari was higher in sugar content than HH 55 at all planting dates, and the difference was statistically significant averaged over planting dates. Total sugar yield followed beet yield trends. After peaking for the May 6 planting, further delays in planting date resulted in reduced sugar production. Gross crop value closely followed yield trends. Returns were significantly higher for the first five planting dates than for the last four dates. Returns were higher for Monohikari than for HH 55 due to the higher sugar content in Monohikari. The interaction between planting date and variety was statistically significant for total sugar production and gross crop value. Monohikari was superior at early planting dates, but HH 55 was more productive in late plantings.

Beet yields declined steadily with each planting delay at KES (Table 2). Varietal differences were small and non-significant. Sugar content was not affected by planting date. Monohikari was significantly higher in sugar content than HH 55. Differences were greater for the early planting dates. Sugar yields and gross crop values closely followed yield trends in response to planting date. Monohikari was significantly higher than HH 55 in sugar yield and crop value. Although the interaction between planting date and variety was not significant, there was a trend for the advantage for Monohikari to decline as planting was delayed.

Effects of planting date on crop performance were similar in 1991 and 1992 at KES. The results at IREC were more varied with a less clear trend. Average total sugar yield for 1991 and 1992 at both locations are plotted by planting date (Figure 1). Based on a trend curve fitted to these results, the optimum time to plant sugarbeets in the Klamath Basin is prior to May 1. The KES data suggests that yield loss occurs if planting is delayed beyond the second week in April. On average, this two-year study indicates that late planting results in a loss of one-third ton/A in total sugar production for each week planting is delayed past May 1. Assuming 1992 contract prices, 17.5 percent sugar content, and a $24.00/cwt net selling price for sugar, the loss of one-third ton/A of sugar would result in the loss of $88.00/A in gross returns to growers.

The 1991 and 1992 seasons represented a range of weather conditions. Cool conditions and frequent frosts in May and June of 1991 may be more typical than the warm and relatively frost-free spring experienced in 1992. Over this range, preliminary findings indicate a large loss to growers results with delayed planting or late replanting. The studies will be continued for one or two more years.

Table 1. Yield and sugar content of sugarbeets with varied planting dates, Intermountain Research & Extension Center, Tulelake, CA. 1992.

Planting date	Beet yield			Sugar content			Sugar yield			Gross crop value		
	Monohikari	HH55	Avg	Monohikari	HH55	Avg	Monohikari	HH55	Avg	Monohikari	HH55	Avg
	-------- ton/A --------			---------- % ----------			-------- ton/A ---------			--------- $/A ---------		
April 8	35.4	34.6	35.0	17.5	17.3	17.4	6.17	5.99	6.08	1626	1574	1600
April 15	34.2	34.7	34.4	17.7	16.7	17.2	6.03	5.77	5.90	1595	1494	1545
April 29	34.1	34.4	34.2	18.4	16.9	17.7	6.27	5.83	6.05	1682	1520	1601
May 6	37.7	36.4	37.0	17.9	17.1	17.5	6.76	6.22	6.49	1795	1627	1710
May 13	30.9	35.5	33.2	18.2	17.8	18.0	5.61	6.31	5.96	1498	1671	1585
May 20	23.6	25.9	24.7	18.2	16.3	17.2	4.29	4.23	4.26	1146	1016	1081
May 27	20.6	24.4	22.5	17.5	17.4	17.4	3.59	4.25	3.92	906	1016	961
June 3	18.4	19.1	18.8	17.5	17.2	17.4	3.22	3.27	3.25	849	842	846
June 10	19.5	18.5	18.8	18.0	17.1	17.6	3.42	3.16	3.29	846	807	827
Mean	28.0	28.8	28.4	17.9	17.0	17.5	5.00	4.92	5.02	1327	1285	1306
CV(%)(Date)			8			7			19			21
LSD(0.05)(Date)			1			NS			0.49			222
CV(%)(Variety)			10			6			10			11
LSD(0.05)(Variety)			NS			0.4			NS			NS

Variety x date interaction was statistically significant (0.05) for total sugar (T/A) and gross crop value ($/A).

Table 2. Yield and sugar content of sugarbeets with varied planting dates, Klamath Experiment Station, Klamath Falls, OR. 1992.

Planting date	Beet yield			Sugar content			Sugar yield			Gross crop value		
	Monohikari	HH55	Avg	Monohikari	HH55	Avg	Monohikari	HH55	Avg	Monohikari	HH55	Avg
	-------- ton/A --------			---------- % ----------			-------- ton/A --------			--------- $/A ---------		
April 8	39.1	38.8	39.0	18.0	16.5	17.2	7.06	6.38	6.72	1879	1647	1763
April 17	35.6	34.7	35.2	18.2	15.7	17.0	6.48	5.47	5.98	1732	1389	1561
April 28	34.5	33.4	33.9	17.7	15.7	16.7	6.11	5.24	5.68	1616	1329	1473
May 7	31.6	31.9	31.8	16.9	16.5	16.7	5.34	5.29	5.31	1392	1367	1380
May 18	28.5	28.8	28.6	17.3	16.3	16.8	4.94	4.68	4.81	1299	1202	1250
May 29	25.3	26.3	25.8	17.1	17.1	17.1	4.32	4.5	4.41	1131	1177	1154
Mean	32.4	32.3	32.4	17.5	16.3	16.9	5.71	5.26	5.48	1508	1352	1430
CV(%)(Date)			6			5			8			9
LSD(0.05)(Date)			1.9			0.9			0.44			132
CV(%)(Variety)			4			5			8			9
LSD(0.05)(Variety)			NS			0.5			0.26			80

Variety x date interaction not significant for any parameter.

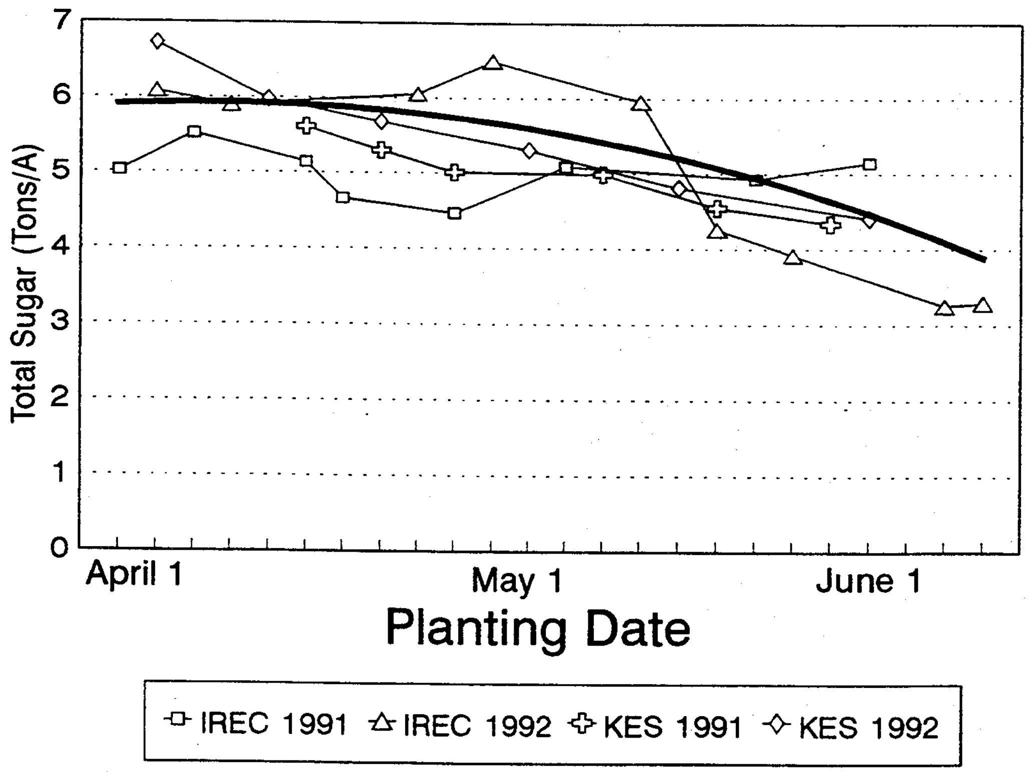

Figure 1. Decline in total sugar production with delayed planting dates at Klamath Falls, OR (KES) and Tulelake, CA (IREC), 1991-1992.

Sugarbeet Response to Nitrogen Fertilizer Rates

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

INTRODUCTION

Fertilizer requirements for sugarbeets grown on low organic matter mineral soils in the Klamath Basin have not been established. Research in other areas has shown important relationships between nitrogen supplied and beet sugar content. High nitrogen content in petioles late in the season has been related to reduced sugar content and lower sugar extraction efficiency. The high efficiency of sugarbeet roots in scavenging nitrogen from considerable soil depths may reduce fertilizer nitrogen requirements compared to shallow-rooted crops such as cereals and potatoes. This study was established to evaluate effects of a range of applied nitrogen rates on sugarbeet petiole nitrate levels, yield, and sugar content.

PROCEDURES

The experimental site was a Hosley sandy loam soil. Previous crops were spring barley from 1989 to 1991. The experimental design was a randomized complete block with four replications. N fertilizer rates evaluated were 30, 60, 90, 120, and 150 lb N/A. Individual plots were four 22-inch rows, 20 feet long.

The field was fumigated with Telone II, shanked in at 20 gpa on November 15, 1991. Spring tillage included plowing on April 2, and disking on April 20, after a broadcast application of 1.0 ton/A of agricultural gypsum. A uniform application of 188 lb/A of 16-16-16 fertilizer was supplemented with urea applied at appropriate rates to individual plots to achieve planned N rates. Fertilizer was immediately incorporated by harrowing on May 4. The seedbed was firmly packed with a Brillion roller.

Monohikari seed was planted 0.5 inches deep at 8 seeds/foot with a Planet-Junior type planter on May 4. Cultural practices were the same as those described for KES variety trials (page 55). Stands were hand thinned to achieve in-row spacings of 8 inches on June 3. No additional fertilizer was applied. A total of approximately 22 inches of irrigation water was applied through solid-set sprinklers on a twice weekly schedule.

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Acknowledgment: Partial funding of the study by the California Beet Grower's Association and laboratory analyses of beet sugar content by the Holly Sugar Corporation are gratefully recognized.

Before fertilizer was applied, composite soil samples were collected from depths of 1, 2, and 3 feet. Samples were analyzed at the University of California, Davis. Beet petioles were collected from the two center rows of each plot on July 14 and August 27. Samples were dried at KES and analyses were performed at the Southern Oregon Analytical Laboratory at Tulelake, CA.

Beet tops were removed with a flail chopper immediately before harvest. Beets were hand-harvested from 15 feet of the two center rows of each plot on October 9. All beets from both rows were weighed and counted. All beets from one row were analyzed for percent sucrose by Holly Sugar Corporation. Gross crop values were calculated as described for variety experiments (page 55).

RESULTS AND DISCUSSION

Plant stands after thinning were quite uniform at populations of about 35,000 plants/A. The crop remained healthy throughout the season. There were no visual differences in canopy development between plants over the range of fertilizer treatments evaluated. Soil analyses showed uniform texture for all depths sampled: 89 percent sand; 6 percent silt; and 5 percent clay. Organic matter contents were 0.93, 0.17, and 0.10 percent for depths of 1, 2, and 3 feet, respectively. Soil pH increased with depth from 7.6 in the top foot, to 8.0 in the second foot, and 8.4 in the third foot. Soil cation exchange capacity (CEC) was uniform with depth at about 13 meq/100g.

Soil N determinations included nitrate and ammonium-N for each foot and mineralizable-N in the top foot. Nitrate-N concentrations were 7.83, 0.58, and 0.29 ppm at depths of 1, 2, and 3 feet, respectively. Corresponding ammonium-N was 1.16, 2.02, and 0.59 ppm, and mineralizable-N was 8.08 ppm in the top foot. This represented total soil nitrogen reserves of about 85 lb N/A.

Petiole nitrate-N concentrations did not correlate well with fertilizer rates at either sampling date (Table 1). Variability between replicates was high and differences between treatments were not statistically significant. The range of concentrations observed at both sampling dates was considered within sufficiency limits for sugarbeets at that stage of development.

Effects of N-rate on yield, sugar content, sugar production, and gross crop value were small and non-significant. Yield and sugar content increased slightly as N-rate increased from 30 to 120 lb N/A. The highest N-rate did not reduce sugar content. At current prices for nitrogen fertilizer, the economically optimum rate in this study was 120 lb N/A. However, results suggest that high yields and sugar content are attainable with low fertilizer inputs. Under climatic conditions experienced in the Klamath Basin, nitrogen status of plants may not be as critical for sugar production as it is in long growing season areas with higher fall temperatures. Local crops grown in soils with 10 percent organic matter and high mineralizable-N have attained over 19 percent sugar content in each of the last three seasons. Additional research is needed to further define fertilizer requirements under local conditions for major soil types.

Table 1. Effects of fertilizer N-rates on petiole nitrate-N levels, beet yields, sugar content, sugar yield, and gross crop value for Monohikari grown at Klamth Falls, OR. 1992.

N Rate	Petiole Nitrate-N July 14	Petiole Nitrate-N August 27	Beet yield	Sugar content	Sugar yield	Gross value
lb N/A	ppm	ppm	T/A	%	T/A	$/A
30	11,470	2,620	32.4	19.2	6.22	1649
60	15,200	3,575	33.6	19.2	6.46	1709
90	16,720	3,235	33.6	19.4	6.51	1724
120	14,350	1,430	34.6	19.4	6.71	1776
150	13,260	1,590	33.6	19.5	6.52	1720
Mean	14,200	2,490	33.6	19.5	6.48	1715
CV (%)	45	82	6	2	6	6
LSD (0.05)	NS	NS	NS	NS	NS	NS

Spring Barley Variety Screening, 1992

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

INTRODUCTION

Spring barley accounts for about 80 percent of cereal crops grown on over 100,000 acres in the Klamath Basin. Both feed and malting types are important in the region. Barley variety trials planted at the Klamath Experiment Station (KES) in 1991 included: the Western Regional Spring Barley trial in cooperation with western states plant breeders; a collection of new and promising lines from the Oregon State University barley breeding program; and a trial comprised of experimental naked barley lines from CIMMYT (International Center for Maize and Wheat Improvement). 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. Only one organic soil site was irrigated.

All trials were arranged in a randomized complete block design with three or four replications. Crops at the KES were planted between April 20 and 22. Those at both organic soil sites were planted on June 4. Seed was planted to a depth of one inch at a seeding rate of 100 lb/A. All crops were fertilized with 100 lb N, 60 lb P_2O_5, and 44 lb S/A at time of seeding. Plots measured 5 x 20 feet, with a row spacing of 6 inches (10 rows). At KES, bromoxynil and MCPA were applied at labeled rates to control broadleaf weeds. Weed control at organic soil sites was achieved with a mixture of 2,4-D and Banvel. Plots were harvested in early September using a plot combine with a 5-foot wide header. Grain yield was recorded for all plots. Test weight, percent plumps, and percent thins were measured in only one replication.

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

RESULTS AND DISCUSSION

Western Regional Spring Barley Nursery

Yields were slightly lower in 1992 than in the 1990 Western Regional trial, and substantially lower than the same trial in 1991 (Tables 1 and 2). This is partially due to an unusually high infestation of wheatstem maggot. Data was not collected on wheatstem maggot damage on this trial, but an adjacent study had over 50 percent tiller damage by this pest. Warm spring weather and early planting resulted in earlier than normal heading dates. In general, test weights were high and percent plump seed was above normal. ORS 3 was the highest yielding entry in the trial, but it did not produce significantly higher yields than the standard variety, Steptoe. A number of other varieties produced yields that were comparable to Steptoe. Lodging was not a problem in the plots in 1992. In part, this was due to earlier than normal termination of irrigation.

When averaged over three years, ORS 2 produced the highest yields in the trial, followed closely by ORS 3 (Table 2). Grain yields of these two lines were significantly higher than five other selections, but not Steptoe. Following region wide testing in the Western Regional Spring Barley Nursery, ORS 2 has been approved for release by OSU under the name Maranna. This is a 6-row feed variety with smooth awns. It is slightly shorter than Steptoe and more lodging resistant.

OSU Spring Barley Trials

OSU spring barley variety trials were established at three different locations. The 24-entry trial was located at the KES on mineral soil, and at two organic soil locations on the Lower Klamath Lake. One organic soil site was irrigated by overhead sprinkler irrigation. The other site was flood irrigated prior to planting, with no further irrigation.

Yield trends over the past three years at KES were similar to those seen in the Western Regional Spring Barley Nursery discussed above. Wheatstem maggot damage was extensive in 1992, and undoubtedly reduced yields. In 1992, ORS 3 was the highest yielding variety in this trial, as it was in the Western Regional trial (Table 3). A number of varieties were not significantly lower in grain yield than ORS 3. Grain yields in 1992, were substantially lower than in 1991 and slightly lower than 1990 (Table 4). Averaged over three years, Gustoe was the highest yielding variety at KES, closely followed by ORS 3, ORS 2, and Columbia. Colter, a new release by Idaho State University, has produced high yields both years it has been in this trial.

While Colter has been impressive but not outstanding on mineral soil, it has been the highest yielding variety at both organic soil sites for the past three years (Tables 5-8). At the irrigated organic soil site, Colter produced yields significantly higher than all entries except Gustoe, Russell, and BA 2601 in 1992. Note that entry 24, 79Ab10719-66LC, is actually Colter under its old name, from a different seed source. When averaged over three years, Colter produced grain yields significantly higher than all entries except Gustoe and Russell, at the irrigated organic soil site (Table 6).

At the unirrigated organic site, the relative performance of Colter was even more impressive. In 1992, Colter produced significantly more grain than all other entries in the trial (Table 7). Colter averaged 5,280 lb/A at the unirrigated organic soil site over a three-year period, significantly outyielding all other entries in the trial (Table 8). Russell is another variety that seems to perform better in organic soils than in mineral soil. It ranked sixth at KES over a three-year period, but third and fourth at the irrigated and unirrigated organic soil sites, respectively. Russell produced higher yields than Steptoe at the irrigated organic soil site each year it was in the study. Russell is a 6-row malting variety that could be an attractive option if malting contracts are available. In contrast to Colter and Russell, Columbia seems to perform best on mineral soil. It ranked fourth at KES over a three-year period and is planted on mineral soils throughout the region. It ranked seventh and sixth at the two organic soil sites and is generally not planted on organic soils.

Barley yields from all three plot sites are summarized with two- and three-year averages (Table 9). When averaged over three years and three locations, Gustoe was the highest yielding variety, followed closely by ORS 2, Russell, and ORS 3. Colter was not included in the three-year average because it has been planted at the mineral soil site for only two years. Over two years, Colter averaged 220 lb/A more than Gustoe. Despite good yields of Gustoe at the unirrigated site, Gustoe is not considered appropriate for such management systems.

1992 Naked Barley Variety Trial

There is new interest in developing naked or hulless barley for specialty and human food uses. A variety trial evaluating the yield potential of experimental two-row naked barley lines has been conducted at KES for two years. Average yield for the trial in 1992 was 2,981 lb/A, compared to 5,132 lb/A for the Western Regional Spring Barley Variety Trial, which had only hulled varieties (Tables 1 and 10). In 1991, mean yields for the same trials were 3,496 and 6,147 lb/A, respectively (Tables 2 and 11). Over a two-year period, naked barleys produced yields nearly 60 percent lower than standard barley varieties in the Western Regional trial. A price incentive for naked barley of 75 percent over feed barley would be required for comparable gross returns. The highest yielding naked barley entry averaged 3,855 lb/A over a two-year period, compared to 6,611 for ORS 2, the highest yielding entry in the Western Regional trial. This agrees with the yield relationship of naked and hulled varieties seen in the trial averages. There was considerable variability in yields of the naked barley entries with a range of 1,874 to 3,855 lb/A.

Test weights of naked barley varieties are generally heavier than traditional hulled varieties. The naked barley trial averaged 59.0 lb/bu compared to 54.1 lb/bu for the Western Regional trial. Test weights of the naked barley entries varied from 55.0 to 60.8 lb/bu. Higher test weights could be important in specialty products, and selection for such a trait is advisable. Several higher yielding entries had higher than average test weights as well. Although there is interest by industry and growers in hulless varieties, there is currently no commercial market for such a product. Continued work on product development by industry and university researchers is needed. Due to lower yields, price incentives will be necessary to make hulless or naked varieties attractive to growers.

Table 1. 1992 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
		lb/A	lb/bu	---------- % ----------			%	inches	Julian days
1	Trebi	5391	54.0	95.9	3.0	1.1	0	31	174
2	Steptoe	5736	54.0	98.7	0.9	0.4	0	30	167
3	Klages	5088	54.0	97.8	1.7	0.4	0	33	174
4	Morex	5018	57.0	96.3	2.7	1.0	0	35	168
5	Excel	5360	55.0	96.7	2.3	1.0	0	30	170
6	ID 842974	4698	56.5	98.1	1.2	0.7	0	31	177
7	OR 006	5192	52.0	94.1	4.5	1.5	0	33	170
8	OR 1209	4163	52.0	93.3	4.8	1.9	0	26	176
9	ORS 2	5210	52.5	93.3	4.9	1.7	0	26	174
10	WA 11163-86	5205	54.0	94.0	4.3	1.6	0	29	173
11	BA 2B86-5113	5107	56.5	95.9	2.7	1.4	0	29	174
12	BA 2B88-5133	4359	57.0	98.2	1.3	0.5	0	28	170
13	ID 86Ab2317	4673	55.5	99.2	0.7	0.1	0	34	174
14	UT 502355	5709	53.0	98.1	1.4	0.5	0	34	174
15	PB 401	5357	53.0	93.4	4.9	1.8	0	33	175
16	WA 7190-86	4669	57.0	96.1	2.7	1.1	0	26	177
17	WA 9593-87	5363	52.0	95.3	3.5	1.2	0	28	175
18	WA 10489-86	5460	52.0	97.9	1.5	0.6	0	31	170
19	BZ 588-335	3539	52.0	94.7	4.1	1.3	0	17	175
20	BA 1614	4821	53.0	96.4	2.7	0.9	0	31	174
21	UT 1181	5489	51.5	94.2	4.2	1.6	0	28	167
22	UT 11640	5682	49.5	94.4	4.4	1.2	0	30	170
23	UT 3109	5054	50.0	95.4	3.1	1.5	0	26	171
24	UT 150582	5665	49.5	90.8	6.8	2.4	0	28	170
25	PB 882R801	4998	55.5	97.5	1.8	0.7	0	28	174
26	ND 11853	5664	56.0	98.8	0.8	0.4	0	30	168
27	ND 11231-6	5191	58.0	98.1	1.3	0.6	0	30	168
28	ORS 3	5831	55.0	89.9	7.8	2.4	0	26	174
	Mean	5132	53.8	95.8	3.1	1.1	0	29	172
	CV (%)	12						9	1
	LSD (0.05)	857						4	2

Table 2. Summary of Western Regional Spring Barley Yields, 1990-1992. Grain yields of spring barley varieties planted at the Klamath Experiment Station, OR.

Entry	Selection	Yield 1992	Yield 1991	Yield 1990	Yield 2-yr Avg		Yield 3-yr Avg	
		lb/A	lb/A	lb/A	lb/A	Rank	lb/A	Rank
1	Trebi	5391	5890	3762	5641	7	5014	7
2	Steptoe	5736	6694	6364	6215	3	6265	3
3	Morex	5018	4658	5007	4838	15	4894	8
4	ID 842974	4698	5979	4940	5339	11	5206	6
5	OR 006	5192	5940	6010	5566	9	5714	4
6	OR 1209	4163	6218	6353	5191	13	5578	5
7	ORS 2	5210	8012	6849	6611	1	6690	1
8	ORS 3	5831	6991	6803	6411	2	6542	2
9	Klages	5088	5450		5269	12		
10	Excel	5360	5504		5432	10		
11	WA 11163-86	5205	7107		6156	4		
12	BA 2B86-5113	5107	6129		5618	8		
13	BA 2B88-5133	4359	5665		5012	14		
14	ID 86Ab2317	4673	4911		4792	16		
15	UT 502355	5709	6537		6123	5		
16	PB 401	5357	6672		6015	6		
17	WA 7190-86	4669						
18	WA 9593-87	5363						
19	WA 10489-86	5460						
20	BZ 588-335	3539						
21	BA 1614	4821						
22	UT 1181	5489						
23	UT 11640	5682						
24	UT 3109	5054						
25	UT 150582	5665						
26	PB 882R801	4998						
27	ND 11853	5664						
28	ND 11231-6	5191						
	Mean	5132	6147	5761	5639		5738	
	CV (%)	12	12	12	12		12	
	LSD (0.05)	857	1013	857	654		559	

Table 3. 1992 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
		lb/A	lb/bu	%	%	%	%	inches	Julian days
1	Bearpaw	5405	56.0	97.9	1.7	0.4	0	33	174
2	Crystal	4176	55.0	96.4	2.7	0.9	0	33	174
3	Gustoe	5398	51.5	96.7	2.3	1.0	0	19	174
4	BA 1202	5005	56.0	98.2	1.4	0.4	0	30	174
5	Russell	4582	52.0	96.4	2.7	0.9	0	27	168
6	Shonkin	4231	60.0	76.3	18.2	5.5	0	36	174
7	Steptoe	5594	51.0	98.4	1.2	0.4	0	30	168
8	82Ab519	4931	52.5	94.5	4.2	1.3	0	32	168
9	82Ab23222	5010	52.0	92.2	5.3	2.5	0	26	181
10	ORSM 8408	4607	56.0	96.9	2.3	0.8	0	32	174
11	BA 2601	5093	53.5	95.5	3.3	1.2	0	28	174
12	ORS 2	5295	52.5	89.2	7.4	3.3	0	25	174
13	ORS 3	5756	53.0	92.2	5.5	2.3	0	25	174
14	Columbia	4877	52.0	97.2	2.2	0.6	0	25	181
15	Klages	4450	54.5	85.9	9.3	4.9	0	34	174
16	Harrington	4911	56.0	97.6	1.9	0.5	0	31	174
17	Excel	5257	53.5	94.4	4.4	1.3	0	33	171
18	Morex	3728	52.0	92.3	5.6	2.1	0	36	168
19	MT 140523	5753	56.0	98.1	1.4	0.5	0	28	173
20	Medalion	5662	52.0	88.5	8.1	3.3	0	25	179
21	Colter	5407	51.0	95.4	3.2	1.4	0	29	170
22	WA 8771-78	5571	56.0	98.4	1.2	0.4	0	31	173
23	PH 585-6	5237	53.5	97.1	2.3	0.6	0	23	174
24	79Ab10719-66LC	4645	51.0	98.0	1.5	0.6	0	20	174
	Mean	5024	53.7	94.3	4.2	1.6	0	29	173
	CV (%)	12					0	8	1
	LSD (0.05)	831					0	3	2

Table 4. Summary of OSU Spring Barley Trial on Irrigated Mineral Soil, 1990-1992. Grain yields of spring barley varieties planted at the Klamath Experiment Station, OR.

		Yield					Yield	
Entry	**Selection**	**1992**	**1991**	**1990**	**2-yr Avg**		**3-yr Avg**	
		lb/A				Rank	lb/A	Rank
1	Bearpaw	5405	5891	5817	5648	12	5704	7
2	Crystal	4176	6810	4790	5493	14	5259	9
3	Gustoe	5398	7977	6858	6688	1	6744	1
4	Russell	4582	7167	6491	5875	10	6080	6
5	Shonkin	4231	4631	3407	4431	17	4090	10
6	Steptoe	5594	6843	5872	6219	5	6103	5
7	ORSM 8408	4607	6710	5323	5659	11	5547	8
8	ORS 2	5295	7661	6668	6478	3	6541	3
9	ORS 3	5756	7547	6679	6652	2	6661	2
10	Columbia	4877	7340	6752	6109	6	6323	4
11	Klages	4450	6339		5395	15		
12	Colter	5407	7254		6331	4		
13	Harrington	4911	6903		5907	9		
14	Excel	5257	6643		5950	7		
15	Morex	3728	5817		4773	16		
16	MT 140523	5753	6140		5947	8		
17	WA 8771-78	5571	5520		5546	13		
18	BA 1202	5005						
19	82Ab519	4931						
20	82Ab23222	5010						
21	BA 2601	5093						
22	Medalion	5662						
23	PH 585-6	5237						
	Mean	5041	6658	5866	5829		5905	
	CV (%)	10	10	12	10		11	
	LSD (0.05)	855	923	831	593		529	

Table 5. 1992 Irrigated Organic Soil OSU Barley Variety Trial. Grain yield, test weight, and percent thins of spring barley varieties planted in organic soil at the Lower Klamath Lake, OR.

Entry	Selection	Yield	Rank	Test weight	Rank	Thins 6/64	Thins 5.5/64	Thins Pan
		lb/A		lb/bu		%		
1	Bearpaw	3775	18	47.5	15	88.7	6.9	4.4
2	Crystal	3844	17	48.5	13	86.0	7.9	6.0
3	Gustoe	5500	5	48.0	14	92.5	4.5	3.0
4	BA 1202	4933	10	53.5	3	98.1	1.4	0.5
5	Russell	5897	3	52.5	5	95.8	2.7	1.5
6	Shonkin	3574	19	52.5	4	64.0	21.3	14.7
7	Steptoe	4770	11	46.5	17	93.7	2.9	3.4
8	-----	---	-	---	-	---	---	--
9	-----	---	-	---	-	---	---	--
10	ORSM 8408	3163	21	49.0	10	85.1	8.7	6.2
11	BA 2601	5630	4	59.0	1	93.0	5.8	1.2
12	ORS 2	5025	7	46.0	18	73.0	13.5	13.5
13	ORS 3	4307	16	39.5	22	89.7	5.5	4.8
14	Columbia	4336	14	40.0	21	90.6	4.8	4.6
15	Klages	2913	22	48.5	11	78.6	13.1	8.3
16	Harrington	3231	20	48.5	12	85.5	7.4	7.1
17	Excel	5088	6	52.0	6	93.9	4.8	1.3
18	Morex	4966	9	51.5	8	93.4	5.2	1.4
19	MT 140523	4441	13	53.5	2	94.8	3.9	1.3
20	Medalion	4986	8	43.0	20	70.0	15.8	14.2
21	Colter	6025	1	49.5	9	90.0	6.9	3.2
22	WA 8771-78	4333	15	51.5	7	94.8	3.2	1.9
23	PH 585-6	4685	12	46.0	19	83.1	10.4	6.6
24	79Ab10719-66LC	5926	2	47.0	16	84.3	7.0	8.6
	Mean	4607		48.8		87.4	7.4	5.2
	CV (%)	13						
	LSD (0.05)	869						

Table 6. Summary of OSU Spring Barley Trial on Irrigated Organic Soil, 1990-1992. Grain yields of spring barley varieties planted at the Lower Klamath Lake, OR.

Entry	Selection	Yield 1992	1991	1990	2-yr Avg		Yield 3-yr Avg	
		lb/A	lb/A	lb/A	lb/A	Rank	lb/A	Rank
1	Bearpaw	3775	4550	3465	4163	13	3930	9
2	Crystal	3844	4948	3292	4396	11	4028	8
3	Gustoe	5500	5906	5013	5703	3	5473	2
4	Russell	5897	5803	4489	5850	2	5396	3
5	Shonkin	3574	1795	1105	2685	17	2158	12
6	Steptoe	4770	5642	4167	5206	5	4860	6
7	ORSM 8408	3163	3919	3320	3541	15	3467	11
8	ORS 2	5025	5908	4098	5467	4	5010	5
9	ORS 3	4307	5782	5368	5045	7	5152	4
10	Columbia	4336	5032	4036	4684	9	4468	7
11	Klages	2913	3962	4301	3438	16	3725	10
12	Colter	6025	6132	5162	6079	1	5773	1
13	Harrington	3231	4493		3862	14		
14	Excel	5088	5047		5068	6		
15	Morex	4966	4848		4907	8		
16	MT 140523	4441	4652		4547	10		
17	WA 8771-78	4333	4261		4297	12		
18	BA 1202	4933						
19	Medalion	4986						
20	PH 585-6	4685						
	Mean	4490	4864	3985	4643		4453	
	CV (%)	13	12	25	13		15	
	LSD (0.05)	869	783	1232	596		545	

Table 7. 1992 Unirrigated Organic Soil OSU Barley Variety Trial. Grain yield, test weight, and percent thins of spring barley varieties planted in organic soil at the Lower Klamath Lake, OR.

Entry	Selection	Yield	Test weight	Thins 6/64	Thins 5.5/64	Thins Pan
		lb/A	lb/bu	%	%	%
1	Bearpaw	2913	51.0	83.7	11.3	4.9
2	Crystal	3151	49.5	76.3	13.6	10.2
3	Gustoe	4700	51.0	82.8	11.4	5.7
4	BA 1202	3988	52.0	91.1	6.5	2.4
5	Russell	4830	55.0	93.1	3.8	3.1
6	Shonkin	2684	53.5	57.1	25.2	17.7
7	Steptoe	4498	48.0	94.5	2.9	2.6
8	-----	--	--	--	--	--
9	-----	--	--	--	--	--
10	ORSM 8408	1966	47.0	76.7	13.5	9.8
11	BA 2601	4358	51.5	90.7	6.1	3.2
12	ORS 2	4117	48.0	73.0	14.5	12.5
13	ORS 3	2962	41.0	87.2	6.5	6.2
14	Columbia	2962	41.0	86.7	7.0	6.3
15	Klages	1838	47.5	75.6	13.7	10.7
16	Harrington	2953	50.0	89.2	6.4	4.3
17	Excel	4629	52.0	89.8	7.5	2.7
18	Morex	4051	53.0	91.5	6.2	2.3
19	MT 140523	3057	53.0	82.7	11.8	5.4
20	Medalion	4964	45.0	77.0	13.9	9.1
21	Colter	5399	51.5	91.9	5.9	2.1
22	WA 8771-78	3329	51.5	92.2	5.5	2.4
23	PH 585-6	4221	47.5	87.0	8.5	4.5
24	79Ab10719-66LC	5821	50.0	92.7	4.5	2.7
	Mean	3790	49.5	84.7	9.4	5.9
	CV (%)	8				
	LSD (0.05)	443				

Table 8. Summary of OSU Spring Barley Trial on Unirrigated Organic Soil, 1990-1992. Grain yields of spring barley varieties planted at the Lower Klamath Lake, OR.

Entry	Selection	Yield 1992	1991	1990	2-yr Avg		Yield 3-yr Avg	
		lb/A				Rank	lb/A	Rank
1	Bearpaw	2913	4026	3816	3470	11	3585	8
2	Crystal	3151	4203	3861	3677	9	3738	7
3	Gustoe	4700	5074	4227	4887	2	4667	2
4	Russell	4830	3638	4151	4234	7	4206	4
5	Shonkin	2684	1161	1988	1923	17	1944	12
6	Steptoe	4498	4124	4316	4311	4	4313	3
7	ORSM 8408	1966	3556	3843	2761	16	3122	11
8	ORS 2	4117	4370	4067	4244	6	4185	5
9	ORS 3	2962	3357	4227	3160	14	3515	9
10	Columbia	2962	4096	4497	3529	10	3852	6
11	Klages	1838	3914	4126	2876	15	3293	10
12	Colter	5821	5230	4789	5526	1	5280	1
13	Harrington	2953	3985		3469	12		
14	Excel	4629	4837		4733	3		
15	Morex	4051	4492		4272	5		
16	MT 140523	3057	3536		3297	13		
17	WA 8771-78	3329	4075		3702	8		
18	BA 1202	3988						
19	BA 2601	4358						
20	Medalion	4964						
21	PH 585-6	4221						
	Mean	3714	3981	3992	3769		3808	
	CV (%)	8	12	14	22		19	
	LSD (0.05)	443	783	699	826		582	

Table 9. 1992 OSU Spring Barley Varieties - 2- and 3-year observations of grain yield over 3 locations - Irrigated mineral soil (IMS), Irrigated organic soil (IOS), and Unirrigated organic soil (UOS). Klamath Experiment Station, OR.

		IMS		IOS		UOS		2-Yr Avg		3-Yr Avg	
Entry	Selection	2-Yr	3-Yr	2-Yr	3-Yr	2-Yr	3-Yr				
		---------- lb/A	----------					lb/A	Rank	lb/A	Rank
1	Bearpaw	5648	5704	4163	3930	3470	3585	4427	13	4406	7
2	Crystal	5493	5259	4396	4028	3677	3738	4522	11	4342	8
3	Gustoe	6688	6744	5703	5473	4887	4667	5759	2	5628	1
4	Russell	5875	6080	5850	5396	4234	4206	5320	4	5227	3
5	Shonkin	4431	4090	2685	2158	1923	1944	3013	17	2731	10
6	Steptoe	6219	6103	5206	4860	4311	4313	5245	6	5092	5
7	ORSM 8408	6559	5547	3541	3467	2761	3122	4287	15	4045	9
8	ORS 2	6478	6541	5467	5010	4244	4185	5396	3	5245	2
9	ORS 3	6652	6661	5045	5152	3160	3515	4952	7	5109	4
10	Columbia	6109	6323	4684	4468	3529	3852	4774	8	4881	6
11	Klages	5395		3438		2876		3903	16		
12	Colter	6331		6079		5526		5979	1		
13	Harrington	5907		3862		3469		4413	14		
14	Excel	5950		5068		4733		5250	5		
15	Morex	4773		4907		4272		4651	9		
16	MT 140523	5947		4547		3297		4597	10		
17	WA 8771-78	5546		4297		3702		4515	12		
	Mean	5882	5905	4643	4394	3769	3713	4765		4671	

Table 10. 1992 Naked Barley Variety Trial. Grain yield, test weight, percent lodging, plant height, and heading date of naked spring barley varieties planted at the Klamath Experiment Station, OR.

Entry	Selection	Yield	Test weight	Lodge	Height	Heading date
		lb/A	lb/bu	%	inches	Julian days
1	PMI DES- 2	3621	56.5	0	29	169
2	PMI DES- 4	1893	56.5	0	28	173
3	PMI DES- 6	2534	58.0	0	22	174
4	PMI DES- 9	2984	60.0	0	27	174
5	PMI DES-10	3335	61.0	0	29	174
6	PMI DES-11	3403	60.0	0	29	174
7	PMI DES-12	3656	61.5	0	30	174
8	PMI DES-13	3294	60.0	0	26	174
9	PMI DES-14	3422	60.0	0	28	174
10	PMI DES-15	3493	60.5	0	29	174
11	PMI DES-16	3178	61.5	0	30	174
12	PMI DES-17	3551	61.0	0	29	174
13	PMI DES-19	2969	59.0	0	27	174
14	PMI DES-20	3357	60.0	0	31	174
15	PMI DES-21	3322	60.0	0	28	174
16	PMI DES-24	2129	57.0	0	28	173
17	PMI DES-25	2702	57.0	0	32	174
18	PMI DES-26	2402	56.5	0	29	174
19	PMI DES-27	2728	57.5	0	31	172
20	PMI DES-29	1642	60.0	0	31	174
	Mean	2981	59.2	0	29	174
	CV (%)	10		0	10	1
	LSD (0.05)	400		0	4	2

Table 11. Two-year summary of Naked Barley Variety Trial, 1991-1992. Grain yields and test weight (TW) of naked spring barley varieties planted at Klamath Experiment Station, OR.

		1991		1992		2 Year Average	
Entry	**Selection**	**Yield**	**TW**	**Yield**	**TW**	**Yield**	**TW**
		lb/A	lb/bu	lb/A	lb/bu	lb/A	lb/bu
1	PMI DES- 2	4002	57.0	3621	56.5	3812	56.8
2	PMI DES- 4	1855	53.5	1893	56.5	1874	55.0
3	PMI DES- 6	3674	58.0	2534	58.0	3104	58.0
4	PMI DES- 9	3999	61.0	2984	60.0	3492	60.5
5	PMI DES-10	4375	60.0	3335	61.0	3855	60.5
6	PMI DES-11	4145	59.0	3403	60.0	3774	59.5
7	PMI DES-12	3442	59.0	3656	61.5	3549	60.3
8	PMI DES-13	4085	61.5	3294	60.0	3690	60.8
9	PMI DES-14	4234	60.0	3422	60.0	3828	60.0
10	PMI DES-15	3820	57.0	3493	60.5	3657	58.8
11	PMI DES-16	3873	60.0	3178	61.5	3526	60.8
12	PMI DES-17	3840	59.0	3551	61.0	3696	60.0
13	PMI DES-19	3642	59.0	2969	59.0	3306	59.0
14	PMI DES-20	3610	60.0	3357	60.0	3484	60.0
15	PMI DES-21	3823	59.0	3322	60.0	3573	59.5
16	PMI DES-24	2434	62.0	2129	57.0	2282	59.5
17	PMI DES-25	2300	56.5	2702	57.0	2501	56.8
18	PMI DES-26	3172	59.0	2402	56.5	2787	57.8
19	PMI DES-27	3024	59.0	2728	57.5	2876	58.3
20	PMI DES-29	2566	60.0	1642	60.0	2104	60.0
	Average	3496	59.0	2981	59.0	3239	59.0

Spring Wheat Variety Screening in the Klamath Basin, 1992

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

INTRODUCTION

Spring wheat is grown on approximately 8,000 acres annually in the Klamath Basin. Soft white (SW) and hard red (HR) selections predominate; however, interest has grown recently in the hard white (HW) class. In 1992, spring wheat variety trials were conducted at the KES in cooperation with plant breeding and evaluation programs at Oregon State University, the Central Oregon Experiment Station, and Western Regional evaluation programs. Cold-tolerant, short-season cultivars are needed in the Klamath Basin due to a short growing season with the possibility of frost throughout the growing season. Entries evaluated in these trials included SW, HW, and HR selections. Historically, there has been little disease or insect pressure on small grains in the Klamath Basin. However, the recent introduction of the Russian wheat aphid has altered this situation. Wheatstem maggot is endemic in the area and generally causes only slight damage at the KES. Under mild winter and warm spring conditions in 1992, significant damage to cereal crops was experienced, with up to 50 percent of the tillers affected at KES and with serious crop losses in several commercial fields in the Lower Klamath Lake area.

PROCEDURES

All small-grain variety trials at the KES were on land planted in potatoes the previous year. Soils at the station include Poe, Fordney, and Hosley series, all of which have a fine loamy to sandy texture and are moderately deep and somewhat poorly drained. All plots were sprinkler irrigated. Irrigation was terminated in early August, approximately two weeks earlier than normal, due to early crop development and water conservation considerations.

All trials were arranged in a randomized complete block design with three or four replications. Crops at the KES were planted between May 1 and 3. Seed was planted at a depth of 1 inch. The seeding rate for wheat trials was 80 lb/A. All plots were fertilized with 100 lb N, 60 lb $P_2 0_5$, and 44 lb S/A at time of seeding. Plots measured 5 x 20 feet, with 10 rows at 6-inch spacing. Bromoxynil and MCPA were applied at labeled rates to control broadleaf weeds. Crops were harvested using a plot combine with a 5-foot wide header. Grain yield was recorded for all plots. Test weight was measured in only one replication.

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RESULTS AND DISCUSSION

Western Regional Spring Wheat Nursery

Average yield for this trial in 1992 was 5,573 lb/A (Table 1), an increase of 355 lb/A over the previous year (Table 2). Test weights were similar to those in 1991, at 61.8 and 62.0 lb/bu, respectively. The highest yielding entry in 1992 was Penawawa, a SW spring wheat. However, it was not significantly higher than a number of lines including other SW, HR, and HW lines. Penawawa is also the highest yielding entry in the trial when averaged over three years (Table 2). The HR spring wheat, ID 420, is the second highest yielding variety in the trial over a three-year period. If quality testing shows this bread wheat to have adequate milling and baking quality, this variety could substantially increase yields over current industry standards Yecora Rojo and Westbred 906R. Among the HW varieties, OR 487453 and OR 487279 were not significantly different than Klasic, the standard HW wheat in Oregon and California. OR 487279 has undergone extensive quality testing in a wheat management study. It has milling and baking quality equivalent to Klasic and is generally slightly higher in protein.

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 second year for this trial at KES. Yecoro Rojo, a standard HR variety, was included for comparison as was Klasic, the standard HW variety. Yields in this trial were average or slightly below normal, and variability within entries was high, making mean separation difficult. The variability may be due to tiller damage caused by wheatstem maggot. Test weights in this trial were high. No experimental line yielded significantly more than Klasic or Yecora Rojo (Table 3). Several experimental lines produced equivalent yields to Klasic, and warrant further testing for both yield and baking quality. The experimental line OR 4870279 was also included in the Western Regional trial discussed above, under the designation OR 487279. It produced a much higher yield in the Western Regional trial.

OSU Hard Red Spring Wheat Variety Trial

Standard HR spring wheat varieties in the Klamath Basin are Westbred 906R and Yecora Rojo. Spillman, a recently released variety, is increasing in acreage. There was not a significant difference in grain yield among these varieties in the 1992 trial (Table 4). Four entries; OR 4870400, Star, Star'S', and ORS 8413, produced significantly higher grain yields than the standards. The high yielding lines were all later in maturity than the standards. With warm spring conditions, no damaging frosts in June, and excellent fall weather, the 1992 season was very favorable for spring wheat. Under more typical Klamath Basin conditions, these varieties may not mature early enough. More testing is needed to determine the response of these high yielding, but longer season varieties to local conditions.

Commercial Hard Red Spring Wheat Variety Trial

This trial compared the yield potential of commercially available HR spring wheat varieties with that of local standards, Westbred 906R and Yecoro Rojo. None of the entries produced significantly higher yields than the standards (Table 5). Yields of standards were over 1,000 lb/A lower than in the OSU HR spring wheat trial (Tables 4-5). Glenman and Norm appear to have high yield potential and merit further evaluation. Wampum and Bronze Chief were significantly lower in yield than the standard varieties.

Table 1. 1992 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 weight	Lodge	Height	Heading date
		lb/A	lb/bu	%	inches	Julian days
1	McKay	5483	63.0	0	30	174
2	Federation	4941	60.0	0	43	181
3	Owens	5699	59.5	0	30	172
4	Penawawa	6604	62.0	0	32	173
5	Wakanz	5829	60.5	0	32	177
6	WA 7176	5666	60.0	0	33	173
7	ID 420	5764	60.5	0	27	175
8	Klasic	5170	62.0	0	28	170
9	Serra	4541	63.0	0	30	170
10	OR 487462	5346	62.0	0	28	169
11	OR 487279	5734	63.0	0	27	172
12	OR 487453	6222	61.0	0	29	178
13	UC 784	4896	62.0	0	20	170
14	UC 786	5407	62.0	0	23	173
15	UC 785	4903	61.0	0	22	177
16	ID 392	6539	63.0	0	32	174
17	ID 408	5764	58.0	0	29	173
18	UT 1708	6518	63.0	0	38	176
19	UT 1711	5909	63.0	0	36	175
20	UT 1723	5637	62.0	0	35	175
21	OR 487249	5096	60.0	0	27	171
22	OR 487255	5851	64.0	0	30	170
23	OR 488403	5704	59.5	0	29	174
24	OR 487469	5227	62.5	0	28	170
25	OR 488189	4461	63.0	0	30	173
26	ID 377S	6204	63.5	0	31	170
27	ID 410	5838	63.0	0	29	174
28	OR 489025	4840	63.5	0	31	172
29	OR 386306	6197	63.0	0	26	175
30	WA 7677	6157	63.0	0	33	176
31	WA 7702	5084	62.0	0	30	171
32	ID 439	4937	59.5	0	30	173
33	ID 440	5679	62.0	0	29	169
34	ID 441	5537	58.5	0	31	175
35	ID 429	5725	64.0	0	32	169
36	UT 1597	6011	62.0	0	32	171
37	UT 2571	5818	63.0	0	40	171
38	UT 850646	6030	61.0	0	28	174
39	Sunstar 2	5172	61.0	0	26	170
40	ML 42	4773	61.5	0	34	176
	MEAN:	5573	61.8	0	30	173
	CV (%)	10		0	7	1
	LSD (0.05)	879		0	6	3

Table 2. Summary of Western Regional Spring Wheat Nursery 1990-1992. Three-year summary of spring wheat planted at the Klamath Experiment Station, OR.

Entry	Selection	Class	Yield 1992	Yield 1991	Yield 1990	Yield 2-yr Avg	Rank	Yield 3-yr Avg	Rank
			lb/A	lb/A	lb/A	lb/A	Rank	lb/A	Rank
1	ID 420	HR	5764	5905	5606	5835	5	5758	2
2	McKay	HR	5483	4999	5229	5241	21	5237	7
3	Serra	HR	4541	4882	4492	4712	25	4638	16
4	Klasic	HW	5170	4841	5285	5006	22	5099	10
5	Federation	SW	4941	4285	3830	4613	27	4352	17
6	Owens	SW	5699	5085	4757	5392	16	5180	8
7	Penawawa	SW	6604	5652	5236	6128	1	5831	1
8	WA 7176	SW	5666	5246	4520	5456	14	5144	9
9	OR 487462	HR	5346	5203	3635	5275	20	4728	14
10	UC 784	HR	4896	4587	4497	4742	24	4660	15
11	UC 785	HR	4903	4834	4491	4869	23	4743	13
12	UC 786	HR	5407	5238	4520	5323	19	5055	11
13	OR 487279	HW	5734	5374	3924	5554	11	5011	12
14	OR 487453	HW	6222	5399	4905	5811	6	5509	4
15	ID 392	SW	6539	5504	4541	6022	3	5528	3
16	ID 408	SW	5764	5503	4974	5634	9	5414	6
17	Wakanz	SW	5829	5546	5145	5688	7	5507	5
18	OR 487469	HR	5227	5467		5347	18		
19	OR 488189	HR	4461	4821		4641	26		
20	UT 1708	HR	6518	5267		5893	4		
21	UT 1711	HR	5909	5123		5516	13		
22	UT 1723	HR	5637	5411		5524	12		
23	ID 377S	HW	6204	5953		6079	2		
24	OR 487249	HW	5096	5668		5382	17		
25	OR 487255	HW	5851	5005		5428	15		
26	OR 488403	HW	5704	5599		5652	8		
27	ID 410	SW	5838	5357		5598	10		
28	OR 489025	HR	4840						
29	OR 386306	HW	6197						
30	WA 7677	SW	6157						
31	WA 7702	HR	5084						
32	ID 439	HR	4937						
33	ID 440	SW	5679						
34	ID 441	SW	5537						
35	ID 429	SW	5725						
36	UT 1597	HR	6011						
37	UT 2571	HR	5818						
38	UT 850648	HR	6030						
39	Sunstar 2	HR	5172						
40	ML 42	SW	4773						
	Mean		5573	5250	4682	5421		5141	
	CV (%)		8	11	27	9		17	
	LSD (0.05)		606	781	1816	490		690	

Table 3. 1992 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 weight	Lodge	Height	Heading date
		lb/A	lb/bu	%	inches	Julian days
1	Klasic	5337	64.0	0	23	169
2	ORS 8413	4973	56.5	0	29	178
3	OR 4870279	5436	62.5	0	27	173
4	OR 4870453	5815	61.0	0	29	176
5	OR 4870255	5086	65.0	0	32	169
6	OR 4870374	5209	61.5	0	24	172
7	OR 4870249	4014	62.0	0	26	174
8	OR 4880391	3679	55.0	0	26	177
9	OR 4880403	5574	61.0	0	30	175
10	OR 4895143	4561	63.0	0	28	173
11	OR 4880536	5249	63.5	0	26	171
12	OR 3865306	5488	62.0	0	26	177
13	OR 4880331	5254	64.0	0	26	172
14	OR 4880372	4998	62.0	0	30	178
15	OR 4880406	4846	59.0	0	32	181
16	OR 4895175	5155	62.0	0	31	177
17	OR 4895181	5165	61.5	0	31	176
18	OR 4895182	5423	61.5	0	30	177
19	OR 4895207	4530	61.0	0	27	174
20	OR 4880496	5293	64.0	0	29	173
21	OR 4880514	4971	61.0	0	29	174
22	OR 4895222	4144	63.5	0	28	173
23	OR 4895224	3951	63.0	0	30	176
24	OR 4895246	3948	63.5	0	25	171
25	OR 4880296	4975	63.5	0	26	175
26	OR 4880348	4652	62.5	0	28	174
27	OR 4880395	4808	62.5	0	33	177
28	OR 490027	4586	62.5	0	33	170
29	OR 488528	5222	64.5	0	25	170
30	SERI 82	5762	60.0	0	26	173
31	4895179	5015	61.5	0	29	175
32	4895174	5273	61.5	0	28	176
33	FALKE	5171	63.5	0	29	171
34	Yecora Rojo	5008	64.0	0	21	169
	Mean	4958	62.0	0	28	174
	CV (%)	17		0	6	1
	LSD (0.05)	1205		0	3	2

Table 4. 1992 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 weight	Lodge	Height	Heading date
		lb/A	lb/bu	%	inches	Julian days
1	McKay	5128	62.0	0	28	174
2	Westbred 906R	4555	62.0	0	26	170
3	Yecora Rojo	4993	65.0	0	21	169
4	Spillman	4985	59.0	0	31	173
5	OR 485010	4651	62.5	0	28	173
6	Klasic	4517	65.0	0	21	169
7	OR 4870456	4822	63.5	0	27	169
8	OR 4870475	4419	60.5	0	19	171
9	OR 4870400	5893	63.0	0	32	179
10	OR 4870401	5013	62.5	0	30	177
11	OR 4870462	5329	62.5	0	29	171
12	OR 4870469	5153	64.0	0	28	169
13	OR 4880189	4648	62.5	0	27	172
14	OR 4880200	4822	64.0	0	24	171
15	OR 4870410	5212	63.0	0	30	171
16	OR 4870355	4677	63.0	0	29	177
17	OR 4895019	4559	63.5	0	25	169
18	OR 4895025	4899	63.0	0	32	174
19	OR 4895105	5514	60.0	0	27	172
20	OR 4870251	5398	64.0	0	27	171
21	OR 4895103	5465	64.0	0	30	174
22	OR 4895011	4791	64.0	0	29	170
23	OR 4895014	4367	64.0	0	30	171
24	OR 4895017	4424	63.0	0	31	176
25	OR 4895021	4775	63.0	0	27	170
26	OR 4895037	4182	62.0	0	31	178
27	OR 4895045	5097	60.0	0	30	177
28	OR 4895072	4711	63.0	0	26	174
29	OR 4895073	5310	62.5	0	26	181
30	OR 4870456	4859	62.0	0	21	171
31	OR 4870456	4429	61.5	0	20	170
32	OR 4870456	4723	60.5	0	25	171
33	OR 4870456	5372	64.0	0	29	173
34	OR 4870456	4615	61.0	0	21	171
35	OR 4870456	5186	64.0	0	29	176
36	OR 4870456	4739	63.5	0	25	170
37	OR 4920002	5624	63.0	0	27	173
38	CUMPAS86	4730	63.5	0	23	170
39	4895043	4827	64.0	0	30	175
40	Star	5989	61.0	0	28	181
41	TUI	4963	61.5	0	31	173
42	4880232	5259	60.0	0	26	177
43	Star'S'	5974	61.5	0	29	181
44	ORS 8413	5868	62.5	0	28	177
	MEAN	4988	62.6	0	27	173
	CV (%)	12		0	10	1
	LSD (0.05)	863		0	9	2

Table 5. 1992 OSU Hard Red Spring Wheat Variety Trial. Observations of grain yield, test weight, lodging, plant height, and days to 50 percent heading of spring wheat varieties planted at the Klamath Experiment Station, OR.

Entry	Selection	Yield	Test weight	Lodge	Height	Heading date
		lb/A	lb/bu	%	inches	Julian days
1	Yecora Rojo	3408	62.5	0	18	169
2	Westbred 926	3357	63.0	0	27	169
3	Bronze Chief	2620	59.0	0	24	169
4	Glenman	4025	64.0	0	29	171
5	Norm	4150	61.5	0	28	170
6	Hi-Line	3865	61.5	0	26	169
7	Wampum	1543	63.0	0	28	170
8	Newana	3856	60.0	0	29	176
	MEAN	3353	61.8	0	26	170
	CV (%)	20		0	9	1
	LSD (0.05)	1008		0	4	2

Triticale Variety Trials

Mylen Bohle, Randy L. Dovel, Russ Karow, Mathias Kolding[1]

INTRODUCTION

Triticale, a "new" crop to many growers, is a product of modern crop breeding. It is the hybrid progeny of crosses made between wheat (genus Triticum) and rye (genus Secale). The goal in making wheat-rye hybrids is to combine the high yield and high seed protein content of wheat with the broad adaptability and higher lysine content of rye. Such crosses were first successfully made in the 1870's, but the resulting offspring were sterile. Fertile progeny were produced in the late 1930's, and serious research efforts began in the 1950's. Today, triticales are grown on hundreds of thousands of acres around the world, offering new food and feed resources.

Triticales have a broad genetic base and vary dramatically in plant characteristics. Some are very wheatlike, but others exhibit more of the rye parent features. Because of their unusual genetic background, triticale varieties will vary significantly in their adaptability and in grain quality.

In the past, triticales have been frowned on in some parts of the Pacific Northwest. Growers saw triticale as just another type of rye that was likely to become a weed problem in fields where it was grown. Indeed, this may be true. At maturity, triticales will exhibit some shattering, and the resulting volunteer plants can be quite obvious in the next barley and wheat crops because of their greater height and/or head characteristics. Barley and wheat also shatter, but their volunteer progeny are often hidden in subsequent crops. Newer triticales have a shatter rate similar to currently grown wheat and barley varieties, and similar cultural practices can be used to control volunteers. In general, cultural practices for triticale are identical to those for wheat.

Older triticale varieties are tall and are susceptible to lodging. Extensive breeding efforts are producing new semidwarf, lodging-resistant varieties. Studies were initiated at the Central Oregon Agricultural Research Center (COARC) and at the KES in 1992, to evaluate established and experimental triticale selections.

1/ COARC Forage & Cereal Agronomist and OSU Crook County Extension Crops Agent; Prineville, Assistant Professor, OSU Klamath Experiment Station, Klamath Falls; OSU Extension Cereal Specialist, Corvallis; OSU Cereal Breeder, Hermiston, respectively.

Acknowledgment: Partial financial support for this study from the Oregon Grains Commission is gratefully recognized.

MATERIALS AND METHODS

COARC

Twenty-eight triticale cultivars and experimental lines (OSU and WSU), and Stephens soft white wheat were planted on October 17, 1991 at the COARC Madras site on Dogwood Lane. Planting rate was 30 seeds per square foot in a randomized complete block design, in 5 x 20 foot plots (6-8 inch rows), replicated four times. Fertilizer included 200 lb N and 60 lb S/A applied on March 11, 1992. The crop was irrigated as needed. The triticales were harvested July 29, 30, and 31 with a Hege plot combine.

Yield, test weight, crude protein, hardness factor, protein yield, 1,000 kernel weight, flower date (one replication), height, percent lodging, percent chaff, and grain N uptake were determined. Yield data are reported on a 10 percent moisture basis. Protein percentage was predicted with a near infra-red spectrophotometer (NIRS) (OSU Crop & Soil Science Dept.), and bias adjusted after calibration with micro-kjeldahl determined N.

KES

The triticale variety trial at KES was established 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. Plots were irrigated by a solid-set sprinkler system. Standard varieties of spring wheat and barley were included in the trial to compare yield of triticale to these more traditional commodities.

The trial was arranged in a randomized complete block design with four replications. Seed was planted on May 1 at a depth of 1 inch with a seeding rate of 30 seeds per square foot. The crop was fertilized with 100 lb N, 60 lb P_20_5, and 44 lb S/A at time of seeding. Plots measured 5 x 20 feet with a row spacing of 6 inches. Bromoxynil and MCPA were applied at labeled rates to control broadleaf weeds. Plots were harvested using a plot combine with a 5-foot wide header. Grain yield was recorded for all plots. Test weight was measured in only one replication.

Lodging, plant height, and heading date were recorded for each plot prior to harvest. Heading date was determined by estimating the date of 50 percent head emergence. Average triticale yield and protein content were determined without including Pika, a winter triticale variety that did not produce any grain. Damage from wheatstem maggot was assessed by harvesting 1 square foot of the plot area and examining each tiller for damage by the insect. All tillers with growing point damage typical of the wheatstem maggot were considered to be damaged by the insect. Data were summarized and expressed as percent dead tillers due to wheatstem maggot activity.

RESULTS AND DISCUSSION

COARC

Agronomic data are presented in Tables 1 and 2.

Yield: Flora and Celia ranked first and second among released cultivars in grain yield. Eight experimental lines exceeded 7,000 lb/A. These cultivars and lines all produced significantly (P=0.01) higher yields than Stephens soft white winter wheat.

Test Weight: Flora had the lowest test weight at 52.5 lb/bu. Celia, Presto, and several experimental lines were not significantly lower than Stephens wheat in test weight. FT 90478, P001 and FT 90235 combined high yields and high test weights.

Crude Protein: Breaker and Stan 1 had the highest protein level at 14.5 and 13.9 percent, respectively. Generally, higher yielding lines had lower percent protein.

Hardness Factor: This number is a reflection of kernel hardness. Stan 1 was by far the hardest kernel of the entries (even greater than hard red winter wheat numbers). It was almost 200 percent harder than any other cultivar or line.

Protein Yield: Protein production was very high for many of the triticale cultivars and experimental lines. Seven selections exceeded Stephens wheat by 40 percent or more, in pounds of grain protein per acre.

1000 Kernel Weight: Breaker and FT90478, P001 equaled Stephens' 1,000 kernel weight.

Flower Date: The earliest flowering cultivar was Newcale, the latest an FT line. Flowering dates ranged from May 18 to June 4. Breeders are presently attempting to transfer a wheat gene for earliness into the FT lines.

Height and Lodging: Plant heights varied widely. Several lines were similar to Stephens, at 40 inches or less. None of the triticales with plant heights of 40 inches or less experienced lodging, while Stephens, at 37 inches, had 61 percent lodging. Breaker is considered to be a stiff-strawed variety and generally stands well, but lodged severely in this trial. Flora and Celia were the only released cultivars that did not lodge.

"Percent Chaff": This was a measure of the amount of chaff or trash in the "combine tank." One harvest setting was used on the Hege combine for all selections. It may not be useful in determining the ease of threshability for the cultivar or line, as a combine would be adjusted for conditions and variety.

Grain N Uptake: Preplant soil analysis indicated approximately 70 lb N/A in the top foot of soil. Nitrogen fertilizer was applied at 200 lb N/A. WT 06 accumulated the most N, 165 lb N/A in the grain. This suggests fertilization may have been excessive.

KES

Agronomic data are presented in Table 3, and Figures 1 and 2.

Yield: Average triticale yield was not significantly different from the average wheat or barley yields (Table 3 and Figure 1). However, performance of individual wheat and barley varieties differed. Grain yields of Fieldwin and Westbred 926 were similar to the average triticale yield, but yields of Yecora Rojo were significantly lower. Steptoe was the highest yielding barley variety, producing significantly higher yields than all triticale lines except UC 84, 91F 26016, 91F 25012, and Eronga 83. There were large differences in grain yield among triticale varieties. Eronga 83 produced significantly higher yields than all triticale entries except UC 84, RSI 2700, 91F 26016, and 91F 25012.

Test Weight: Triticale test weights ranged from 51 to 60 lb/bu. The three highest yielding triticale varieties had test weights above 55 lb/bu. Low test weight appeared to be correlated with low yield. The lowest triticale test weights were comparable to barley test weights.

Lodging: There was no lodging in the KES trial in 1992.

Height: Most triticale varieties were significantly taller than Yecoro Rojo wheat and Gustoe barley. Plant height varied significantly among the triticale varieties. The tallest varieties were over 40 inches tall. Although lodging was not a problem in 1992, taller varieties could be prone to lodging under different conditions. Tall varieties were more difficult to harvest, and residual biomass following harvest could impede farming operations following harvest. Highest yielding varieties ranged from 35 to 39 inches tall.

Heading Date: Heading date among triticale varieties ranged from 168 to 188 Julian days, compared to 168 to 180 Julian days for wheat, and 169 to 174 Julian days for barley varieties. Only the longest season triticale line, Whitman, required too long a growing season to be grown on a regular basis in the Klamath Basin.

Grain Protein: Triticale protein contents ranged from 9.9 percent (similar to Gustoe barley) to 15.5 percent (higher than hard red wheats). Average triticale protein content was much higher than the protein content of barley varieties included in the trial. Hippo and 16-A had the highest protein contents, but both selections produced low yields. In general, high yields were associated with low protein content. This is common in small grains. Of the five highest yielding varieties, only UC 86 and RSI 2700 had protein levels above 12 percent.

Wheatstem Maggot Damage: Wheatstem maggot damage is usually minimal at the KES; however, considerable damage resulted from this pest in 1992. Samples were collected in late July and the percent damaged tillers was determined in each plot. Tiller damage ranged from 41.7 to 61.3 percent, and was not dependent on commodity or significantly different among varieties. There was no apparent correlation between percent damaged tillers and yield. It is difficult to estimate the yield reduction due to this pest; however, a trial average of 4,683 lb/A is well below expected yields.

CONCLUSIONS

Triticale appears to have potential as a viable alternative crop for central and southern Oregon. It is excellent livestock and poultry feed. Triticale is a non-program crop and may be useful as growers consider farm program options. The key to its success is further development of markets.

Flora and Celia (a new release to replace Flora) are winter varieties that would be recommended for central Oregon irrigated conditions. Flora has good winter hardiness while Celia has excellent winter hardiness. Whitman is a widely grown variety, but tends to lodge more, yield less, and is less winter hardy than Flora or Celia. Flora and Celia have excellent lodging resistance. Whitman and Celia have high test weights. Flora has poor seed characteristics. Whitman is facultative (low vernalization requirements) and can be planted in the spring. Celia may also be facultative and has been planted in a 1992/1993 statewide spring and winter variety trial to further evaluate this characteristic.

A number of high yielding triticale lines appear to be adapted to southern Oregon. The top five yielding varieties at KES were UC 84, RSI 2700, 91F 26016, 91F 25012, and Eronga 83. Of these, UC 84 and RSI 2700 had superior grain protein levels. All spring varieties matured at rates similar to wheat and barley varieties currently grown in the area. Whitman, a facultative winter triticale variety, required over a week longer to mature than the latest spring wheat in the trial. Spring planting of this variety is not recommended. Pika, another winter variety, does not appear to be facultative and is not recommended for spring planting.

Table 1. Observations of grain yield, test weight, crude protein, hardness factor and protein yield for triticale selections grown at Madras, OR, 1992.

Variety	Yield	Test Wt.	Crude Protein	Hardness Factor	Protein Yield
	lb/A	lb/bu	%		lb/A
Stephens (Check)	5406	60.3	11.4	52	612
Flora	7760	52.5	11.6	36	897
Whitman	5704	56.1	13.1	62	749
WT 51	6965	53.6	11.4	49	779
WT 06	8252	55.4	11.4	57	939
WT 11	5578	58.7	11.4	43	632
WT 17	6479	58.6	13.1	43	847
Breaker	3890	55.7	14.5	58	565
Newcale	5380	58.4	13.2	43	712
Pika	3318	55.0	13.1	55	429
Lasko	5740	59.2	12.7	51	720
Presto	5276	59.5	12.8	53	668
Stan 1	6505	59.0	13.9	130	900
"239"	4419	56.0	12.6	43	555
FT 8046	6505	54.1	11.3	60	735
FT 86044, B002	6157	53.8	12.6	52	770
FT 86044, B004	7020	53.1	11.2	45	780
FT 86044, B0017	6949	53.3	11.8	40	808
FT 86053	7874	54.7	10.5	37	823
FT 86072, B002	4670	55.2	12.6	49	584
FT 89260	6924	58.8	11.2	48	772
FT 90234	6535	57.7	12.8	49	836
FT 90235	7944	59.2	11.2	51	888
FT 90239	7454	57.0	11.3	50	838
FT 90478, P007	7529	58.4	11.4	47	852
FT 89259	6956	55.5	13.0	51	899
Celia (FT 90456)	7378	59.5	11.3	50	833
FT 90477, P003	7668	58.0	11.3	66	863
FT 90478, P001	7956	59.5	11.4	50	906
Mean	6420	56.8	12.1	52	765
LSD (.10)	901	1.5	1.0	5	85
LSD (.05)	1077	1.8	1.2	6	102
LSD (.01)	1427	2.3	1.6	8	135
CV %	12	2	7	8	10

Table 2. Observations of 1000 kernel weight, flower date, height, lodging, chaff, and grain N uptake for tritacale selections grown at Madras, OR, 1992.

Variety	1000 Kernel Wt.	Flower Date	Height	Lodging	Chaff	Grain N Uptake
	g		inches	%	%	lb/A
Stephens (Check)	47.3	5/24	36	61	5	108
Flora	39.8	5/28	39	0	6	157
Whitman	44.0	5/22	47	88	8	132
WT 51	36.2	5/30	37	0	7	137
WT 06	33.4	5/24	35	0	6	165
WT 11	30.1	5/30	49	69	11	111
WT 17	39.7	5/29	56	31	7	149
Breaker	47.6	5/30	63	98	11	99
Newcale	41.4	5/18	46	94	7	125
Pika	37.8	6/26	28	9	10	75
Lasko	37.2	5/20	52	74	5	127
Presto	42.2	5/21	53	83	5	117
Stan 1	37.3	5/24	53	89	6	158
"239"	44.5	5/22	61	86	7	97
FT 8046	39.6	6/3	46	51	11	129
FT 86044, B002	38.0	5/28	47	71	9	135
FT 86044, B004	32.4	6/4	45	44	9	137
FT 86044, B0017	31.8	6/3	42	15	9	142
FT 86053	38.8	5/30	40	0	7	144
FT 86072, B002	37.9	5/28	47	71	11	103
FT 89260	41.0	5/30	39	0	10	136
FT 90234	37.2	5/30	40	0	8	147
FT 90235	43.2	5/29	38	0	7	156
FT 90239	38.0	5/22	38	0	8	147
FT 90478, P007	39.0	5/28	41	0	9	149
FT 89259	30.4	5/30	37	0	8	158
Celia (FT 90456)	40.9	5/22	40	0	9	146
FT 90477, P003	42.4	5/30	40	0	11	151
FT 90478, P001	46.7	5/24	38	0	8	159
Mean	39.2	5/27	45	36	8	134
LSD (.10)	2.6		2	18	3	15
LSD (.05)	3.1		3	22	3	18
LSD (.01)	4.1		3	29	4	24
CV %	6		4	43	26	10

Table 3. 1992 Triticale Variety Trial. Observations of grain yield, test weight, lodging, plant height, days to 50% heading, grain protein content, and wheat stem maggot (WSM) damage of spring triticale varieties planted at the Klamath Experiment Station, OR.

Entry	Selection	Yield	Test weight	Lodge	Height	Heading date	Protein	WSM Damage
		lb/A	lb/bu	%	inches	Julian days	%	% dead tillers
1	Fieldwin	4492	64.0	0	31	180	11.6	55.8
2	Yecora Rojo	3046	61.5	0	19	169	14.3	53.6
3	Westbred 926	4519	63.5	0	31	168	14.4	51.5
4	Steptoe	6028	51.5	0	31	169	8.7	55.8
5	Gustoe	5001	52.0	0	25	174	9.7	59.9
6	Juan	5104	55.0	0	37	174	9.9	47.8
7	Stier	4741	58.0	0	32	174	11.4	56.0
8	Rhino	5051	60.0	0	34	169	11.8	55.5
9	UC 84	5212	59.0	0	36	169	13.2	43.9
10	Hippo	3741	57.0	0	32	169	15.5	53.5
11	UC 86	4446	57.5	0	31	169	12.8	53.0
12	Grace	4856	53.0	0	44	177	10.7	57.4
13	Victoria	4688	51.0	0	34	175	12.4	60.0
14	RSI 2700	5115	52.0	0	49	177	12.4	61.3
15	91F 26016	5396	56.0	0	35	174	10.1	48.1
16	91F 25003	5070	57.5	0	32	174	11.6	42.1
17	91F 25001	4451	57.0	0	35	177	11.8	60.5
18	91F 25007	4811	57.5	0	33	170	13.1	41.7
19	91F 25012	5431	55.5	0	35	174	10.0	55.9
20	91F 26102	5029	57.5	0	35	170	13.3	48.1
21	Karl	3881	52.5	0	33	174	12.2	55.4
22	Eronga 83	5922	55.0	0	39	174	11.0	45.0
23	ALAMOS 83	4838	54.5	0	32	173	13.0	51.8
24	Sunland	3604	58.0	0	37	181	11.5	50.1
25	Florida 201	3923	54.5	0	39	175	11.8	47.7
26	Whitman	3570	51.0	0	35	188	10.5	53.7
27	Frank	4888	55.0	0	38	176	12.6	44.4
28	Pika	-	-	-	-	-	-	-
29	Norico	5096	56.0	0	45	168	11.4	55.7
30	16-A	3865	58.0	0	36	173	14.5	43.3
31	16-12	4657	55.0	0	33	171	11.9	57.5
32	16-13	4713	57.0	0	35	174	11.5	57.2
	Mean	4683	56.2	0	35	174	11.6	52.4
	CV (%)	12		0	13	1		19
	LSD (0.05)	887		0	7	2		16.0

Figure 1. Comparison of grain yield of wheat, barley and triticale varieties planted at the Klamath Experiment Station in 1991. Average triticale yield was calculated excluding Pika (Entry 28), a winter variety which did not vernalize and produced no grain. Varieties are identified by entry number in Table 3.

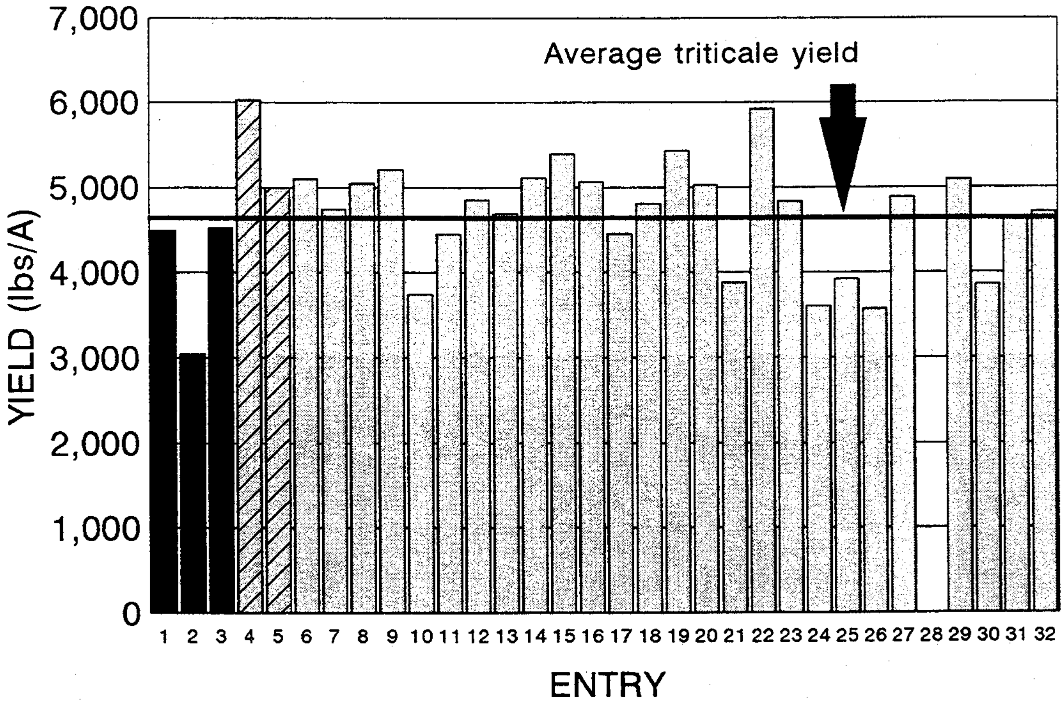
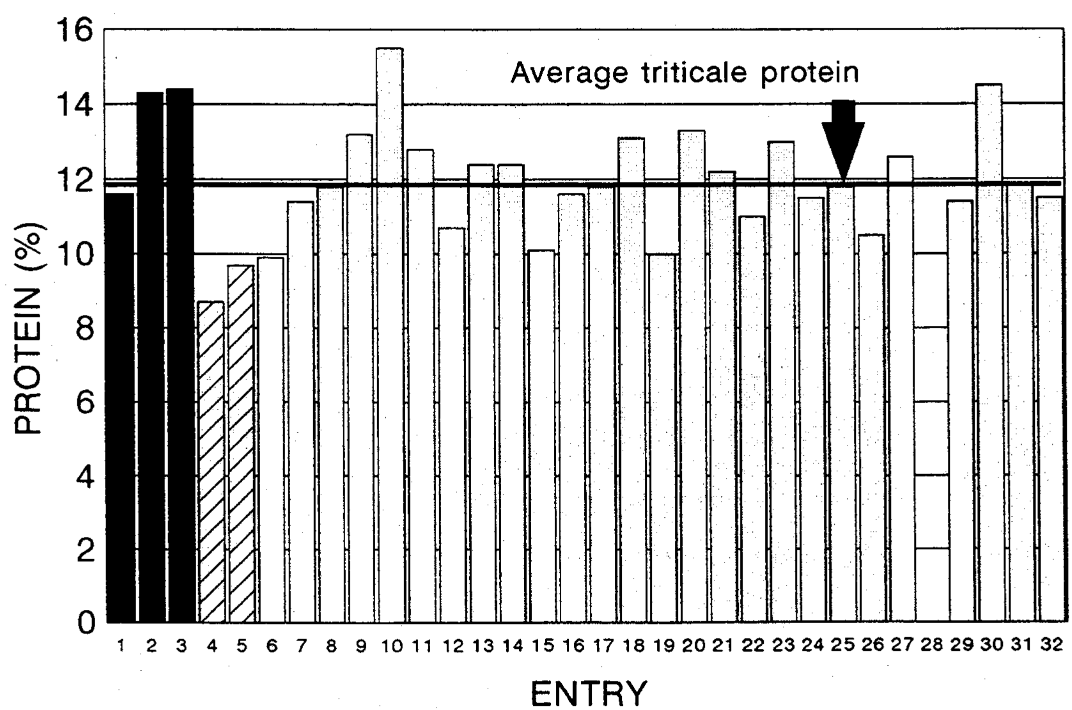


Figure 2. Comparison of grain protein content of wheat, barley and triticale varieties planted at the Klamath Experiment Station in 1991. Average triticale yield was calculated excluding Pika (Entry 28), a winter variety which did not vernalize and produced no grain. Varieties are identified by entry number in Table 3.



Oat Variety Screening in the Klamath Basin

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

INTRODUCTION

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

PROCEDURES

The Uniform Northwestern States Oat Nursery was established at KES on Fordney fine sandy loam that is moderately deep and somewhat poorly drained. The previous crop was potatoes. The crop was irrigated by a solid set sprinkler system.

The trial was arranged in a randomized complete block design with four replications. Seed was planted on April 22 at a depth of 1 inch and a seeding rate of 100 lb/A. All plots were fertilized with 100 lb N, 60 lb P_20_5, and 44 lb S/A at time of seeding. Plots measured 5 x 20 feet with a row spacing of 6 inches. Bromoxynil and MCPA were applied at labeled rates to control broadleaf weeds. Plots were harvested using a plot combine with a 5-foot wide header. Grain yield was recorded for all plots. Test weight was measured in only one replication.

RESULTS AND DISCUSSION

Oat yields were substantially lower than in the previous two years, averaging only 3,858 lb/A (Table 1). Average test weight for the trial (38.7 lb/bu) was equivalent to the average for the previous three years. The highest yielding variety in 1992 was 82Ab1178. It produced yields significantly higher than Cayuse, the standard variety in the area.

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

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

Border, a newer variety that is being planted on increasing acreages in the basin, was not significantly lower in yield than 82Ab1178. Averaged over the three-year period from 1990 to 1992, 83Ab3250 was the highest yielding variety in the trial (Table 2). Six other experimental lines produced yields equivalent to 83Ab3250. Ajay, Minimax, Ogle, and Border were the highest yielding commercially available varieties in the trial. Border is the most widely planted of these four leading commercial varieties in the Klamath Basin. Three experimental lines, 83Ab3250, 83Ab3119, and 80Ab5807, had significantly higher yields than Border over the last three years.

Lodging resistance and grain test weight are also important considerations in oat variety selection. Of the seven top yielding entries, 86Ab1867 and 80Ab5807 had the highest test weights in 1992. This trend was also seen in 1991 and 1990. Over the three-year period they averaged 40.5 and 39.7 lb/bu, respectively, compared to a trial average of 37.5 lb/bu. There was no lodging in the trial in 1992, however, lodging was present in 1991 and 1990, averaging 18 and 21 percent, respectively. Two high yielding varieties, 82Ab1178 and 83Ab3119, did not lodge in either year, and 86Ab1867 had no lodging in 1991 and only 5 percent lodging in 1990.

Table 1. 1992 Northwestern Uniform Oat Nursery. Grain yield, test weight, percent lodging, plant height, and heading date of spring oat varieties planted at the Klamath Experiment Station, OR.

Entry	Selection	Yield	Test weight	Lodge	Height	Heading date
		lb/A	lb/bu	%	inches	Julian days
1	Park	3262	38.0	0	51	183
2	Cayuse	2983	38.0	0	46	178
3	Otana	3054	41.0	0	52	181
4	Appaloosa	3861	36.0	0	49	183
5	Border	4222	38.0	0	47	182
6	Monida	3290	35.0	0	50	184
7	Ogle	3839	37.0	0	39	174
8	Calibre	2352	38.0	0	54	184
9	81Ab5792	3684	38.0	0	45	178
10	Riel	3586	40.0	0	53	181
11	80Ab5807	4442	39.5	0	46	182
12	Valley	4496	41.0	0	45	180
13	80Ab5322	4633	34.5	0	37	183
14	82Ab248	4179	35.0	0	43	182
15	82Ab1178	4978	37.0	0	40	178
16	Ajay	4461	37.5	0	34	182
17	Robert	3275	38.5	0	45	183
18	Trucker	2191	42.0	0	45	176
19	Minimax	4475	38.0	0	31	188
20	83Ab3119	4730	35.0	0	38	184
21	83Ab3250	4502	35.0	0	40	184
22	86Ab664	4840	38.5	0	44	183
23	86Ab1867	4705	40.0	0	40	174
24	Newdak	3985	37.5	0	48	176
25	ND 860416	3323	41.0	0	51	182
26	ND 852107	3045	39.5	0	51	178
27	87Ab5125	4642	37.5	0	40	183
28	84Ab825	4599	36.0	0	40	183
29	88Ab3073	4040	47.0	0	40	184
30	Derby	2417	40.0	0	56	183
31	83Ab3725	4063	38.0	0	34	180
32	Pennuda	3311	51.5	0	35	171
	MEAN	3858	38.7	0	44	181
	CV (%)	15		0	9	1
	LSD (0.05)	792		0	6	2

Table 2. Summary of Northwestern States Oat Nursery Yields, 1990-1992. Grain yields of spring oat varieties planted at the Klamath Experiment Station, OR.

Entry	Selection	Yield 1992	1991	1990	2-yr Avg		Yield 3-yr Avg	
		lb/A				Rank	lb/A	Rank
1	Park	3262	4466	3831	3864	22	3853	20
2	Cayuse	2983	4548	4049	3766	24	3860	19
3	Otana	3054	4052	3593	3553	26	3566	22
4	Appaloosa	3861	4928	3530	4395	18	4106	16
5	Border	4222	5255	4390	4739	17	4622	13
6	Monida	3290	4337	3779	3814	23	3802	21
7	Ogle	3839	5841	4267	4840	13	4649	11
8	Calibre	2352	3286	3836	2819	29	3158	25
9	81Ab5792	3684	6119	5063	4902	11	4955	7
10	Riel	3586	4660	3555	4123	20	3934	18
11	80Ab5807	4442	6464	4865	5453	2	5257	3
12	Valley	4496	5661	3428	5079	9	4528	14
13	80Ab5322	4633	5980	4423	5307	5	5012	5
14	82Ab248	4179	5352	3801	4766	14	4444	15
15	82Ab1178	4978	5856	4105	5417	3	4980	6
16	Ajay	4461	5798	3978	5130	8	4746	9
17	Robert	3275	5264	3589	4270	19	4043	17
18	Trucker	2191	4236	3414	3214	28	3280	24
19	Minimax	4475	5018	4479	4747	16	4657	10
20	83Ab3119	4730	5861	5429	5296	6	5340	2
21	83Ab3250	4502	6750	5242	5626	1	5498	1
22	86Ab664	4840	5946	3134	5393	4	4640	12
23	86Ab1867	4705	5242	5330	4974	10	5092	4
24	83Ab3725	4063	5660	4897	4862	12	4873	8
25	Pennuda	3311	3509	3228	3410	27	3349	23
26	Newdak	3985	5535		4760	15		
27	ND 860416	3323	4729		4026	21		
28	ND 852107	3045	4113		3579	25		
29	87Ab5125	4642	5779		5211	7		
30	84Ab825	4599						
31	88Ab3073	4040						
32	Derby	2417						
	Mean	3858	5181	4129	4529		4410	
	CV (%)	22	12	15	13		16	
	LSD (0.05)	1309	702	792	581		561	

Alfalfa Variety Trial

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

INTRODUCTION

Alfalfa is a major forage commodity in the Klamath Basin. It is grown on over 40,000 acres in Klamath County alone. Major markets for Klamath Basin alfalfa are dairies, cattle ranches, and horse farms in Oregon and California. Premium quality hay suitable for the dairy hay market, requires timely cutting, good weed control, and an adequate stand. Little difference in forage quality has been seen between alfalfa varieties in the past. Breeding programs are striving to improve alfalfa quality. Varieties reportedly superior in quality are beginning to be marketed; however, management still appears to have more effect on forage quality than varietal differences.

Few pests attack alfalfa in the Klamath Basin. The main diseases present are bacterial wilt and phytophthora root rot. Verticillium wilt has not been found in the basin, but it occurs in many surrounding areas. The main insect pest is the alfalfa weavil. Some breeding programs are beginning to select for resistance to this pest. Rest resistances are important variety selection criteria.

Winter hardiness is important in selecting a variety for the Klamath Basin. Winter hardiness has been closely linked with fall dormancy ratings; however, less dormant varieties have experienced reasonable stand longevity in recent years, perhaps due to relatively mild winters. Local variety trials are being used to develop empirical winter hardiness and stand persistence measurements to supplement fall dormancy ratings as a measure of variety hardiness.

Forage yield is a function of a complex set of interactions between the alfalfa plant and its environment. Variety trials conducted at the KES provide alfalfa producers locally developed data on the yield potential and persistence of new alfalfa varieties. One trial, established in 1986, was monitored for yield during the period from 1987-1990; was maintained as a commercial field in 1991 and 1992; and will be evaluated for stand persistence and yield in 1993. A trial established in 1991 is the main subject of this report.

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PROCEDURES

A trial including 48 released and experimental alfalfa varieties was established in May, 1991. Varieties were arranged in a randomized complete block design with four replications. Soil samples from the field were analyzed and the appropriate fertilizer applied prior to planting. A tank mix of EPTC and Benefin was applied prior to planting at 3 and 1.2 lb ai/A, respectively. Immediately after application, herbicides were incorporated with a rototiller. Seed was drilled to a depth of 1/4 inch at a rate of 20 lb/A using a modified Kincaid drill. Plots were 5 x 30 feet with 5-foot borders and alleyways. The crop was sprinkler irrigated with a solid set system.

Plants were allowed to grow through the first growing season with only a fall cutting. Alfalfa was harvested in 1992 when plants reached early bud stage. Unusually warm spring weather allowed four cuttings, one more than is normally obtained in trials at KES. The crop was harvested using a flail harvester with a three-foot wide head. All yields are reported on a dry weight basis.

RESULTS AND DISCUSSION

Over the first two years, most of the varieties produced similar yields. About 35 percent of the varieties were significantly higher in total yield than the standard variety, Vernal (Table 1). None of the varieties were significantly lower than Vernal. The selection of an appropriate variety should be based on pest resistance and winter hardiness as well as yield. The collection of only one full year of data is inadequate to provide an estimate of the relative yield potential of the varieties in the trial. An additional two years of data are needed to adequately assess yield potential, and preferably longer, to evaluate stand survival of these varieties.

Another 48 entry alfalfa variety trial was established at KES in 1986 and yield data was collected from 1987-1990. A four-year summary of that trial has been published in the 1990 station annual report. Sixteen of the varieties in the 1991 trial were also in the trial established in 1986. Of that group, WL 225, Arrow, Excalibur, and Vector averaged 6.4 tons dry matter (DM)/A over a four-year period. This was a significantly higher yield than Vernal. Six other entries were not significantly different than the four top yielding varieties. They were Max 85 brand, WS 320, Apollo II, Sparta, Centurion, and DK 120. Harvest of this trial was suspended in 1990; however, the trial was maintained and harvested as a hay field. These plots will be harvested as a variety trial in 1993 to evaluate the long term persistence of varieties.

Table 1. Alfalfa Variety Trial. Forage yields of 48 alfalfa varieties planted at the Klamath Experiment Station in 1991.

Entry No.	Variety	1991 Cut 1	1992 Cut 1	1992 Cut 2	1992 Cut 3	1992 Cut 4	1992 Total	2 Year Total
		lb/A						
1	DK 122	2690	7060	4350	2900	1190	15500	18180
2	DK 120	2200	7750	4500	2850	1140	16240	18440
3	DK 135	2390	6300	4300	3000	1160	14760	17140
4	DK 125	3040	6270	4210	2810	1130	14430	17470
5	Asset (VS 655)	2410	7230	4180	3030	1420	15850	18270
6	Centurion	2280	6290	4290	3250	1260	15090	17360
7	Multistar	2360	7620	3880	2780	1170	15440	17800
8	Majestic (NY 86 I-08)	2130	5760	4250	3070	1110	14190	16310
9	Sabre (NY 86 I-11)	2120	6510	4220	2880	1110	14720	16840
10	Webfoot	2240	6640	3900	2900	950	14370	16620
11	MS 90	2420	6410	4450	3100	1260	15220	17640
12	UN-74	2570	7250	4160	2890	1260	15560	18130
13	Legend	2620	6990	4220	2980	1310	15510	18130
14	Apollo Supreme	2260	6470	4240	3090	1110	14900	17170
15	Arrow	2600	6400	4180	2900	1170	14650	17240
16	Aggressor	2050	6620	3970	2870	1350	14800	16860
17	Archer	2240	6900	4360	3150	1760	16170	18400
18	Husky	1960	5980	4370	2910	1080	14340	16300
19	GS-88	2330	6050	4140	2820	1340	14330	16670
20	Ultra	2680	6850	4390	3090	1050	15380	18060
21	Expt. 91-01	1950	5590	2970	3200	1700	13450	15400
22	Max 85	2820	6500	4400	2640	1280	14820	17640
23	87-201	2720	6630	4010	2950	1690	15280	17990
24	WL-317	1940	6020	4010	2710	1070	13810	15750
25	WL-320	2340	5970	4280	3000	1460	14720	17060
26	WL-225	2870	6230	4450	2810	930	14420	17290
27	WL-316	2560	5790	4100	3100	1460	14450	17010
28	Vernal	2040	6230	4310	2660	660	13850	15890
29	Sparta	2350	6330	4120	2930	1190	14570	16920
30	Champ	2110	5710	4390	3040	1220	14360	16460
31	Fortress	2480	6630	4450	3010	1310	15390	17870
32	Multileaf II	2450	6980	3970	3120	1200	15270	17720
33	Excaliber	2490	7480	4180	3070	1320	16050	18530
34	Blazer	2650	6460	4350	3310	1410	15530	18190
35	Belmont	2280	5630	4290	3240	1360	14520	16800
36	Cimmaron VR	2720	6040	4110	3170	1440	14760	17480
37	Columbo	2650	6270	4360	2900	1310	14840	17500
38	9047 IV	2490	7290	4040	2720	1040	15080	17570
39	Milkmaker II	2560	6860	4010	2840	1040	14750	17310
40	Flint	2520	6460	3940	2920	1240	14570	16980
41	PB 5364	2520	6760	4030	2910	1130	14830	17350
42	SCO 0042	2060	4880	3580	3310	1670	13440	15500
43	SCO 0043	1920	4140	3560	2960	1730	12390	14320
44	Rancher Special	2300	7210	4400	2790	1160	15570	17870
45	Appollo II	2520	6280	4410	2980	1190	14850	17370
46	Atra 55	1730	7970	4650	3010	1390	17020	18750
47	Vector	2340	6330	4150	2870	1310	14670	17010
48	LM 331	2280	6190	4030	3110	1430	14760	17040
	Mean	2380	6460	4190	2970	1260	14870	17260
	CV (%)	16	17	10	9	16	9	8
	LSD(0.05)	530	1570	560	390	280	1780	1870

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, a variety released in the late 1940's. Quackgrass is also an important hay and pasture species in the area. Recently developed cultivars need to be evaluated for adaptation to the Klamath Basin. The acquisition of new germplasm from forage breeding programs in New Zealand and Australia add further emphasis to the development of a forage variety screening program in the Klamath Basin.

Three variety trials were established in August, 1988, to examine the relative forage production of commercially available tall fescue and orchardgrass varieties, and to compare hybrids of bluebunch wheatgrass and quackgrass with a locally acquired selection of quackgrass. The identification of a less weedy hybrid that is better adapted to both hay and pasture production would be beneficial.

PROCEDURES

Trials were established on sandy loam 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. Seeding rates were 15 lb/A for orchardgrass varieties, 12 lb/A for tall fescue varieties, and 10 lb/A for quackgrass-bluebunch wheatgrass selections and crosses. Plots were 5 x 20 feet with 3-foot wide alleyways. Crops were irrigated with solid set sprinklers.

Forages were allowed to grow uncut through the first growing season. Three harvests per year were taken when plants began to flower in 1989, 1990, and 1991. Only two harvests were taken in 1992. Crops were harvested with a flail harvester. All yields are reported on a dry weight basis. Forage quality, as determined by crude protein (CP) and acid detergent fiber (ADF), was evaluated in all trials from samples obtained at the second harvest in 1990.

RESULTS AND DISCUSSION

Tall Fescue

Tall fescue was the most aggressive species in these trials. It had the best seedling vigor, was the most competitive against weeds, and maintained stands through four years. Average yield of tall fescue was 50 percent higher than other species in 1989 and slightly

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higher than the other forage grasses over the four-year period (Tables 1-3). There was no significant difference in total forage yield between tall fescue cultivars in either 1989, 1990, 1992, or over four years. Tall fescue has been the recommended grass species for irrigated pastures due to ease of establishment, forage production, weed suppression, and stand longevity. Results of these trials support this view.

Large yield differences between years may be related to fertility management of the crop. The average crude protein content of tall fescue varieties from the second harvest in 1990 was 9.4 percent. At that CP level, the 1989 crop removed about 225 lb N/A. Fertilizer N was applied at 100 lb/A in 1989 and 1990, and at 150 lb N/A in 1991 and 1992. While these rates are typical of local management practices, research from other areas has shown tall fescue yield responses to rates up to 300 lb N/A. In a monoculture hay situation, with no nitrogen fixation by legumes, and no nutrient contribution from cattle, higher fertilizer rates may be needed to achieve the yield potential of this species. Assuming CP was consistent in all years, tall fescue hay removed approximately 120 lb N/A annually from 1990 through 1992. The probable deficiency in N may also be an important reason for the lack of yield differences among varieties.

Quackgrass-Bluebunch Wheatgrass

All entries in this trial established well. They exhibited 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 in 1989 and 1990 (Table 2). It produced similar yields to other entries in 1991 and 1992. 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. It is possible that RS MC87 will be a high-yielding variety for irrigated sites that also tolerates dryland conditions.

Forage quality evaluations from 1990 samples showed average CP and ADF of 13.4 percent and 36.9 percent, respectively. 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 was superior to all timothy, tall fescue, and orchardgrass varieties tested at KES. Average ADF values were lower than in improved species, indicating higher digestibility. CP values were higher in the quackgrass-bluebunch wheatgrass.

Quackgrass and hybrid yields were also limited by nitrogen deficiency. At CP levels of 13.4 percent, hay removed about 150 lb N/A, annually. This was greater than N removal from tall fescue, even though yields were substantially lower.

The hybrids in this trial were developed for use in dry land situations. It was thought that the incorporation of quackgrass rhizomes into bluebunch wheatgrass would result in an improved range grass. The hybrids have demonstrated good performance in rangeland situations and were competitive with a local accession of quackgrass in this study. Questions about their potential as a weed problem have delayed their release.

Orchardgrass Variety Trial

Average orchardgrass yields were higher than quackgrass yields in each year, and higher than tall fescue yields in 1990 (Tables 1-3). Although Orion produced significantly higher yields than all other entries in 1989, this trend did not continue (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. Stand longevity was clearly inferior for orchardgrass compared to tall fescue and quackgrass.

There were slight, yet statistically significant, differences in forage quality among varieties. Latar, the highest yielding variety, had the highest ADF and lowest CP values. At the average yield and CP, as determined in 1990, orchardgrass hay removed about 140 lb N/A, annually. The discussion of effects on N deficiency on yields, and relative performance of varieties, probably applies equally to all species evaluated in these trials.

Table 1. Four-year summary of forage yield of tall fescue varieties established in the fall of 1988 at the Klamath Experiment Station, OR.

	Yield				
Entry	**1989**	**1990**	**1991**	**1992**	**Average**
	------------------- lb DM/A -------------------				
--					
Fawn	14,750	7,460	7,960	8,620	9,700
Alta	14,640	7,520	7,500	8,540	9,550
Kentucky 31	16,100	7,430	8,100	8,850	10,120
Tandem	15,480	5,810	7,270	8,500	9,260
Festorina	14,430	6,660	7,790	8,540	9,360
Johnstone	14,280	7,490	7,890	9,220	9,720
Forager	15,520	8,350	7,780	8,230	9,970
Phytor	15,420	7,450	8,420	8,470	9,940
Mean	15,080	7,270	7,840	8,620	9,700
CV (%)	8	18	10	8	7
LSD (0.05)	NS	NS	1,150	NS	NS

Table 2. Four-year summary of forage yields 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	1992	Average
	----------	----------	lb DM/A	----------	----------
RS MC87	9,730	7,050	6,750	6,860	7,600
RS E876	8,260	6,660	7,410	7,300	7,410
RS Hoffman	8,570	7,000	6,560	7,530	7,420
Klamath Basin Selections	6,860	5,060	6,730	7,080	6,430
Mean	8,360	6,440	6,860	7,190	7,215
CV (%)	15	18	13	8	7
LSD (0.05)	1,960	1,860	NS	NS	840

Table 3. Four-year summary of forage yield of ten orchardgrass varieties established in the fall of 1988 at the Klamath Experiment Station, OR.

Entry	Yield 1989	1990	1991	1992	Average
	----------	----------	lb DM/A	----------	----------
Latar	11,740	9,300	8,990	8,830	9,720
Kara	9,280	7,180	5,230	7,040	7,180
Rancho	9,790	8,800	8,080	8,290	8,740
Able	8,750	7,150	7,420	8,080	7,850
Wana	8,420	5,870	5,800	7,550	6,910
Patomic	10,600	7,090	7,830	8,070	8,400
Benchmark	11,680	8,460	8,560	8,100	9,200
Comet	12,110	7,770	8,580	7,960	9,100
Orion	16,140	8,350	8,690	7,990	10,290
Crown	8,850	9,290	7,570	7,320	8,260
Mean	10,740	7,930	7,680	7,920	8,570
CV (%)	13	14	10	8	7
LSD (0.05)	2,080	1,570	1,090	940	930

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. In the race horse industry, it commands higher prices than dairy quality alfalfa hay. Interest in timothy hay is increasing in the Klamath Basin, but 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 10 commercially available Timothy varieties arranged in a randomized complete block design with four replications. Soil samples from the field 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 lb/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 per year were taken in 1989, 1990, and 1991 when plants started heading. Only two harvests were taken in 1992. Crops were harvested using a flail harvester with a 3-foot wide cutting head. All yields are reported on a dry weight basis. Crops were fertilized with 100 lb N/A in 1989 and 1990, 300 lb N/A in 1991, and 150 lb N/A in 1992.

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. Some varieties established much better than others in spite of the depth of seeding. Although stands initially appeared to be marginal, individual plants greatly increased in size, and by the second year stands appeared to be quite adequate for commercial production.

Clair was the highest yielding variety in the trial over the four-year period. The only other entry that produced yields close to Clair was Richmond. Although Richmond had the highest yields in 1989, it was not an outstanding yielding variety in 1990, and yielded less than Clair in 1991 and 1992 (Table 1). All other varieties produced similar forage yields except Drummond. It yielded significantly less than other entries. Due to the importance of stand persistence in this crop, more emphasis should be placed on

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the third and fourth year yields. Fourth year yields of Clair, Timfor, Richmond, and Basho were similar. The generally higher yields observed in 1991 are probably the result of higher fertilizer applications in that year (see discussion on page 113).

The average yield for four years exceeded 4.5 ton/A. At current market prices, this yield would result in comparable or superior net profits to alfalfa hay. However, market establishment for this commodity can be difficult, and should be arranged before crops are planted.

Forage quality was evaluated on the second harvest in 1990. Quality was very similar to tall fescue, with average CP of 9.0 percent and average ADF of 40.3 percent for the ten varieties. Basho had the highest quality with 10.4 percent CP and 39.4 percent ADF.

Table 1. Four-year summary of forage yield of 10 timothy hay varieties established in the fall of 1988 at the Klamath Experiment Station, OR.

	Yield				
Entry	**1989**	**1990**	**1991**	**1992**	**Average**
	lb DM/A				
Clair	11,920	9,330	11,930	11,220	11,100
Drummond	8,390	6,290	9,970	8,310	8,240
Timfor	9,840	6,980	11,980	10,300	9,780
Mariposa	10,970	7,120	10,480	9,930	9,630
Richmond	12,210	8,670	11,330	10,470	10,670
Bounty	9,090	6,980	9,970	9,660	8,930
Basho	7,810	8,380	11,390	10,190	9,440
Climax	8,040	8,160	10,650	9,590	9,110
Champ	9,820	6,530	10,800	8,650	8,950
Salvo	11,000	8,080	10,040	9,410	9,630
Mean	9,910	7,650	10,860	9,770	9,550
CV (%)	12	9	8	12	5
LSD (0.05)	1,780	950	1,060	1,700	640

Weed Control Effects on the Long Term Economics of Alfalfa Production

Mylen Bohle[1] and Randy Dovel[2]

INTRODUCTION

Nearly 50,000 acres of alfalfa are grown in Central Oregon and over 70,000 acres in the Klamath Basin. Though a few growers consistently produce high yields of weed-free hay, many do not. Our observations indicate that weed-free hay is often sold first, and at premium prices, while weedy hay is the last to be purchased and brings lower prices. In years of excess production, growers may be unable to sell weedy hay at any price. Most alfalfa producers in Central Oregon and the Klamath Basin do not use herbicides in the establishment year, and many do not use herbicides in subsequent years.

There are no research data to indicate the role of weed control in the first or subsequent years of alfalfa production under central Oregon or Klamath Basin conditions. With such data, research and extension workers could assist alfalfa growers with weed control decisions directly affecting the economics of alfalfa production. Field plots were established in central and southern Oregon to evaluate the economics of chemical weed control in alfalfa. Only data from the KES will be presented in this report. As further data is collected, results from both sites will be compiled and presented in a more comprehensive form.

PROCEDURES

The experiment is being conducted at the Central Oregon Agricultural Research Center's Powell Butte site (COARC), and at the KES. Herbicide treatments for spring planting include the following:

(1) a. EPTC @ 3.0 lb ai/A plus Benefin @ 1.23 lb ai/A preplant incorporated.
  b. 2,4-DB @ 1.25 lb ae (acid equivolent)/A each year after establishment.
(2) a. EPTC @ 3.0 lb ai/A plus Benefin @ 1.23 lb ai/A preplant incorpotated.
  b. 2,4-DB @ 1.25 lb ae/A the first year after establishment year.
(3) a. No herbicide treatment in establishment stage.
  b. 2,4-DB @ 1.25 lb ae/A each year after establishment year.
(4) a. No herbicide treatment in establishment stage.
  b. 2,4-DB @ 1.25 lb ae/A in year 3 or 4 or both as salvage treatment.
(5) a. No herbicide treatment in establishment year.
  b. No herbicide treatment in subsequent years.

Fall planting treatments were the same except 1a and 2a treatments were 2,4-DB @ 1.25 lb ae/A.

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Each treatment is on a 20 x 40 foot plot at COARC and KES, replicated four times in a split plot design, with establishment time as main plots and herbicide treatments as split plots. Treatments are evaluated by monitoring alfalfa crown and weed stand counts, yield, and forage quality of all cuttings each year. Weeds and alfalfa are separated. Quality is being determined with tests for crude protein, acid detergent fiber, digestible dry matter, neutral-detergent fiber, and minerals. An objective/subjective evaluation of forage quality or buyer appeal is made for hay from each plot.

Economic analysis is based on assumptions found in Table 1. Gross return after herbicide costs is calculated to evaluate cost-effectiveness of the two planting dates and five weed control regimes. Value of hay produced is determined by multiplying the yield of hay at each cutting by the price of the hay. The price of hay depends on the amount of weeds present. Hay with less than 10 percent weeds is considered dairy quality, and hay with more than 10 percent weeds is considered stocker hay. In one case, the presense of hairy nightshade made hay unfit for feed, and no value was produced by that cutting. Herbicide costs included both material and application costs (Table 1).

RESULTS AND DISCUSSION

Species composition and the density of weeds greatly affect benefits of weed control. The major weed species present following establishment of fall seeded treatments were redroot pigweed, lambsquarter, and hairy nightshade. An application of 2,4-DB was made in early September. The night following herbicide application, a severe frost effectively eliminated weeds in the plots. As a result, there was no difference in weed composition between weed control treatments in the fall of 1990. Shepherd's purse, a common weed in alfalfa fields, was noticably absent in the plot area. It is very tolerant of frost, and if present would have greatly increased weed density in plots not receiving any herbicide. Weed content of hay in treatments 4 and 5, which had recieved no herbicide treatment, was high in the first cutting of 1991 (Figure 1). Weeds present included prickly lettuce, mallow, sowthistle, filaree, and smartweed. Due to the amount of weeds present, and the objectionable quality of several spiny species, hay from these plots would not be marketable as dairy hay. Weed content was significantly lower in treatments 1-3, and hay from these treatments was considered dairy quality. There were very few weeds in any plots after the first cutting, with no differences between treatments. Hay from all treatments in both cutting 2 and 3 was dairy quality.

Herbicide treatment at planting significantly reduced weed content in the establishment year of spring planted alfalfa (Figure 2). Weed species present were Indian lovegrass (a warm-season annual), hairy nightshade, redroot pigweed, lambsquarter, filaree, and knotweed. The Indian lovegrass was mature and of very low forage quality, significantly lowering the forage quality of hay from untreated plots. Hairy nightshade was not as prevalent as Indian lovegrass, but it had an even more negative impact than the annual grass. Hairy nightshade is toxic to livestock and hay with a large proportion of this species is not a safe feed. Because of the risk of livestock poisoning, hay from treatments 4 and 5 was burned, and no value was assigned to it. In such an instance, disposal of the hay produced may even be difficult.

Weed control in the spring of 1992 was ineffective, and herbicide treatment did not affect weed content of hay. This was due to inclement weather following the application of 2,4-DB (Figures 3 and 4). However, there was a significant difference between planting dates, and in weed content in the first cutting of 1992 (Figures 3 and 4). Due to the presence of weeds in fall seeded plots, the first cutting hay was considered stock hay, while hay from spring seeded plots was dairy quality. As in 1991, there were very few weeds in any plots following the first cutting, with no difference in alfalfa or weed production between any treatments.

Figure 5 shows the total 1992 alfalfa production of the various planting and weed control treatment combinations. There was no difference in total 1992 alfalfa production due to herbicide treatment in fall established plots. However, in spring established plots, herbicide application at planting (treatments 1 and 2) resulted in higher total alfalfa production in 1992. Spring established plots receiving herbicide treatment at establishment and each year after (treatment 1), had significantly higher alfalfa yields in 1992 than all other treatment combinations.

The economic effect of differences in yield and quality due to herbicide treatment and planting date are summarized (Figure 6). In fall planted plots, treatment 3 resulted in the highest gross returns less herbicide costs; however, it was not significantly higher than those plots receiving no herbicide in the first two years of the trial (treatments 4 and 5). Returns for treatments 1 and 2 were slightly lower than the other treatments due to the cost of initial weed control, which was not needed in 1990. In contrast, treatments 1 and 2 resulted in the highest gross returns less herbicide costs in spring planted crops.

Table 1. Herbicide costs and hay prices used to evaluate economic return.

Item	Cost/unit	Cost/A
Preplant Weed Control		
EPTC	$11.60/gal	$ 4.64
Benefin	8.00/lb	20.00
Application	5.00/A	5.00
Rototilling	20.00/A	20.00
Total		$49.64
Postemergence Weed Control		
2,4-DB	$54.70/A	$34.19
Application	5.00/A	5.00
Total		$39.19
Alfalfa Hay		
Dairy quality	$90.00/ton	
Stock quality	70.00/ton	

Figure 1. Effect of five weed control regimes on alfalfa and weed production (lb/A) of fall planted alfalfa in 1991, the first year following establishment. Bars represent three cutting dates with the first cutting at the bottom. Plots were located at the Klamath Experiment Station, OR.

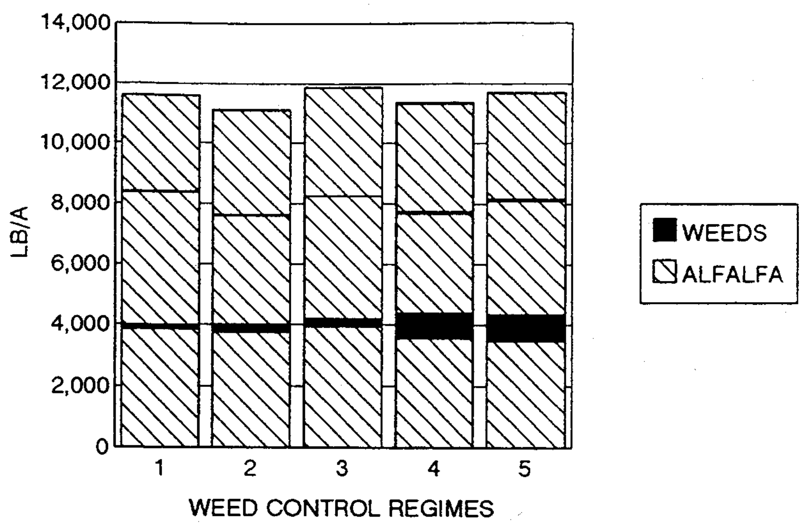


Figure 2. Effect of herbicide treatment on alfalfa and weed production (lb/A) of spring planted alfalfa in the establishment year. Bars represent one cutting taken in late August, 1991. Plots were located at the Klamath Experiment Station, OR.

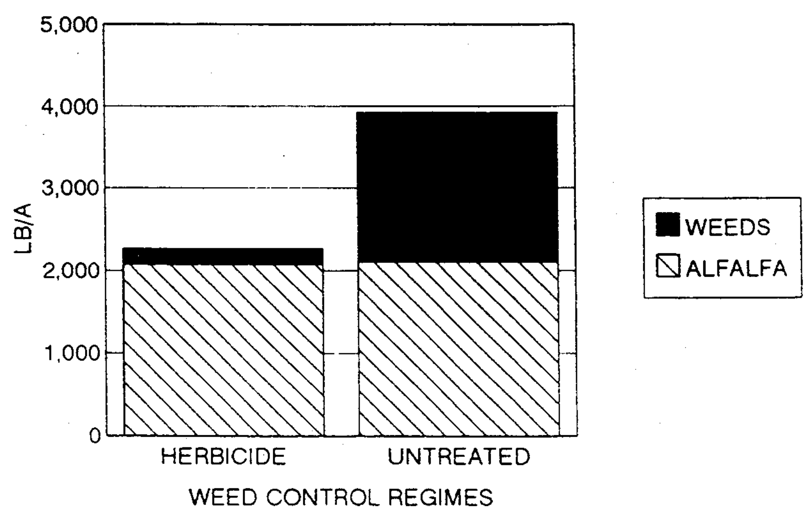


Figure 3. Effect of five weed control regimes on first cutting alfalfa and weed production (lb/A) of fall established alfalfa in 1992. Plots were located at the Klamath Experiment Station, OR.

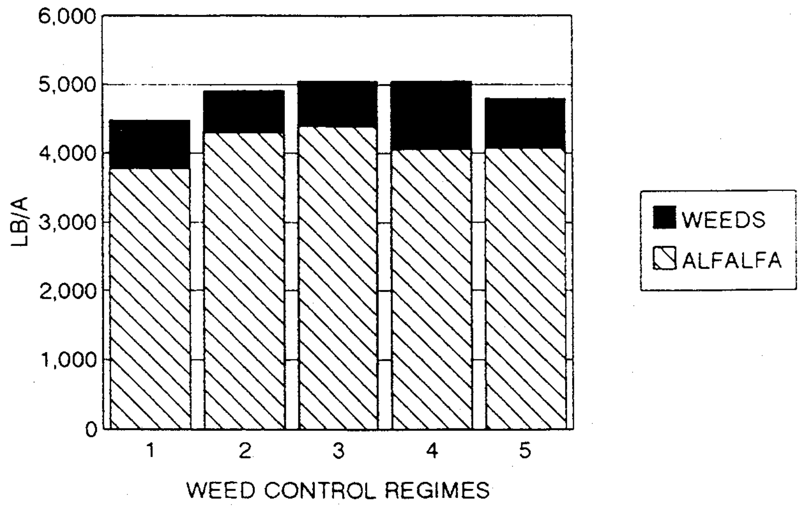


Figure 4. Effect of five weed control regimes on first cutting alfalfa and weed production (lb/A) of spring established alfalfa in 1992. Plots were located at the Klamath Experiment Station, OR.

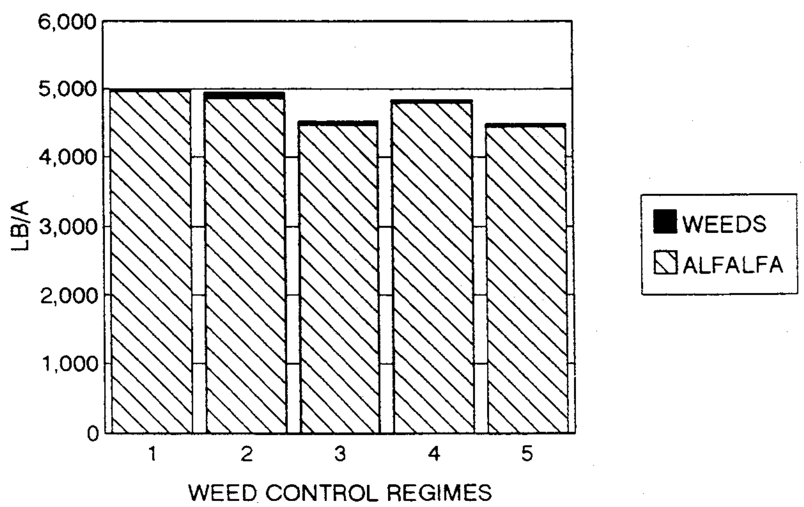


Figure 5. Effect of five weed control regimes on total alfalfa yield (lb/A) of fall and spring established alfalfa in 1992.

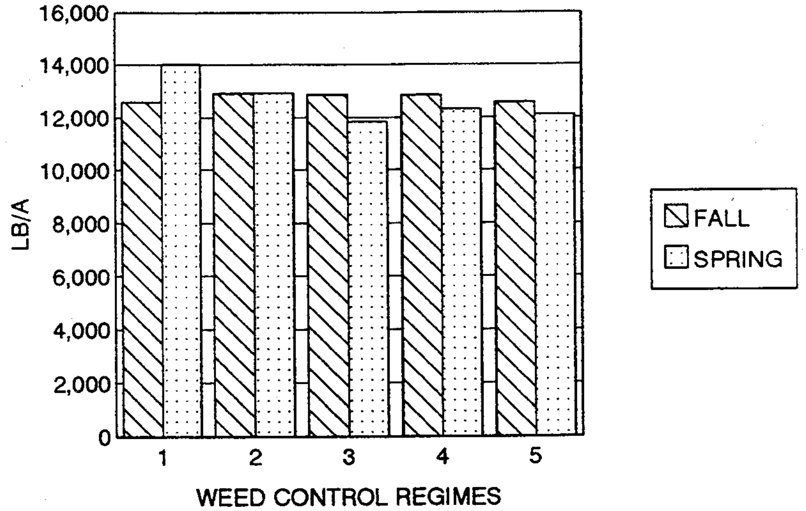
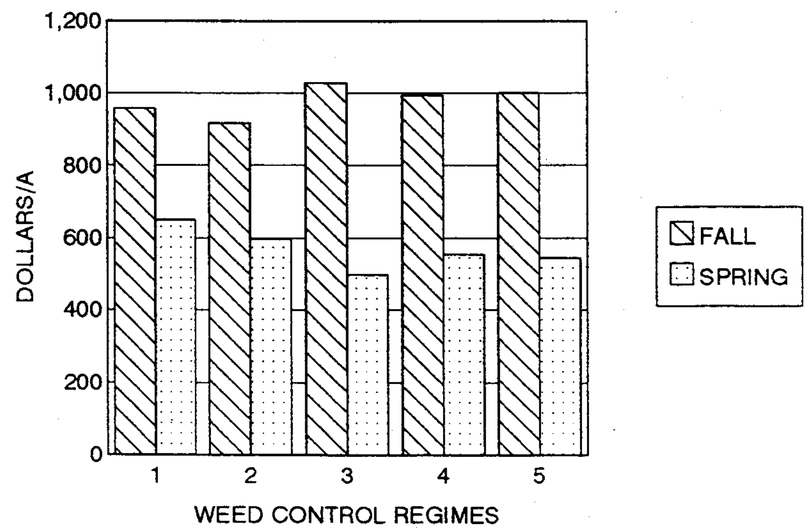


Figure 6. Effects of time of planting and weed control on estimated gross income less herbicide costs from alfalfa grown at the Klamath Experiment Station, OR.



Oregon Annual Legume Trials -1992 Preliminary Report

Randy Dovel[1], Mylen Bohle[2], and David Hannaway[3]

INTRODUCTION

Annual legumes have been used for forage production in the Klamath Basin to a limited degree in the past. There is increasing interest in their use for forage production and as a green manure crop. Annual legumes are often planted in mixtures with small grains for hay and silage. Austrian winter pea is the most common annual legume planted in the Klamath Basin. There has been little research done to compare performance of species and varieties for this or other areas in Oregon. In view of statewide interest in annual legumes, research was initiated at several locations in 1992.

Field trials were conducted at Powell Butte, Klamath Falls, and Corvallis (Hyslop Farm) to evaluate the potential of annual legumes as forage and soil improvement rotation crops. Nineteen small seeded and 19 large seeded legumes were planted in each location. Objectives of the study were to evaluate forage yield in three Oregon locations, and nitrogen supplying capability for following crops at two locations (Powell Butte and Corvallis). Due to the similar environments in Klamath Falls and Powell Butte, data from both locations are included in this report.

METHODS

Two trials were established at each location, one for small seeded and one for large seeded legumes. A randomized complete block experiment design was used with four replications. Plot size varied by location, but was a minimum of 100 ft^2. A preplant glyphosate application was made to minimize grassy weed competition at KES. Seeds of each legume were inoculated with an appropriate *Rhizobium* strain. Seeds were planted with a cone-type seeder in early June at KES and Powell Butte. Plants were harvested when the indicator species (Austrian winter pea) was in the 50 percent bloom stage. The harvested swath was weighed and subsamples were taken for drying and calculation of plot dry weight, which is reported as lb DM/A.

At Powell Butte, the crop was harvested and regrowth was disked into the soil. A wheat crop will be planted on the experimental site to evaluate residual nitrogen benefit from the annual legumes. A single harvest of the large seeded legumes was taken at KES. The small seeded legume trial at KES experienced a stand failure and was abandoned.

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RESULTS

Large Seeded Legumes

Maple pea was the highest yielding entry in the large seeded trial at KES. It produced significantly more forage than Austian winter pea, the most commonly planted annual legume in the area (Table 1). Sirius field pea produced yields equivalent to Maple pea, but it was not significantly higher than Austrian winter pea. Species adapted to cool environments, such as peas, vetches, and flatpeas, performed best at KES, while warm-season legumes such as cowpea and pinto bean showed visible signs of chilling injury. Faba beans were an intermediate group and may do well in the Klamath Basin if planted earlier.

In the large seeded trial at Powell Butte, Miranda yellow field pea and Sirius field pea were the highest yielding entries (Table 2). Maple pea and two faba beans were also in the top yielding group. Yields of all large seeded legumes except Miranda yellow field pea were higher at KES than at Powell Butte. The average yield for all entries was about 30 percent higher at KES. The relative ranking of legume species was similar at both locations. This is not unexpected in view of climatic conditions.

Small Seeded Legumes

The small seeded legume trial at KES did not establish well and data were not collected. However, one entry, Sava snail medic, established and grew well while the other entries failed to thrive. Sava snail medic was also the highest yielding entry at Powell Butte (Table 3). Three other medics and two lentils were in the top yielding group. These trials will be repeated in 1993.

Table 1. 1992 yield (lb DM/A) **and statistical ranking** of large seeded annual legumes planted at Klamath Falls, OR.

Entry	**Yield**	**Rank**[1]
	lb DM/A	
Maple Pea	6600	A
Sirius Field Pea	5560	AB
Austrian Winter Pea	5080	BC
Trapper Pea	4800	BCD
Chickling Vetch	4580	BCDE
Ackerperle Faba Bean	4460	BCDEF
Tingata Tangier Flatpea	4380	BCDEF
Miranda Yellow Field Pea	4020	CDEFG
Hertz Freya Faba Bean	4020	CDEFG
Hairy Vetch	3860	CDEFGH
UI 114 Pinto Bean	3720	DEFGHI
Timeless Aladin Faba Bean	3660	DEFGHI
Sacramento Lt Red Kidney Bean	3380	EFGHI
Dianna Faba Bean	3210	FGHIJ
Cahaba White Vetch	3020	GHIJ
Green Mung Bean	2970	GHIJ
Mississippi Cream Cowpea	2690	HIJ
Victor Cowpea	2440	IJ
Mississippi Pinkeye Cowpea	1930	J
Mean	3910	

[1]/ Entries followed by the same letter are not significantly different (P>0.05).

Table 2. 1992 yield (lb DM/A) **and statistical ranking** of large seeded annual legumes planted at Powell Butte, OR.

Entry	**Yield**	**Rank**[1]
	lb DM/A	
Miranda Yellow Field Pea	4150	A
Sirius Field Pea	4150	A
Maple Pea	4130	AB
Timeless Aladin Faba Bean	4040	AB
Dianna Faba Bean	3690	ABC
Hertz Freya Faba Bean	3600	BC
Trapper Pea	3420	C
Austrian Winter Pea	3290	C
Ackerperle Faba Bean	3230	C
Tingata Tangier Flatpea	2690	D
Chickling Vetch	2650	DE
Cahaba White Vetch	2130	EF
Hairy Vetch	1920	FG
UI 114 Pinto Bean	1770	FG
Sacramento Lt Red Kidney Bean	1440	GH
Victor Cowpea	1440	GH
Mississippi Cream Cowpea	1170	H
Mississippi Pinkeye Cowpea	1150	H
Green Mung Bean	1080	H
Mean	2690	

1/ Entries followed by the same letter are not significantly different ($P > 0.05$).

Table 3. **1992 yield** (lb DM/A) **and statistical ranking** of small seeded annual legumes planted at Powell Butte, OR.

Entry	**Yield**	**Rank**[1]
	lb DM/A	
Sava Snail Medic	3380	A
Paraggio Barrel Medic	3100	AB
Timeless T-2000 Green Lentil	2900	ABC
Santiago Polymorpha Medic	2830	ABC
Ascot Barrel Medic	2770	ABCD
Indianhead Lentil	2670	ABCD
Selection 1 Berseem Clover	2600	BCD
Borung Barrel Medic	2600	BCD
Multicut Berseem Clover	2500	BCDE
Maral Shaftal Clover	2440	BCDEF
Parabinga Barrel Medic	2350	CDEF
Bigbee Berseem Clover	2100	DEFG
Jemalong Barrel Medic	2100	DEFG
M.O.A. Alfalfa	1830	EFGH
Nitro Alfalfa	1750	FGHI
George Black Medic	1500	GHI
MTBM-5 Black Medic (Dr. B)	1330	HI
Mt. Baker Subterranean Clover	1310	HI
Youchi Arrowleaf Clover	1080	I
Mean	2690	

[1]/ Entries followed by the same letter are not significantly different ($P > 0.05$).

Alternative Forages For The Klamath Basin

Randy Dovel[1]

INTRODUCTION

Several new forage species or varieties have recently been introduced to the United States from New Zealand. Some have shown great promise in other areas but there has been little testing of this material in the Pacific Northwest and none in the Klamath Basin. Two New Zealand pasture grass varieties, Kara and Wana orchardgrass, have done quite well in other areas but have not performed well in local variety trials. Kara failed to yield as well as currently grown varieties, and Wana did not persist past the second winter. Testing of other new forage varieties is needed to determine if they are adapted to the unique environment found in the Klamath Basin.

PROCEDURES

Matua Test Strip

A test strip of Matua prairie grass was planted at KES in August, 1990, adjacent to a Timothy trial. Land was prepared for planting by rototilling, harrowing, and compacting with a Brillion cultipacker. Seed was planted 1/4 inch deep at a rate of 35 lb/A using a modified Kincaid grain drill . The area was sprinkler irrigated three times weekly for the first month after planting and weekly thereafter. Plots were fertilized with 50 lb N/A at planting and after each cutting. After dormancy, excess growth was removed with a green chopper. The crop was harvested four times in 1991 and three times in 1992. Four sections, measuring 3 x 15 feet, were harvested to determine dry matter yield and estimate variability in the test strip. Forage quality, as measured by CP and ADF, was analyzed for each cutting.

Matua N Fertility Block

A block of Matua was established at KES in August, 1991 to examine N fertilization management in this species. Planting method, depth, and rate were as described above. The 70- x 170-foot block was irrigated with solid-set sprinklers. Cutting management in the establishment year was as described above. At planting, 50 lb N/A was applied, and the following spring 50 lb N/A was also applied to the entire plot area. The block was harvested for hay in 1992 and the yields recorded. Nitrogen fertilization treatments were to be initiated in the spring of 1993.

Chickory and Sheeps Burnett Trial

A small trial was established in 1991 to examine adaptation and yield of Puna chickory and sheeps burnett. There were two entries and four replications in a randomized complete block design. The trial was established next to the Matua N Fertility trial described above. Similar establishment procedures were employed. Three cuttings were taken in 1992 and yield and quality data recorded.

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RESULTS

Matua

Initial testing of Matua in the strip trial was mainly to evaluate the winter survival of this new species under the harsh winter conditions common to Klamath County. It survived the first winter quite well, and was one of the earliest grasses to green up in the spring of 1991. The winter of 1990-1991 was not as cold as many winters in the Klamath Basin. Snowfall was a little below normal, but it could be called a typical winter for the region. Matua grew quite well in 1991, producing 16,530 lb DM/A in the first year following establishment (Table 1). Forage quality of Matua was also quite good (Table 2). The ADF content of Matua was comparable or superior to that of orchardgrass, tall fescue, and quackgrass. Protein content of Matua was very high for a grass, far exceeding levels observed in other cool season grasses at KES. Crop N removal was about 450 lb N/A, based on DM yield and protein content. Matua continued to yield exceptionally well in 1992, producing 16,510 lb DM/A. Average yields of tall fescue, orchardgrass, and timothy were 8,620, 7,920, and 9,770 lb dry matter/A, respectively.

In view of the outstanding yield and forage quality observed in the strip trial, another larger Matua planting was made in August, 1991, to examine N fertilizer response. Both the strip trial and the newly seeded block survived the winter of 1991-1992. However, some winterkill occurred in the new planting. As in the fall of 1990, excess top growth of newly established plants was removed with a green chopper after the plants went dormant. Tractor tires compacted the top growth of some plants immediately prior to harvest. Top growth of these plants was not removed. Plants with an accumulation of top growth were dead the next spring from what appeared to be fungal activity.

The mild and very dry winter of 1991-1992 did not provide a good test of winter hardiness in the Klamath Basin. The winter of 1992-1993 was not colder than usual, but record levels of snow fell in both December and January. Above normal snowfall continued through February, resulting in a continual snow cover from early December to early March. Above normal spring rains and lower than normal spring temperatures extended the period of soil saturation into April. The strip plot of Matua, which had survived normal and mild winters, was almost totally killed. Less than 10 percent of the plants survived. The larger block was planted in better drained soil and had 20-30 percent survival. However, both plots appeared to be depleted beyond commercial use.

The strip trial had been allowed to reach the soft dough stage before harvesting in 1992. Seed production of Matua is prolific and a large amount of viable seed shattered and fell to the ground. Observations in the spring of 1993 indicate that a large number of seeds germinated. While there are few surviving perennial plants, there is a very dense stand of new volunteer seedlings. Plants were not allowed to reach the soft dough stage in the N fertilization block, and fewer volunteer seedlings occur in that trial. However, plants that appeared to be dead are beginning to recover. Both trials will be harvested in 1993 to quantify stand recovery.

Matua appears to have a high yield potential and it produces high quality forage. However, the ability of this variety to persist in the Klamath Basin is in question. It may work as a short lived, self reseeding perennial. Further testing is required to clarify the potential of Matua in the Klamath Basin.

Chickory and Sheeps Burnett

Chickory is used to improve the forage quality of set stocked and intensively grazed pastures in New Zealand. It is reported to be highly digestible and to have high mineral and protein content. Chickory produced over 4 tons DM/A in the trial at KES in 1992. An adjacent alfalfa variety averaged 7.4 tons DM/A. Chickory is not a legume and does not fix nitrogen, as does alfalfa. It is not adapted to hay production, but it is best utilized in a pasture situation. This trial does not provide a good estimate of the yield potential of this species in a pasture, but does show that the species has a moderate yield potential, and it may be productive in a pasture as well. Chickory has survived two winters in the Klamath Basin, and it appears to be winter hardy.

Sheeps burnett survived both winters, and it produced 6,770 lb DM/A in 1992. This species is also recommended for pasture and range situations and may be a candidate for interseeding. Both species have been seeded in a rangeland seeding trial. Further testing is needed to identify their potential for the Klamath Basin.

Table 1. Forage yield (lb DM/A) of three new forage species at the Klamath Experiment Station, OR.

Variety/ Date	Yield				
	Cutting				
	1	2	3	4	Total
	lb DM/A				
Matua 1991	3410	1310	6260	5550	16530
Matua 1992	7750	7470	1290		16510
Chickory 1992	4430	1980	1940		8350
Sheeps Burnett 1992	4860	1400	510		6770

Table 2. 1991 Forage Quality of Matua prairie grass. Acid detergent fiber (ADF) and crude protein content (CP) of Matua at the Klamath Experiment Station, OR.

	Cutting				
	1	2	3	4	Average
	%				
ADF	40.3	32.5	41.3	35.8	37
CP	15.8	17.5	16.9	18.5	17

Alfalfa Management Research at the Klamath Experiment Station

Randy Dovel[1], David Hannaway[2], and Steve Orloff[3]

INTRODUCTION

Alfalfa is grown on almost 40,000 acres in Klamath County, and accounts for about 25 percent of total crop sales in the region. Alfalfa research at KES currently involves variety testing (pages 109-111) and several management studies. Research on alfalfa management includes the alfalfa weed management study (pages 118-123), a date of planting study, and alfalfa phenology research. Although planting date and phenological studies are incomplete, a brief description of studies in progress may be of interest to producers and colleagues.

Planting Date Trial

Alfalfa field establishment timing can have significant effects on stand density, seedling development, weed competition, yields, and ultimately, profitability. Common practice in the area includes a wide range of planting dates. Most establishment occurs from March to early June, or in mid- to late August. The warmest portion of the season is avoided, probably for concern about moisture stress. Early season planting is intended to produce a crop during the establishment year. Locally derived data on crop response to establishment timing has not been available.

University of California research has recently resulted in the development of a model to predict optimum time for alfalfa establishment. The model is based on alfalfa response to photoperiod and soil temperatures. The model predicts that under Klamath Basin conditions the optimum time to plant alfalfa occurs in the last two weeks of July, a time carefully avoided by local producers. Research in Yolo and Fresno Counties has validated the model for conditions in that part of California. Through the establishment and two subsequent years, yields were reduced by 1 ton/A in each year, when planting was delayed one month past the optimum time predicted by the model. Experience at the Intermountain Research and Extension Center (IREC) also tends to support the model; however, formal studies specifically addressing this question have not been conducted at IREC.

Experiments were established at KES and IREC in 1992 to evaluate the economics of time of planting for alfalfa under local conditions. A split-plot design includes eight planting dates in three-week intervals from early April through late August as main-plot treatments, and three varieties with dormancy ratings of 2 to 4 (typical of varieties planted locally) as split-plot treatments. Crops will be harvested individually when plants

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reach the early bud stage. Forage yield data and economics of crop production will be monitored through three years. Stand counts will be made after the first cutting in 1993 to evaluate stand establishment success. Preliminary observations of stand and vigor in the KES trial, indicate poor establishment of the late August planting. All other planting dates experienced good alfalfa survival in the first winter.

Alfalfa Phenology Studies

Alfalfa Phenology and Forage Quality

Cutting management of alfalfa requires a balance between competing interests in yield and quality. Dairy quality alfalfa commands price premiums, but at a significant yield sacrifice. Producers require reliable information on the relationship between yield and quality. They also need easily measured criteria for cutting management decision-making to meet individual producer marketing goals. Recent research in other regions has devised systems for predicting forage quality, based on simple procedures. The validity of these procedures for local conditions remains to be determined.

Phenology is the study of the development of an organism as influenced by genotype and the total environment. Alfalfa forage quality is greatly affected by age or growth stage. A 10-stage classification system has been developed to accurately determine the growth stage of alfalfa. The phenological stage of individual stems is determined and assigned a value. The mean stage by count (MSC) procedure estimates the mean stage as the average of observed stages weighted for the number of shoots in each stage. MSC is a relatively simple procedure that can be performed in the field. By correlating stage and forage quality values, the MSC has provided a quick way to estimate forage quality of growing alfalfa in some areas. However, initial studies in Oregon do not support the correlation found elsewhere. It may be necessary to modify the equation for Oregon conditions to accurately estimate forage quality using MSC values.

A second method for evaluating and predicting growth stage is the mean stage by weight (MSW) procedure. This system estimates the average of observed stages, weighted by the dry weight of shoots in each stage. The procedure is more time consuming and expensive than the MSC procedure; however, it may be more accurate as a research tool.

A cooperative study has been initiated to determine the relationship of MSC to forage quality under Oregon conditions. Samples will be collected from alfalfa fields throughout Oregon, and MSC and forage quality will be determined for each sample. Quality parameters to be determined include acid detergent fiber (ADF) and crude protein (CP). Data has been collected at KES for two years on nine alfalfa varieties. More extensive sampling at other locations will be used to compare findings at KES and other Oregon sites.

Alfalfa Phenological Models

Stage determination using MSC requires destructive sampling and processing to estimate current alfalfa phenological stages. In addition, rate of future development cannot be predicted using this method. Accurate prediction of alfalfa development stages is important in scheduling management practices such as planting, pesticide applications, irrigation periods, and harvest. Computer models have been developed to predict alfalfa phenological stage using a number of environmental measurements. Although alfalfa models have been quite successful in predicting alfalfa stage, they are still considered too complex for commercial use. Growers and crop modelers need a simple and reliable index for predicting alfalfa development. The model should be based on temperature, and accurately describe alfalfa development over a range of environmental conditions.

Temperature is the most important variable influencing alfalfa phenological development, and it is easily monitored. Other factors include photoperiod, soil moisture, solar radiation, soil conditions, and genotype. Phenological development may also vary according to fall dormancy classification, since alfalfa cultivars differ in their growth response to temperature. The concept of growing degree days (GDD) has been advanced to describe the effect of temperature on the rate of progress toward maturity for crop species. The heat unit system has found widespread use in predicting development of several cultivated crops, including wheat, cotton, corn, peas, and beans. Several studies have indicated that temperature indices (GDD) can account for more than 95 percent of the variability for corn and sorghum development.

Linear GDD models have been used to predict growth and development of alfalfa. Since alfalfa is a perennial crop, phenological models are needed for both new plantings and perennial fields. Work at OSU to further develop these models is currently underway. Validation of these models in southern Oregon with varieties from a range of dormancy groups is needed.

A study examining the phenological development of nine alfalfa varieties has been underway at KES since 1990. Three varieties were very dormant (Maverick, Spreador 2, and Vernal); three were moderately dormant (Apollo II, WL-320, and Vernema); and three were non-dormant (Florida 77, WL-605, and Madera). Phenological stage of plots was determined by both MSC and MSW procedures. A new trial was established each year, and phenological stage of the newly planted seedlings was monitored approximately every two weeks. In 1991 and 1992, perennial plots established the previous year were also sampled, and phenological stage was determined. Forage samples used to estimate phenological stage in each plot were analyzed for both ADF and CP concentration. Perennial plots were cut to a 2-inch height as close to the new planting date as possible. Phenological stage of regrowth after cutting was monitored. Forage quality and computer analysis is currently underway. Results will be used to determine the validity of existing models for Klamath Basin conditions, and perhaps they will lead to a simple model predicting alfalfa performance on the basis of easily monitored weather conditions.