Special Report 934
May 1994

Crop Research in the Klamath Basin, 1993 Annual Report

in cooperation with Klamath County

Agricultural Experiment Station
Oregon State University

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CONTENTS

INTRODUCTION

The Klamath Experiment Station (KES) presents the seventh in a current series of annual reports, summarizing KES research programs conducted in 1993. Many of the KES projects are cooperative efforts involving faculty at Oregon State University (OSU), other branch stations, or other institutions within the region. The team approach to our research efforts broadens the scope of our programs. It is appropriate to recognize those who contribute to the KES research activities in various ways. Although not all cooperators are involved in projects each year, they are an integral part of overall team efforts aimed at enhancing agricultural productivity in the Klamath Basin, Oregon, and the region.

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Dr. Ron Voss,	Department of Vegetable Crops

USDA-ARS, Aberdeen, Idaho:

Dr. Joseph Pavek,	Potato Genetics
Dr. Darrell Wesenberg,	Cereal Genetics

North Dakota State University:

Dr. Robert Johansen,	Department of Horticulture and Forestry
Dr. Gary Secor,	Department of Plant Pathology

Financial support of KES research programs is derived from a variety of sources. As state and county fiscal constraints reduce these traditional funding sources, the support from grower commodity organizations, industry, and federal grants becomes more vital to the continuation of programs at KES. Reports on individual research projects include recognition of this support.

The continuing support of KES by the Klamath County Board of Commissioners is gratefully recognized. Klamath County owns the land and buildings at KES, has provided substantial funding in the past six years for facility improvements, and funds two full-time positions. This investment in the agricultural industry of Klamath County is testimony to the Board's recognition of the economic importance of agriculture to the county and the region, and the contributions of research to the industry.

A KES milestone was achieved in 1993, when both faculty members were granted indefinite tenure and promotion. For the first time in over two decades, the KES has two tenured faculty positions. The support of colleagues, local producers, university administrators, the KES Advisory Board, and most importantly, KES staff members, that made this possible is deeply appreciated.

Ken Rykbost, Superintendent
KLAMATH EXPERIMENT STATION

STAFF AT KES

Dr. Kenneth A. Rykbost	Superintendent, Professor of Crop and Soil Science
Dr. Randy L. Dovel	Associate Professor of Crop and Soil Science
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Weather and Crop Summary, 1993

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

The Klamath Basin and the region experienced a dramatic change in weather conditions in 1993. A seven-year period of below normal precipitation that led to the first water restrictions for irrigation in the Bureau of Reclamation's Klamath Project in 1992, ended with record snowfall in the winter of 1992-1993. The previous Klamath Falls snowfall record of 78 inches was bettered by 20 inches. Plentiful spring rains contributed to total precipitation of about 150 percent of normal for the water year, from October 1, 1992 to September 30, 1993. Late snowmelt and spring rains delayed field access in poorly drained soils. Field activities were as much as three weeks late in portions of the basin. Further adversity for local crops resulted from low temperatures through most of the spring and summer. Frosts occurred in each month. Average air temperatures from April through October were 4 °F lower than in 1992, and 2 °F below the mean for the past 15 years. These conditions had major implications for local crop production.

An official weather station is maintained at Kingsley Field, one-half mile east of the KES. It is at 4,092 feet elevation, 42°09′ N latitude, and 121°44′ W longitude. KES also maintains limited weather observation capabilities. Observations at KES are generally in good agreement with those at Kingsley Field, except that minimum daily air temperatures are usually 2 to 4 °F lower at KES. This is probably due to the proximity of large buildings to the Kingsley Field station. Weather records are summarized on a weekly basis for the period of April 1 through October 27 (Tables 1-3). This 30-week period represents the majority of the local field activity season from early field preparation to harvest of most crops. "Climatological Data, Oregon", published by the National Oceanic and Atmospheric Administration, provided the data base for a portion of these records. KES data were used to replace missing observations for years prior to 1989, and are the base for 1989 through 1993 data. The 1993 data are compared with 14-year means for the period from 1979 through 1992. This period includes several of the warmest years since official records began at Klamath Falls in 1949.

Air temperatures in 1993 were near the averages from 1979 to 1992 for May, September, and October (Table 1). April and June were about 3 to 4 °F cooler, and July and August about 6 to 7 °F cooler than the 14-year means. Frosts were officially recorded at KES on June 8, 12, 22, and 23, and August 25. Temperatures at the crop canopy are lower than those recorded in the weather station. Frost protection with sprinkler irrigation was required for potatoes at the KES on July 14 and August 25. In lower elevation areas in the southern portion of the basin, frosts occurred almost daily from July 3 through July 21 and on several nights in August. Minimum air temperatures in these frost prone areas are commonly 5 to 7 °F below temperatures

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

recorded at KES. Cool nights continued through September, with frosts recorded at KES on September 14, 15, 24, 25, and 27. Minimum temperatures reached 24 °F on September 24. The 1993 frost-free season at Klamath Falls was officially 63 days, but at crop canopy level was effectively 42 days. In comparison with the previous 14 years, 1993 experienced more frequent frosts in April, June, and September, but less frequent frosts in May (Table 2).

Brief periods of high temperatures occurred in the first week of August and the first week of September. Daily maximum temperatures from 90 to 93 °F were recorded on August 3-6, and September 9-11. This was a significant change from 1992, when temperatures reached 90 °F on 23 days, including one day in May and three days in June.

Precipitation was well above normal for April, May, and June (Table 3). This followed over 6.5 inches of precipitation during the first three months of 1993. In 1992, crops required irrigation before or shortly after planting. Excessive soil moisture was experienced in 1993. Drainage of fields that are typically flooded during the winter was delayed up to a month beyond normal by limited pumping and drain capacities. Extensive areas reclaimed from Lower Klamath Lake were not accessible for field work until mid June. Crops required little, if any, irrigation until late June. Total irrigation requirements for the season were at least 25 percent below normal.

Precipitation patterns returned to below normal in late summer. Total rainfall at KES from October 1 to December 31 was 2.57 inches in 1993, compared to 5.65 inches for the same period in 1992. January through March 1994 rainfall was also below normal. Water storage for irrigation may again become a concern in 1994.

Effects of weather conditions experienced in 1993 on agricultural production were varied. Plentiful rainfall restored stock-water ponds and reservoirs to adequate levels and produced excellent conditions for rangeland and irrigated pastures. First cutting hay crops were produced without irrigation in some cases. Hay harvest was delayed by cool weather and rains in late May and early June. Hay yields were only fair as cool weather slowed regrowth, but quality was improved by the cool season. Rain in early August caused quality losses in a significant acreage of alfalfa. Third cutting alfalfa produced low yields. Losses in yields were partially compensated by higher prices received for all classes of hay and improved quality in alfalfa.

Cereal crop performance ranged from excellent in fields that were planted early to very poor in situations where planting was delayed into late June. Cereal harvest was about two weeks later than normal for crops planted early and extended well into October for late-planted crops. Both yields and quality were reduced in late fields, with very low test weights in some cases. Record yields were observed in some of the early plantings. Russian wheat aphid damage was light compared with the previous two years. Wheatstem maggot injury was spotty, but losses were serious in a few fields. This problem seems to be concentrated in fields adjacent to quackgrass pastures, which may provide overwintering habitat for the adult stage and probably experience yield losses due to tiller injury. Common root rot was more serious than either insect problem, causing very substantial losses to some crops. Experience at the KES suggests that Gustoe barley is highly susceptible to common root rot.

Potato yields and quality were also widely varied depending on time of planting. Planting was delayed two to three weeks in northern portions of the Klamath Basin. Russet Burbanks planted in June produced low yields and very small tuber size. Russet Norkotah, planted late, produced much better tuber size, resulting in better returns to growers, even though total yields were lower than for Russet Burbank. Crops planted early achieved better yields and size. Some hollow heart and brown center was observed, principally in early-planted crops. Tuber roughness was also common in early-planted Russet Burbank. Excessive soil moisture in July, in areas where frost protection was required almost nightly for three weeks, contributed to some disease problems. Pink rot and pythium (leak) were observed in these fields. Low soil temperatures and high soil moisture content provided favorable conditions for rhizoctonia, which affected crops more in 1993 than in recent years.

The combined effects of late planting, low temperatures throughout the season, and hard frosts in late September, affected potato sugar levels. French fry tests on KES variety trial samples showed high sugar levels and dark fry color in varieties that normally fry light. Local restaurants that French fry potatoes report they are unable to find local potatoes that will consistently fry light. This situation would have very serious consequences if there were a French fry processing operation in the Klamath Basin. One positive effect of the cool season was reduced nematode injury. Rootknot nematodes probably produced one less generation than normal. Reports of nematode damage to local crops are very limited.

Sugarbeet crops were adversely affected by growing season conditions in several ways. Frost injury resulted in stand losses on beets in the 4- to 6-leaf stage in areas south of Tulelake on June 12. Several hundred acres replanted in mid June produced low yields. Herbicide injury to plants stressed by frosts, insect, and wind damage reduced crop vigor. Herbicide efficacy on weed populations was reduced and weed competition reduced yields in some fields. Average yields declined from 20 tons/acre in 1992 to 18 tons/acre in 1993. Sugar content averaged 17.5 percent in 1993; down from 18.5 percent for 1992 Klamath Basin crops. The net effect of these differences was to lower gross returns by approximately $100/acre. Diseases were not a factor in the 1993 crop. Flea beetle injury was minimal in fields treated with Temik; about 50 percent of the local acreage. A late season infestation of black bean aphids did not damage crops, but may be a concern for the future as this insect is a vector for viruses causing beet yellows, beet western yellows, and beet mosaic.

Table 1. Weekly average maximum, minimum, and mean air temperatures for 1993 and the 14-year period from 1979 to 1992, and the accumulated departure of 1993 weekly means from the 14-year average at Klamath Falls, OR.

		1979-1992 Weekly average			1993 Weekly average			1993 Accumulated
Weekly Period		Max	Min	Mean	Max	Min	Mean	departure[1]
		°F						
April	1-7	55	29	42	50	32	41	-1
	8-14	58	30	44	49	30	40	-5
	15-21	60	33	47	54	32	43	-9
	22-28	59	32	46	54	32	43	-12
	29-5	63	34	49	62	35	49	-12
May	6-12	62	34	48	66	37	51	-9
	13-19	66	35	51	72	41	56	-4
	20-26	70	40	55	68	42	55	-4
	27-2	69	41	54	62	42	52	-6
June	3-9	70	42	56	59	38	48	-14
	10-16	73	43	58	69	39	54	-18
	17-23	76	45	61	76	43	59	-20
	24-30	78	47	63	76	43	59	-24
July	1-7	78	47	62	76	40	58	-28
	8-14	81	48	64	78	38	58	-34
	15-21	83	50	67	70	38	54	-47
	22-28	85	50	67	73	44	59	-55
	29-4	85	49	67	84	51	68	-54
Aug.	5-11	86	50	68	84	46	65	-57
	12-18	84	48	66	73	43	58	-65
	19-25	81	46	64	76	40	58	-71
	26-1	79	43	61	78	42	60	-72
Sept.	2-8	80	44	62	85	46	66	-68
	9-15	76	40	58	82	37	60	-66
	16-22	73	38	55	68	36	52	-69
	23-29	73	38	55	79	34	56	-68
	30-6	73	36	54	79	37	58	-64
Oct.	7-13	69	34	52	61	35	48	-68
	14-20	63	30	47	59	30	45	-70
	21-27	61	32	47	68	31	49	-68
Mean		72	40	56	70	38	54	

[1]/ Accumulated difference in mean weekly temperature between 1993 and the 14-year period from 1979-1992.

Table 2. Weekly minimum air temperatures and percent of days with frost for 1993 and the 14-year period from 1979 to 1992 at Klamath Falls, OR.

Weekly Period		Weekly minimum 14-year	Weekly minimum 1993	Frost days/week 14-year	Frost days/week 1993
		°F		%	
April	1-7	11	27	77	57
	8-14	17	23	64	71
	15-21	17	25	49	71
	22-28	20	25	53	57
	29-5	19	28	35	43
May	6-12	23	28	48	43
	13-19	19	34	36	0
	20-26	24	40	18	0
	27-2	27	30	20	14
June	3-9	28	27	7	14
	10-16	27	30	6	29
	17-23	30	37	3	0
	24-30	31	36	0	0
July	1-7	33	34	0	0
	8-14	35	34	0	0
	15-21	36	37	0	0
	22-28	35	36	0	0
	29-4	39	36	0	0
Aug.	5-11	37	42	0	0
	12-18	37	39	0	0
	19-25	31	30	2	14
	26-1	32	38	1	0
Sept.	2-8	31	42	3	0
	9-15	24	29	10	29
	16-22	26	33	14	0
	23-29	26	24	20	43
	30-6	20	33	22	0
Oct.	7-13	18	27	36	43
	14-20	18	22	67	57
	21-27	20	25	58	57

Table 3. Weekly and accumulated precipitation for 1993 and the 14-year period from 1979 to 1992 at Klamath Falls, OR.

Weekly period		1979 - 1992		1993	
		Weekly	Accumulated	Weekly	Accumulated
		Precipitation, inches			
April	1-7	.13	.13	.36	.36
	8-14	.11	.24	.11	.47
	15-21	.21	.45	.48	.95
	22-28	.27	.72	.24	1.19
	29-5	.14	.86	.40	1.59
May	6-12	.15	1.01	.07	1.66
	13-19	.21	1.22	.00	1.66
	20-26	.21	1.43	.58	2.24
	27-2	.25	1.68	1.45	3.69
June	3-9	.20	1.88	.88	4.57
	10-16	.12	2.00	.00	4.57
	17-23	.06	2.06	.00	4.57
	24-30	.11	2.17	.00	4.57
July	1-7	.07	2.24	.00	4.57
	8-14	.02	2.26	.00	4.57
	15-21	.17	2.43	.01	4.58
	22-28	.05	2.48	.05	4.63
	29-4	.07	2.55	.00	4.63
Aug.	5-11	.06	2.61	.08	4.71
	12-18	.06	2.67	.88	5.59
	19-25	.14	2.81	.10	5.69
	26-1	.25	3.06	.00	5.69
Sept.	2-8	.09	3.15	.00	5.69
	9-15	.10	3.25	.00	5.69
	16-22	.42	3.67	.13	5.82
	23-29	.17	3.84	.00	5.82
	30-6	.07	3.91	.12	5.94
Oct.	7-13	.16	4.07	.42	6.36
	14-20	.06	4.13	.35	6.71
	21-27	.39	4.52	.00	6.71

Red-skinned Potato Variety Development,1993

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

INTRODUCTION

The quest for superior red-skinned potato varieties for western states was continued and expanded in 1993. Progeny from red-skinned crosses at North Dakota State University and USDA-ARS Aberdeen, Idaho potato breeding programs were screened in single-hills at KES. Advanced selections from the KES program were evaluated in replicated yield trials at two sites in the Willamette Valley of Oregon and at KES, and in replicated or observational trials at two California locations. Three KES selections were also included in observational trials in Texas and Colorado. Three selections from 1989 single-hills will be promoted to a western regional red-skinned variety trial in 1994.

In response to a growing interest in red-skinned potato varieties in several production areas, a regional red-skinned potato variety trial was established in 1993. Six numbered selections and three standard varieties were evaluated at two locations in California and one each in Colorado, Oregon, Texas, and Washington. The KES compiled data from all locations and prepared a trial summary report for review by western regional cooperators.

I. SINGLE-HILL SEEDLING SCREENING

Procedures

The North Dakota State University potato breeding program provided 7,354 first-generation mini-tubers from 50 crosses. The USDA-ARS Aberdeen, Idaho breeding program supplied 1,639 mini-tubers from 10 crosses. Tuber families were preselected on the basis of skin color, firmness, size, shape, and degree of sprouting to reduce the number of clones planted to 3,869.

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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 Cooperative State Research Service (CSRS), the USDA Agricultural Research Service (ARS), and the Oregon Potato Commission. The North Dakota State University and USDA-ARS Aberdeen, Idaho potato breeding programs supply all tuber families for first-year screening.

All KES red-skinned screening trials were planted in a field that was in spring barley in 1992. The field was fumigated with Telone II (1,3 dichloropropene), applied at 18 gallons per acre (gpa), on May 18. Gypsum was broadcast at 1 ton/acre (ton/A) and plowed down on May 27. Clones were planted at 36-inch spacing in 32-inch rows with a two-row, assisted-feed planter on June 10. Fertilizer was banded at planting at 900 lb/A of 15-15-15. Granular Di-Syston was banded in the seed furrow at planting at 3.0 lb active ingredient (ai)/A. Herbicides Dual and Prowl were applied with a conventional ground sprayer at 1.5 and 0.75 lb ai/A, respectively, on June 15 and incorporated with a rolling cultivator. Aerial applications for disease and pest control included: Ridomil/Bravo at 1.5 lb ai/A and Monitor at 0.75 lb ai/A on July 29; Ridomil/Bravo at 2.0 lb ai/A on August 14; and Kocide at 1.0 qt/A and Monitor at 0.75 lb ai/A on August 29. Vines were desiccated with 2.0 gpa Des-i-cate, applied with a ground sprayer on September 11.

Results and Discussion

Emergence was delayed by low soil temperatures, high soil moisture content, and rhizoctonia injury to stems. Serious stand losses occurred due to herbicide injury. Final population of healthy plants was only about 30 percent. Under normal conditions, over 90 percent stands of healthy plants are typical for single-hills from mini-tubers. Plants that were healthy remained very vigorous in mid September and were difficult to topkill.

Tuber families were dug with a two-row digger on October 4. A total of 30 clones were selected at harvest and stored under typical seed storage conditions at the KES. Selection criteria included skin color, shape, tuber numbers and size, and eye depth. Five tubers from each clone selected were eye-indexed and virus tested. Virus-free lines will be planted in 12-hill plots at KES in 1994. Clones selected included 22 North Dakota and 8 Idaho lines (Table 1). Four of the Idaho selections were progeny of crosses with NDO 2438-7R, a promising 1989 selection from KES.

II. SECOND GENERATION SEEDLING SCREENING

Procedures

Twenty-seven selections from 1992 single-hills were eye-indexed and grown in a greenhouse for disease evaluations. All were virus-free, and were planted in 12-hill plots on June 10. Seedpieces were tuber-unit planted with 9-inch spacing between seedpieces and 18-inch spacing between units in 32-inch rows. Cultural practices, time of harvest, and selection procedures and criteria were as described for single-hills.

Results and Discussion

Emergence and plant vigor was generally good, although several selections suffered minor herbicide injury. Observations were made throughout the season on emergence, plant type, vigor, and vine maturity. Eight clones were selected at harvest for further evaluation (Table 2). Selection criteria included all factors considered for single-hills, with added emphasis on tuber yield and size and shape uniformity. Thirty tubers from each clone selected were eye-indexed and greenhouse tested for disease evaluation. Virus-free material will be planted in 50-hill plots at KES in 1994. Five tubers from each selection will be provided for observational plots at Tulelake, CA.

III. THIRD GENERATION SEEDLING SCREENING

Procedures

Eleven selections from 1991 single-hills were planted in 50-hill plots at KES on June 10. Seedpieces were spaced at 9 inches in 32-inch rows. All cultural practices were as described for single-hill plots. Two of these selections; NDO 3994-2R, and NDO 4030-12R were also planted in 27-hill observational trials at Tulelake and Bakersfield, CA. Bakersfield trials were planted in early February and harvested in early June. Tulelake trials were planted in mid-May and harvested on September 13. The KES trial was harvested on October 4. Seed of all entries in this trial was increased at Madras, OR.

Results and Discussion

Emergence, plant vigor, and vine maturity notes were taken at each trial site. At KES, herbicide injury was observed in several of the clones. Plant stands ranged from 82 to 98 percent. Four clones were selected at KES for further evaluation; NDO 4232-1R, NDO 4300-1R, NDO 4323-2R, and NDO 4333-1R (Table 3). One clone; NDO 4030-12R, was selected at both Tulelake and Bakersfield. It experienced herbicide injury at KES. NDO 3994-2R was also selected at Bakersfield. These two selections will be advanced to replicated yield trials at Willamette Valley, KES and California sites in 1994. The four KES selections will be included in observational trials for one more year, as seed supplies are limited. Thirty tubers of each clone have been eye-indexed. Virus-free material will be used for observational trials.

IV. ADVANCED TRIALS

Procedures

Three standard red-skinned varieties, one selection from the Oregon variety development program, and 12 advanced selections from the KES program were planted at KES in a randomized complete block design with four replications on June 9. Individual plots were one row, 22 feet long. Seed was hand cut to 1.5 to 2.0 ounces per seedpiece, treated with Tops 2.5 (thiophanate-methyl) fungicide, and suberized for 10 days before planting. Seed was planted at 8.7-inch spacing in 32-inch rows with an assisted-feed planter. Other cultural practices were as described for single-hill seedlings (page 10).

Potatoes were harvested with a one-row digger-bagger on October 6. All tubers were stored and graded according to USDA standards on October 28. Tuber appearance ratings were scored for color, eye depth, shape, shape uniformity, and skinning damage. Specific gravity was determined by the weight-in-air, weight-in-water method on a 10-pound sample of 6- to 10-ounce U.S. No.1 tubers. Ten large tubers from each plot were cut to inspect for internal defects. Sub-samples of U.S. No.1 tubers were stored until mid December and evaluated for culinary quality for boiling, oven baking, and microwave preparation methods.

A replicated yield trial at Corvallis, Oregon included all entries in the KES trial except NDO 2686-4R. Plots were 35 hills at 9-inch seed spacing, with four replications. Standard commercial practices were followed for disease and pest control. The trial was planted in mid-June and harvested in late September. All tubers from each plot were graded in October. Specific gravity was determined by the weight-in-air, weight-in-water method.

A replicated yield trial at Sherwood, Oregon included three red-skinned standards and NDO 2438-7R, NDO 3849-12R, NDO 4001-2R, and COO86107-1R. This experiment was decimated by late blight. No meaningful data was obtained for most selections in the trial.

Several advanced selections from the KES program were included in replicated yield trials at Tulelake and Bakersfield, CA. Plots were 27 hills with four replications. The Bakersfield trial was planted February 16 and harvested June 21. The Tulelake trial was planted May 12 and harvested September 13. Standard cultural practices were followed. All tubers from each plot were graded the day after harvest.

Results and Discussion

KES

Crop establishment and early development was delayed by cold, wet soil conditions and minor herbicide injury to some selections. Final plant stands were acceptable for all selections except NDO 2686-4R (Table 4). Vine vigor was only fair at best, and several selections produced small, weak vines. None of the selections were earlier in maturity than Dark Red Norland. Two selections; NDO 2469-1R and NDO 4001-2R, were later in maturity than Sangre. Most selections exhibited better color, shallower eyes, and more uniform tuber shape than the Red LaSoda and Sangre standards (Table 4).

The highest marketable yield was achieved by NDO 2438-7R (Table 5). This selection had slightly smaller tuber size than Red LaSoda. NDO 2469-1R and NDO 2686-6R produced relatively high yields of small tubers. Each of these selections also achieved high yields in a replicated trial at KES in 1992. Other selections with fair yields in both 1992 and 1993 included NDO 2438-6R and COO86107-1R. NDO 3846-9R was not included in the 1992 trial, but produced fairly high yields of small tubers in the 1993 trial. Culinary tests showed acceptable quality in all clones with the exception of NDO 4001-2R. This clone was downgraded in the baking test but was acceptable when boiled or microwaved.

Corvallis

Most of the selections that produced high yields in the KES trial also had relatively high yields in the Corvallis trial (Table 6). Tuber size of U.S. No.1s was not differentiated, but can be deduced from yield of tubers under 4 ounces and mean tuber weights. All selections except NDO 3846-3R, NDO 3846-9R, and NDO 4001-2R achieved marketable yields as high as Red LaSoda. Highest yields occurred for NDO 2469-1R, NDO 2438-6R, NDO 2438-7R, and NDO 2686-6R.

Sherwood

Late blight invaded the foliage of varieties in this trial quite early in the season. Most varieties were seriously affected and yields were very low. Total yields of U.S. No.1s were 48 and 28 cwt/A for Dark Red Norland and Red LaSoda, respectively. NDO 2438-7R had less defoliation from late blight and produced 106 cwt/A of U.S. No.1s, the highest yield of 16 entries in the trial. This suggests that NDO 2438-7R has some degree of resistance or tolerance to late blight. This selection will be included in late blight screening trials in Washington and New York in 1994.

Tulelake

Six advanced KES selections, and Red LaSoda and Sangre standards were included with several other varieties and selections in this trial. Yields and specific gravity are presented only for the eight selections of interest to this discussion (Table 7). As in other trials, NDO 2438-7R produced a higher yield of No.1s with smaller tuber size than Red LaSoda. Other selections with outstanding performance were NDO 2686-6R and NDO 3849-12R.

Bakersfield

Ten advanced KES red-skinned selections were compared with three standard reds and 17 additional varieties and selections. Data are presented for the standards and KES selections (Table 8). Red LaSoda produced a high yield, but a high percent of large tubers. KES selections with high yields of smaller tubers included; NDO 4001-2R, NDO 2438-7R, NDO 4030-12R, and NDO 2686-4R. The highest yield of tubers under 4 ounces was produced by NDO 2686-6R.

Texas and Colorado

NDO 2438-6R, NDO 2438-7R, and NDO 2686-6R were included in observational trials in both states. Each received good ratings for appearance. The Texas trial was affected by heat stress and yields were generally low. In the Colorado trial, which included entries in the western regional red-skinned variety trial and several standard reds, NDO 2438-7R was selected as best-of-trial.

Summary

On the basis of performance in several trials in 1992 and 1993, NDO 2438-7R, NDO 2469-1R, and NDO 2686-6R are advanced to the regional trials in 1994. They will also be entered into tissue culture to produce disease free seed for distribution to interested seed producers and researchers in other regions.

V. WESTERN REGIONAL RED-SKINNED VARIETY TRIAL

Procedures

Three standard red-skinned varieties and six numbered selections were planted with an assisted-feed planter in a randomized complete block design with four replications on June 9. Individual plots were single rows, 22 feet long. All cultural practices and procedures were as described for the advanced red trial (page 11).

Results and Discussion

Crop establishment and development was affected by the same factors discussed in the previous report on advanced red-skinned selections. Plant stands were over 90 percent for all selections except ND 2224-5R (Table 9). Vine maturity of all numbered selections was later than Dark Red Norland and Red LaSoda. Three selections had later maturity than Sangre. Moderate skinning damage was noted for these late maturing lines. Tuber appearance ratings of numbered lines were better than for Red Lasoda.

As in the advanced red-skinned trial, Sangre produced higher yields than Red LaSoda (Table 10). Red LaSoda usually has higher yields and larger tuber size than Sangre. Red LaSoda had deep eyes and quite extensive growth cracking. Dark Red Norland produced lower yields and smaller tubers than either Sangre or Red LaSoda in both trials at KES, and in most regional trial locations. It usually has better skin color than Red LaSoda. That was not the case in 1993 trials at KES.

ND 2224-5R, a North Dakota selection, was evaluated at KES in replicated yield trials in 1990, 1991, and 1992. It has consistently produced low yields with a high ratio of small tubers. This selection has excellent skin color and is quite resistant to skinning damage, but yields are unacceptably low. Similar performance was noted at all regional trial sites in 1993.

A82705-1R, an Idaho selection, was included in a 1990 KES trial, and produced similar yield and tuber size to Red LaSoda. In the 1993 trial, yields were significantly higher than Red LaSoda yields. Averaged over six regional trial sites in 1993, A82705-1R achieved slightly higher U.S. No.1 yields than Red LaSoda, with slightly smaller tuber size. Eyes are not as deep in A82705-1R, but skin color was not better than Red LaSoda at any location except KES.

AD82745-1R is a California selection of uncertain origin. Similarities in the selection numbers and in performance at most regional trial locations, suggest this selection may be the same as A82705-1R. Yields, tuber size distribution, and plant and tuber characteristic ratings at KES would support this theory. Averaged over all regional trial locations, differences in most parameters between the two selections were quite small. AD82745-1R produced the highest yield of U.S. No.1s at KES and at Ellensburg, Washington.

A83359-5R, an Idaho selection, had very late vine maturity and excessive skinning damage at KES and several other trial locations. Tuber size distribution was similar to Red LaSoda. Yields were about the same as in Red LaSoda at KES, but were considerably higher in locations that had a longer growing season. Skin color was not better than Red LaSoda at most locations, but few internal tuber defects were observed at any location. This selection is clearly a full season line. Growth cracks were a serious detraction from appearance at KES, accounting for the relatively high yield of culls.

NDTX8-731-1R is a Texas selection from the North Dakota breeding program. It produced a high yield and the largest size at KES, and averaged over six locations. At the Texas location, which experienced extreme heat stress, No.1 yield was double that of any other selection. It has relatively deep eyes, light skin color, and had a high incidence of hollow heart and brown center at Ellensburg, Washington. Vine maturity was slightly later than Red LaSoda. Growth cracks and skin russetting were noted at KES.

ND 1871-3R, a North Dakota selection, produced the highest yield of U.S. No.1s at Tulelake. It was second in yield of No.1s over all locations. Tuber size distribution was similar to Dark Red Norland. It had a high incidence of vascular discoloration in Kern County, California, but was relatively free of internal defects at other locations. Eyes are moderately deep and skin color was inferior to Red LaSoda at all locations except KES. This selection had the best appearance at KES.

Summary

At individual locations, several of the entries in the regional red trial were better than Red LaSoda, Sangre, or Dark Red Norland in yield, external appearance, or internal tuber quality. Averaged over all locations, none were particularly outstanding. Very low yields clearly justify dropping ND 2224-5R from future testing programs. The other selections were similar to Red LaSoda in yield and tuber size distribution, and did not produce significantly better tuber appearance.

The western regional red-skinned variety trial will be expanded to include a site at Sherwood, Oregon in 1994. More consistent grading of size classes is needed to provide uniformity across trial sites. All cooperators will be encouraged to adopt size categories of 4- to 6-ounces, 6- to 10-ounces and over 10-ounces. Markets for red-skinned varieties provide substantial price incentives for small tubers. The addition of a 4- to 6-ounce class would assist in identifying selections with the potential for high yields of small tubers.

Table 1. Single-hill red-skinned potato seedlings selected at Klamath Falls, OR. 1993

Clone	Parentage	Number of selections
NDO 4583	Norland x 3312-3R	1
NDO 4751	3312-3R x La 12-59	3
NDO 4783	3574-5R x La 12-59	1
NDO 4831	3879-4R x 1562-4R	2
NDO 4836	3884-3R x 1871-3R	1
NDO 4888	Red Norland x 3574-5R	1
NDO 4935	1562-4R x 1871-3R	1
NDO 4944	2224-5R x La 12-59	1
NDO 4945	2225-1R x 2050-1R	2
NDO 4968	2842-3R x La 12-59	1
NDO 5003	3504-3R x 2050-1R	1
NDO 5014	3574-5R x 2224-5R	3
NDO 5059	3974-1R x 2050-1R	1
NDO 5069	3994-4R x 2225-1R	1
NDO 5082	4035-1R x 1871-3R	1
NDO 5108	4128-5R x 2225-1R	1
AO91846	A82705-1R x NDO 2438-7R	1
AO91847	A82705-1R x NDTX9-1068-11R	1
AO91849	COA86147-3 x ND 2224-5R	2
AO91850	COA86147-3 x NDO 2438-7R	1
AO91852	ND2224-5R x NDO 2438-7R	2
AO91853	ND2224-5R x NDTX9-1068-11R	1

Table 2. Second-year red-skinned potato selections retained for further evaluation at Klamath Falls, OR. 1993.

Clone	Parentage	Vine vigor[1]	Vine maturity[2]
NDO 4578-1R	Norland x 1196-2R	4	2
NDO 4588-5R	Reddale x 2050-1R	4	3
NDO 4592-3R	Reddale x 3198-1R	5	3
NDO 4602-3R	Viking x NDTX9-1068-11R	3	5
NDO 4615-1R	La 12-59 x 2050-1R	5	3
NDO 4625-12R	Minn 14309 x 2842-3R	3	3
NDO 4735-1R	3048-2R x Norland	3	3
NDO 4784-2R	3574-5R x 2050-1R	3	3

[1]/ Vigor: 1 - small plant; 5 - large plant
[2]/ Maturity: 1 - early; 5 - late

Table 3. Third-year red-skinned potato selections retained for further evaluation at Klamath Falls, OR, and Tulelake and Bakersfield, CA. 1993.

Clone	Parentage	Vine vigor[1]	Vine maturity
NDO 4232-1R	Ruby Red x 1618-13R	2	4
NDO 4300-1R	1196-2R x 2225-1R	2	3
NDO 4323-2R	1871-3R x La 12-59	4	3
NDO 4333-1R	2050-1R x NDTX9-1068-11R	3	4
NDO 3994-2R*	Redsen x La 12-59	2	4
NDO 4030-12R**	Mn 12945 x 3049-1R1	1	4

* Selected at Bakerfield, CA
** Selected at Bakersfield and Tulelake, CA

[1]/ Vine vigor and maturity ratings at KES

Table 4. Plant and tuber characteristics of red-skinned potato varieties and advanced selections grown at Klamath Falls, OR. 1993.

Variety/ Selection	Percent stand	Vine vigor[1]	Vine maturity[2]	Appearance rating[3] color	eyes	shape	uniform	skin
Red LaSoda	94	3.0	2.8	2.8	2.0	2.3	2.0	4.0
Sangre	96	2.3	3.5	3.0	3.0	2.5	2.5	4.3
D.R. Norland	93	3.8	2.0	3.8	3.8	2.0	3.3	4.0
COO86107-1R	97	3.3	3.0	5.0	4.0	2.0	3.5	3.3
NDO 2438-6R	89	2.8	3.0	5.0	4.3	2.0	3.5	4.0
NDO 2438-7R	92	3.3	2.5	4.5	4.0	2.0	3.3	3.8
NDO 2438-9R	92	1.8	2.0	4.0	4.0	1.0	3.5	3.8
NDO 2469-1R	93	3.0	3.8	4.8	4.5	2.0	3.8	3.3
NDO 2686-4R	79	3.3	2.0	4.0	4.3	1.5	3.0	3.8
NDO 2686-6R	89	2.5	2.5	5.0	5.0	2.0	4.0	4.0
NDO 2686-10R	90	2.0	2.0	5.0	4.0	1.5	3.5	3.0
NDO 3846-3R	87	1.8	3.3	4.5	4.0	1.0	3.8	4.0
NDO 3846-7R	95	2.5	3.3	4.3	4.0	1.5	4.0	3.3
NDO 3846-9R	96	2.8	2.0	4.0	3.5	1.8	3.8	2.8
NDO 3849-12R	90	1.8	2.8	3.5	3.5	2.0	3.0	3.8
NDO 4001-2R	92	2.3	4.0	4.0	4.0	2.5	2.3	4.0

[1]/ Vine vigor: 1 - small; 5 - large
[2]/ Vine maturity: 1 - early; 5 - late
[3]/ Color: 1 - pale to pink; 5 - dark 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 potato varieties and advanced selections, at Klamath Falls, OR. 1993.

Variety/ Selection	Yield U.S. No. 1s				Yield			Specific gravity
	4-6 oz.	6-10 oz.	>10 oz.	Total	Bs	Culls	Total	
	cwt/A							
Red LaSoda	142	131	115	388	38	31	457	1.071
Sangre	217	161	76	454	37	14	505	1.068
Dark Red Norland	151	93	21	265	60	16	341	1.069
COO86107-1R	207	128	37	372	43	10	425	1.076
NDO 2438-6R	176	163	92	431	43	13	487	1.068
NDO 2438-7R	172	202	87	461	54	28	543	1.068
NDO 2438-9R	98	43	11	152	47	24	223	1.062
NDO 2469-1R	212	103	37	352	75	13	440	1.074
NDO 2686-4R	168	71	14	253	83	7	343	1.070
NDO 2686-6R	198	68	16	282	93	2	376	1.075
NDO 2686-10R	97	54	28	179	55	13	247	1.060
NDO 3846-3R	166	86	20	272	56	12	340	1.066
NDO 3846-7R	147	74	21	242	92	13	322	1.064
NDO 3846-9R	203	89	28	319	67	3	388	1.063
NDO 3849-12R	153	68	28	249	72	10	331	1.065
NDO 4001-2R	118	60	28	205	53	48	306	1.070
Mean	164	100	41	305	60	16	380	1.068
CV(%)	29	41	59	27	30	76	21	1
LSD(.05)	68	59	35	116	26	18	113	0.004

Table 6. Yield and specific gravity of red-skinned potato varieties and advanced selections at Corvallis, OR. 1993.

Variety/ Selection	Yield No. 1s	Yield < 4oz	Yield Culls	Yield Total	Specific gravity	Mean tuber weight
	cwt/A					oz/tuber
Red LaSoda	276	26	63	375	1.065	6.7
Sangre	340	64	62	466	1.073	6.3
Dark Red Norland	291	59	25	375	1.068	5.7
COO86107-1R	308	56	46	410	1.077	5.7
NDO 2438-6R	386	67	15	468	1.064	5.9
NDO 2438-7R	340	87	38	465	1.072	5.9
NDO 2438-9R	307	92	14	413	1.063	5.7
NDO 2469-1R	344	83	72	499	1.077	5.5
NDO 2686-6R	276	120	8	404	1.074	5.3
NDO 2686-10R	278	75	18	371	1.062	5.3
NDO 3846-3R	105	19	11	135	1.057	6.4
NDO 3846-7R	283	114	6	403	1.064	4.6
NDO 3846-9R	112	45	22	179	1.059	4.5
NDO 3849-12R	264	59	12	335	1.059	5.5
NDO 4001-2R	205	57	21	283	1.065	5.2
A82705-1R	458	56	19	533	1.068	6.5
NDTX8-731-1R	408	59	29	496	1.065	6.1
Mean	293	67	28	388	1.067	5.7
LSD(.05)	105	37	22	103	0.007	1.0

Table 7. Yield and specific gravity of red-skinned potato varieties and KES advanced selections at the Intermountain Research and Extension Center, Tulelake, CA. 1993.

Variety/ Selection[1]	Yield U.S. No. 1s			Yield			Specific gravity
	4-12 oz.	>12 oz.	Total	Bs	Culls	Total	
	cwt/A						
Red LaSoda	465	163	628	4	27	659	1.070
Sangre	440	164	604	3	20	627	1.076
NDO 2438-7R	563	120	683	8	66	757	1.071
NDO 2438-9R	476	50	526	11	14	551	1.062
NDO 2686-6R	543	16	559	23	1	583	1.072
NDO 2686-10R	430	29	459	10	24	493	1.062
NDO 3849-12R	587	52	639	9	16	664	1.063
NDO 4030-12R	383	34	417	19	12	448	1.069
Mean	474	108	581	9	41	631	1.069
CV(%)	16	51	15	57	83	16	----
LSD(.05)	106	74	128	6	44	131	----

[1]/ Data is not presented for 15 additional selections included in this trial. Statistical parameters are based on all trial entries.

Table 8. Yield and specific gravity of red-skinned potato varieties and KES advanced selections at Bakersfield, CA. 1993.

Variety/ Selection[1]	**Yield U.S. No. 1s**			**Yield**			**Specific**
	4-12 oz.	**>12 oz.**	**Total**	**Bs**	**Culls**	**Total**	**gravity**
	----------------------------- cwt/A			-----------------------------			
Red LaSoda	433	159	592	13	17	622	1.076
Sangre	330	59	389	34	3	426	1.081
Dark Red Norland	378	36	414	32	6	452	1.067
NDO 2438-6R	333	46	379	67	5	451	1.076
NDO 2438-7R	435	73	508	39	4	541	1.075
NDO 2438-9R	305	31	336	66	4	406	1.068
NDO 2469-1R	367	42	409	50	26	485	1.077
NDO 2686-4R	406	28	434	54	3	491	1.080
NDO 2686-6R	260	10	270	101	5	376	1.082
NDO 2686-10R	379	23	402	70	3	475	1.071
NDO 3994-2R	370	12	382	55	11	448	1.066
NDO 4001-2R	505	43	548	25	9	582	1.072
NDO 4030-12R	409	30	439	61	3	503	1.076
Mean	381	57	438	47	13	498	1.076
CV(%)	15	53	15	34	96	14	----
LSD(.05)	80	57	97	18	17	96	----

[1]/ Data is not presented for 17 additional selections included in this trial. Statistical parameters are based on all trial entries.

Table 9. Plant and tuber characteristics of red-skinned potato varieties and advanced selections in the western regional red variety trial at Klamath Falls, OR. 1993.

Variety/ Selection	Percent stand	Vine vigor[1]	Vine maturity[2]	Appearance rating[3]				
				color	eyes	shape	uniform	skin
Red LaSoda	94	2.5	2.3	3.0	2.5	2.0	2.0	3.8
Sangre	98	2.5	4.0	4.0	3.8	2.5	2.0	4.0
Dark Red Norland	95	4.0	2.0	3.0	4.0	2.3	3.0	4.0
A83359-5R	93	2.5	5.0	4.0	3.0	2.0	2.3	2.8
AD82745-1R	95	2.0	4.5	4.0	4.0	2.0	3.5	3.0
A82705-1R	92	2.3	4.3	5.0	4.0	2.3	3.5	3.3
NDTX8-731-1R	93	3.0	3.0	4.0	3.0	1.3	3.5	3.8
ND2224-5R	87	2.5	3.3	4.0	4.0	2.0	3.3	4.8
ND1871-3R	98	3.3	3.8	4.5	3.5	1.3	4.0	3.8

1/ Vine vigor: 1 - small, weak; 5 - large, robust
2/ Vine maturity: 1 - early; 5 - late
3/ Color; 1 - pale to pink; 5 - dark red
Eyes: 1 - deep; 5 - shallow
Shape: 1 - round; 2 - oval; 3 - oblong
Uniformity: 1 - poor; 5 - excellent
Skinning: 1 - severe; 5 - none

Table 10. Yield and specific gravity of red-skinned potato varieties and advanced selections in the western regional red variety trial at Klamath Falls, OR, 1993.

Variety/ Selection	Yield U.S. No. 1s				Yield			Specific gravity
	4-6 oz.	6-10 oz.	>10 oz.	Total	Bs	Culls	Total	
	cwt/A							
Red LaSoda	145	111	51	307	42	55	404	1.069
Sangre	116	207	98	421	43	18	482	1.072
Dark Red Norland	187	109	30	326	96	18	440	1.070
A83359-5R	128	121	63	312	44	41	397	1.069
AD82745-1R	189	219	76	484	35	17	536	1.068
A82705-1R	152	208	89	449	45	19	513	1.071
NDTX8-731-1R	143	208	100	451	32	36	519	1.069
ND2224-5R	139	77	8	224	75	10	309	1.073
ND1871-3R	188	202	68	458	73	14	545	1.071
Mean	154	162	65	381	54	25	460	1.070
CV(%)	24	27	59	16	31	66	14	1
LSD(.05)	54	64	56	91	24	24	95	0.006

Potato Variety Screening Trials, 1993

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

INTRODUCTION

The Oregon potato variety development program is a cooperative project involving two campus departments and four branch experiment stations located in the potato producing regions. True seed from crosses made by the USDA-ARS potato breeding program at Aberdeen, Idaho produces approximately 65,000 plants in greenhouse culture in Corvallis. Tuberlings produced by these plants are grown as single-hills at Powell Butte (about 50,000 annually) and Ontario (about 15,000 annually) in the year following greenhouse production. Selections from single hills (400 to 700) are grown at Hermiston in four-hill plots and in seed increase plots at Powell Butte in the second field season. Clones selected in the second year are advanced to preliminary yield trials conducted at Powell Butte (COARC), Ontario (MES), Hermiston (HAREC), and Klamath Falls (KES). Promising lines from this one-year screening are promoted to the Oregon statewide trial conducted at the same locations. Seedlings that survive three years of statewide evaluation are entered in tri-state trials conducted at one location each in Oregon, Washington, and Idaho. Selections that are advanced after two years in tri-state trials, are promoted to western regional trials conducted at 13 locations in seven states. Regional trials are the final step in the formal evaluation process. Selections remain in the regional trials up to three years. Formal release as a named variety, if warranted, follows in one to two years.

The USDA-ARS breeding program at Aberdeen has emphasized development of russet-skinned selections with processing quality and disease resistance. Most of the material selected in the Oregon program has been russets. A few tuberlings from North Dakota and Colorado breeding programs are also screened in Oregon. All three breeding programs are represented in five advanced Oregon selections that are currently being considered for release.

Extensive data collected on each selection is carefully considered in decisions to promote clones through the sequence of evaluations. This report on KES trials will emphasize yield data. While yield is a very important consideration, many other characteristics receive appropriate attention in determining the fate of clones.

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PROCEDURES

All variety screening trials were conducted in a two-year grain-potato rotation with randomized complete block experimental design. The field was fumigated with Telone II applied at 18 gpa on May 18. Gypsum was applied at 1 ton/A and plowed down on May 27. All seed was hand cut to 1.5 to 2.0 ounce seedpieces, treated with Tops 2.5 fungicide, and suberized at 50 °F and 95 percent relative humidity for two weeks prior to planting. Potatoes were planted with a two-row, assisted-feed planter in 32-inch rows on June 3. Di-Syston was applied at 3.0 lb ai/A in the seed furrow. Fertilizer included 700 lb/A of 15-15-15, banded at planting, and 50 lb N/A applied as solution 32 on June 15. Eptam was applied with a ground sprayer at 3.5 lb ai/A on June 15 and incorporated immediately with a rolling cultivator.

Crops received about 16 inches of irrigation water during the season, applied twice weekly with solid-set sprinklers on a 40-foot by 48-foot spacing. Standard fungicides were applied aerially at labeled rates on July 29, August 14, and August 29. Monitor was included in aerial applications at 0.75 lb ai/A on July 29 and August 29. Vines were desiccated with Diquat applied with a ground sprayer at 1.0 pint/A on September 18. Potatoes were harvested with a one-row digger-bagger on October 4 and 5. All tubers were saved and stored under typical commercial conditions until grading was done in early November.

The preliminary yield trial included five standard varieties and 99 selections in single-row, 15-hill plots with two replications. Seed was spaced at 12 inches. The statewide trial included five standard varieties and 21 numbered selections in single-row, 30-hill plots with 8.7-inch seed spacing and four replications. The western regional trial included four standard varieties and 16 numbered selections in 30-hill, single-row plots with four replications and 8.7-inch seed spacing.

Plant emergence data were recorded on July 6 and July 20. Vine vigor was rated on July 20 and vine maturity was rated on September 16. External tuber characteristics were noted for each replication prior to grading. Internal defects were recorded on 10 large tubers, usually over 10 ounces, cut longitudinally, from each plot. Specific gravity was determined by the weight-in-air, weight-in-water method on a 10-pound sample of U.S. No.1s in the 6- to 10-ounce size fraction. Yields of U.S. No.1s were not adjusted for external blemishes such as rhizoctonia, elephant hide, or scab, or internal defects such as hollow-heart or brown center. The incidence of these defects was generally low. Approximately 10-pound samples of 6- to 10-ounce U.S. No.1s were saved from one replication of each selection in all trials for culinary evaluation. Culinary quality was evaluated for boiling, oven baking, and microwave preparation methods. French fry quality was not determined due to high sugar content and dark fry color in preliminary fry tests with several standard and numbered selections. Culinary tests were conducted in early December after two months of storage. Yield, grade, and size distribution data from statewide and regional trials were subjected to statistical analysis using MSUSTAT software.

RESULTS AND DISCUSSION

High soil water content resulted from 2.03 inches of precipitation during the last two weeks in May and 0.88 inches of rain the day after planting. Plant stands were not adversely affected, however, and most selections achieved 95 to 100 percent emergence. No herbicide injury occurred in any of the trials. Vine vigor was generally good. Frost protection with sprinkler irrigation was required on July 15, August 25, and September 14 and 15. Vines were generally very vigorous when desiccated on September 18. Vine kill was aided by hard frosts on September 24 and 25. The combination of late planting and cool weather through most of the growing season delayed maturity. High sugar content in tubers, as evidenced by dark fry color, was probably due to growing season conditions in general. A minimum air temperature of 24 °F on September 24 may have contributed to sugar levels sufficient to produce dark fry color. Yields were generally lower than those observed in the very favorable growing season experienced in 1992.

Preliminary Yield Trial

Emergence reached 90 percent in all but five numbered selections in this trial (Table 1). Most selections produced vigorous vines that remained healthy until vines were topkilled. The standard varieties demonstrated quite typical vine maturity and specific gravity readings. Internal tuber quality was excellent in most selections. Russet Burbank exhibited more hollow-heart and brown center than any other selection in the trial. Very few other internal defects were observed in any of the selections. Growth cracks were the most common external defects observed. Several selections had up to 15 to 20 percent of total yield as U.S. No.2s or culls due to growth cracks. Skinning damage at harvest was a common problem in those selections with late maturity.

The standard varieties all achieved relatively high yields with a high percent of U.S. No.1s (Table 2). Shepody yields were higher than in previous KES trials. In most previous trials herbicide injury has seriously affected Shepody. Russet Norkotah also achieved a high yield with excellent size distribution for count cartons. Russet Burbank had small size in spite of the 12-inch seed spacing used. However, tuber type was better than normal and percent No.2s and culls was very low for Russet Burbank, compared to typical performance under local conditions.

Only five numbered selections produced higher yields of No.1s than all standard varieties in the KES trial. Over one-half of the selections exceeded Russet Burbank in No.1 yields. Nineteen selections were promoted to the statewide trial for 1994. All but three of these exceeded Russet Burbank's No.1 yield at KES (Table 2). At Ontario and Hermiston, Russet Burbank achieved excellent yields under cooler than normal weather conditions. Several selections advanced to the statewide trial did not yield as well as Russet Burbank at these locations. However, averaged over all locations, Russet Burbank had 16 and 21 percent hollow-heart and brown center, respectively. Very few of the numbered selections had over 5 percent of both defects combined.

Selections that performed well across all locations included four fresh market lines: AO87119-3; AO87224-5; AO87245-9; and AO89142-2; and three clones with good processing quality: AO87277-6; AO89113-1; and AO89142-6. One russetted selection; AO87257-1, with bright yellow flesh color, was retained for further evaluation. All of these selections produced relatively high yields at KES.

Oregon Statewide Trial

All selections in this trial achieved over 90 percent emergence (Table 3). Canopy vigor was generally good, and specific gravity of standard varieties was normal. None of the selections were earlier in vine maturity than Norkotah. Several exhibited later maturity than Russet Burbank. At 8.7-inch seed spacing, tuber size was generally smaller than in the preliminary yield trial, and internal defects were less common. Skinning damage was noted in three selections. Growth cracks were only noted on Russet Burbank.

All standard varieties produced lower yields and much smaller size than in the preliminary yield trial (Table 4). The closer seed spacing in the statewide trial was responsible for smaller tuber size. Larger plot size and more replications accounts in part for lower yields. Yield of U.S. No.1s for Russet Burbank, Lemhi, Shepody, and Russet Norkotah were about 75 percent of yields in the preliminary trial, while yields of Bs (tubers under 4 ounces) were higher.

A74212-1E and AO83037-10 were evaluated in the western regional trial for the third year in 1993. A74212-1E will be released as Century Russet in 1994. Averaged across locations, it achieved the highest yield of No.1s in statewide trials in 1992 and 1993, and was third highest in 1991. AO83037-10 has also produced very high yields, but does not have a very attractive tuber type or appearance. This selection is being discarded from the Oregon program.

AO82611-7 and COO83008-1 are in advanced stages of evaluation by processors, and have completed three years of testing in the regional program. Both are being considered for release pending processor acceptance. NDO2904-7 is an early maturing fresh market clone that was included in the regional trials for the first time in 1993. AO85165-1 is also a fresh market selection. It was evaluated in the tri-state trial in 1993. Both of these selections have Russet Norkotah as one parent, and both have very attractive tuber type.

With the possible exception of AO82611-7, each of these advanced Oregon selections performed well in this and other trials, and are likely candidates for naming and release. AO85165-1 will be entered in the regional trial in 1994 while NDO2904-7 will be included for the second year. Additional performance data will be provided on several of these selections later in this report.

Two additional selections from the statewide trial were retained for further testing. AO84022-108 was promoted to the tri-state trial for 1994. It is a multi-purpose selection with an attractive russet type. AO85436-1 is a round white chipping selection that ranked second to A74212-1E in yield across locations. It will be included in the statewide trial for the second year in 1994. All other selections were discarded. All selections retained for further evaluation were free of serious culinary deficiencies. AO85165-1 had the highest score of all selections in the trial.

Western Regional Trial

The 1993 regional trials included six early harvest sites and 10 late harvest locations. Although the KES trial was reported as a late harvest trial, time from planting to harvest was similar to early harvest trials at other locations. Plant emergence was less than 90 percent for AO83037-10 and ATX84378-1, but 95 percent or higher for all other selections (Table 5). Reduced canopy vigor and earlier vine maturity of standard varieties compared with the statewide trial were probably due to soil differences. All cultural practices were the same for both trials. Lower specific gravity was also noted in the regional trial for Russet Burbank, Lemhi, and Shepody.

Russet Burbank and Lemhi yields were very similar to those observed in the statewide trial (Table 6). Shepody and Norkotah yields were considerably lower in the regional trial. A74212-1E produced the highest yield of U.S. No.1s in this trial and across locations in both early and late harvest trials. This is consistent with the performance of this selection over several years. AO83037-10 was second highest in yield at KES and across locations in late harvest trials. High yields were also observed for A81286-1 and A8333-5. Both of these selections are dual purpose russets that remain in the trials in 1994. Both received high scores for culinary quality.

NDO2904-7 produced nearly 50 percent more No.1s than Russet Norkotah in the KES trial. In six early harvest trials, yields were similar for NDO2904-7 and Norkotah. Both entries were also included in six late harvest regional trials. NDO2904-7 averaged 63 cwt/A more No.1s than Russet Norkotah in these trials.

In addition to A74212-1E, selections graduating from three years in the regional trial include A81473-2, A82119-3, and ATX84378-1. Final disposition of these selections will be determined by cooperators in Idaho and Texas. Selections discarded included AC83172-1, A79180-10, and AO81235-102. The latter two early maturing selections were not evaluated at KES. Other entries will remain in the early or late harvest trials in 1994.

Advanced Oregon Selections

The Oregon potato variety selection and development program will be releasing several new varieties in the next two to three years. Two selections; A74212-1E, and NDO2904-7, are strictly fresh market types that have shown superior performance in KES trials and are excellent prospects for Klamath Basin production. Two dual purpose selections, COO83008-1 and AO82611-7, are more likely to gain acceptance as processing varieties in the Columbia Basin and the Treasure Valley. The yield, grade, and size distribution of these selections in statewide and regional trials conducted at Klamath Falls since 1990 is compared with Russet Burbank and Russet Norkotah (Table 7). Data represent averages from six trials for each selection. Total yield of U.S. No.1s for A74212-1E is 53 percent higher than for Russet Burbank, with a higher percent in count carton sizes. NDO2904-7 has averaged 25 percent more No.1s than Russet Norkotah with better size distribution for count cartons. COO83008-1 has produced similar yields and size to NDO2904-7, but tuber type and appearance are not as attractive. AO82611-7 does not achieve yields much higher than Russet Burbank under Klamath Basin conditions.

One additional Oregon selection that has shown considerable promise is a round white chipping clone, NDO1496-1. This selection was not included in any of the trials discussed above in 1993, but was evaluated in the Snack Food Association chipping trials conducted at several locations in the United States and Canada. This selection will produce light chip color out of 45 °F storage and will recondition better than other chipping lines out of cold storage. Its release is being considered pending performance in the Snack Food Association trials.

Summary

The Oregon potato variety development program was formalized and expanded in 1983. During the ensuing 10 years, much progress has been achieved. Within the next two to three years, the program will release two fresh market selections, at least one processing or dual purpose line, and possibly one chipping variety. The prospects for improving on Russet Burbank and Russet Norkotah for fresh market crops in the Klamath Basin appear to be excellent. The difficult growing season experienced locally in 1993 clearly demonstrated the limitations of Russet Burbank in short-season areas. Late planted crops produced few count carton size tubers. Internal defects were common in crops planted early. These problems were even more pronounced in Eastern Idaho production areas. NDO2904-7 appears to be a good candidate for fresh market production with earlier maturity than Russet Burbank, and the ability to produce a high percent of count carton size tubers. A74212-1E has found limited acceptance in Texas and is being evaluated in eastern U.S. and Canada production areas. It produced high yields and high economic returns in several commercial fields in the Klamath Basin in 1993.

Table 1. Performance of entries in the Preliminary Yield Trial, Klamath Falls, OR. 1993.

Variety/ selection	Percent stand	Vigor rating[1]	Vine maturity[2]	Specific gravity	Percent H.H. & B.C.[3]	Comments[4]
Russet Burbank	100	5.0	2.5	1.087	35	fair
Lemhi	100	3.0	2.0	1.090	0	fair
Shepody	100	4.5	3.0	1.081	0	
Norkotah	100	3.5	2.0	1.070	0	fair
Atlantic	97	4.0	3.5	1.096	5	poor
AO87007-8	97	3.0	3.5	1.078	0	sk, rough, ugly
AO87009-2	97	1.0	3.5	1.082	25	ugly
AO87009-3	97	2.5	2.5	1.073	0	too round
AO87009-5	100	4.0	3.0	1.078	0	rough, GC
AO87009-8	100	4.5	2.5	1.082	0	IPS
AO87009-9	100	4.0	3.5	1.075	0	GC, ugly
AO87009-14	97	3.5	2.0	1.091	0	fair
AO87009-16	100	2.5	3.0	1.084	5	nice
AO87011-1	83	4.0	3.0	1.082	0	coarse
AO87011-2	100	4.0	3.0	1.087	0	coarse
AO87011-7	93	3.0	3.5	1.073	5	fair
AO87011-8	97	3.0	4.5	1.079	0	coarse
AO87011-10*	97	3.0	3.0	1.079	5	misshapen
AO87011-11	100	3.0	4.0	1.083	5	fair, pty
AO87018-2	93	4.5	2.0	1.070	0	poor
AO87018-3	90	2.0	3.0	1.074	5	coarse
AO87018-4	97	3.0	2.5	1.080	10	coarse
AO87018-6	90	2.5	2.5	1.072	0	EH, not bad
AO87018-9	97	4.0	2.0	1.078	0	SEB, coarse, rough
AO87018-20*	100	4.0	3.5	1.080	0	rough, ugly
AO87018-21	97	2.0	2.0	1.070	0	long, nice
AO87018-22	100	4.0	2.5	1.076	0	fair
AO87018-23*	100	3.5	2.0	1.086	0	nice
AO87025-1	100	3.0	4.0	1.091	5	ugly
AO87032-4*	100	3.5	3.5	1.079	0	sk, rough
AO87032-6	100	4.0	2.5	1.087	0	nice, heavy net
AO87032-7	93	2.0	3.5	1.081	0	fair, heavy net
AO87063-4	90	3.5	4.0	1.083	0	IPS
AO87079-1	93	2.0	3.0	1.086	0	coarse, fair
AO87111-2	97	3.0	2.5	1.083	0	sk, rough
AO87111-6	93	2.5	4.0	1.070	0	EH, rough
AO87118-1	100	4.5	2.5	1.078	0	too round
AO87119-1	100	3.5	4.0	1.071	0	rough, ugly
AO87119-3*	100	4.0	2.5	1.074	0	long, nice
AO87138-5	97	3.0	3.0	1.071	0	fair
AO87138-8	87	4.0	2.0	1.070	5	fair
AO87138-11	100	3.5	2.0	1.072	0	fair
AO87138-14	100	4.0	3.5	1.074	5	fair
AO87206-3*	100	4.0	2.5	1.084	0	nice net
AO87211-9	100	2.5	2.5	1.073	5	heavy net
AO87212-3*	93	4.0	2.5	1.076	0	very nice
AO87217-4	97	4.5	3.5	1.088	0	GC, SB
AO87217-7	97	3.0	3.0	1.080	0	fair
AO87218-6	93	2.5	3.0	1.080	0	rough, EH
AO87218-13*	93	3.0	2.0	1.084	0	very nice
AO87221-2	90	1.0	2.5	1.083	0	sk, ugly
AO87223-2	100	2.5	3.5	1.069	0	
AO87223-5	83	3.0	2.0	1.077	5	fair
AO87224-1	100	4.0	2.0	1.078	0	fair, heavy net
AO87224-5*	100	4.0	2.5	1.085	0	nice

Table 1. Performance of entries in the Preliminary Yield Trial, Klamath Falls, OR. 1993. (contd)

Variety/ selection	Percent stand	Vigor rating[1]	Vine maturity[2]	Specific gravity	Percent H.H. & B.C.[3]	Comments[4]
AO87228-3	93	3.5	2.5	1.079	0	very nice
AO87229-1	100	3.0	3.5	1.072	0	GC, SB
AO87230-1	100	2.0	3.0	1.069	5	fair
AO87230-2	97	2.0	2.5	1.074	0	nice smooth
AO87232-1	87	3.0	2.5	1.077	0	coarse, rough
AO87232-3	97	2.5	3.5	1.075	0	flat
AO87232-5	100	3.0	4.0	1.074	0	coarse, fair
AO87232-8	97	4.0	3.5	1.069	0	severe sk
AO87233-8	100	3.5	4.0	1.088	10	severe sk
AO87234-1	100	2.5	3.5	1.080	0	coarse, rough
AO87234-6*	100	4.5	3.5	1.082	0	sk, GC, IPS
AO87245-9*	100	3.5	3.5	1.078	0	fair
AO87245-13	100	3.0	2.0	1.080	0	fair
AO87245-22	97	3.0	2.5	1.075	0	GC, EH
AO87245-24	97	3.5	2.0	1.075	0	GC, ugly
AO87251-2	83	3.0	2.5	1.083	5	pty, light YF
AO87257-1*	97	3.0	3.5	1.080	0	bright YF
AO87257-7	100	3.5	2.0	1.075	0	light YF
AO87257-18	100	3.0	2.5	1.075	0	poor
AO87258-5	100	3.5	2.0	1.073	10	ugly, GC
AO87259-1	97	3.5	2.5	1.086	0	GC
AO87259-8	100	4.0	3.0	1.080	0	rough, sk
AO87262-1	100	3.0	4.0	1.089	5	GC
AO87267-1	100	5.0	3.5	1.080	0	fair
AO87274-11	93	2.0	3.5	1.084	5	sk
AO87277-6*	97	4.5	3.0	1.082	5	SB, flat
AO87278-2	100	4.0	2.0	1.089	0	small
AO89111-6	93	3.0	2.5	1.078	0	fair
AO89113-1*	100	4.0	2.5	1.087	0	fair
AO89128-4*	93	4.0	3.0	1.094	0	sk
AO89142-2*	100	2.5	3.0	1.079	0	fair, sk
AO89142-3	100	4.5	3.0	1.080	0	sk, coarse
AO89142-4	100	3.0	2.5	1.087	0	sk, rough
AO89142-6*	100	4.0	4.0	1.090	0	severe sk
AO89142-7	90	4.0	2.5	1.076	0	rough, sk
AO89142-8	100	2.0	5.0	1.081	0	severe sk
AO89235-1	100	3.5	2.0	1.077	0	no yield
COO89003-2*	100	4.0	3.5	1.079	0	coarse, sk
COO89018-2	97	2.0	2.5	1.079	0	no yield
COO89026-5	90	3.0	3.5	1.078	5	coarse, ugly
COO89026-8	90	3.5	3.0	1.086	0	nice
COO89032-6	97	3.5	3.5	1.081	0	fair
COO89034-3	90	3.5	2.5	1.081	0	fair
COO89034-4	100	4.5	3.0	1.078	0	small
COO89037-6	93	3.5	2.0	1.072	0	nice
COO89065-2*	97	4.0	2.5	1.088	0	sk, coarse
AO87286-206	100	3.0	2.0	1.082	0	fair
AO89031-202	97	3.5	2.0	1.084	5	fair
90-2	100	3.0	4.0	1.079	0	too round

* Advanced to 1994 Oregon Statewide Trial
1/ Vigor rating: (1 - small, weak; 5 - large, robust)
2/ Vine maturity: (1 - early; 5- late)
3/ H.H. anc B.C.: (Hollow heart plus brown center - % in 10 large tubers/sample)
4/ Comments: GC - growth cracks, sk - skinning damage, EH - elephant hide, SB - shater bruise, YF - yellow flesh, IPS - internal purple spots, SEB - stem end browing, pty - pointy

Table 2. Tuber yield by grade for entries in the Preliminary Yield Trial, Klamath Falls, OR. 1993.

Variety/ Selection	Yield U.S. No. 1s 4-12 oz.	> 12 oz.	Total	Yield Bs	No. 2s	Culls	Total
	cwt/A						
Russet Burbank	388	43	431	50	16	5	502
Lemhi	330	222	552	20	11	23	606
Shepody	337	226	563	20	5	11	599
Norkotah	400	154	554	27	0	2	583
Atlantic	333	72	405	46	9	44	504
AO87007-8	331	109	440	47	34	51	572
AO87009-2	137	49	186	35	0	58	279
AO87009-3	283	39	322	49	10	1	382
AO87009-5	311	163	474	28	24	65	591
AO87009-8	326	9	335	78	3	26	442
AO87009-9	274	198	472	24	9	86	591
AO87009-14	453	17	470	49	3	12	534
AO87009-16	357	44	401	30	4	11	446
AO87011-1	344	167	511	21	35	65	632
AO87011-2	324	206	530	15	3	5	553
AO87011-7	317	37	354	55	0	7	416
AO87011-8	356	131	487	44	5	1	537
AO87011-10*	255	237	492	18	9	12	531
AO87011-11	314	196	510	30	12	10	562
AO87018-2	190	37	227	73	4	10	314
AO87018-3	190	124	314	28	0	0	342
AO87018-4	252	141	393	25	9	6	433
AO87018-6	191	161	352	24	3	8	387
AO87018-9	299	148	447	27	24	10	508
AO87018-20*	315	56	371	56	28	71	526
AO87018-21	253	51	304	17	0	16	337
AO87018-22	320	62	382	46	3	13	444
AO87018-23*	347	104	451	47	0	5	503
AO87025-1	321	67	388	70	12	1	471
AO87032-4*	297	28	325	29	18	45	417
AO87032-6	305	39	344	62	10	3	419
AO87032-7	198	144	342	9	14	13	378
AO87063-4	369	69	438	72	3	9	522
AO87079-1	250	216	466	21	0	8	495
AO87111-2	386	64	450	43	0	11	504
AO87111-6	293	147	440	43	3	17	503
AO87118-1	392	63	455	60	9	7	531
AO87119-1	357	152	509	53	11	31	604
AO87119-3*	360	233	593	39	36	5	673
AO87138-5	213	195	408	16	4	10	438
AO87138-8	337	63	400	64	6	1	471
AO87138-11	377	93	470	61	16	38	585
AO87138-14	277	133	410	26	5	45	486
AO87206-3*	384	45	429	88	6	5	528
AO87211-9	292	34	326	25	4	11	366
AO87212-3*	348	105	453	19	5	8	485
AO87217-4	350	156	506	15	16	134	671
AO87217-7	329	39	368	51	0	28	447
AO87218-6	283	95	378	43	0	23	444
AO87218-13*	357	113	470	18	2	8	498
AO87221-2	89	36	125	43	3	9	180
AO87223-2	408	53	461	39	0	1	501
AO87223-5	361	98	459	46	8	1	514
AO87224-1	367	81	448	53	0	1	502
AO87224-5*	346	211	557	60	3	17	637

Table 2. Tuber yield by grade for entries in the Preliminary Yield Trial, Klamath Falls, OR. 1993. (contd)

Variety/ Selection	Yield U.S. No. 1s			Yield			
	4-12 oz.	> 12 oz.	Total	Bs	No. 2's	Culls	Total
	cwt/A						
AO87228-3	306	45	351	54	0	4	409
AO87229-1	293	219	512	33	7	45	597
AO87230-1	354	8	362	56	3	7	428
AO87230-2	243	116	359	16	0	0	375
AO87232-1	120	383	503	8	0	25	536
AO87232-3	316	148	464	17	10	2	493
AO87232-5	285	248	533	39	5	6	583
AO87232-8	324	242	566	26	9	51	652
AO87233-8	358	68	426	53	6	36	521
AO87234-1	193	320	513	20	0	20	553
AO87234-6*	240	280	520	22	49	65	656
AO87245-9*	321	199	520	16	0	32	568
AO87245-13	268	94	362	24	5	14	405
AO87245-22	233	123	356	30	19	52	457
AO87245-24	292	79	371	48	21	59	499
AO87251-2	322	13	335	86	0	12	433
AO87257-1*	287	168	455	18	3	8	484
AO87257-7	266	123	389	21	6	26	442
AO87257-18	241	117	358	13	11	18	400
AO87258-5	151	24	175	22	70	117	384
AO87259-1	363	70	433	41	28	56	558
AO87259-8	370	95	465	38	0	38	541
AO87262-1	302	163	465	32	19	57	573
AO87267-1	341	200	541	44	14	8	607
AO87274-11	347	32	379	44	2	5	430
AO87277-6*	339	170	509	32	19	23	583
AO87278-2	415	14	429	49	2	0	480
AO89111-6	394	7	401	55	0	9	465
AO89113-1*	486	85	571	39	12	9	631
AO89128-4*	338	74	412	57	19	21	509
AO89142-2*	329	270	599	17	0	9	625
AO89142-3	430	216	646	30	8	21	705
AO89142-4	373	19	392	63	0	35	490
AO89142-6*	447	72	519	59	5	9	592
AO89142-7	281	142	423	18	21	47	509
AO89142-8	373	84	457	46	9	20	532
AO89235-1	200	0	200	63	7	26	296
COO89003-2*	351	104	455	33	6	9	503
COO89018-2	161	123	284	34	7	7	332
COO89026-5	297	243	540	18	8	31	597
COO89026-8	264	215	479	28	6	14	527
COO89032-6	304	128	432	28	0	5	465
COO89034-3	344	133	477	32	5	0	514
COO89034-4	407	18	425	49	0	16	490
COO89037-6	304	115	419	46	0	0	465
COO89065-2*	320	196	516	9	22	14	561
AO87286-206	383	22	405	51	0	7	463
AO89031-202	335	59	394	56	4	4	458
90-2	377	53	430	29	3	3	465
Mean	313	116	429	38	9	21	498

* Advanced to 1994 Oregon Statewide Trial

Table 3. Performance of entries in the Oregon Statewide Trial, Klamath Falls, OR. 1993.

Variety/ selection	Percent stand	Vigor rating[1]	Vine maturity[2]	Specific gravity	Percent H.H. & B.C.[3]	Comments[4]
Russet Burbank	100	4.3	2.8	1.085	10	rough, GC
Lemhi	94	3.5	2.5	1.090	0	smooth, fair
Shepody	97	3.5	2.5	1.082	0	nice
Norkotah	100	4.0	2.0	1.072	0	nice
Atlantic	99	4.8	3.0	1.096	0	
A74212-1E	96	3.3	3.0	1.082	0	smooth, nice
AO82611-7	98	4.0	2.8	1.085	0	fair, pty
COO83008-1	96	3.8	3.0	1.087	0	coarse, flat
AO83037-10	91	3.8	4.3	1.079	0	flat, fair
NDO 2904-7	98	4.5	2.3	1.071	0	nice
AO85165-1	100	3.5	3.3	1.077	0	nice
COO86042-2	99	3.8	2.8	1.076	0	poor
AO83221-204	98	2.5	3.0	1.081	5	smooth, skinning
AO83141-5	99	4.0	2.5	1.094	0	smooth, skinning
AO83113-4	95	3.0	3.8	1.078	0	coarse, nice net
AO84022-108	100	3.0	3.0	1.091	0	nice
AO84017-1	99	4.0	2.8	1.073	0	fair
AO84053-2	98	4.3	2.3	1.078	0	coarse, skinning
AO85105-1	96	3.8	3.0	1.078	0	nice
AO85419-5	99	4.8	3.3	1.088	10	nice
AO85419-12	98	4.5	3.0	1.087	0	nice
AO85436-1	95	4.5	3.5	1.079	3	
COO88165-5	98	2.8	2.3	1.100	0	small
AO88114-2	91	3.5	3.0	1.080	0	fair, pty
AO87138-2	98	2.0	2.3	1.078	0	small
AO88009-1	100	4.0	2.3	1.095	0	small
Mean	97	3.8	2.9	1.083	1	

[1]/ Vigor rating: (1 - small, weak; 5 - large, robust)
[2]/ Vine maturity: (1 - early; 5- late)
[3]/ H.H. and B.C.: (Hollow heart plus brown center - % in 10 large tubers/sample)
[4]/ Comments: GC - growth cracks, pty - pointy

Table 4. Tuber yield by grade for entries in the Oregon Statewide Trial, Klamath Falls, OR. 1993.

Variety/ selection	Yield U.S. No. 1s 4-12 oz.	> 12 oz.	Total	Yield Bs	No. 2s	Culls	Total
	cwt/A						
Russet Burbank	309	15	324	85	33	32	474
Lemhi	299	80	379	39	22	13	453
Shepody	280	147	427	22	23	20	492
Norkotah	319	79	398	45	8	12	463
Atlantic	338	26	365	78	14	11	468
A74212-1E	370	72	442	53	2	11	508
AO82611-7	335	30	365	77	3	5	450
COO83008-1	301	160	461	28	7	18	514
AO83037-10	329	176	505	31	4	14	554
NDO 2904-7	253	154	407	34	2	7	450
AO85165-1	389	112	501	50	10	3	564
COO86042-2	377	61	438	64	20	36	558
AO83221-204	325	41	366	51	2	3	422
AO83141-5	365	41	406	90	13	4	513
AO83113-4	249	219	468	28	13	46	555
AO84022-108	303	78	381	32	13	14	440
AO84017-1	358	56	414	48	12	14	490
AO84053-2	278	211	490	35	22	14	561
AO85105-1	334	123	457	28	3	11	499
AO85419-5	435	151	586	40	4	10	640
AO85419-12	380	57	436	54	5	10	505
AO85436-1	413	126	539	73	11	16	639
COO88165-5	219	25	244	54	15	7	320
AO88114-2	244	63	307	39	5	24	375
AO87138-2	205	2	207	95	2	1	305
AO88009-1	307	4	311	111	5	12	439
Mean	320	89	409	53	11	14	487
CV(%)	16	39	13	29	87	92	13
LSD(.05)	71	49	75	22	13	19	87

Table. 5. Performance of entries in the Western Regional Potato Variety Trial, Klamath Falls, OR. 1993.

Variety/ selection	Percent stand	Vigor rating[1]	Vine maturity[2]	Specific gravity	Percent H.H. and B.C.[3]
Russet Burbank	99	4.0	2.3	1.082	13
Lemhi	99	3.0	2.5	1.084	5
Norkotah	95	3.3	1.5	1.073	0
Shepody	98	2.5	2.0	1.075	0
A74212-1E	100	3.8	3.0	1.076	0
A81286-1	100	4.0	3.3	1.076	0
A81473-1	98	2.5	3.0	1.077	0
A82119-3	95	3.3	2.8	1.081	0
A8390-3	98	3.8	3.5	1.078	0
AO83037-10	86	3.8	4.0	1.075	3
AO84275-3	98	3.5	3.5	1.085	0
ATX 84378-1	88	3.5	3.3	1.076	0
NDO 2904-7	96	3.8	2.3	1.069	0
A8495-1	99	2.5	3.8	1.083	0
A81386-1	99	3.3	2.8	1.075	0
A84180-8	98	3.8	2.8	1.074	3
A8333-5	99	4.0	3.0	1.073	0
AC83064-1	96	2.3	2.8	1.073	0
AC83064-6	95	3.5	2.3	1.078	0
AC83172-1	98	3.0	2.5	1.083	0
Mean	97	3.4	2.9	1.077	1

[1]/ Vigor rating: (1 - small, weak; 5 - large, robust)
[2]/ Vine maturity: (1 - early; 5 - late)
[3]/ H.H. and B.C.: (hollow heart and brown center - % in 10 large tubers/sample

Table 6. Tuber yield by grade for entries in the Western Regional Potato Variety Trial, Klamath Falls, OR. 1993.

Variety/ selection	Yield U.S. No. 1s 4-12 oz.	>12 oz.	Total	Yield Bs	No. 2s	Culls	Total
	cwt/A						
Russet Burbank	294	9	303	59	18	34	414
Lemhi	320	76	396	40	19	20	475
Norkotah	217	19	236	40	2	7	285
Shepody	205	62	267	28	5	4	304
A74212-1E	490	99	589	54	8	6	657
A81286-1	357	122	479	36	14	35	564
A81473-1	247	145	392	24	7	8	431
A82119-3	297	83	380	36	12	0	428
A8390-3	362	16	378	54	6	1	439
AO83037-10	329	233	562	20	9	3	594
AO84275-3	405	78	483	65	7	4	559
ATX 84378-1	91	252	343	18	20	81	462
NDO 2904-7	244	108	352	32	8	5	397
A8495-1	345	52	397	43	10	10	460
A81386-1	334	29	363	64	3	4	434
A84180-8	316	113	429	22	18	27	495
A8333-5	427	81	508	52	3	11	574
AC83064-1	308	85	393	33	6	3	435
AC83064-6	242	48	291	43	3	9	346
AC83172-1	254	45	299	38	5	14	356
Mean	304	88	392	40	9	14	455
CV(%)	19	36	17	36	99	71	16
LSD(.05)	80	45	95	21	13	15	104

Table 7. Four-year, six-trial summary of tuber yields by grade for Russet Burbank, Norkotah, and four advanced Oregon potato selections grown at Klamath Falls, OR. in 1990 - 1993.

Variety/ selection	**Yield U.S. No. 1s**			**Yield**		
	4-12 oz.	**>12 oz.**	**Total**	**Bs**	**No. 2s & Culls**	**Total**
	----------	----------	----------	cwt/A	----------	----------
Russet Burbank	314	42	356	77	58	491
Norkotah	252	89	340	38	20	398
A74212-1E	408	137	545	46	21	612
NDO 2904-7	267	158	425	29	13	467
COO83008-1	273	155	428	31	28	487
AO82611-7	294	83	377	67	30	474

[1]/ Size fractions were separated at 10 oz. in 1990 and 12 oz. in 1991 - 1993.

Potato Cultivar Response to Seed Spacing and Nitrogen Fertilizer Rates

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

INTRODUCTION

New potato varieties continue to erode the dominance of Russet Burbank in the Pacific Northwest. A late spring and cool weather through much of the 1993 growing season resulted in low yields, small size, and a high incidence of hollow heart and brown center in Russet Burbanks grown in high elevation areas in Idaho and Oregon. This experience and the economic consequences will further encourage potato growers to seek varieties less susceptible to weather-related physiological disorders and capable of producing a higher percent of marketable tubers.

Most new varieties and advanced selections require different cultural management practices than Russet Burbank to produce optimum yields, size, and quality. Effects of plant population and nitrogen fertilizer rates on the performance of new varieties and advanced selections have been evaluated as an integral part of the KES variety development program for several years. In 1993, these studies included Russet Burbank, Russet Norkotah, Goldrush, Snowden, and five promising advanced selections from the Oregon variety development program.

PROCEDURES

Nine varieties or advanced selections were evaluated in two separate experiments. Split-plot experimental designs were used with four replications. Standard practices were followed for disease and pest management, and irrigation (see page 26). Weed control with Eptam was supplemented with 0.4 lb ai/A metribuzin applied aerially on July 7. Potatoes were planted with a two-row, assisted-feed planter in 32-inch rows on June 8. Vines were desiccated with diquat applied at 1.0 pint/A with a ground sprayer on September 18.

In the seed spacing experiment, main plots were spacings of 6.8, 8.7, or 12 inches. Individual plots were two rows, 30 feet long. Fertilizer included 700 lb/A of 15-15-15 banded at planting, and 60 lb N/A applied as solution 32 and incorporated with a rolling cultivator on June 14. Potatoes were harvested with a one-row digger-bagger on October 7. 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 6- to 10-ounce No.1 tubers.

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In the nitrogen fertilizer rate experiment, main plots were nitrogen rates of 130, 160, or 190 lb N/A. Fertilizer was banded at planting at 870 lb/A of 15-15-15. Solution 32 was sprayed on with a ground sprayer at 0, 30, or 60 lb N/A and incorporated with a rolling cultivator on June 14. Individual plots were four rows, 30 feet long, with Russet Burbank planted in the two outside rows at 12-inch seed spacing. Varieties or advanced selections were spaced at 8.7 inches in the center rows. All seed for both experiments was hand cut to 1.5 to 2.0 ounces/seedpiece, treated with Tops 2.5 fungicide, and suberized for two weeks prior to planting. Potatoes were harvested on October 8. Harvest and grading procedures were the same as described for the seed spacing experiment. Internal tuber quality was evaluated by cutting 10 large tubers from each plot (usually over 10-ounce tubers).

RESULTS AND DISCUSSION

Response to seed spacing

Plant emergence was recorded on July 5 and July 21, 27 and 43 days after planting. A74212-1E, Goldrush, and NDO2904-7 ranged from 80 to 88 percent emergence, and all other selections were at 90 percent or more on July 5. All selections exceeded 95 percent emergence on July 21. Plant stands were not a factor in performance of any of the varieties or selections. Russet Norkotah was the only variety that started senescence prior to vine desiccation. Canopy development was delayed about three weeks due to late planting and cool weather in June and July.

Yields and tuber size of late maturing selections were clearly affected by the late planting date and cool season. Russet Burbank total No.1 yields in this study in 1991 and 1992, averaged 378 cwt/A. The 1993 average of 280 cwt/A (Table 1) represents a decline in No.1 yield of 26 percent. A74212-1E produced about 75 percent of the No.1 yield achieved in the 1991 study. In contrast, the early maturing Russet Norkotah produced an average No.1 yield nearly equal to the average for the two previous years. Goldrush yields were also similar in 1991 and 1993. COO83008-1 and AO82611-7 were both included in the 1992 experiment. Total No.1 yields were only slightly lower in 1993 for COO83008-1, but were 100 cwt/A lower in 1993 for the later maturing AO82611-7. Yields of tubers over 10 ounces were much lower in Russet Burbank, A74212-1E, and AO82611-7 in 1993 than in previous years.

Significant differences were found between varieties for all yield parameters and specific gravity (Table 1). COO83008-1, A74212-1E, and NDO2904-7 produced the highest No.1 yields. Russet Burbank yield of No.1s was significantly lower than all other varieties. COO83008-1 and NDO2904-7 had high yields of count carton size while Russet Burbank produced very few tubers over 10 ounces. Russet Norkotah, Goldrush, and AO82611-7 were intermediate in yields and had similar yields and tuber size distribution. The two chipping varieties, Snowden and NDO1496-1, were similar in yields, tuber size, and specific gravity. Both selections produced high tuber numbers and small size, with higher yields under 4 ounces than all selections except Russet Burbank. Yields of No.2s and culls were low except for Goldrush, which produced quite a few misshapen tubers.

Specific gravity followed expected trends. Snowden and NDO1496-1 had significantly higher specific gravity than all other selections. Russet Burbank, COO83008-1, and AO82611-7 were similar and intermediate in specific gravity. Russet Norkotah, Goldrush, and NDO2904-7 had lower specific gravity than A74212-1E. As in past years, specific gravity was not affected by seed spacing.

The interaction between seed spacing and variety was only statistically significant for small and intermediate No.1 tubers. Increased seed spacing resulted in much lower yields of 4- to 6-ounce tubers in A74212-1E and AO82611-7, but only minor differences in the other selections. Russet Burbank produced higher yields of 6- to 10-ounce tubers as seed spacing increased. The yield of 6- to 10-ounce tubers decreased when seed spacing increased in COO83008-1. Other selections showed little effect of seed spacing on yield of this size fraction. Other effects of seed spacing on yields produced similar responses in all varieties. General trends were increased tuber size, but little effect on total No.1s, No.2s, culls, or total yield.

While seed spacing effects on total No.1 yields were not statistically significant, the effects on economic returns are much more pronounced. Current fresh market prices for russet varieties are over $20/cwt for count cartons and No.1s over 10 ounces. No.1s under 8 ounces return about $6/cwt. Tubers under 4 ounces (Bs) are valued at about $1.50/cwt. Based on these values, the optimum seed spacing was 12 inches for all russet varieties in this trial except Russet Norkotah. Norkotah produced optimum returns at the 8.7-inch spacing, as in five previous years. Both chipping varieties also achieved optimum production at the 12-inch spacing.

Response to seed spacing in A74212-1E was much different than in 1991, and in the late maturing variant of this selection in several prior years of evaluation. A74212-1 typically produces high yields of large tubers. In all previous trials, excessive size has occurred at 12-inch spacing. In most cases, the total No.1 yield has declined as spacing was increased beyond 6.7 inches. In 1993, tuber size was not excessive at the 12-inch spacing and yield benefits were observed for each increase in seed spacing. Russet Burbank also achieved greater benefits from the lowest plant population than in either 1991 or 1992. Clearly, late maturing varieties require adjustments in plant population when circumstances result in late planting in short-season areas.

Russet Burbank had the highest incidence of internal defects, with about 5 percent hollow heart and 10 percent brown center. Other selections exhibited less than 5 percent defects. Seed spacing did not affect the incidence of internal defects.

Response to nitrogen rate

Plant populations were similar to those observed in the seed spacing experiment, with final stands exceeding 95 percent in all varieties. Canopy vigor was affected by nitrogen rate. Most varieties were showing signs of senescence at the low nitrogen rate by mid September. At the high rate, all varieties except Russet Norkotah remained vigorous until vines were desiccated.

Average yields for all varieties or selections except Snowden and NDO1496-1 were slightly lower than yields observed in the seed spacing experiment (Table 2). The relative ranking of varieties was similar in both experiments except A74212-1E had higher No.1 yields than COO83008-1 in the nitrogen rate study. Russet Burbank No.1 yields were significantly less than yields of all other varieties.

Varietal response to nitrogen rate was varied. Several individual varieties responded differently than in previous years. Higher nitrogen rates improved yield in Russet Norkotah and AO82611-7. In 1991 and 1992, Norkotah yields were highest at 130 lb N/A. The yield response in AO82611-7 was the same in 1992 and 1993. The 130 lb N/A rate was optimum for Russet Burbank. In both 1991 and 1992, Russet Burbank required 160 lb N/A for optimum yield. A74212-1E produced optimum yields at 130 lb N/A in 1992 and 160 lb N/A in 1993. COO83008-1 achieved maximum yield at 190 lb N/A in both 1992 and 1993. Increased nitrogen rates did not improve yields in Goldrush, NDO2904-7, or NDO1496-1. The response for Goldrush was the same in 1992. These varietal response differences were noted as significant interactions for 6- to-10 ounce, total No.1, and under 4-ounce yield components. Averaged over varieties, nitrogen responses were small for all yield components, and non-significant for most.

Specific gravity declined slightly as nitrogen rate increased. This response has been observed in each year of this study. Few internal defects were observed in any of the selections, and nitrogen rate did not affect their incidence.

SUMMARY

A significant portion of the 1993 Klamath County potato crop was planted after June 1. The Russet Burbank portion of this acreage produced low yields and small size in most cases. The need for an earlier maturing variety in short-season areas is evident. Russet Norkotah produced much higher returns than late planted Russet Burbank under these conditions. However, variety changes are usually not an option in late spring due to seed availability. Results of these studies suggest changes in crop management will improve crop performance when late planting becomes necessary. Specifically, lower nitrogen rates and lower plant populations will increase yields, tuber size, and economic returns in Russet Burbank. Similar results were observed in a four-year evaluation of Russet Burbank response to planting date, nitrogen rate, and seed spacing conducted in New Brunswick, Canada in the early 1980's. Early maturing varieties may not respond in the same way.

As reported in the previous section, several advanced Oregon selections appear to offer much improved performance compared with standard varieties. Yields and tuber size distribution were excellent in both trials for A74212-1E, COO83008-1, and NDO2904-7. NDO1496-1 produced higher yields than Snowden, with equal specific gravity.

Table 1. Effect of seed spacing on performance of nine potato selections, Klamath Experiment Station, Oregon 1993.

Variety/ Selection	Seed Spacing	Yield U.S. No. 1s 4-6 oz	6-10 oz	>10 oz	Total	Yield Bs	No. 2s	Culls	Total	Specific Gravity
	inches	cwt/A								
R. Burbank	6.8	169	88	8	265	123	10	23	421	1.084
	8.7	149	105	13	267	113	9	28	417	1.084
	12.0	149	134	24	307	84	1	16	408	1.083
R. Norkotah	6.8	129	192	60	381	78	2	11	472	1.075
	8.7	135	179	83	397	56	19	10	482	1.076
	12.0	105	151	95	351	42	7	21	431	1.072
A74212-1E	6.8	215	187	43	445	101	5	13	564	1.077
	8.7	171	194	101	466	77	16	26	585	1.078
	12.0	139	195	153	487	46	8	22	563	1.073
Goldrush	6.8	147	137	45	329	72	24	36	461	1.072
	8.7	141	160	64	365	59	24	26	474	1.073
	12.0	107	154	90	351	52	20	29	452	1.074
Snowden	6.8	182	99	25	306	127	1	16	450	1.091
	8.7	156	123	45	324	101	0	14	439	1.090
	12.0	176	129	51	357	106	0	11	474	1.090
COO83008-1	6.8	80	216	196	492	34	3	24	553	1.084
	8.7	85	188	205	478	39	11	17	545	1.081
	12.0	67	128	275	470	17	5	25	517	1.081
AO82611-7	6.8	178	196	33	407	103	0	12	522	1.081
	8.7	150	177	55	382	64	5	16	467	1.080
	12.0	115	171	93	379	49	7	16	451	1.083
NDO 2904-7	6.8	121	186	140	447	52	4	11	514	1.072
	8.7	126	196	121	443	55	8	10	516	1.073
	12.0	92	172	170	434	36	9	17	496	1.072
NDO 1496-1	6.8	158	134	46	338	115	0	16	469	1.089
	8.7	175	128	51	354	104	0	9	467	1.090
	12.0	156	149	67	372	70	2	11	455	1.090
Variety Main Effect (average of three spacings)										
R. Burbank		156	109	15	280	107	7	22	415	1.083
R. Norkotah		123	174	79	376	58	9	14	462	1.070
A74242-1E		175	192	99	466	75	10	20	570	1.076
Goldrush		132	151	66	348	61	22	31	462	1.073
Snowden		171	117	41	329	112	0	13	454	1.090
COO83008-1		77	177	225	480	30	7	22	538	1.082
AO82611-7		148	181	60	389	72	4	15	480	1.082
NDO 2904-7		113	185	144	441	48	7	12	508	1.072
NDO 1496-1		163	137	55	354	96	1	12	464	1.090
CV (%)		16	17	35	12	23	99	55	9	1
LSD (0.05)		18	22	25	36	13	6	8	36	0.004
Seed Spacing Main Effect (average of nine selections)										
	6.8	153	160	66	379	89	6	18	492	1.080
	8.7	143	161	82	386	74	10	17	488	1.081
	12.0	123	154	113	390	56	7	19	472	1.078
CV (%)		23	23	46	17	27	112	37	12	1
LSD (0.05)		18	NS	23	NS	11	NS	NS	NS	NS

Table 2. Effect of nitrogen fertilizer rate on performance of nine potato selections, Klamath Experiment Station, Oregon 1993.

Variety/ Selection	Nitrogen Rate	Yield U.S. No. 1s 4-6 oz	6-10 oz	>10 oz	Total	Yield Bs	No. 2s	Culls	Total	Specific Gravity
	lbs N/A	cwt/A								
R. Burbank	130	180	62	3	245	119	7	28	399	1.083
	160	164	74	8	246	109	12	26	393	1.079
	190	143	62	12	217	95	10	44	366	1.077
R. Norkotah	130	105	130	83	318	44	16	23	401	1.070
	160	122	132	78	333	58	19	21	431	1.072
	190	106	189	87	382	50	14	7	453	1.071
A74212-1E	130	196	148	72	416	69	9	13	507	1.077
	160	163	220	90	473	68	5	14	560	1.072
	190	157	162	99	418	72	8	15	513	1.072
Goldrush	130	132	144	59	335	53	16	29	433	1.074
	160	126	137	50	313	64	23	21	421	1.071
	190	129	130	63	322	60	18	34	433	1.071
Snowden	130	214	118	33	365	78	1	8	452	1.088
	160	198	114	30	343	84	2	14	443	1.087
	190	184	79	22	285	120	2	13	415	1.087
COO83008-1	130	82	135	209	426	28	9	13	476	1.082
	160	93	155	132	380	38	11	34	463	1.081
	190	85	180	168	433	40	1	10	484	1.079
AO82611-7	130	142	155	68	365	63	10	7	446	1.079
	160	143	177	55	375	62	12	12	462	1.080
	190	127	173	92	392	44	13	21	470	1.076
NDO 2904-7	130	112	164	144	420	43	4	18	485	1.069
	160	94	129	156	379	35	9	12	435	1.070
	190	79	125	172	376	34	17	22	449	1.065
NDO 1496-1	130	208	124	24	356	74	2	6	438	1.090
	160	209	112	28	349	84	0	8	441	1.088
	190	200	110	31	341	67	0	9	417	1.088
Variety Main Effect (average of three nitrogen fertilizer rates)										
R. Burbank		162	66	8	236	107	10	33	386	1.080
R. Norkotah		111	150	83	344	51	16	17	429	1.071
A74212-1E		172	177	87	436	70	7	14	527	1.073
Goldrush		129	137	58	323	59	19	28	429	1.072
Snowden		199	104	28	331	94	2	12	437	1.087
COO83008-1		87	157	170	413	36	7	19	474	1.081
AO82611-7		137	168	72	377	56	12	13	459	1.079
NDO 2904-7		95	139	157	392	38	10	17	456	1.068
NDO 1496-1		206	115	28	349	75	1	8	432	1.088
CV (%)		17	20	33	11	25	87	61	9	1
LSD (0.05)		20	22	21	33	11	7	9	33	0.003
N-Rate Main Effect (average of nine selections)										
	130	153	131	77	361	64	8	16	449	1.079
	160	146	139	70	354	67	10	18	450	1.078
	190	134	134	83	352	65	9	19	444	1.076
CV (%)		21	9	16	10	29	109	44	10	1
LSD (0.05)		17	8	7	NS	NS	NS	NS	NS	0.003

Potato Response to Post-Emergence Herbicides in Cool Weather

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

INTRODUCTION

An experimental post-emergence herbicide with reduced toxicity to herbicide sensitive potato varieties and improved activity against nightshade species is in advanced stages of evaluation. The product, Matrix, combines the numbered compound, E9636, with low rates of metribuzin. The product was evaluated at KES in 1992 on the metribuzin-sensitive Shepody variety. Excellent control of nightshade, Indian lovegrass, and redroot pigweed was achieved with little crop injury. A 1993 study evaluated crop injury potential for this product when application coincided with near-frost conditions, a common occurrence in the Klamath Basin.

PROCEDURES

Shepody potatoes were planted at 8.7-inch seed spacing in 32-inch rows June 9. Standard fertilizer, and disease and insect control practices were followed. Pre-emergence herbicides applied on June 15 included Prowl at 0.75 lb ai/A and Dual at 1.5 lb ai/A. Four row plots, 20 feet long were established to accommodate 10 treatments and four replications in a randomized complete block design. Treatments included an untreated control and three herbicide combinations applied the day a frost or near frost was expected, the day following a frost or near frost, and several days after a frost or near frost, when minimum air temperatures would remain above 40 °F. Herbicide combinations included: E9636 at 0.25 oz ai/A + Lexone at 2.0 oz ai/A; E9636 at 0.50 oz ai/A + Lexone at 4.0 oz ai/A; and E9636 alone at 0.50 oz ai/A. Treatments were applied with a backpack sprayer at 20 gpa of solution. Treatment dates were July 15 (minimum air temperature at canopy level was 31 °F at 6:00 am on July 15), July 16, and July 26 (minimum air temperature at canopy level was 40 °F on July 27). Moderate pre-emergence herbicide injury was experienced and pre-treatment crop stress was evident in approximately 50 percent of plants prior to application of post-emergence treatments.

Weather conditions from July 14 to July 24 were cool and overcast through much of the period. Minimum air temperatures recorded at the KES weather station reached 34 or 35 °F on July 15, 16, 17, 18, and 22. Maximum air temperatures were 65, 65, 69, 70, and 70 °F on these dates, respectively. Rainfall ranging from a trace to 0.04 inches was recorded on 4 days during the period. Sprinkler irrigation was used for frost protection on July 15.

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2/ Klamath County Cooperative Extension Agent, Klamath Falls, OR.

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

RESULTS AND DISCUSSION

Serious crop injury was experienced in over 50 percent of the study, with plant death the end result. The injury was first evident shortly after emergence, indicating that the pre-emergence herbicides, Dual and Prowl, were at least partially responsible. Plants were not beyond hope of recovery in mid-July, and treatments were applied as planned. All treatments applied on July 15 and 16 resulted in plant death when prior crop injury was evident. Plants that were relatively vigorous prior to treatment were not injured by any of the treatments applied on July 26. Due to the confounding influence of injury from pre-emergence herbicides, the study was abandoned and no data was obtained. However, the difference in plant response to herbicides applied at near-frost conditions on July 15 and 16, and at warmer conditions on July 26, demonstrated that the risk of crop injury from post-emergence herbicides is much higher when plants are subjected to near-frost minimum temperatures.

Effects of Foliar-Applied Methanol on Potato Yield and Quality

K.A. Rykbost, R.L. Dovel, and J. Maxwell[1]

INTRODUCTION

Repeated foliar applications of methanol have been reported to increase yields, hasten maturity, and improve nutrient and water use efficiency in C3 plants under conditions of high temperatures and high light intensity in Arizona. Widely publicized in the popular press, preliminary findings have generated considerable interest in the research community, but also among many commercial producers in Oregon, Washington, and California. If preliminary findings are valid and can be demonstrated to apply to climatic conditions prevailing in the Klamath Basin, the use of methanol on high value crops would be beneficial for water conservation, and as a possible remedy to production limitations imposed by short-season climatic conditions. However, if this technology is not applicable under local conditions, or if the preliminary reports are unfounded, evidence to that effect will assist producers to avoid inappropriate expenditures for non-beneficial practices.

Research was initiated at several Oregon locations to evaluate effects of methanol on important crops under a range of climatic and geographic conditions. Trials with potatoes were conducted at Klamath Falls, Madras, and Ontario. Results from Madras and Ontario will be reported in other publications.

PROCEDURES

Russet Burbank potatoes were planted at 12-inch seed spacing in 32-inch rows on June 3. Standard cultural practices were followed (see page 26). Four-row plots, 50 feet long were established in a randomized complete block design to accommodate six treatments and four replications. Treatments included solutions of 0, 20, and 40 percent methanol with no surfactant, and solutions of 20, 40, and 80 percent methanol with 0.1 percent Triton X-100 surfactant. Solutions were applied at 20 gpa with a backpack sprayer. All treatments were applied between noon and 1:00 pm on July 18, July 28, and August 11. Maximum/minimum air temperatures recorded at the KES weather station on these dates were; 70/40, 86/46, and 81/46 °F, respectively. Average monthly maximum and minimum air temperatures were 74 and 40 °F for July, and 69 and 40 °F for August. Potatoes from the two center rows were harvested on October 5. Total weights were determined at harvest. Samples of 120 lb/plot were stored and graded to USDA standards in early November.

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Acknowledgment: The Oregon Potato Commission provided funding in support of this project.

RESULTS AND DISCUSSION

Foliar treatments did not produce visible effects on the crop canopy. Vines were beginning to senesce at the time desiccant was applied, with no apparent maturity differences between treatments. Methanol treatments did not result in significant differences in any of the yield parameters or in specific gravity (Table 1). This result was similar to observations in field studies conducted at Madras and Ontario.

The original report of crop responses to methanol was based on high light intensity and high air temperatures typical for southern Arizona. The 1993 growing season in Klamath Falls was cooler than normal. Air temperatures only reached 90 °F on four days in August and 3 days in September. Average temperatures in July were about 7 °F below long-term averages. However, temperatures experienced in Ontario were higher than would occur in the warmest season in the Klamath Basin. Any crop benefits from methanol that may be obtained in the weather extremes of the southwest, do not appear to apply to potatoes grown in the Klamath Basin or other production areas of Oregon. Growers are advised that foliar application of methanol to potatoes is unlikely to produce benefits greater than the costs of application, and may actually reduce gross crop revenue.

Table 1. Effect of foliar applications of methanol on yield, tuber size, and specific gravity of Russet Burbank potatoes at Klamath Falls, OR, 1993.

Treatment[1]	Yield U.S. No. 1s 4-6 oz	6-10 oz	>10 oz	Total	Yield Bs	No.2s	Culls	Total	Specific gravity
1	136	86	31	252	64	10	15	342	1.084
2	118	102	37	256	78	14	14	361	1.086
3	112	97	33	242	72	9	13	335	1.085
4	117	88	30	237	78	13	17	344	1.084
5	127	103	27	257	72	16	23	368	1.084
6	121	112	37	269	76	14	20	380	1.086
Mean	122	98	33	252	73	13	17	355	1.085
CV (%)	12	21	38	13	18	65	89	14	1
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

[1]/ 1) 20 gal/A water applied on 7/18, 7/28, 8/11.
2) 20 gal/A, 20% methanol, 0.1% Triton X-100, applied on 7/18, 7/28, 8/11.
3) 20 gal/A, 40% methanol, 0.1% Triton X-100, applied on 7/18, 7/28, 8/11.
4) 20 gal/A, 80% methanol, 0.1% Triton X-100, applied on 7/18, 7/28, 8/11.
5) 20 gal/A, 20% methanol, applied on 7/18, 7,28, 8/11.
6) 20 gal/A, 40% methanol, applied on 7/18, 7/28, 8/11.

Sugarbeet Variety Evaluations in the Klamath Basin

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

INTRODUCTION

Coded 1993 sugarbeet variety trials were conducted at the Klamath Experiment Station (KES) on a sandy loam soil, and at the U.C. Intermountain Research and Extension Center (IREC) on a silty loam soil with high organic matter content. Trials at each site included a commercial trial with 16 entries, most of which have been evaluated in two previous years, and an experimental trial with 35 entries, many being evaluated for the first time in the Klamath Basin. These trials are conducted on behalf of the California Beet Growers Association (CBGA) and they serve as officially sanctioned trials for the purpose of determining suitability of varieties for commercial production in the Klamath District.

PROCEDURES

Both trials were conducted in a randomized complete block design with four replications at each site. KES trials used two-row, 15-foot plots, with yields determined from both rows. IREC plots consisted of three rows, 50 feet long, with yields determined from the center row. Beets in KES trials were hand planted in 22-inch rows on May 12 and 13 and hand harvested on October 18 and 19. Modified machinery was used to plant beets in 24-inch rows in mid-April and harvest on October 11 in IREC trials. Beets followed spring cereals at both locations. Weed control was achieved with two (KES) or three (IREC) applications of Betamix and hand weeding. Flea beetle control required two applications of carbaryl at both sites. Irrigation was provided with solid-set sprinklers. Stands were hand-thinned about five weeks after planting to achieve populations of approximately 30,000 to 35,000 plants/A. Approximately 20 lb samples from each plot were analyzed by Spreckels Sugar Company, Inc. laboratory personnel to determine sucrose content, purity, and recoverable sugar. Gross crop values were calculated based on terms of the 1993 Holly Sugar Corporation contract and a net selling price of $24.00/cwt.

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[2]/ Superintendent/Farm Advisor and Research Associate, respectively, U.C. Intermountain Research and Extension Center, Tulelake, CA.

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RESULTS AND DISCUSSION

Crop development was influenced by high soil moisture content and low soil temperatures through May and June, and below normal temperatures through most of the summer. Both yields and sugar content were reduced, compared to results of trials in the more favorable 1992 season. However, with one or two exceptions in the experimental variety trials, all entries achieved excellent stands, reasonably high yields and acceptable sugar content. The effect of location on crop performance was not as large as in previous years. Differences between entries were minor at both locations. Most of the entries were not significantly different in yield or sugar content at either location.

I. Commercial Variety Trials

All entries in this trial have been approved for commercial production in the Klamath District. Thirteen entries were also evaluated in these trials in 1991 and 1992. KW 316, KW 6000, and HM 5892 were not included in 1991 commercial trials. Harvested beet populations in the 1993 KES trial ranged from 29,100 to 33,700 beets/A (Table 1). Average beet yields, at 27.0 tons/A, were 5.4 tons/A less than the 1992 KES trial average. The average sugar content of 17.0 percent, was 1.8 percent lower than in the 1992 trial. Effects of planting date on yield, presented later in this report, account for much of the yield difference between 1992 and 1993 trials. The 1993 trial was planted nearly three weeks later than the 1992 trial. Planting date has not been shown to have a significant effect on sugar content under Klamath Basin conditions. Lower sugar contents in the 1993 trial were probably due primarily to cool daytime temperatures during much of the season.

Gross crop value represents the best measure of crop performance, as this parameter combines yield, sugar content, and contract price incentives for high sugar content. In the 1993 KES trial, Monohikari and ACH 203 produced significantly higher crop value than four other selections (Table 1). Monohikari has consistently achieved high yields and sugar content at KES. Beta 1996, ACH 304, KW 316, KW 6000, and WS-91 also produced high crop values.

Sugar purity and recoverable sugar were determined from additional laboratory analyses in 1993. Average purity for the KES trial was 92.3 percent, ranging from a low of 91.0 percent for ACH 191, to a high of 93.5 percent for Beta 1996, WS-26, and Monohikari.

Beet yield, sugar content, recoverable sugar production, and gross crop value at KES and IREC locations are compared in Table 2. The IREC trial was planted three weeks earlier, and harvested one week earlier than the KES trial. Average yields were 1.7 tons/A higher at IREC. Average sugar content was similar at both locations. WS-62, HH 55, WS-91, and ACH 203 produced the highest gross crop value at IREC. The interaction between selections and location was not statistically significant for any of the performance parameters. Averaged over locations, the highest gross crop value was achieved by WS-62, ACH 203, and Monohikari.

Data for 13 commercial selections are summarized over three years at both locations (Table 3). Average beet yield, sugar content, sugar yield, and gross value were very similar in 1991 and 1993, and significantly lower than in 1992. Yields and crop value were significantly greater at IREC, but sugar content was not affected by location. The interaction between year and location was significant for all parameters. Location effects were relatively large in 1991 and 1992, but not in 1993. Selections were significantly different in sugar content. Differences in beet yield, sugar yield, and gross value were not significant when averaged over locations and years. The interaction between variety, year, and location was significant for sugar yield and gross crop value (Table 3).

Selections that have consistently produced higher yields at KES were severely damaged by curly top virus in a 1992 variety trial at Susanville, CA. The selections that have produced the highest yields at IREC were least affected by curly top virus in the Susanville trial. Low virus infection levels or late infections at IREC, but not at KES, may be a plausible explanation for differences in variety performance between locations in the 1991 and 1992 trials. It is also highly likely that soil type and minor climatic differences between locations are partly responsible for observed location effects.

Site-specific variety selection within the Klamath Basin seems justified. It is interesting to note that averaged over three years, Monohikari has produced the highest crop value at KES and the lowest crop value at IREC, while the reverse is true for ACH 199. The high susceptibility of Monohikari to severe damage from curly top virus has not been a factor in the Klamath Basin to date. However, if infection occurs in the future, Monohikari crops would suffer serious losses.

II. Experimental variety trials

Crop development, yields, and sugar content of 35 selections in the experimental variety trials were similar to results observed in the commercial trials. In the KES trial, 9BG 9264 had about 50 percent stand and produced 67 percent of the mean yield for the trial. All other selections achieved acceptable stands in both locations. Average beet yields were 1.2 and 1.8 tons/A lower than average yields in the commercial trials at KES and IREC, respectively (Table 4). Average sugar contents were 0.5 percent higher in the experimental trials. Significant differences between selections were found for beet yield and sugar content at KES. At IREC, yield differences were not statistically significant. Recoverable sugar yield and gross crop value were significantly higher at IREC than at KES. The interaction between selections and location was not significant for any of the parameters.

Monohikari and HH 55 were included as standard varieties. Monohikari ranked 5th and 6th in gross crop value at KES and IREC, respectively. Four selections; ACH 88-643, HM 5894, HM 7006, and HM 7022, were equal to Monohikari in gross crop value across locations. The difference in sugar content between HH 55 and Monohikari has been observed in all trials at both locations over three years. Several selections exceeded Monohikari in sugar content, and all were higher than HH 55.

Ten of the experimental selections were also evaluated in the experimental trials in 1992. To be eligible for commercial production, selections must achieve sugar yields of at least 97 percent of average yields of the approved varieties for the district during three years of evaluation. ACH 89-320 and SX 1401 have failed to meet this criteria after two years of testing. A second condition for approval is the selection's response to beet curly top virus. Official disease evaluation trials are conducted elsewhere. Several of the selections that meet yield criteria based on KES and IREC trials may not be approved for local production due to curly top susceptibility.

Since the introduction of sugarbeet production to the Klamath Basin in 1989, diseases have not been a significant factor in crop performance. A late-season infestation of black bean aphids occurred in 1993. This aphid is a vector for beet yellows virus, a serious disease in other production areas. Beet leafhoppers, the vector for beet curly top virus, are also present in the area. Monitoring of these insects and related diseases will be important for the protection of future beet production. Several years of evaluations have identified a large number of varieties capable of producing high yields and high sugar content under local conditions. Several of these varieties have disease resistance that may be very important in the future.

Table 1. Performance of 16 commercial sugarbeet varieties at the Klamath Experiment Station, Klamath Falls, OR, 1993.

Selection	Population	Beet Yield	Sugar Content	Sugar Yield	Recoverable Sugar	Gross Value
	1000 beets/A	tons/A	%	lb/A	lb/A	$/A
ACH 191	31.5	26.8	16.6	8910	8110	1100
ACH 199	31.9	26.3	16.9	8890	8120	1100
ACH 203	33.1	28.8	17.1	9840	9020	1210
ACH 304	31.3	28.1	17.1	9600	8810	1180
BETA 1996	30.9	26.5	18.0	9520	8900	1180
KW 316	32.1	27.8	17.5	9720	8990	1200
KW 6000	31.9	28.8	17.0	9770	9060	1200
WS-26	31.7	24.1	17.4	8410	7860	1040
WS-62	31.3	27.8	16.7	9270	8490	1140
WS-91	33.1	27.8	16.9	9390	8650	1160
HM 5892	31.9	24.7	17.1	8420	7760	1040
HH-50	30.1	27.5	16.8	9220	8530	1140
HH-55	31.9	28.4	16.2	9210	8430	1130
MONOHIKARI	32.7	28.0	17.6	9840	9200	1210
SX 1	29.1	25.0	17.1	8550	7930	1060
SS-502	33.7	26.5	16.7	8820	8100	1090
Mean	31.8	27.0	17.0	9210	8500	1140
CV (%)	5	6	3	7	8	7
LDS (.05)	2.3	2.4	0.8	920	910	110

Table 2. Yield, percent sugar, recoverable sugar production, and gross crop value for 16 commercial sugarbeet varieties at Klamath Falls, OR (KES) and Tulelake, CA (IREC), 1993.

Selection	Beet Yield			Sugar Content			Recoverable Sugar			Gross Crop Value		
	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean
	----- tons/A -----			------- % --------			-------- lb/A ---------			------ $/A -------		
ACH 191	26.8	28.5	27.7	16.6	16.7	16.7	8110	8760	8440	1100	1230	1160
ACH 199	26.3	27.3	26.8	16.9	17.3	17.1	8120	8810	8470	1100	1240	1170
ACH 203	28.8	30.0	29.4	17.1	17.5	17.3	9020	9830	9430	1210	1380	1300
ACH 304	28.1	27.9	28.0	17.1	17.2	17.2	8810	9020	8920	1180	1260	1220
Beta 1996	26.5	26.5	26.5	18.0	17.6	17.8	8900	8850	8880	1180	1240	1210
KW 316	27.8	27.4	27.6	17.5	17.3	17.4	8990	8800	8900	1200	1240	1220
KW 6000	28.8	29.5	29.2	17.0	17.1	17.1	9060	9460	9260	1200	1320	1260
WS 26	24.1	28.7	26.4	17.4	17.5	17.5	7860	9440	8650	1040	1320	1180
WS 62	27.8	32.6	30.2	16.7	17.2	17.0	8490	10460	9480	1140	1470	1310
WS 91	27.8	31.4	29.6	16.9	17.0	17.0	8650	9960	9310	1160	1390	1270
HM 5892	24.7	28.9	26.8	17.1	17.3	17.2	7760	9340	8550	1040	1310	1180
HH 50	27.5	28.6	28.1	16.8	16.7	16.8	8530	8870	8700	1140	1230	1180
HH 55	28.4	31.4	29.9	16.2	17.0	16.6	8430	10030	9230	1130	1400	1270
Monohikari	28.0	29.8	28.9	17.6	17.3	17.5	9200	9640	9420	1210	1360	1290
SX-1	25.0	24.8	24.9	17.1	16.4	16.8	7930	7540	7740	1060	1040	1050
SS 502	26.5	26.1	26.3	16.7	17.1	16.9	8100	8340	8220	1090	1170	1130
Mean	27.0	28.7	27.9	17.0	17.1	17.1	8500	9200	8850	1140	1290	1210
CV(%)	6	10	8	3	4	4	8	11	10	7	12	10
LSD(0.05)	2.4	4.1	2.3	0.8	NS	0.7	910	1470	850	110	210	120

Table 3. Three-year summary of performance of 13 sugarbeet varieties at Klamath Falls, OR (KES) and Tulelake, CA (IREC), 1991 - 1993.

Selection	Beet Yield			Sugar Content			Sugar Yield			Gross Crop Value		
	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean
	----- tons/A -----			------- % --------			-------- lb/A ---------			------ $/A -------		
HH-50	27.5	31.9	29.7	17.2	17.6	17.4	9530	11200	10370	1230	1480	1360
HH-55	29.5	31.3	30.4	17.0	17.0	17.0	10080	10670	10380	1240	1480	1360
Beta 1996	27.2	30.0	28.4	18.2	18.1	18.1	9940	10880	10410	1300	1450	1380
Monohikari	29.0	29.4	29.2	18.0	17.5	17.8	10500	10320	10410	1370	1360	1370
SX-1	28.8	29.8	29.3	17.3	17.3	17.3	10020	10350	10190	1300	1360	1330
ACH 191	27.7	30.0	28.9	17.8	17.3	17.5	9910	10360	10140	1300	1360	1330
ACH 199	26.0	31.3	28.7	17.7	17.8	17.8	9220	11180	10200	1200	1480	1340
ACH 203	29.1	31.7	30.4	17.5	17.4	17.4	10250	10990	10620	1330	1440	1390
ACH 304	27.6	30.1	28.9	17.8	17.6	17.7	9620	10400	10010	1290	1400	1340
WS 26	26.6	30.5	28.6	18.0	17.9	17.9	9630	10960	10290	1260	1460	1360
WS 62	27.7	31.9	29.8	17.5	17.5	17.5	9730	11190	10460	1260	1480	1370
WS 91	27.1	31.1	29.1	17.9	17.4	17.6	9700	10820	10260	1270	1420	1350
SS 502	27.4	30.3	28.9	17.3	17.2	17.2	9590	10430	10010	1230	1370	1300
Mean	27.8	30.8	29.3	17.6	17.5	17.5	9820	10750	10290	1270	1430	1350
LSD(0.05)			NS			0.5			NS			NS
Significance:[1]												
Year			**			**			**			**
Location			**			NS			**			**
Year x Location			**			*			**			**
Selection			NS			**			NS			NS
Year x Selection			**			NS			**			**
Location x Selection			*			NS			**			**
Year x Location x Selection			NS			NS			*			*

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

Table 4. Yield, sugar content, recoverable sugar production, and gross crop value for 35 experimental sugarbeet varieties at Klamath Falls, OR (KES) and Tulelake, CA (IREC), 1993.

Selection	Beet Yield			Sugar Content			Recoverable Sugar			Gross Crop Value		
	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean
	----- tons/A -----			------- % --------			-------- lb/A --------			------ $/A -------		
ACH 209	28.3	25.8	27.1	17.9	17.7	17.8	9330	8150	8740	1250	1210	1230
ACH 316	25.5	26.4	25.9	17.6	18.3	18.0	8170	8680	8430	1100	1290	1200
ACH 317	22.8	26.2	24.5	17.3	18.3	17.8	7170	8920	8040	970	1290	1130
ACH 88-643	30.0	28.2	29.1	16.9	18.1	17.5	9270	9570	9420	1250	1360	1300
ACH 89-320	22.6	26.3	24.5	17.9	18.0	18.0	7520	8550	8030	1000	1270	1130
ACH 890373	26.1	26.3	26.2	17.9	18.5	18.2	8540	8810	8680	1150	1300	1230
ACH 9000428	26.6	25.7	26.1	17.4	18.2	17.8	8500	8610	8560	1140	1250	1200
ACH 9200337	28.5	28.6	28.6	17.1	17.7	17.4	8920	9090	9010	1200	1330	1270
Beta 8422	24.5	26.6	25.5	17.4	17.9	17.6	7790	8790	8290	1050	1260	1160
Beta 8450	27.3	27.5	27.4	16.9	18.0	17.4	8400	9010	8710	1130	1310	1220
9G 6915	27.4	28.4	27.9	18.0	17.6	17.8	9090	9210	9150	1220	1320	1270
9BG 5349	24.7	25.5	25.1	18.0	18.8	18.4	8270	8850	8560	1100	1290	1190
9BG 9264	17.4	24.3	20.8	17.9	18.6	18.2	5750	8470	7110	760	1210	990
9BG 9276	26.5	26.1	26.3	17.4	18.1	17.7	8490	8660	8580	1140	1260	1200
0BG 4156	22.9	24.7	23.8	17.9	18.2	18.0	7650	8220	7940	1020	1200	1110
1BG 6164	26.5	27.7	27.1	17.6	18.6	18.1	8660	9540	9100	1150	1390	1270
HM 5893	27.8	26.7	27.2	17.5	17.9	17.7	8980	8940	8960	1200	1270	1230
HM 5894	28.9	29.6	29.2	16.9	17.6	17.3	9100	9260	9180	1200	1370	1290
HM 7006	27.2	28.4	27.8	17.6	18.2	17.9	8820	9570	9200	1180	1370	1280
HM 7022	28.0	28.8	28.4	17.3	18.4	17.8	8950	9970	9460	1190	1410	1300
93 HX 16	23.9	26.3	25.1	16.9	17.7	17.3	7410	8710	8060	1000	1230	1110
93 HX 17	26.5	26.8	26.6	16.4	17.7	17.1	8080	8660	8370	1070	1250	1160
93 HX 19	25.4	28.4	26.9	16.3	17.6	16.9	7530	9250	8390	1020	1320	1170
93 HX 20	23.3	25.7	24.5	16.9	17.9	17.4	7290	8480	7890	970	1220	1090
SX 1401	24.9	28.8	26.9	16.8	17.6	17.2	7620	9300	8460	1030	1340	1190
SX 1402	27.0	27.3	27.1	17.1	17.9	17.5	8490	8930	8710	1140	1270	1210
SX 1403	23.1	24.3	23.7	17.5	17.5	17.5	7530	7630	7580	990	1130	1060
H88200	24.6	26.9	25.7	17.1	17.8	17.5	7780	8700	8240	1040	1270	1150
H90446	26.5	26.8	26.7	17.5	17.7	17.6	8670	8820	8740	1150	1250	1200
H90451	28.2	27.3	27.8	18.0	17.4	17.7	9380	8640	9010	1260	1240	1250
H91258	24.0	24.5	24.3	16.4	17.4	16.9	7200	7800	7500	970	1120	1050
H92510	25.3	26.3	25.8	17.7	17.8	17.8	8310	8750	8530	1100	1240	1170
H92848	26.8	27.5	27.2	16.9	17.9	17.4	8190	9100	8650	1120	1310	1210
HH 55	26.2	27.4	26.8	16.7	16.6	16.6	8110	8130	8120	1080	1170	1130
Monohikari	27.7	28.4	28.0	17.7	17.8	17.8	9140	9310	9220	1210	1340	1270
Mean	25.8	26.9	26.3	17.3	17.9	17.6	8230	8830	8530	1100	1280	1190
CV(%)	8	9	8	4	3	4	9	10	10	9	10	9
LSD(0.05)	3.0	NS	2.2	1.1	0.8	0.7	1080	NS	830	140	NS	110

Sugarbeet Date of Planting Studies in the Klamath Basin

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

INTRODUCTION

The Klamath Basin experiences a high desert climate with warm days, cool nights, and a short growing season. Sugarbeets are planted in April and May and harvested in October. It is assumed yield and sugar content of beets grown in the basin are limited by the short season, and there should be a yield and/or sugar content advantage to early sugarbeet stand establishment. Unfortunately, early spring weather is typically wet, windy, and cold, with frequent frosts; conditions that are less than optimum for small seeded row crops like sugarbeets. Therefore, sugarbeet growers face a dilemma between the high risk of stand loss with early planting and the potential for reduced crop yields or sugar content if planting is delayed.

A series of field experiments were conducted to determine the extent of any yield or sugar content advantage to early season sugarbeet planting. Date of planting experiments were conducted at IREC and KES during the 1991, 1992, and 1993 growing seasons. The two experiment stations are located only 30 miles apart, but they represent the diversity of soil types and weather patterns that occur in the Klamath Basin. KES has a sandy mineral soil with less than 1 percent organic matter, while IREC has a silty clay loam lake bottom soil with 13 percent stable organic matter content. Chances of plant injury from frost are much greater at IREC as minimum air temperatures during the growing season are often several degrees below temperatures recorded at KES.

PROCEDURES

Field studies were established as replicated, randomized complete block, split-plot experiments. Planting date treatments were assigned to main plots. Two sugarbeet varieties, Monohikari and HH 55, were randomly assigned to split-plots. Initial plantings were made in early to mid-April. Sequential plantings were made at 7 to 10 day intervals through the end of May or early June. Uniform irrigation was supplied through solid set sprinklers with frequent, light applications as necessary during stand establishment. In the 1991 IREC experiment, furrow irrigation was used following stand establishment. Season-long sprinkler irrigation was used in all other experiments. Weeds were controlled with post-emergence herbicide applications and hand weeding. Insecticides were applied to control flea beetles and armyworms. At IREC, sulfur was applied to control late season outbreaks of powdery mildew.

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Acknowledgments: Financial support from the California Beet Growers Association and sample analyses by Holly Sugar Corporation are gratefully recognized.

Widely varied weather and soil conditions between seasons and locations affected the timing of planting schedules (Table 1). Fertilizer practices, plot size, cropping history, and other experimental variables also varied between years and locations. Planting was accomplished with a modified mechanical planter at IREC and with a Planet-Junior type, hand operated planter at KES. Plant stands were hand thinned to approximately 30,000 to 35,000 plants/A about 5 to 6 weeks after planting. At IREC, stands in early 1991 plantings were below target populations. High seeding rates at KES resulted in excellent final stands in all plantings.

All beets were harvested for yield measurement in mid October. Sample beets from each plot were sent to Imperial Holly Sugar Corporation within one day of harvest for tare and sugar content analysis. Total sugar production was calculated as the product of yield, adjusted for tare, and sugar percentage. Gross crop values were calculated based on terms of the CBGA-processors contract, yield and sugar percentages measured in each plot, and a sugar net selling price of $24.00/cwt.

RESULTS AND DISCUSSION

Measured yields and sugar contents, and calculated total sugar production and gross crop values for each experiment are presented (Tables 2-7). In the KES experiments, beet yields consistently declined with each delay in planting date. In the IREC experiments, beet yields did not decline markedly with planting delays during April, but declined rapidly with each delay in planting after May 1. Averaging the yield response to planting date over all years and experiments, yields declined modestly with planting delays in April and precipitously with delays in planting after May 1 (Figure 1). The best fit quadratic regression equation of yield response to planting date was: Yield = 33.45 - 0.002784 X^2, where X equals the planting date expressed as the number of days after March 31 ($p<0.001$, $R^2 = 0.64$). Based on this regression curve, beet yields declined an average of 1.75 tons/A for each week delay in planting after May 1.

Sugar content of the beets was generally unaffected by planting date. Statistically significant differences in sugar content by planting date were only observed in the 1991 IREC experiment, which showed a trend for higher sugar content with later planting date. The general lack of response in sugar content to planting date is illustrated by a plot of average sugar percentages by planting date for all experiments (Figure 2). The two varieties differed in sugar content as Monohikari produced significantly higher sugar content than HH 55 in all six experiments.

As sugar percentage was largely unaffected by planting date, the effect of planting date on total sugar production generally mirrored the response of beet yields to planting delays (Figure 3). Significant reductions in total sugar production occurred with delayed planting in each experiment. In the KES experiments, reductions in total sugar production occurred with each delay in planting. In the experiments at IREC, reductions in total sugar yield were not pronounced until plantings were delayed past the end of April or first week in May. Averaged over years and locations, the response of total sugar production to planting date was described by the regression relationship: Total Sugar (lb/A) = 11448 - 0.9515 X^2, where X equals the planting date expressed as the number of days past March 31 ($p<0.001$, $R^2 = 0.62$). Total sugar production declined by 600 lb/A for each week planting was delayed past May 1.

The gross dollar return for sugarbeets is affected by both the sugar content of the beets and beet yield. Generally following the trend in beet yields, gross crop values declined sharply with delayed planting (Figure 4). Over years and locations, the average response of gross crop value to planting dates was described by the regression equation: Gross Crop Value ($/A) = 1502 - 0.1325 X^2, where X is the planting date expressed as days after March 31 ($p<0.001$, $R^2 = 0.62$). On average, gross crop value decreased $85/A for each week planting was delayed after May 1.

Effects of planting date on rates of stand establishment, or effects of partial stands on beet yields, were not evaluated. Because of high seeding rates, adequate stands were obtained in all plantings, in all but one experiment. In the 1991 IREC study, the one experiment where early plantings resulted in less than optimum stands, plots established early with poor stands produced higher yields than plots with far better stands established later in the season. More research is needed to quantify the yield response to various plant densities established over the planting season. This information would be valuable in assessing the economic feasibility of replanting poor stands given the expected loss in yield with late season planting.

SUMMARY

Clearly, as expected, there was a yield advantage to early establishment of sugarbeet crops. Planting delays, particularly after May 1, resulted in significant yield reductions in each year. Beet yield reductions resulted in significantly lower total sugar production and gross crop values. To optimize returns, growers are urged to establish sugarbeets as early in the season as possible. Plantings earlier than the first of April were not attempted. Plantings prior to April 1 would be limited by the availability of irrigation water, the opportunity to complete spring field preparation work, and by low soil temperatures.

Table 1. Description of field experiments at Klamath Experiment Station (KES) and Intermountain Research and Extension Center (IREC).

Description	Year 1991	 1992	 1993
		KES	
No. of Plantings	6	6	5
	Planting range	4/18 - 5/28	4/8 - 5/29
5/11 - 6/11			
Row spacing (inches)	32	32	22
Size:			
Main plot (feet)	10.7 x 32	10.7 x 40	7.3 x 50
Sub-plot (feet)	10.7 x 16	10.7 x 20	5.3 x 18
Harvest (feet)	5.3 x 16	5.3 x 18	3.7 x 22
Harvest date	10/7	10/13	10/20
Replications	4	4	5
Fertilizer:			
Pre-plant			
formula	16-16-16	15-15-15	15-15-15
amount	320 lb/A	200 lb/A	300 lb/A
Post-plant			
formula	N	N	N
amount	80 lb/A	80 lb/A	50 lb/A
Previous crop	potatoes	barley	barley
		IREC	
No. of Plantings	8	9	8
Planting range	4/3 - 5/29	4/8 - 6/10	4/15 - 6/2
Row spacing (inches)	24	24	24
Size:			
Main plot (feet)	6 x 50	6 x 100	6 x 100
Sub-plot (feet)	6 x 25	6 x 50	6 x 50
Harvest (feet)	2 x 20	2 x 40	2 x 45
Harvest date	10/21	10/21	10/18
Replications	4	4	6
Fertilizer:			
Pre-plant			
formula	16-20-0	12-12-12	21-0-0
amount	200 lb/A	175 lb/A	280 lb/a
formula	21-0-0	NH_3	16-20-0
amount	400 lb/A	88 lb N/A	280 lb/A
Previous crop	fallow	barley	barley

Table 2. Yield, sugar content, and gross value of sugarbeets with varied planting dates - Intermountain Research & Extension Center, 1991.

Planting Date	Yield (Ton/A)			Sugar %			Sugar Yield (lb/A)			Gross Crop Value ($/A)		
	Monohikari	HH55	Avg.	Monohikari	HH55	Avg.	Monohikari	HH55	Avg.	Monohikari	HH55	Avg.
April 03, 1991	29.8	28.9	29.3	17.4	16.8	17.1	10380	9720	10040	1367	1264	1316
April 10, 1991	32.8	31.6	32.2	17.6	16.7	17.2	11540	10540	11040	1524	1366	1445
April 18, 1991	31.1	28.4	29.8	17.4	17.1	17.3	10820	9720	10280	1424	1272	1348
April 25, 1991	27.0	26.0	26.5	17.8	17.4	17.6	9580	9060	9320	1271	1192	1231
May 03, 1991	25.2	24.8	25.0	18.8	17.1	17.9	9440	8460	8940	1272	1106	1189
May 08, 1991	29.4	26.8	28.1	18.7	17.6	18.1	10960	9380	10180	1476	1238	1357
May 22, 1991	27.1	28.2	27.6	18.5	17.3	17.9	10020	9720	9860	1344	1277	1310
May 29, 1991	29.0	28.0	28.5	18.4	17.6	18.0	10700	9900	10300	1434	1310	1372
Mean	28.9	27.8	28.4	18.1	17.2	17.6	10420	9560	10000	1389	1253	1321
LSD(0.05)(Date)			2.2			0.7			980			141
LSD(0.05)(Variety)	NS			0.33			420			58		

Variety X date interaction was not significant for any parameter.

Table 3. Yield, sugar content, and gross value of sugarbeets with varied planting dates - Klamath Experiment Station, 1991.

Planting Date	Yield (Ton/A)			Sugar %			Sugar Yield (lb/A)			Gross Crop Value ($/A)		
	Monohikari	HH55	Avg.	Monohikari	HH55	Avg.	Monohikari	HH55	Avg.	Monohikari	HH55	Avg.
April 18, 1991	33.3	34.6	33.9	17.1	16.0	16.5	11400	11060	11220	1493	1412	1452
April 28, 1991	30.6	32.8	31.7	17.7	15.8	16.8	10820	10380	10600	1434	1321	1377
May 03, 1991	32.9	29.4	31.2	16.4	15.7	16.0	10760	9260	10020	1387	1168	1278
May 10, 1991	30.7	29.9	30.3	16.8	16.2	16.5	10280	9680	9980	1336	1241	1288
May 20, 1991	27.3	28.5	27.9	16.6	16.2	16.4	9040	9180	9100	1170	1175	1173
May 28, 1991	26.5	26.8	26.6	16.9	15.7	16.3	8980	8400	8680	1171	1066	1118
Mean	30.2	30.3	30.3	16.9	15.9	16.4	10220	9660	9960	1332	1230	1281
LSD(0.05)(Date)			2.1			NS			940			148
LSD(0.05)(Variety)	NS			0.5			380			53		

Variety X date interaction was not significant for any parameter.

Table 4. Yield, sugar content, and gross value of sugarbeets with varied planting dates - Intermountain Research & Extension Center, 1992.

Planting Date	Yield (Ton/A)			Sugar %			Sugar Yield (lb/A)			Gross Crop Value ($/A)		
	Monohikari	HH55	Avg.	Monohikari	HH55	Avg.	Monohikari	HH55	Avg.	Monohikari	HH55	Avg.
April 08, 1992	35.4	34.6	35.0	17.5	17.3	17.4	12340	11980	12160	1626	1574	1600
April 15, 1992	34.2	34.7	34.4	17.7	16.7	17.2	12060	11540	11800	1595	1494	1545
April 29, 1992	34.1	34.4	34.2	18.4	16.9	17.7	12540	11660	12100	1682	1520	1601
May 06, 1992	37.7	36.4	37.0	17.9	17.1	17.5	13520	12440	12980	1795	1627	1710
May 13, 1992	30.9	35.5	33.2	18.2	17.8	18.0	11220	12620	11920	1498	1671	1585
May 20, 1992	23.6	25.9	24.7	18.2	16.3	17.2	8580	8460	8520	1146	1016	1081
May 27, 1992	20.6	24.4	22.5	17.5	17.4	17.4	7180	8500	7840	906	1016	961
June 03, 1992	18.4	19.1	18.8	17.5	17.2	17.4	6440	6540	6500	849	842	846
June 10, 1992	19.5	18.5	18.8	18.0	17.1	17.6	6840	6320	6580	846	807	827
Mean	28.0	28.8	28.4	17.9	17.0	17.5	10000	9840	10040	1327	1285	1306
LSD(0.05)(Date)			0.98			NS			980			222
LSD(0.05)(Variety)	NS			0.41			NS			NS		

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

Table 5. Yield, sugar content, and gross value of sugarbeets with varied planting dates - Klamath Experiment Station, 1992.

Planting Date	Yield (Ton/A)			Sugar %			Sugar Yield (lb/A)			Gross Crop Value ($/A)		
	Monohikari	HH55	Avg.	Monohikari	HH55	Avg.	Monohikari	HH55	Avg.	Monohikari	HH55	Avg.
April 08, 1992	39.1	38.8	39.0	18.0	16.5	17.2	14120	12760	13440	1879	1647	1763
April 17, 1992	35.6	34.7	35.2	18.2	15.7	17.0	12960	10940	11960	1732	1389	1561
April 28, 1992	34.5	33.4	33.9	17.7	15.7	16.7	12220	10480	11360	1616	1329	1473
May 07, 1992	31.6	31.9	31.8	16.9	16.5	16.7	10680	10580	10620	1392	1367	1380
May 18, 1992	28.5	28.8	28.6	17.3	16.3	16.8	9880	9360	9620	1299	1202	1250
May 29, 1992	25.3	26.3	25.8	17.1	17.1	17.1	8640	9000	8820	1131	1177	1154
Mean	32.4	32.3	32.0	17.5	16.3	16.9	11420	10520	10960	1508	1352	1430
LSD(0.05)(Date)			1.9			0.9			880			132
LSD(0.05)(Variety)	NS			0.5			520			80		

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

Table 6. Yield, sugar content, and gross value of sugarbeets with varied planting dates - Intermountain Research & Extension Center, 1993.

Planting Date	Yield (Ton/A)			Sugar %			Sugar Yield (lb/A)			Gross Crop Value ($/A)		
	Monohikari	HH55	Avg.	Monohikari	HH55	Avg.	Monohikari	HH55	Avg.	Monohikari	HH55	Avg.
April 15, 1993	32.0	30.8	31.4	17.7	16.7	17.2	11300	10300	10800	1497	1338	1417
April 22, 1993	30.5	30.5	30.5	17.1	16.5	16.8	10440	10100	10260	1366	1307	1337
April 27, 1993	29.3	33.4	31.4	17.3	16.7	17.0	10180	11160	10680	1340	1449	1394
May 04, 1993	27.2	27.8	27.5	17.8	16.7	17.3	9680	9320	9500	1286	1213	1249
May 14, 1993	22.0	22.5	22.3	17.9	15.7	16.8	7960	7120	7540	1062	908	984
May 18, 1993	22.4	22.8	22.6	18.0	16.9	17.4	8060	7700	7880	1073	1003	1038
May 24, 1993	23.6	23.6	23.6	17.5	16.5	17.0	8280	7760	8020	1094	1003	1048
June 02, 1993	21.3	21.6	21.4	17.4	16.3	16.9	7440	7080	7260	979	913	946
Mean	26.0	26.6	26.3	17.6	16.5	17.0	9168	8818	8993	1212	1142	1177
LSD(0.05)(Date)			2.8			NS			1120			161
LSD(0.05)(Variety)	NS			0.3			NS			62		

Variety X date interaction was not statistically significant for any parameter.

Table 7. Yield, sugar content, and gross value of sugarbeets with varied planting dates - Klamath Experiment Station, 1993.

Planting Date	Yield (Ton/A)			Sugar %			Sugar Yield (lb/A)			Gross Crop Value ($/A)		
	Monohikari	HH55	Avg.	Monohikari	HH55	Avg.	Monohikari	HH55	Avg.	Monohikari	HH55	Avg.
May 11, 1993	26.4	25.3	25.8	17.3	16.5	16.9	9160	8320	8740	1128	1027	1078
May 18, 1993	25.0	25.6	25.3	17.3	16.2	16.8	8680	8260	8480	1070	1019	1045
May 26, 1993	25.1	23.8	24.4	17.1	15.9	16.5	8560	7560	8060	1056	931	993
June 06, 1993	22.6	22.9	22.8	17.4	16.0	16.7	7860	7640	7760	969	901	935
June 11, 1993	20.1	20.3	20.2	17.1	16.6	16.9	6900	6740	6820	851	831	841
Mean	23.9	23.6	23.7	17.3	16.2	16.8	8240	7700	7960	1015	942	978
LSD(0.05)(Date)			2.7			NS			880			106
LSD(0.05)(Variety)	NS			0.22			880			41		

Variety X date interaction was not statistically significant for any parameter.

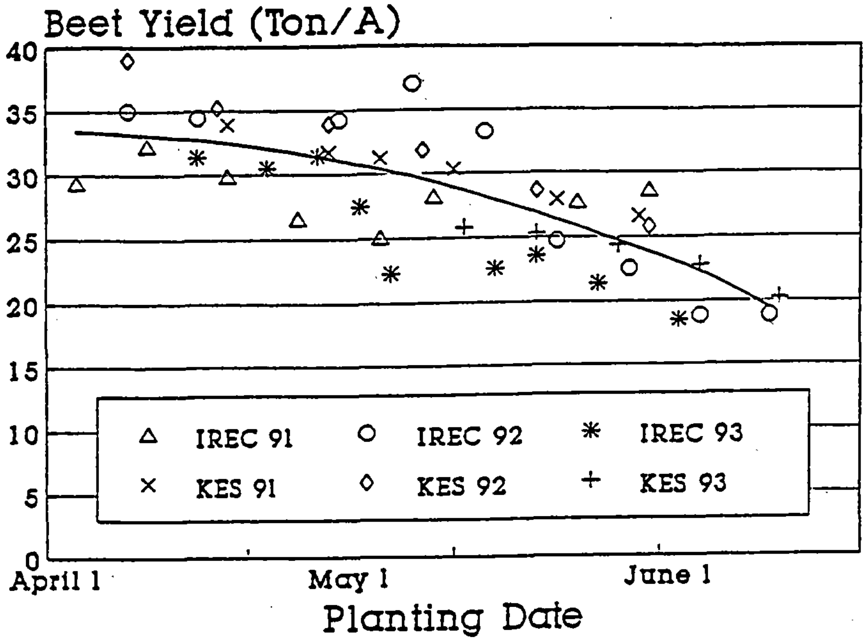

Figure 1. Sugarbeet yield response to planting date.

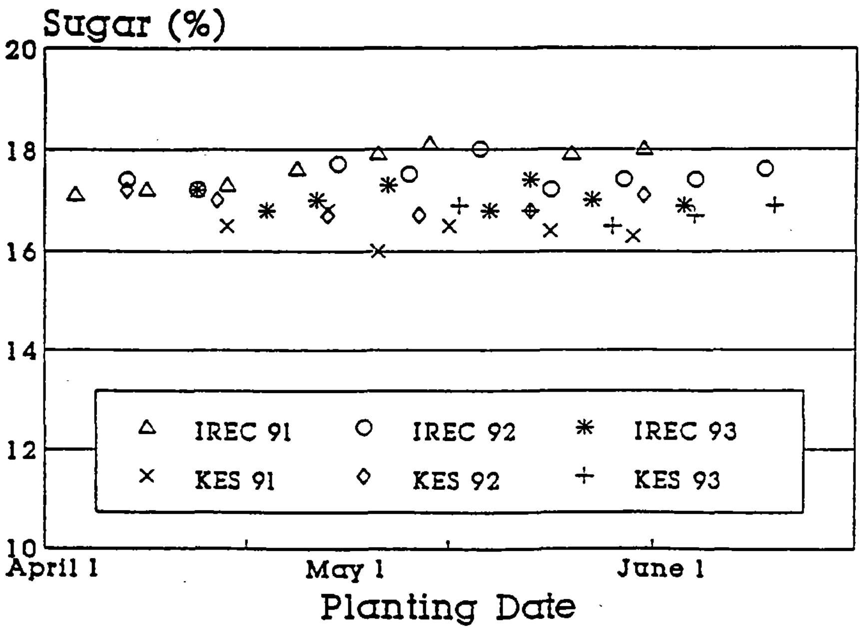

Figure 2. Sugar content (%) of sugarbeets planted on varied dates.

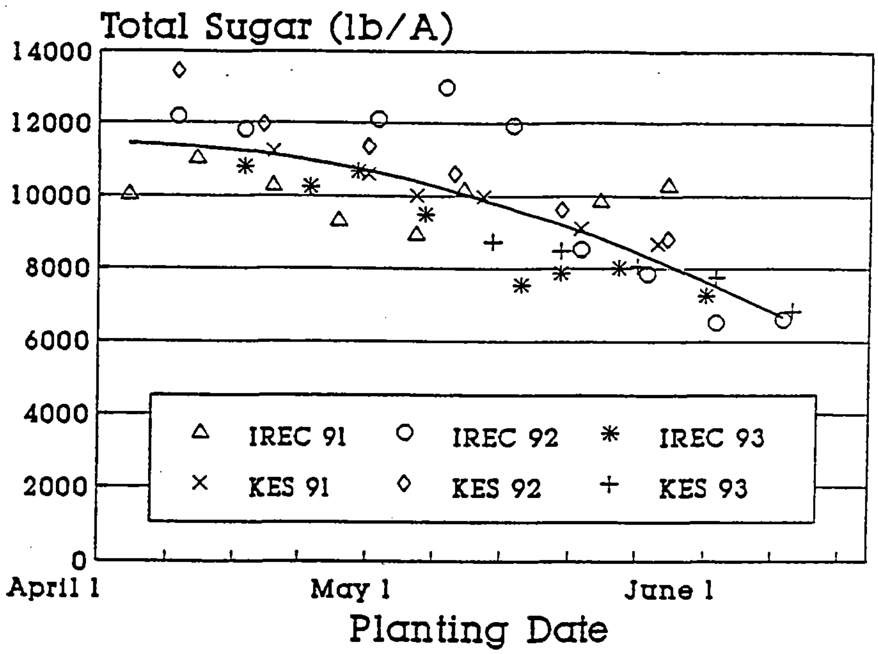

Figure 3. Total sugar production for sugarbeets planted at varied dates.

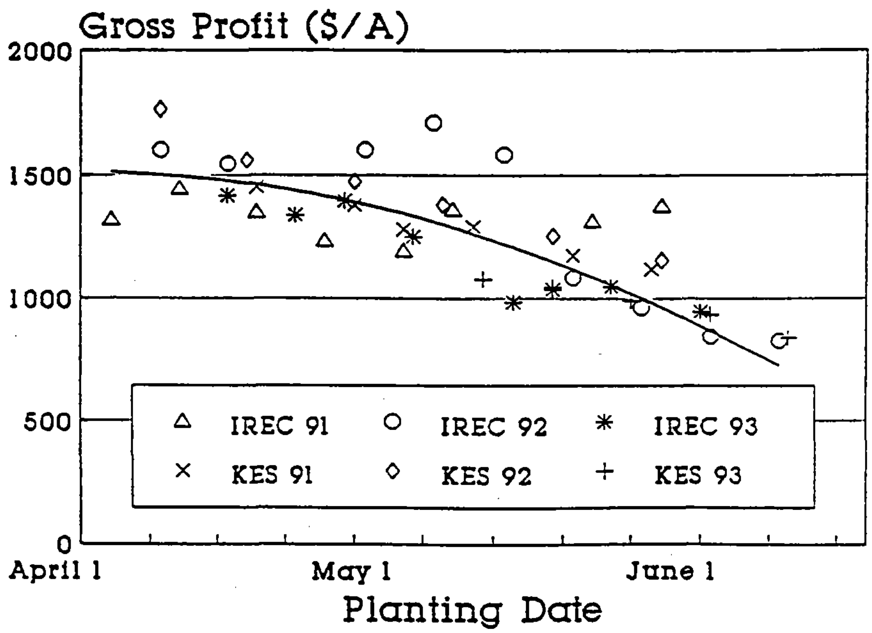

Figure 4. Gross crop values of sugarbeets planted on varied dates.

Effects of Foliar-Applied Methanol on Sugarbeet Production

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

INTRODUCTION

This and a companion study reported on pages 48-49 evaluated the response of crops to repeated foliar applications of methanol under Klamath Basin conditions. A similar study was conducted on sugarbeets at the Malheur Experiment Station in 1993. Findings from that study will be in the Malheur Experiment Station Annual Report.

PROCEDURES

The sugarbeet variety ACH 199 was planted with a hand operated Planet-Junior type planter in 22-inch rows on May 13. Seed was planted at 10 seeds/foot at a depth of 0.5 inches. Plant stands were thinned to 8-inch spacing in mid-June. A broadcast application of 300 lb/A of 15-15-15 analysis fertilizer was incorporated as beds were formed. An additional 50 lb N/A as Solution 32 was applied on July 7 with a ground sprayer and incorporated with irrigation. Weed control was achieved with Betamix, applied at 0.25 lb ai/A on June 3 and 0.33 lb ai/A on June 8, and hand weeding as necessary to control escapes. Flea beetles were controlled with diazinon applied at 1.0 lb ai/A on June 7 and carbaryl applied at 1.0 lb ai/A on June 14 and June 24. Solid set sprinkler irrigation was used throughout the season.

Three row plots, 38 feet long were established to accommodate seven treatments arranged in a randomized complete block design with four replications. Treatments included solutions of 10, 20, 40, and 80 percent methanol with 0.1 percent Triton X-100 surfactant, and solutions of 0, 20, and 40 percent methanol with no surfactant. Solutions were applied at 20 gpa with a backpack sprayer on July 18, July 28, and August 11 between noon and 1:00 pm. Weather conditions on these dates and throughout the season are described elsewhere (pages 3-8 and 48). Beets were harvested by hand on October 19. All beets from the center row of each plot were weighed to determine yield. A 30-pound sample from each plot was sent to the Imperial Holly Sugar Corporation laboratory at Hamilton City, California for tare and sucrose content determinations. Total sugar production was calculated from measured yield and sugar contents. Gross value was calculated from total sugar production and processing contracts, assuming a net selling price of $24/cwt.

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Acknowledgments: Funding for the study was provided by the California Beet Growers Association. Imperial Holly Sugar Corporation provided laboratory analyses of tare losses and sucrose content.

RESULTS AND DISCUSSION

An error in calculation resulted in applying 1.0 percent Triton X-100 surfactant to all treatments that included surfactant on the first application date. Minor leaf bronzing injury was observed on all plants in the four treatments by the following day. Symptoms remained evident for about two weeks. No other visual foliar effects of any treatments were observed throughout the season.

Methanol treatments did not affect beet yield, sugar content, total sugar production, or gross crop value (Table 1). Similar results were obtained from a sugarbeet experiment conducted at the Malheur Experiment Station, and from experiments with potatoes at several Oregon locations. Reported benefits from repeated foliar applications of methanol to C3 crops in Arizona cannot be demonstrated for potatoes or sugarbeets grown at high elevation, short-season areas, or low elevation, long-season areas in Oregon. None of the field studies with either crop produced a sufficient economic response to offset costs of methanol and its application. Growers are advised against the use of methanol in sugarbeet crops.

Table 1. Effect of foliar applications of methanol on yield, sugar content, total sugar production, and gross value of sugarbeets at Klamath Falls, OR, 1993.

Treatment[1]	**Beet Yield**	**Sugar Content**	**Total Sugar Production**	**Gross Value**
	tons/A	%	lb/A	$/A
1	22.8	17.0	7720	954
2	22.1	16.9	7450	918
3	21.7	17.1	7410	913
4	21.2	16.7	7050	871
5	23.2	16.9	7850	967
6	23.3	17.0	7930	978
7	22.4	17.4	7770	959
Mean	22.4	17.0	7600	937
CV (%)	6	3	7	7
LSD (0.05)	2.1	0.7	740	92

[1]/ 1. 20 gal/A water, applied on 7/18, 7/28, 8/11.
2. 20 gal/A, 10% methanol, 0.1% Triton X-100, applied on 7/18, 7/28, 8/11.
3. 20 gal/A, 20% methanol, 0.1% Triton X-100, applied on 7/18, 7/28, 8/11.
4. 20 gal/A, 40% methanol, 0.1% Triton X-100, applied on 7/18, 7/28, 8/11.
5. 20 gal/A, 80% methanol, 0.1% Triton X-100, applied on 7/18, 7/28, 8/11.
6. 20 gal/A, 20% methanol, applied on 7/18, 7/28, 8/11.
7. 20 gal/A, 40% methanol, applied on 7/18, 7/28, 8/11.

Weed Control in Sugarbeets

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

INTRODUCTION

Weed control continues to be one of the most limiting factors in successful production of sugarbeets in the Klamath Basin. Weed competition reduces yields, and costs for hand weeding of herbicide failures greatly reduces profits. In the Treasure Valley of Malheur County, producers have adopted herbicide practices that produce weed-free crops with no hand labor required. This study was conducted to evaluate several post-emergence herbicide options that have been successful in the Treasure Valley, and to determine yield and economic losses that are associated with heavy weed competition in the first half of the growing season.

PROCEDURES

The sugarbeet variety ACH 199 was planted on May 13. With the exception of herbicide applications, cultural practices mirrored those described for the sugarbeet methanol study (page 67). Three row plots, 25 feet long were established in a randomized complete block design with four replications to accommodate seven herbicide treatments. Treatments were applied with a backpack sprayer at 20 gpa of solution on June 8 and June 17. Products evaluated included Betamix, an experimental product combining Betamix and Nortron in a proprietary premixed formulation (NA308/1), and Upbeat, applied alone and in combination with Betamix in a premixed formulation. Plots were scored for sugarbeet injury on June 16, June 22, and July 1. Weed counts, based on 15 square feet per plot, were made on August 8.

The treatment of Upbeat failed due to omission of a surfactant with this product. The combination of Betamix and Upbeat was formulated with surfactant included, and produced effective weed control. Plots treated with Upbeat alone were hand weeded on July 1 to provide a measure of early season weed competition on crop performance. Control treatment plots were hand weeded on August 10, providing a severe test of sugarbeet production in dense weed competition. Beets were harvested by hand on October 19. Yields were measured from the center row of each plot. Approximately 20-pound samples/plot were analyzed for tare loss and sugar content. Total sugar production was calculated as the product of beet yield, times percent sugar. Gross value was calculated on the basis of beet yields, sugar content, processing contract price, and a net selling price of $24/ cwt.

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RESULTS AND DISCUSSION

Initial herbicide applications coincided with cotyledon to two-true-leaf stage of beet development. On June 17, beets were in the two-to-four-leaf stage. Most weed plants were at a similar stage of development on these dates. Weed populations were not uniform throughout the study area. Relatively high populations of hairy nightshade and lambsquarter occurred in two replications. Filaree was present at lower and more consistent density. Indian lovegrass, redroot pigweed, sheperds purse, and purslane populations were very low and are ignored in this report.

In the absence of surfactant, Upbeat, applied alone at 0.0156 lb ai/A on both application dates, had a stimulatory effect on both sugarbeets and weeds. Plants were darker colored and slightly larger in plots treated with Upbeat than in all other plots. Differences in beet plants were not visually evident after two to three weeks. All weeds were removed from these plots by hand on July 1. Untreated control plots had extreme weed competition in two replications. Sugarbeet plants in these plots were very weak and underdeveloped when weeds were removed on August 10.

Weed density in untreated check plots was high for lambsquarter and hairy nightshade (Table 1). Betamix at the low application rate, provided about 50 percent control of lambsquarter and 75 percent control of nightshade. All other herbicide treatments resulted in satisfactory control of these species. Filaree was present at low density and was not effectively eliminated by any of the treatments. In all previous experiments at the KES, filaree has required hand weeding for control. Very minimal crop injury was observed in the plot treated with the high rate of NA308/1, and in the combination treatment of Betamix plus Upbeat. No injury symptoms were observed in the other treatments.

Harvested beet populations were uniform across treatments at 32,000 to 35,000 beets/A. Beet yields were significantly lower in the untreated control than in all other treatments (Table 2). Yield differences between treatments other than the control were not significant. Sugar content was not affected by treatments, except that weed competition through August 6, in the control plot, significantly reduced beet sugar content. The net effect of weed competition in the control treatment was a reduction in total sugar production and gross crop value of about 50 percent. With production costs in the area ranging from about $550 to $750/A, substantial economic losses would be realized in commercial crops under similar conditions, as has been observed in several cases.

Small yield reductions were evident at low application rates of Betamix and where weed competition progressed until the end of June (Upbeat treatment). The low application rate of NA308/1 appeared to be as effective as the high rate, and a slight improvement over the Betamix and Upbeat combination. Relative costs of the various herbicide combinations are not available, but would be a consideration in the choice of products and rates.

Table 1. Weed density and crop injury as affected by herbicide treatments to ACH199 sugarbeeets at the Klamath Experiment Station, Klamath Falls, OR, 1993.

Treatment	Rate	Weed density[1]			Crop injury[2]		
		H. Nightshade	Lambsquarter	Filaree	6/16	6/22	7/1
	lb ai/A	plants/sq. ft.			%		
Control	0	4.2	8.6	0.2	0	0	0
Betamix	.125+ .25	1.0	3.8	0.2	0	0	0
Betamix	.33 + .50	0	0.3	0.2	0	0	0
NA308/1	.25 + .33	0	0.5	0.2	0	0	0
NA308/1	.375+ .50	0.2	0.3	0.3	0	1	0
Upbeat	.0156+.0156	0	0	0	0	0	0
Betamix + Upbeat	.25 + .33 .0156+.0156	0.2	0.9	0.5	0	1	0

1/ Weed density data collected on August 6.
2/ Crop injury expressed as percent of sugarbeets showing injury symptoms.

Table 2. Effect of herbicide treatments on yield, sugar content, total sugar production and gross value of ACH199 sugarbeets at the Klamath Experiment Station, Klamath Falls, OR, 1993.

Treatment	Rate	Beet yield	Sugar content	Total sugar production	Gross value
	lb ai/A	tons/A	-- % --	-- lb/A --	$/A
Control	0	12.0	15.6	3800	467
Betamix	.125 + .25	20.4	17.1	6990	862
Betamix	.33 + .50	21.8	17.1	7470	922
NA308/1	.25 + .33	22.7	17.0	7660	945
NA308/1	.375 + .50	22.3	17.4	7760	956
Upbeat	.0156 + .0156	20.6	17.2	7130	878
Betamix + Upbeat	.25 + .33 .0156 + .0156	20.1	17.4	6980	862
Mean		20.0	17.0	6830	842
CV(%)		15	3	15	15
LSD(.05)		4.5	0.8	1510	186

Spring Barley Variety Screening, 1993

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 1993 included entries in the Western Regional Spring Barley trial done in cooperation with western states plant breeders, and a collection of new and promising lines from the Oregon State University (OSU) barley breeding program. The trial in cooperation with OSU was planted at KES and at two sites in the Lower Klamath Lake area. Early selections from Idaho, Montana, and Washington breeding programs were screened in non-replicated trials at KES.

PROCEDURES

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

All trials were arranged in a randomized complete block design with four replications. Crops at the KES were planted between May 17 and 19. Irrigated and unirrigated organic soil sites were planted on June 9 and 24, respectively. Seed was planted to a depth of 1 inch at a seeding rate of 100 lb/A. All plots were fertilized with 100 lb N, 60 lb P_2O_5, and 44 lb S/A at time of seeding. Plots measured 5 x 20 feet, with a row spacing of 6 inches (10 rows). At KES, bromoxynil and MCPA were applied at labeled rates to control broadleaf weeds. Weed control at organic soil sites was achieved with a mixture of 2,4-D and Banvel. Plots were harvested in late September at the KES and in late October at off-station sites using a plot combine with a 5-foot wide header. Grain yield was recorded for all plots. Test weight, percent plumps, and percent thins were measured in only one replication.

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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 lower in 1993 than in 1991 or 1992 (Tables 1 and 2). This is partially due to high infestations of both wheatstem maggot and common root rot. Data was not collected on wheatstem maggot damage on this trial, but in an adjacent study over 50 percent of the tillers were damaged by this pest. Lower than normal yields may also be due to cooler than normal temperatures throughout the growing season and to later than normal planting dates due to cool and wet spring weather. Despite lower yields in 1993, test weights were generally good, averaging 51.9 lb/bu. UT 11640 was the highest yielding entry in 1993; however, yields of Steptoe, UT 1705L, UT 1705D, and BA 2B88-5648 were not significantly different than UT 11640 (Table 1). UT 11640 was also one of the highest yielding entries in 1992 and the highest yielding entry when averaged over two years (Table 2). Although UT 11640 was high yielding, it produced low test weights in both 1992 and 1993 (49.5 lb/bu in both years). BA 2B88-5648 produced both high yields and test weights in 1993 (4,340 lb/A and 55.5 lb/bu).

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 1993, and undoubtedly reduced yields. Yields were further reduced in 1993 by a severe infestation of common root rot. Baroness was the highest yielding entry in 1993 (Table 3). Other entries that were not significantly different than Baroness include Steptoe, BA 1202, Klages, and ORS 3.

Over a three-year period, top yielding entries include ORS 3, Gustoe, Steptoe, Maranna, and Columbia (Table 4). Two-row varieties such as Baroness, Bearpaw, Crystal, BA 1202, and Harrington had test weights above 54 lb/bu (Table 3). Six-row varieties tended to have lower test weights, averaging about 51 lb/bu. Six-row varieties with higher than average test weights included Russell and Maranna, which had test weights of 53.0 and 53.5 lb/bu, respectively.

Colter was the highest yielding entry at the irrigated organic soil site for the fourth consecutive year (Table 5). Other entries not significantly different from Colter at this site in 1993 included ORS 3, Gustoe, BA 2601, PH 585-6, and Russell. 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). Later than normal planting dates in 1992 and 1993 resulted in lower yields than in 1991 (Table 6). Late planting and lower than normal temperatures with occasional frosts resulted in very low test weights at this site in 1993, averaging 42.8 lb/bu (Table 5).

Late planting combined with mid-August frosts greatly reduced yield and test weight at the unirrigated organic soil site. Grain yield averaged just over 1 ton/A and average test weight was 35 lb/bu (Table 7). In 1993, Colter produced average yields and test weights at the unirrigated organic site. In 1992, Colter produced significantly more grain than all other entries in the trial (Table 8). Colter averaged 4,421 lb/A at the unirrigated organic soil site over a three-year period, significantly more than many other entries in the trial, but not Excel, Gustoe, Steptoe, or Russell (Table 8).

Table 1. 1993 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	Row	Use	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	6	F	3798	50.0	96.8	2.4	0.8	23	86	194
2	Steptoe	6	F	4728	50.5	97.5	1.7	0.8	1	80	192
3	Klages	2	M	4068	56.5	97.4	1.9	0.7	5	79	204
4	Morex	6	M	3517	53.0	95.9	3.0	1.1	1	103	192
5	Excel	6	M	3975	53.0	96.6	2.8	0.7	0	93	195
6	BA 2B88-5133	2	M	3462	56.0	99.0	0.6	0.4	0	81	204
7	ID 86Ab2317	2	M	4106	51.5	94.5	3.9	1.6	0	81	196
8	UT 502355	-	F	3548	50.5	95.7	3.1	1.2	0	71	201
9	PB 401	6	F	4115	54.0	96.1	2.8	1.1	0	83	198
10	WA 9593-87	6	F	4143	51.5	96.2	2.9	0.9	0	81	201
11	WA 10489-86	6	M	4115	50.5	97.5	1.7	0.8	3	93	197
12	BA 1614	6	M	3843	51.5	95.8	3.2	1.0	0	88	197
13	UT 11640	6	F	4836	49.5	96.3	2.8	0.8	0	89	195
14	UT 3109	6	F	4091	48.0	96.3	2.2	1.6	0	91	194
15	ID 85474	6	M	3582	53.0	97.0	2.3	0.8	0	89	193
16	ND 11853-3R	6	-	3546	52.5	97.9	1.2	0.9	0	76	193
17	ND 11231-11	2	-	4283	55.0	97.8	1.0	1.1	0	86	193
18	ND 12567	2	-	3877	54.5	98.7	0.9	0.4	0	93	195
19	UT 1705L	6	F	4580	51.0	96.6	2.6	0.8	0	89	193
20	UT 1705D	6	F	4454	49.5	95.0	3.7	1.2	0	85	195
21	UT 2144	6	F	4105	47.0	95.8	3.3	0.9	0	83	191
22	WA 9589-87	6	M	4137	51.0	95.7	3.4	0.9	0	76	201
23	WA 16277-85	2	M	3724	55.0	98.6	0.9	0.5	0	83	203
24	DA 587-170	-	F	3584	50.0	96.1	2.7	1.1	0	68	201
25	BU 585-82	-	F	3580	52.0	98.1	1.4	0.6	0	68	201
26	BA 2B88-5648	2	M	4340	55.5	97.1	2.1	0.8	0	89	202
27	MT 81161	2	M	4315	54.0	98.2	1.2	0.6	4	84	198
28	Gustoe	6	F	3965	48.5	96.7	2.5	0.7	0	61	200
	Mean			4015	51.9	96.8	2.3	0.9	1	83	197
	CV(%)			9					686	13	1
	LSD(0.05)			516					13	15	2

Table 2. Summary of Western Regional Spring Barley Yields, 1991-1993. Grain yields of spring barley varieties planted at the Klamath Experiment Station, OR.

Entry	Selection	Yield 1993	1992	1991	2-yr Avg		Yield 3-yr Avg	
		lb/A				Rank	lb/A	Rank
1	Trebi	3798	5391	5890	4595	8	5026	4
2	Steptoe	4728	5736	6694	5232	2	5719	1
3	Morex	3517	5018	4658	4268	13	4398	9
4	Klages	4068	5088	5450	4578	9	4869	6
5	Excel	3975	5360	5504	4668	6	4946	5
6	BA 2B88-5133	3462	4359	5665	3911	14	4495	8
7	ID 86Ab2317	4106	4673	4911	4390	11	4563	7
8	UT 502355	3548	5709	6537	4629	7	5265	3
9	PB 401	4115	5357	6672	4736	5	5381	2
10	WA 9593-87	4143	5363	4753		4		
11	WA 10489-86	4115	5460		4788	3		
12	BA 1614	3843	4821		4332	12		
13	UT 11640	4836	5682		5259	1		
14	UT 3109	4091	5054		4573	10		
15	ID 85474	3582						
16	ND 11853-3R	3546						
17	ND 11231-11	4283						
18	ND 12567	3877						
19	UT 1705L	4580						
20	UT 1705D	4454						
21	UT 2144	4105						
22	WA 9589-87	4137						
23	WA 16277-85	3724						
24	DA 587-170	3584						
25	BU 585-82	3580						
26	BA 2B88-5648	4340						
27	MT 81161	4315						
28	Gustoe	3965						
	Mean	4015	5219	5776	4622		4962	
	CV(%)	9	18	12	11		13	
	LSD(0.05)	516	1056	1013	244		255	

Table 3. 1993 Irrigated Mineral Soil OSU Spring 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	3942	54.5	98.1	1.5	0.4	0	30	203
2	Crystal	3727	54.5	98.2	1.0	0.8	0	31	202
3	Gustoe	3555	51.0	97.8	1.5	0.7	0	21	201
4	BA 1202	4316	55.0	98.8	0.8	0.4	0	32	201
5	Russell	3085	53.0	96.5	2.4	1.1	0	29	194
6	Baroness	4680	54.0	98.4	1.0	0.6	0	27	200
7	Steptoe	4464	50.0	98.0	1.4	0.6	0	28	193
8	82Ab519	3509	52.0	97.0	2.2	0.8	0	39	192
9	82Ab23222	3076	50.5	96.0	2.9	1.2	0	25	203
10	BA 1215	3958	54.0	98.2	1.2	0.7	0	31	201
11	BA 2601	3472	52.0	95.6	3.3	1.1	0	31	202
12	Maranna	3859	53.5	95.4	3.6	1.0	0	24	201
13	ORS 3	4142	52.5	94.8	3.9	1.3	0	26	201
14	Columbia	3630	49.0	96.6	2.6	0.8	0	25	202
15	Klages	4162	55.0	98.2	1.2	0.6	1	35	203
16	Harrington	3871	55.0	98.6	1.0	0.4	0	30	201
17	Excel	3927	54.0	97.5	1.8	0.7	0	35	196
18	Morex	3144	50.0	96.6	2.6	0.8	0	39	194
19	MT 140523	3767	54.0	98.1	1.1	0.8	0	28	203
20	Medalion	3784	52.0	95.4	3.7	0.9	0	26	201
21	Colter	3157	48.5	96.9	2.3	0.8	0	20	197
22	WA 8771-78	3731	55.0	99.4	0.5	0.1	0	31	201
23	PH 585-6	3326	51.5	96.2	2.8	1.0	0	23	201
24	BA 1614	3523	51.5	96.8	2.2	0.9	0	32	197
	Mean	3742	52.6	97.2	2.0	0.8	0	29	200
	CV(%)	12					979	9	1
	LSD(0.05)	646					1	4	2

Table 4. Summary of OSU Spring Barley Trial on Irrigated Mineral Soil, 1991-1993. Grain yields of spring barley varieties planted at the Klamath Experiment Station, OR.

Entry	Selection	Yield 1993	Yield 1992	Yield 1991	Yield 2-yr Avg		Yield 3-yr Avg	
		------ lb/A			------	Rank	lb/A	Rank
1	Bearpaw	3942	5405	5891	4674	5	5079	10
2	Crystal	3727	4176	6810	3952	19	4904	14
3	Gustoe	3555	5398	7977	4477	10	5643	2
4	Russell	3085	4582	7167	3834	20	4945	12
5	Steptoe	4464	5594	6843	5029	1	5634	3
6	Maranna	3859	5295	7661	4577	9	5605	4
7	ORS 3	4142	5756	7547	4949	2	5815	1
8	Columbia	3630	4877	7340	4254	16	5282	5
9	Klages	4162	4450	6339	4306	12	4984	11
10	Colter	3157	5407	7254	4282	14	5273	7
11	Harrington	3871	4911	6903	4391	11	5228	8
12	Excel	3927	5257	6643	4592	8	5276	6
13	Morex	3144	3728	5817	3436	21	4230	15
14	MT 140523	3767	5753	6140	4760	3	5220	9
15	WA 8771-78	3731	5571	5520	4651	7	4941	13
16	BA 1202	4316	5005		4661	6		
17	82Ab519	3509	4931		4220	17		
18	82Ab23222	3076	5010		4043	18		
19	BA 2601	3472	5093		4283	13		
20	Medalion	3784	5662		4723	4		
21	PH 585-6	3326	5237		4282	15		
22	Baroness	4680						
23	BA 1215	3958						
24	BA 1614	3523						
	Mean	3742	5100	6790	4399		5204	
	CV(%)	12	12	10	13		11	
	LSD(0.05)	646	831	923	548		460	

Table 5. 1993 Irrigated Organic Soil OSU Spring 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	3697	45.5	94.9	3.2	1.8
2	Crystal	4122	41.0	79.7	11.4	8.9
3	Gustoe	5936	43.5	95.4	3.2	1.5
4	BA 1202	4646	47.0	97.2	1.7	1.1
5	Russell	5612	42.0	71.7	6.4	21.9
6	Baroness	3616	45.0	93.9	3.7	2.4
7	Steptoe	3871	35.0	86.4	7.8	5.8
8	82Ab519	4542	44.0	91.0	5.8	3.2
9	82Ab23222	4946	42.5	88.9	7.5	3.6
10	BA 1215	3610	42.0	83.6	10.0	6.4
11	BA 2601	5776	47.5	92.9	5.1	2.0
12	Maranna	5142	42.5	87.0	8.9	4.1
13	ORS 3	6136	43.5	84.6	10.4	5.0
14	Columbia	4679	38.0	93.4	4.3	2.2
15	Klages	3376	44.0	94.5	3.8	1.7
16	Harrington	2871	43.0	94.9	3.3	1.8
17	Excel	4500	41.5	83.4	9.9	6.8
18	Morex	3123	41.5	79.5	11.4	9.2
19	MT 140523	3822	46.0	83.5	9.3	7.2
20	Medalion	5362	41.0	88.3	7.8	3.9
21	Colter	6219	42.0	96.2	2.3	1.5
22	WA 8771-78	3423	43.5	91.7	5.0	3.2
23	PH 585-6	5631	43.0	95.8	3.1	1.2
24	BA 1614	4803	43.0	92.0	5.2	2.8
	Mean	4561	42.8	89.2	6.3	4.6
	CV(%)	13				
	LSD(0.05)	834				

Table 6. Summary of OSU Spring Barley Trial on Irrigated Organic Soil, 1991-1993.
Grain yields of spring barley varieties planted at the Lower Klamath Lake, OR.

Entry	Selection	Yield 1993	1992	1991	2-yr Avg		Yield 3-yr Avg	
		---- lb/A			----	Rank	lb/A	Rank
1	Bearpaw	3697	3775	4550	3736	16	4007	12
2	Crystal	4122	3844	4948	3983	14	4305	10
3	Gustoe	5936	5500	5906	5718	3	5781	2
4	Russell	5612	5897	5803	5755	2	5771	3
5	Steptoe	3871	4770	5642	4321	11	4761	7
6	Maranna	5142	5025	5908	5084	7	5358	5
7	ORS 3	6136	4307	5782	5222	4	5408	4
8	Columbia	4679	4336	5032	4508	10	4682	8
9	Klages	3376	2913	3962	3145	17	3417	15
10	Colter	6219	6025	6132	6122	1	6125	1
11	Harrington	2871	3231	4493	3051	18	3532	14
12	Excel	4500	5088	5047	4794	8	4878	6
13	Morex	3123	4966	4848	4045	13	4312	9
14	MT 140523	3822	4441	4652	4132	12	4305	11
15	WA 8771-78	3423	4333	4261	3878	15	4006	13
16	BA 1202	4646	4933		4790	9		
17	Medalion	5362	4986		5174	5		
18	PH 585-6	5631	4685		5158	6		
19	BA 2601	5776						
20	Baroness	3616						
21	82Ab519	5452						
22	82Ab23222	4946						
23	BA 1215	3610						
24	BA 1614	4803						
	Mean	4565	4614	5131	4590		4710	
	CV(%)	13	13	12	14		13	
	LSD(0.05)	834	869	783	308		498	

Table 7. 1993 Unirrigated Organic Soil OSU Spring 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	1478	36.0	57.4	24.5	18.0
2	Crystal	1167	33.5	55.3	22.7	22.1
3	Gustoe	2341	35.0	73.3	16.3	10.4
4	BA 1202	1724	35.5	70.0	16.0	14.0
5	Russell	3269	43.0	80.8	11.9	7.3
6	Baroness	2363	36.0	86.2	7.7	6.1
7	Steptoe	3324	39.0	91.4	5.3	3.3
8	82Ab519	3190	44.0	84.9	10.4	4.7
9	82Ab23222	1494	30.0	57.6	23.4	19.0
10	BA 1215	1618	35.5	62.8	16.9	20.3
11	BA 2601	1731	32.5	63.1	19.1	17.8
12	Maranna	1916	33.0	57.0	25.0	18.0
13	ORS 3	2499	32.0	47.4	31.9	20.7
14	Columbia	507	27.0	56.1	25.3	18.6
15	Klages	959	33.0	34.2	33.6	32.2
16	Harrington	1658	35.5	75.0	14.3	10.7
17	Excel	2869	37.0	80.4	11.5	8.1
18	Morex	2785	42.0	71.0	15.1	13.9
19	MT 140523	1600	37.0	31.8	38.3	29.9
20	Medalion	2029	29.0	57.6	23.5	18.9
21	Colter	2212	34.0	81.0	10.7	8.3
22	WA 8771-78	1617	34.0	69.0	16.4	14.6
23	PH 585-6	1783	30.5	61.6	22.1	16.2
24	BA 1614	2438	37.0	85.9	8.5	5.6
	Mean	2024	35.0	66.3	18.8	14.9
	CV(%)	11				
	LSD(0.05)	326				

Table 8. Summary of OSU Spring Barley Trial on Unirrigated Organic Soil, 1991-1993. Grain yields of spring barley varieties planted at the Lower Klamath Lake, OR.

Entry	Selection	Yield 1993	Yield 1992	Yield 1991	Yield 2-yr Avg		Yield 3-yr Avg	
		------------------- lb/A			-------------------	Rank	lb/A	Rank
1	Bearpaw	1478	2913	4026	2196	16	2806	12
2	Crystal	1167	3151	4203	2159	17	2840	11
3	Gustoe	2341	4700	5074	3521	5	4038	3
4	Russell	3269	4830	3638	4050	1	3912	5
5	Steptoe	3324	4498	4124	3911	3	3982	4
6	Maranna	1916	4117	4370	3017	9	3468	7
7	ORS 3	2499	2962	3357	2731	12	2939	9
8	Columbia	507	2962	4096	1735	18	2522	14
9	Klages	959	1838	3914	1399	19	2237	15
10	Colter	2212	5821	5230	4017	2	4421	1
11	Harrington	1658	2953	3985	2306	15	2865	10
12	Excel	2869	4629	4837	3749	4	4112	2
13	Morex	2785	4051	4492	3418	7	3776	6
14	MT 140523	1600	3057	3536	2329	14	2731	13
15	WA 8771-78	1617	3329	4075	2473	13	3007	8
16	BA 1202	1724	3988		2856	11		
17	BA 2601	1731	4358		3045	8		
18	Medalion	2029	4964		3497	6		
19	PH 585-6	1783	4221		3002	10		
20	Baroness	2363						
21	82Ab519	3190						
22	82Ab23222	1494						
23	BA 1215	1618						
24	BA 1614	2438						
	Mean	2024	3860	4197	2916		3310	
	CV(%)	11	8	29	10		21	
	LSD(0.05)	326	443	1519	142		556	

Spring Wheat Variety Screening in the Klamath Basin, 1993

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 1993, spring wheat variety trials were conducted at the KES in cooperation with Oregon State University and Western Regional plant breeding and evaluation programs. Cold-tolerant, short-season cultivars are needed in the Klamath Basin due to a short growing season with the possibility of frost throughout the growing season. Entries evaluated in these trials included SW, HW, and HR selections. Historically, there has been little disease or insect pressure on small grains in the Klamath Basin. However, the recent introduction of the Russian wheat aphid has altered this situation. Wheatstem maggot is endemic in the area and generally causes only slight damage at the KES. Under mild winter and warm spring conditions in 1992, significant damage to cereal crops was experienced. Up to 50 percent of the tillers were affected at KES with serious crop losses sustained in several commercial fields in the Lower Klamath Lake area. Damage from this pest was less severe in 1993.

PROCEDURES

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

All trials were arranged in a randomized complete block design with three or four replications. Plots at the KES were planted on May 17. 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. Plots were harvested in late September using a plot combine with a 5-foot wide header. Grain yield was recorded for all plots. Test weight was measured in only one replication.

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

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

RESULTS AND DISCUSSION

Western Regional Spring Wheat Nursery

Average grain yield for this trial in 1993 was intermediate to 1991 and 1992 yields (Tables 1 and 2). Average test weight in 1993 was 61.0 lb/bu compared to 61.8 and 62.0 lb/bu in 1992 and 1991, respectively. Effects of wheatstem maggot and common root rot on wheat variety trials were less than seen in adjacent barley trials. ID 440 was the highest yielding soft white (SW) entry in 1993. Five SW varieties, including SDM 405, Penewawa, ID 441, ID 448, and ID 392 produced grain yields that were not significantly lower than ID 440 (Table 1). However, Penewawa produced more grain than ID 440 over a two-year period (table 2). When averaged over three years, Penewawa was the highest producing SW entry with ID 392 producing yields that were not significantly different.

ID 377S was the highest yielding hard white (HW) entry in 1993, with OR 488403, OR 7255, OR 386306, OR 487453, and OR 487255 producing grain yields that were not significantly lower (Table 1). This entire group produced yields that were significantly higher than Klasic, the standard HW variety, in 1993. When averaged over a three-year period from 1991 to 1993, ID 377S was also the highest yielding HW entry. Other HW entries not significantly different than ID 377S over a three-year period include OR 487453 and OR 488403. ID 377S has good milling and baking quality and is being considered for release by the University of Idaho.

The group of highest yielding hard red (HR) entries in 1993 included UT 1708, UT 1597, UT 850646, McKay, ID 420, ID 439, UT 1711, ID 439, and UT 1117. Of these entries, UT 1708 and ID 420 yielded significantly more than McKay, the standard HR variety, over a three-year period (Table 2).

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 1993 trial (Table 3). Yields of 19 entries, including McKay and Spillman, were not significantly less than OR 4870401, the highest yielding entry in the trial. Yecora rojo reached 50 percent heading earlier than all other entries in the trial. Grain baking quality is an important consideration in the selection of HR wheat varieties. Further evaluation of baking quality of top yielding entries will be needed prior to release of these lines.

OSU Hard White Spring Wheat Variety Trial

Yields of eight entries were significantly lower than OR 91808, the highest yielding entry in the trial, in 1993 (Table 4). Most of the experimental lines in the trial produced yields that were significantly higher than Klasic, the standard hard white (HW) variety in California and the Pacific Northwest. This contrasts sharply with 1992 results where no experimental line yielded significantly more than Klasic or Yecora Rojo, the standard

HR variety in the area. 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. This HW line has good baking quality and may be released if yields in other areas of the Pacific Northwest justify it.

Soft White Spring Wheat Variety Trial

Centennial and Fieldwin yielded significantly more grain than any other released soft white (SW) variety in the trial. However, there were also three other top yielding entries that were not significantly different than Centennial and Fieldwin. These entries included OR 4900154, the highest yielding entry in the trial, ORS 5801, and OR 4880013 (Table 5). Centennial is a recent release from the University of Idaho that was planted in joint trials at KES and the Intermountain Research and Extension Center from 1989 to 1991. Yields of this line were comparable or superior to all released SW varieties at both locations.

Table 1. 1993 Western Regional Spring Wheat Nursery. 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	Class	Yield	Test weight	Lodge	Height	Heading date
			lb/A	lb/bu	%	inches	Julian days
1	McKay	HR	5498	60.5	0	30	201
2	Federation	SW	4980	60.5	0	41	208
3	Penawawa	SW	6123	61.0	0	31	201
4	Wakanz	SW	5456	59.5	0	31	203
5	WA 7176	SW	5641	60.0	0	32	201
6	Klasic	HW	4895	62.0	0	29	197
7	Serra	HR	5061	62.0	0	30	197
8	ID 392	SW	5823	63.0	0	31	201
9	ID 408	SW	5779	60.0	0	28	201
10	UT 1708	HR	5610	61.0	0	35	202
11	UT 1711	HR	5327	61.0	0	35	202
12	UT 1723	HR	5086	63.0	0	35	201
13	OR 487255	HW	5669	64.5	0	30	196
14	OR 488189	HR	5066	61.5	0	28	200
15	ID 377S	HW	6010	63.0	0	30	196
16	OR 386306	HW	5652	61.5	0	25	202
17	WA 7677	SW	5265	61.5	0	31	204
18	ID 439	HR	5252	61.0	0	29	198
19	ID 440	SW	6262	61.0	0	33	196
20	ID 441	SW	6063	61.0	0	30	201
21	ID 429	SW	5488	64.0	0	33	196
22	UT 1597	HR	5597	62.0	0	31	200
23	UT 850646	HR	5506	57.0	0	29	202
24	Sunstar 2	HR	4990	63.0	0	29	197
25	ML 42	SW	4932	62.0	0	31	203
26	WA 7712	SW	4899	62.5	3	33	199
27	WA 7715	SW	4882	61.5	0	31	197
28	UT 1117	HR	5191	60.0	0	33	203
29	ID 448	SW	5952	61.0	0	30	201
30	ID 452	HR	4724	57.0	0	29	202
31	OR 487374	HW	4383	60.0	0	21	197
32	OR 487410	HR	4914	60.5	0	31	201
33	OR 895224	SW	4644	58.0	0	25	203
34	FM 5702	HR	4688	60.0	0	20	192
35	FM 8631	HR	4593	61.0	0	20	194
36	SDM 405	SW	6189	63.5	0	29	201
37	SDM 406	SW	5796	63.0	0	30	197
38	ID 420	HR	5392	60.0	0	29	201
39	OR 487453	HW	5617	58.0	0	28	208
40	OR 488403	HW	5798	58.0	0	28	203
	Mean		5367	61.0	0	30	200
	CV(%)		6			5	51
	LSD(0.05)		463			5	2

Table 2. Summary of Western Regional Spring Wheat Nursery 1991-1993. Three-year summary of spring wheat yields at the Klamath Experiment Station, OR.

Entry	Selection	Class	Yield					Yield	
			1993	1992	1991	2-yr Avg		3-yr Avg	
			lb/A				Rank	lb/A	Rank
1	ID 420	HR	5392	5764	5905	5578	19	5687	7
2	McKay	HR	5498	5483	4999	5491	20	5327	14
3	Serra	HR	5061	4541	4882	4801	27	4828	16
4	Klasic	HW	4895	5170	4841	5033	24	4969	15
5	Federation	SW	4980	4941	4285	4961	25	4735	18
6	Penawawa	SW	6123	6604	5652	6364	1	6126	1
7	WA 7176	SW	5641	5666	5246	5654	15	5518	10
8	OR 487453	HW	5617	6222	5399	5920	7	5746	5
9	ID 392	SW	5823	6539	5504	6181	2	5955	3
10	ID 408	SW	5779	5764	5503	5772	10	5682	8
11	Wakanz	SW	5456	5829	5546	5643	16	5610	9
12	OR 488189	HR	5066	4461	4821	4764	28	4783	17
13	UT 1708	HR	5610	6518	5267	6064	4	5798	4
14	UT 1711	HR	5327	5909	5123	5618	17	5453	12
15	UT 1723	HR	5086	5637	5411	5362	21	5378	13
16	ID 377S	HW	6010	6204	5953	6107	3	6056	2
17	OR 487255	HW	5669	5851	5005	5760	12	5508	11
18	OR 488403	HW	5798	5704	5599	5751	13	5700	6
19	OR 386306	HW	5652	6197		5925	6		
20	WA 7677	SW	5265	6157		5711	14		
21	ID 439	HR	5252	4937		5095	22		
22	ID 440	SW	6262	5679		5971	5		
23	ID 441	SW	6063	5537		5800	9		
24	ID 429	SW	5488	5725		5607	18		
25	UT 1597	HR	5597	6011		5804	8		
26	UT 850646	HR	5506	6030		5768	11		
27	Sunstar 2	HR	4990	5172		5081	23		
28	ML 42	SW	4932	4773		4853	26		
29	WA 7712	SW	4899						
30	WA 7715	SW	4882						
31	UT 1117	HR	5191						
32	ID 448	SW	5952						
33	ID 452	HR	4724						
34	OR 487374	HW	4383						
35	OR 487410	HR	4914						
36	OR 895224	SW	4644						
37	FM 5702	HR	4688						
38	FM 8631	HR	4593						
39	SDM 405	SW	6189						
40	SDM 406	SW	5796						
	Mean		5367	5679	5275	5587		5492	
	CV(%)		6	8	11	7		8	
	LSD(0.05)		463	606	781	400		352	

Table 3. 1993 OSU Hard Red Spring Wheat Variety Trial. Grain yield, test weight, lodging, plant height, and days to 50 percent heading of spring wheat 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	4547	64.5	0	31	200
2	Westbred 906R	3947	61.5	0	31	194
3	Yecora Rojo	4060	62.0	0	22	193
4	Spillman	4564	63.0	0	30	198
5	OR 485010	4281	65.0	0	30	201
6	Klasic	3260	64.0	0	21	193
7	OR 4870456	3770	63.0	0	29	196
8	OR 4870400	4858	65.0	0	33	204
9	OR 4870401	5139	64.0	0	33	204
10	OR 4880189	4411	62.5	0	30	197
11	OR 4870410	4363	61.5	0	32	201
12	OR 4895019	4511	64.5	0	30	196
13	OR 4870251	4779	63.0	0	28	201
14	OR 4895103	4502	64.0	0	31	202
15	OR 4895011	4549	64.0	0	29	196
16	OR 4895014	4006	64.5	0	29	199
17	OR 4895073	3971	61.5	0	28	204
18	OR 4870456	4365	64.0	0	31	202
19	OR 4870456	3665	64.5	0	26	199
20	OR 4920002	4677	63.0	0	29	203
21	CUMPAS86	4566	64.0	0	24	197
22	4880232	4335	60.0	0	30	207
23	4895109	4275	55.5	0	29	211
24	OR 4895109	4400	63.0	0	30	201
25	OR 4343	4276	65.0	0	30	197
26	OR 390037	3947	63.0	0	27	201
27	OR 4910025	4002	59.5	0	28	208
28	OR 4910027	4469	61.5	0	30	208
29	OR 4910028	4947	63.0	0	31	194
30	OR 4900041	4966	64.0	0	31	203
31	OR 4900045	4663	65.0	0	34	203
32	OR 4900050	4431	62.5	0	29	199
33	4900060	4009	61.5	0	29	204
34	OR 4880536	4595	63.0	0	28	197
	Mean	4356	62.9	0	29	200
	CV(%)	11			7	1
	LSD(0.05)	646			3	2

Table 4. 1993 OSU Hard White Spring Wheat Variety Trial. Grain yield, test weight, lodging, plant height, and days to 50 percent heading of spring wheat 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	2959	62.0	0	21	193
2	OR 484013	4097	63.0	0	28	204
3	OR 487027	3588	62.0	0	28	200
4	OR 487045	4572	63.0	0	30	204
5	OR 487025	3800	65.0	0	28	194
6	OR 487037	2960	61.0	0	19	197
7	OR 487027	3950	64.0	0	29	203
8	OR 488033	4178	65.0	0	28	201
9	OR 488037	3383	65.0	0	31	208
10	OR 488040	3329	62.5	0	31	208
11	OR 489517	3747	64.0	0	32	205
12	OR 489518	4601	62.0	0	32	201
13	OR 489520	3610	62.0	0	28	200
14	OR 488051	3915	65.0	0	29	201
15	OR 489522	3957	62.5	0	26	197
16	OR 488029	4467	64.0	0	28	203
17	OR 488034	3346	63.0	0	26	200
18	OR 488039	4366	65.0	0	30	202
19	OR 48852	3852	64.5	0	23	196
20	SERI 82	4308	62.0	0	30	201
21	OR 91806	4270	62.0	0	27	203
22	OR 91806	4491	62.0	0	29	203
23	OR 91807	4090	62.0	0	28	194
24	OR 91808	5072	57.0	0	30	208
25	OR 490015	3792	61.5	0	26	201
26	OR 490006	5040	63.0	0	31	200
27	OR 490007	4873	64.5	0	31	199
28	OR 490007	3922	65.0	0	29	196
29	OR 91804	4697	64.0	0	31	208
30	OR 91805	4820	60.0	0	32	208
	Mean	4068	62.9	0	28	201
	CV(%)	12			8	0
	LSD(0.05)	677			3	2

Table 5. 1993 OSU Soft White Spring Wheat Variety Trial. Grain yield, test weight, lodging, plant height, and days to 50 percent heading of spring wheat planted at the Klamath Experiment Station, OR.

Entry	Selection	Yield	Test weight	Lodge	Height	Heading date
		lb/A	lb/bu	%	inches	Julian days
1	Dirkwin	4930	59.0	0	30	203
2	Centennial	5454	62.5	0	29	198
3	Penawawa	4955	60.0	0	31	201
4	ORS 5801	5306	63.0	0	31	200
5	ORS 8427	4376	60.5	0	31	200
6	OR 487503	4742	59.0	0	31	210
7	OR 487570	4673	60.5	0	31	208
8	OR 4880013	5280	60.5	0	30	211
9	Fieldwin	5299	62.0	0	32	210
10	OR 4900154	5497	61.0	0	30	208
11	OR 4900085	4708	63.0	0	31	194
12	OR 4895224	4344	60.5	0	28	204
	Mean	4964	61.0	0	30	204
	CV(%)	6			6	1
	LSD(0.05)	429			3	2

Oat Variety Screening in the Klamath Basin, 1993

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. The 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 higher yield potentials than the currently grown varieties. Several high yielding lines are also more lodging resistant and have higher test weights than current industry standards. The Uniform Northwestern States Oat Nursery is planted at KES each year to identify promising new oat lines for release by public and private breeding programs.

PROCEDURES

The Uniform Northwestern States Oat Nursery was established at KES on Fordney fine sandy loam that is moderately deep and somewhat poorly drained. The previous crop was potatoes. The crop was irrigated by a solid set sprinkler system. The trial was arranged in a randomized complete block design with four replications. Seed was planted on May 18 at a depth of 1 inch and a seeding rate of 100 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 a row spacing of 6 inches. Bromoxynil and MCPA were applied at labeled rates to control broadleaf weeds. Plots were harvested in late September using a plot combine with a 5-foot wide header. Grain yield was recorded for all plots. Test weight was measured in only one replication.

RESULTS AND DISCUSSION

The Uniform Northwestern States Oat Nursery produced a higher average grain yield than any other variety trial in Klamath County in 1993. Yields of barley, wheat, and triticale were depressed by infestations of wheat stem maggot and common root rot, while oats were relatively unaffected. Oat yields in 1993 were significantly higher than in 1992 and slightly higher than in 1991 (Tables 1 and 2). Oat yields throughout the Klamath Basin were generally higher than usual, while wide variation in yield was seen in the other grain commodities.

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

The highest yielding entry in 1993 was 87Ab4983, with 83Ab3119, 81Ab5792, 87Ab5125, 83Ab3250, 89Ab6153, 86Ab664, and Ajay (82Ab1142) producing yields similar to 87Ab4983. The highest yielding commercially available variety in the trial was Ajay followed closely by Border. Over a three-year period from 1991 to 1993, 83Ab3250 produced the highest grain yield, averaging 5,865 lb/A. Other entries whose yields were not significantly different than 83Ab3250 over the same period included 83Ab3119, 82Ab1178, 86Ab664, 87Ab5125, 81Ab5792, and Ajay. Seed of both 83Ab3250 and 86Ab664 is being increased in preperation for varietal release in other states. Over a four-year period from 1990 to 1993, lodging of 83Ab3250 and 86Ab664 was 4.5 and 15.3 percent, compared to 18.8 and 12.8 percent for Cayuse and Border. Test weight of 83Ab3250 was superior to both Cayuse and Border over the same period. Superior yield, test weight, and lodging resistance make 83Ab3250 a promising oat line. Efforts to secure its release will continue.

Ajay (82Ab1142) is another variety that may fit some production niches. It is a semi-dwarf line recently released by the University of Idaho. Commercial quantities of this variety are now available. It is generally 8-12 inches shorter than Cayuse and is very resistant to lodging, even at high N fertilization rates. In a N fertility management study conducted at KES, Ajay produced equivalent or superior grain yields to Cayuse and Monida at all fertilization rates, and was much less prone to lodging (see 1990 Crop Research at KES). Due to lodging resistance and high yield potential, Ajay may be a viable option in high N situations where traditional oat varieties would not be a wise choice. The short stature of Ajay, 35 to 45 inches, also lends it to use with wheel lines.

Table 1. 1993 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	4582	38.0	30	56	215
2	Cayuse	5659	40.0	7	51	210
3	Otana	5217	41.5	0	52	210
4	Appaloosa	5469	38.0	67	51	212
5	Border	5966	40.0	0	50	211
6	Monida	5497	41.5	23	51	215
7	Ogle	5797	39.5	0	49	204
8	Calibre	3757	39.0	0	55	215
9	81Ab5792	6460	41.0	0	47	208
10	Riel	5321	41.5	2	56	211
11	Valley	5481	43.0	20	51	211
12	82Ab248	5461	39.5	37	51	215
13	82Ab1178	6113	40.5	3	45	208
14	82Ab1142	5946	41.0	0	41	210
15	Robert	4713	39.0	0	56	214
16	83Ab3119	6676	40.0	0	48	214
17	83Ab3250	6342	40.0	0	49	215
18	86Ab664	6135	40.5	20	52	211
19	86Ab1867	5950	43.0	0	42	204
20	Newdak	5905	41.0	2	52	205
21	ND 860416	4870	38.0	60	48	211
22	ND 852107	5316	40.0	17	56	208
23	87Ab5125	6429	42.0	0	54	215
24	87Ab825	5884	38.5	30	48	214
25	88Ab3073	4100	50.0	0	45	215
26	Derby	3446	41.0	0	60	215
27	86Ab1616	4137	47.0	27	56	215
28	87Ab4983	7115	41.5	27	51	208
29	89Ab6153	6249	42.5	0	43	204
30	IA H61-3-3	4897	39.0	0	56	211
	Mean	5496	40.9	12	51	211
	CV (%)	12		199	7	1
	LSD (0.05)	1030		40	15	2

Table 2. Summary of Northwestern States Oat Nursery Yields, 1991-1993. Grain yields of spring oat varieties planted at the Klamath Experiment Station, OR.

Entry	Selection	Yield 1993	1992	1991	2-yr Avg		Yield 3-yr Avg	
		lb/A				Rank	lb/A	Rank
1	Park	4582	3262	4466	3922	24	4103	22
2	Cayuse	5659	2983	4548	4321	18	4397	17
3	Otana	5217	3054	4052	4136	20	4108	21
4	Appaloosa	5469	3861	4928	4665	15	4753	14
5	Border	5966	4222	5255	5094	9	5148	11
6	Monida	5497	3290	4337	4394	17	4375	18
7	Ogle	5797	3839	5841	4818	14	5159	10
8	Calibre	3757	2352	3286	3055	25	3132	23
9	81Ab5792	6460	3684	6119	5072	10	5421	6
10	Riel	5321	3586	4660	4454	16	4522	15
11	Valley	5481	4496	5661	4989	11	5213	9
12	82Ab248	5461	4179	5352	4820	13	4997	13
13	82Ab1178	6113	4978	5856	5546	2	5649	3
14	82Ab1142	5946	4461	5798	5204	8	5402	7
15	Robert	4713	3275	5264	3994	23	4417	16
16	83Ab3119	6676	4730	5861	5703	1	5756	2
17	83Ab3250	6342	4502	6750	5422	5	5865	1
18	86Ab664	6135	4840	5946	5488	4	5640	4
19	86Ab1867	5950	4705	5242	5328	6	5299	8
20	Newdak	5905	3985	5535	4945	12	5142	12
21	ND 860416	4870	3323	4729	4097	21	4307	19
22	ND 852107	5316	3045	4113	4181	19	4158	20
23	87Ab5125	6429	4642	5779	5536	3	5617	5
24	84Ab825	5884	4599		5242	7		
25	88Ab3073	4100	4040		4070	22		
26	Derby	3446	2417		2932	26		
27	86Ab1616	4137						
28	87Ab4983	7115						
29	89Ab6153	6249						
30	IA H-61-3-3	4897						
	Main	5496	3860	5190	4670		4895	
	CV (%)	12	22	12	13		12	
	LSD (0.05)	1030	1309	702	592		475	

Triticale Variety Trials in the Klamath Basin

Randy L. Dovel and Greg Chilocote[1]

INTRODUCTION

Triticale shows promise as feed in poultry and other livestock rations. There has been very little triticale varietal testing in the area. Inquiries to the Experiment Station and Extension Service about triticale production and marketing are frequent and there is a lack of information on adapted varieties. Also, variable grain quality (mainly crude protein concentration) between varieties has been a problem in the acceptance of this commodity. Varietal evaluation of spring and winter triticale has been conducted at the Klamath Experiment Station for two years to determine both yield potential and grain quality of released and promising triticale varieties. Initial varietal evaluation has been promising with yields exceeding those of spring wheat and roughly equivalent to spring barley. Grain crude protein concentration ranged from 9.9 to 15.5 percent in 1992. Further testing is needed to positively identify high yielding, high quality triticale varieties for this region.

MATERIALS AND METHODS

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. Grain was harvested in late September using a plot combine with a 5-foot wide header. Grain yield was recorded for all plots. Test weight was measured in only one replication. 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.

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RESULTS AND DISCUSSION

Grain yields were slightly higher in 1993 than the previous year (Tables 1 and 2). The highest yielding triticale variety in 1992, Eronga 83, ranked fourth in 1993. Juan, 91F 26016, and 91F 25012 were the highest yielding varieties in 1993, producing significantly more than all wheat and barley entries in the trial. When averaged over two years, 91F 26016 was the highest yielding entry in the trial, followed closely by Eronga 83, 91F 25012, and Juan. Average triticale yield over a two-year period was higher than the average wheat yield and slightly lower than the average barley yield.

Test weights of newer triticale varieties are superior to older varieties such as Whitman and Karl. Average test weight for all triticale varieties was 55.8 and 55.3 lb/bu in 1992 and 1993, respectively. Average test weight ranged from 49.0 lb/bu for Whitman to 60 lb/bu for Rhino. However, higher yielding varieties ranged between 53 and 57 lb/bu.

Grain protein content of the 1993 harvest has not been determined at this time. Results from 1992 show a wide range in protein content between varieties. It will be interesting to see if relative protein contents of the various varieties are consistent across years. 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.

There was no lodging in 1992 or 1993. Triticale plant height in 1993 was generally higher than all barley varieties in the trial. Some of the shorter triticale entries were of similar height to Fieldwin, a soft white wheat. However, some entries were very tall, with RSI 2000 almost reaching 5 feet.

CONCLUSIONS

Triticale shows significant yield potential in the Klamath Basin. Top yielding commercially available varieties can match or exceed the highest yielding barley and wheat varieties currently grown in the area. Grain protein concentration varied greatly between varieties. As in other grain commodities, triticale grain protein concentration appears to be inversely proportional to yield. It is hoped that further testing will identify high yielding varieties with acceptable protein concentrations.

Table 1. 1993 Triticale Variety Trial. Grain yield, test weight, lodging, plant height, and days to 50 percent heading of spring triticale, barley, and wheat lines planted at the Klamath Experiment Station, OR.

Entry	Selection	Yield	Test Weight	Lodge	Height	Heading Date
		lb/A	lb/bu	%	inches	Julian
1	Steptoe	5099	50.0	0	29	192
2	Gustoe	4408	47.0	0	19	201
Barley Mean		**4754**	**48.5**	**0**	**24**	**197**
3	Fieldwin	4988	59.5	0	35	211
4	Yecora Rojo	3973	61.5	0	21	193
5	Westbred 926	3979	61.5	0	29	194
Wheat Mean		**4313**	**60.8**	**0**	**28**	**199**
6	Juan	6234	52.5	0	42	204
7	Stier	4545	57.0	0	37	203
8	Rhino "S"	5164	60.0	0	39	197
9	UC 84	4796	59.5	0	38	197
10	Hippo "S"	4298	56.5	0	30	196
11	UC 86	4966	59.0	0	32	197
12	Grace	5439	51.0	0	43	208
13	Victoria	5403	54.5	0	37	203
14	RSI 2700	5479	51.5	0	56	208
15	91F 26016	6283	57.0	0	41	201
16	91F 25003	5113	56.5	0	38	202
17	91F 25001	4394	56.0	0	35	207
18	91F 25007	5259	59.0	0	34	196
19	91F 25012	5905	55.0	0	41	201
20	91F 25102	5505	58.0	0	37	197
21	Karl	4460	52.0	0	31	198
22	Eronga 83	5659	54.0	0	42	203
23	Alamos 83	4321	51.0	0	32	201
24	Sunland	4365	54.5	0	38	208
25	Florida 201	5462	53.0	0	43	203
26	Whitman	3479	47.0	0	40	215
27	Frank	5286	57.0	0	39	203
28	Norico	4358	56.5	0	49	199
29	16-A	3747	59.0	0	42	202
30	16-12	5107	54.0	0	38	201
31	16-13	4686	58.0	0	40	204
Triticale Mean		**4989**	**55.3**	**0**	**39**	**202**
Overall Mean		**4847**	**55.5**	**0**	**37**	**202**
CV (%)		**11**		**0**	**5**	**1**
LSD (0.05)		**721**		**0**	**3**	**2**

Table 2. Two-year summary of grain yield and test weight of spring triticale, barley, and wheat lines planted at the Klamath Experiment Station, OR.

Entry	Selection	Grain yield 1992	Grain yield 1993	Grain yield Avg	Test weight 1992	Test weight 1993	Test weight Avg
		lb/A			lb/bu		
1	Steptoe	6028	5099	5564	51.5	50.0	50.8
2	Gustoe	5001	4408	4705	52.0	47.0	49.5
Barley Mean		**5515**	**4754**	**5135**	**51.8**	**48.5**	**50.2**
3	Fieldwin	4492	4988	4740	64.0	59.5	61.8
4	Yecora Rojo	3046	3973	3510	61.5	61.5	61.5
5	Westbred 926	4519	3979	4249	63.5	61.5	62.5
Wheat Mean		**4019**	**4313**	**4166**	**63.0**	**60.8**	**61.9**
6	Juan	5104	6234	5669	55.0	52.5	53.8
7	Stier	4741	4545	4643	58.0	57.0	57.5
8	Rhino	5051	5164	5108	60.0	60.0	60.0
9	UC 84	5212	4796	5004	59.0	59.5	59.3
10	Hippo	3741	4298	4020	57.0	56.5	56.8
11	UC 86	4446	4966	4706	57.5	59.0	58.3
12	Grace	4856	5439	5148	53.0	51.0	52.0
13	Victoria	4688	5403	5046	51.0	54.5	52.8
14	RSI 2700	5115	5479	5297	52.0	51.5	51.8
15	91F 26016	5396	6283	5840	56.0	57.0	56.5
16	91F 25003	5070	5113	5092	57.5	56.5	57.0
17	91F 25001	4451	4394	4423	57.0	56.0	56.5
18	91F 25007	4811	5259	5035	57.5	59.0	58.3
19	91F 25012	5431	5905	5668	55.5	55.0	55.3
20	91F 26102	5029	5505	5267	57.5	58.0	57.8
21	Karl	3881	4460	4171	52.5	52.0	52.3
22	Eronga 83	5922	5659	5791	55.0	54.0	54.5
23	ALAMOS 83	4838	4321	4580	54.5	51.0	52.8
24	Sunland	3604	4365	3985	58.0	54.5	56.3
25	Florida 201	3923	5462	4693	54.5	53.0	53.8
26	Whitman	3570	3479	3525	51.0	47.0	49.0
27	Frank	4888	5286	5087	55.0	57.0	56.0
28	Norico	5096	4358	4727	56.0	56.5	56.3
29	16-A	3865	3747	3806	58.0	59.0	58.5
30	16-12	4657	5107	4882	55.0	54.0	54.5
31	16-13	4713	4686	4700	57.0	58.0	57.5
Triticale Mean		**4696**	**4989**	**4843**	**55.8**	**55.3**	**55.6**
Overall Mean		**4683**	**4908**	**4796**	**56.2**	**55.4**	**55.8**
LSD (0.05)		**778**	**721**	**473**			

Statewide Cereal Variety Testing Program in the Klamath Basin, 1993

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

INTRODUCTION

Current variety performance data is required by Oregon cereal producers to make intelligent variety selection decisions. To provide this information, a centrally coordinated variety testing program was initiated in 1992. Both fall and spring planted trials have been established at 11 locations throughout the state. On-station sites include Ontario, Pendleton, Hermiston, Madras, Corvallis, Medford, and Klamath Falls.

PROCEDURES

The central team at OSU developed variety lists with input from each site, and obtained and packaged seed. Cereal variety trials were planted at KES on October 24, 1992 and May 17, 1993. The trials were established on Fordney fine sandy loam that is moderately deep and somewhat poorly drained. The previous crop was potatoes. The crop was irrigated with solid set sprinklers.

Trials were arranged in a randomized complete block design with three replications. Seed was planted at a depth of 1 inch with a seeding rate of 30 seed/ft^2. All plots were fertilized with 100 lb N, 60 lb P_2O_5, and 44 lb S/A at time of seeding. Plots measured 5 x 20 feet with a row spacing of 6 inches. Bromoxynil and MCPA were applied at labeled rates to control broadleaf weeds. Crops were harvested in early September using a plot combine with a 5-foot wide header. Plant height and lodging were recorded for all plots. Heading date was only measured in the spring planted trial. Following harvest, combine-run seed was sent to Corvallis for processing. Grain yield, test weight, thousand kernel weight, and seeds per pound were determined.

RESULTS AND DISCUSSION

Winter Barley Varieties

Average yield for winter barley was 4,740 lb/A, compared to 4,510 lb/A for spring barley varieties in an adjacent area (Tables 1 and 2). Variability was high and yield differences between varieties were not statistically significant. Significant differences between varieties were found for plant height and test weight.

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Spring Barley Varieties

Variability in yield within varieties was much less in spring barley lines than in the winter trial. Steptoe produced the highest yield in the trial. Yields of Baroness, Colter, and Maranna were not significantly lower than Steptoe yields.

Winter Wheat and Triticale

Fall planted wheat averaged 77.8 bu/A, compared to 69.2 bu/A in the spring planted trial (Tables 3 and 4). The two highest yielding entries in the winter trial included a soft white (SW) wheat called Red and a triticale variety, Celia. Several other entries were not significantly lower in yield than these two entries. Most entries in this trial were SW wheat; however, there were two triticale, one club wheat, and one hard red (HR) wheat variety. Both the club and HR varieties produced significantly lower yields than leading SW wheat and triticale varieties.

Spring Wheat and Triticale

Six SW wheat varieties, two HR wheat, one club wheat, and three triticale varieties were included in this trial. Calora, the club wheat, produced significantly less grain than two SW spring wheat varieties, Centennial and Owens (Table 4). Other entries with relatively high yields included SW wheats, Treasure and Fieldwin, and triticales, Victoria and Juan. The HR spring wheats failed to produce grain yields comparable to SW wheat and triticale.

Table 1. Results of 1993 Statewide variety testing program winter barley trial at the Klamath Experiment Station, Klamath Falls, OR.

Selection	Class[1]	Height	Lodging	Yield	Test weight	1000K weight	Seeds per pound
		-- in --	--- % ---	lb/A	lb/bu	-- g --	
Boyer	F	31	0	5150	51.5	40.5	11200
Gwen	F	28	0	4550	49.7	40.4	11240
Hesk	F	26	0	4480	50.3	39.8	11390
Hundred	F	24	0	4940	48.2	34.2	13280
Kold	F	28	0	5110	49.9	35.7	12720
Onless	F	26	0	5290	47.1	50.2	9030
ORW4	F	29	0	5130	51.1	44.8	10130
ORW5	F	25	0	4500	50.1	40.7	11140
Pleisant	F	24	0	3670	51.3	43.7	10370
Scio	F	30	0	4880	51.0	43.5	10420
Sprinter	F	22	0	4390	49.2	36.6	12400
Mean		26		4740	50.0	40.9	11210
CV(%)		7		22	2	15	15
LSD(0.05)		3		NS	2.0	NS	NS

[1]/ Class: F - feeding

Table 2. Results of 1993 Statewide variety testing program spring barley trial at the Klamath Experiment Station, Klamath Falls, OR.

Selection	Type[1]	Class[2]	Heading date	Yield	Test weight	1000K weight	Seeds per pound
			Julien days	lb/A	lb/bu	-- g --	
Baroness	2	F/M	201	4990	54.0	50.1	9050
Colter	6	F/M	193	4840	51.0	44.2	10280
Crest	2	M	201	3470	53.9	49.4	9160
Crystal	2	M	201	4310	54.9	50.5	8980
Maranna	6	F	201	4770	52.8	40.8	11120
Russell	6	M	190	4070	51.6	42.6	10660
Steptoe	6	F	191	5110	51.4	52.1	6710
Mean			197	4510	52.8	47.1	9420
CV(%)			1	9	1	3	3
LSD(0.05)			1	740	0.8	2.8	569

[1]/ Type - 2 Row, 6 Row
[2]/ Class - F - feeding; M - malting

Table 3. Results of 1993 Statewide variety testing program winter wheat and triticale trial at the Klamath Experiment Station, Klamath Falls, OR.

Selection	Type[1]	Height	Lodging	Yield	Test weight	1000K weight	Seeds per pound
		-- in --	--- % ---	bu/A	lb/bu	-- g --	
Basin	SW	26	0	71.2	60.8	43.2	10500
Celia	TR	37	0	100.6	57.9	52.7	8610
Dews	SW	30	0	85.4	62.4	49.6	9150
Durheim Pride	SW	32	0	85.4	62.4	49.6	9150
Gene	SW	32	0	87.0	61.9	47.4	9560
Hoff	HR	31	0	37.6	61.4	46.5	8760
MacVicar	SW	30	0	94.2	60.8	56.2	8070
Madsen	SW	27	0	84.3	61.1	47.0	9660
Malcolm	SW	30	0	97.2	61.0	52.3	8670
Red	SW	31	0	102.5	60.5	43.4	10450
Rohde	CL	25	0	86.5	61.3	41.7	10890
Short Club	CL	17	0	18.0	40.7	35.6	12740
Stephens	SW	31	0	93.9	60.0	56.3	8050
W301	SW	88	0	76.3	58.6	56.5	8050
Whitman	TR	38	0	61.4	53.3	55.4	8190
Yamhill	SW	33	0	74.0	59.6	48.0	9460
Mean		30		77.8	58.9	46.9	9370
CV(%)		6		22	2	7	7
LSD(0.05)		3		29.0	1.6	5.3	1015

[1]/ Type: SW - soft white wheat; HR - hard red wheat; CL - club wheat; TR - triticale

Table 4. Results of 1993 Statewide variety testing program spring wheat and triticale trial at the Klamath Experiment Station, Klamath Falls, OR.

Selection	Type[1]	Heading date	Lodging	Yield	Test weight	1000K weight	Seeds per pound
		Julian Days	--- % ---	bu/A	lb/bu	-- g --	
Calora	CL	201	0	60.1	59.9	43.0	10540
Celia	TR	215	0	60.8	50.4	54.2	8370
Centennial	SW	197	0	85.0	61.3	43.0	10540
Dirkwin	SW	201	0	59.0	58.0	50.0	9070
Fieldwin	SW	211	0	72.3	52.3	41.0	11070
Juan	TR	203	0	74.1	51.1	56.1	8090
Klasic	HW	192	0	67.1	62.1	45.9	9830
Owens	SW	200	0	81.5	60.9	47.6	9540
Penawawa	SW	200	0	63.3	59.9	46.9	9680
Treasure	SW	204	0	76.1	57.2	45.2	10040
Victoria	TR	197	0	73.1	51.8	49.0	9260
WB926R	HR	194	0	64.6	60.1	52.6	8620
Yecora Rojo	HR	193	0	62.0	61.1	46.3	9800
Mean		201		69.2	57.4	47.8	9570
CV(%)		1		15	3	14	14
LSD(0.05)		2		18.0	2.6	NS	NS

[1]/ Type: SW - soft white wheat; HR - hard red wheat; CL - club wheat; TR - triticale

Alfalfa Variety Trials

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

INTRODUCTION

Alfalfa, a major forage commodity in the Klamath Basin, 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 recently been found in the Butte Valley area and it occurs in many surrounding areas. The main insect pest is the alfalfa weevil. Some breeding programs are beginning to select for resistance to this pest. Pest 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 was 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 and 1993 when plants reached early bud stage. The crop was harvested using a flail harvester with a three-foot wide head. All yields are reported on a dry weight basis. Unusually warm spring weather in 1992 allowed four cuttings, one more than is normally obtained in trials at KES. The 1993 growing season was cooler than normal. Three cuttings were taken and fall regrowth was documented by a fourth harvest after plants had gone dormant.

RESULTS AND DISCUSSION

Forage yields in the establishment year ranged from 0.87 to 1.52 tons/A. Although there were significant differences between the highest and lowest yielding entries, forage yields of 16 entries were not significantly different than the highest yielding entry in the trial, DK 125 (Table 1). Forage yields of only 11 entries were significantly higher than Vernal, the long term standard included in the trial. Similar trends were seen in subsequent years where significant differences in yield were found, but a large number of varieties were in the top yielding group. Average forage yield in 1992 was 7.44 tons/A, compared to only 5.02 tons/A in 1993 (Tables 1 and 2). This decline in yield was partly due to a cooler than normal year in 1993, and to moisture stress caused by irrigation scheduling conflicts. Identification of differences in forage yield between varieties was no better when three-year total forage production and 1992 to 1993 average production were examined. Twenty-two entries were in the top yielding group when the two-year average yield was examined. The relative ranking of varieties when examining these two parameters was essentially the same. It is interesting to note that the lowest yielding variety in the establishment year, Atra 55, was the highest yielding entry in the two subsequent years.

Another 48 entry alfalfa variety trial was established at KES in 1986. Yield data was collected from 1987 to 1990. 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 (Table 3). This was a significantly higher yield than Vernal. Six other entries; Max 85 brand, WS 320, Apollo II, Sparta, Centurion, and DK 120 were not significantly different than the four top yielding varieties. Harvest of this trial was suspended in 1990; however, the trial was maintained and harvested as a hay field. These plots were harvested as a variety trial in 1993 to evaluate the long term persistence of varieties. Forage yields of 32 out of 48 varieties were not significantly different than the highest producing entry. Relative ranking of entries based on 1993 yields was similar to rankings based on forage yields in 1990. It appears that a four-year test may provide a good indication of stand persistence and yield beyond that time frame.

Variety selection should be based on a number of criteria in addition to yield. Disease and pest resistance, and winter hardiness are two very important factors. Varieties selected for the Klamath Basin should be resistant to bacterial wilt, phytophthora root rot, verticillium wilt, and in some areas stem nematode. Resistance to root knot nematode may also be a factor when alfalfa is grown in rotation with potatoes. In the past, fall dormancy ratings of 2 to 3 have been recommended for the Klamath Basin; however, recently, varieties in dormancy groups 4 and 5 have persisted over a four-year period. This may be the result of relatively mild winters experienced in the last 10 to 15 years.

Table 1. Alfalfa Variety Trial Summary 1991 - 1993. Forage yield summaries of 48 alfalfa varieties from 1991 to 1993. Plots were established in the spring of 1991 at the Klamath Experiment Station, OR.

Entry	Variety	1991	1992	1993	Total	3 year Rank	Average 92-93	Rank
		---------------- tons/A		----------------			tons/A	
1	DK 122	1.35	7.75	5.01	14.11	11	6.38	12
2	DK 120	1.10	8.12	5.27	14.49	2	6.69	2
3	DK 135	1.20	7.38	5.00	13.57	32	6.19	29
4	DK 125	1.52	7.22	4.97	13.71	21	6.09	37
5	Asset	1.21	7.93	5.31	14.44	3	6.62	3
6	Centurion	1.14	7.55	5.04	13.72	20	6.29	19
7	Multistar	1.18	7.72	5.48	14.38	4	6.60	5
8	Majestic	1.07	7.10	5.43	13.59	29	6.26	23
9	Sabre	1.06	7.36	4.69	13.11	41	6.03	40
10	Webfoot	1.12	7.19	4.63	12.93	43	5.91	44
11	MS 90	1.21	7.61	4.99	13.81	17	6.30	17
12	UN-74	1.29	7.78	5.02	14.09	12	6.40	10
13	Legend	1.31	7.76	4.90	13.97	14	6.33	14
14	Apollo Supreme	1.13	7.45	4.97	13.55	33	6.21	26
15	Arrow	1.30	7.33	4.83	13.45	37	6.08	39
16	Aggressor	1.03	7.40	5.23	13.66	23	6.32	15
17	Archer	1.12	8.09	5.14	14.35	7	6.61	4
18	Husky	0.98	7.17	4.87	13.02	42	6.02	41
19	GS-88	1.17	7.17	5.11	13.44	38	6.14	34
20	Ultra	1.34	7.69	4.90	13.93	15	6.29	18
21	Expt. 91-01	0.98	6.73	5.22	12.92	44	5.97	43
22	Max 85	1.41	7.41	4.77	13.59	28	6.09	38
23	87-201	1.36	7.64	5.23	14.23	9	6.43	9
24	WL-317	0.97	6.91	4.50	12.37	47	5.70	47
25	WL-320	1.17	7.36	4.95	13.48	36	6.16	32
26	WL-225	1.44	7.21	5.01	13.65	25	6.11	36
27	WL-316	1.28	7.23	5.48	13.99	13	6.35	13
28	Vernal	1.02	6.93	4.67	12.62	45	5.80	45
29	Sparta	1.18	7.29	5.17	13.63	26	6.23	24
30	Champ	1.06	7.18	5.20	13.44	39	6.19	28
31	Fortress	1.24	7.70	5.43	14.36	6	6.56	7
32	Multileaf II	1.23	7.64	4.94	13.80	18	6.29	21
33	Excaliber	1.25	8.03	5.10	14.37	5	6.56	6
34	Blazer	1.33	7.77	5.18	14.27	8	6.47	8
35	Belmont	1.14	7.26	5.18	13.58	30	6.22	25
36	Cimmaron VR	1.36	7.38	5.40	14.14	10	6.39	11
37	Columbo	1.33	7.42	4.86	13.60	27	6.14	33
38	9047 IV	1.25	7.54	4.79	13.58	31	6.17	30
39	Milkmaker II	1.28	7.38	4.66	13.31	40	6.02	42
40	Flint	1.26	7.29	4.96	13.51	34	6.12	35
41	PB 5364	1.26	7.42	5.21	13.88	16	6.31	16
42	SCO 0042	1.03	6.72	4.69	12.44	46	5.71	46
43	SCO 0043	0.96	6.20	4.36	11.51	48	5.28	48
44	Rancher Special	1.15	7.79	4.79	13.73	19	6.29	20
45	Appollo II	1.26	7.43	4.97	13.65	24	6.20	27
46	Atra 55	0.87	8.51	5.29	14.67	1	6.90	1
47	Vector	1.17	7.34	5.00	13.50	35	6.17	31
48	LM 331	1.14	7.38	5.17	13.69	22	6.27	22
	Mean	1.19	7.44	5.02	13.64		6.23	
	CV(%)	16	9	12	7		8	
	LSD(0.05)	0.30	0.90	0.90	1.40		0.70	

Table 2. 1993 Alfalfa Variety Trial. 1993 forage yield of 48 alfalfa varieties planted in the spring of 1991 at the Klamath Experiment Station, OR.

Entry	Selection	Cut 1	Cut 2	Cut 3	Cut 4	3-cut Total	4-cut Total
		tons/A					
1	DK 122	1.17	2.21	1.40	0.22	4.78	5.00
2	DK 120	1.35	2.21	1.49	0.21	5.05	5.26
3	DK 135	1.16	2.09	1.49	0.25	4.74	4.99
4	DK 125	1.15	2.05	1.47	0.31	4.67	4.98
5	ASSET	1.28	2.24	1.50	0.28	5.02	5.30
6	CENTURION	1.31	2.06	1.47	0.20	4.84	5.04
7	MULTISTAR	1.22	2.24	1.66	0.36	5.12	5.48
8	MAJESTIC	1.42	2.16	1.53	0.32	5.11	5.43
9	SABRE	1.14	1.96	1.41	0.18	4.51	4.69
10	WEBFOOT	1.07	1.89	1.38	0.28	4.34	4.62
11	MS 90	1.14	2.19	1.36	0.30	4.69	4.99
12	UN-74	1.14	2.07	1.52	0.30	4.73	5.03
13	LEGEND	1.14	2.00	1.51	0.25	4.65	4.90
14	APOLLO SUPREME	1.23	2.03	1.45	0.26	4.71	4.97
15	ARROW	1.11	1.98	1.41	0.32	4.50	4.82
16	AGGRESSOR	1.16	2.10	1.57	0.40	4.83	5.23
17	ARCHER	1.07	2.01	1.54	0.52	4.62	5.14
18	HUSKY	1.23	1.94	1.44	0.26	4.61	4.87
19	GS-88	1.31	2.14	1.43	0.22	4.88	5.10
20	ULTRA	1.17	2.05	1.47	0.20	4.69	4.89
21	EXPT. 91-01	1.06	2.02	1.60	0.54	4.68	5.22
22	MAX85	1.05	1.97	1.50	0.25	4.52	4.77
23	87-201	1.15	2.19	1.52	0.37	4.86	5.23
24	WL-317	1.11	1.89	1.36	0.14	4.36	4.50
25	WL-320	1.21	2.07	1.37	0.29	4.65	4.94
26	WL-225	1.22	2.13	1.48	0.17	4.83	5.00
27	WL-316	1.14	2.15	1.59	0.59	4.88	5.47
28	VERNAL	1.20	2.00	1.35	0.12	4.55	4.67
29	SPARTA	1.22	2.02	1.54	0.39	4.78	5.17
30	CHAMP	1.28	2.02	1.55	0.35	4.85	5.20
31	FORTRESS	1.29	2.13	1.57	0.43	4.99	5.42
32	MULTILEAF II	1.21	2.00	1.41	0.32	4.62	4.94
33	EXCALIBER	1.17	2.16	1.42	0.35	4.75	5.10
34	BLAZER	1.19	2.20	1.46	0.31	4.85	5.16
35	BELMONT	1.11	2.17	1.56	0.34	4.84	5.18
36	CIMMARON VR	1.21	2.11	1.57	0.51	4.89	5.40
37	COLUMBO	1.20	2.00	1.34	0.32	4.54	4.86
38	9047IV	1.14	1.98	1.46	0.21	4.58	4.79
39	MILKMAKER II	1.14	1.97	1.41	0.13	4.52	4.65
40	FLINT	1.21	2.04	1.42	0.29	4.67	4.96
41	PB 5364	1.21	2.11	1.53	0.36	4.85	5.21
42	SCO 0042	0.73	1.91	1.42	0.63	4.06	4.69
43	SCO 0043	0.54	1.81	1.42	0.59	3.77	4.36
44	RANCHER SPECIAL	1.15	2.02	1.33	0.29	4.50	4.79
45	APPOLLO II	1.21	1.97	1.54	0.26	4.72	4.98
46	ATRA 55	1.35	2.13	1.52	0.29	5.00	5.29
47	VECTOR	1.19	2.05	1.47	0.29	4.71	5.00
48	LM331	1.17	2.03	1.52	0.44	4.72	5.16
	MEAN	1.17	2.06	1.47	0.32	4.70	5.02
	CV (%)	13	9	11	39	8	12
	LSD (0.05)	0.21	0.26	0.24	0.18	0.55	0.86

Table 3. Alfalfa Variety Trial Summary 1987-1993. Forage yield summaries of 48 alfalfa varieties from 1987 to 1993. Plots were established in the fall of 1986 at the Klamath Experiment Station, OR.

	Entry	Yield 1987	1988	1989	1990	1987-1990 Avg.	1993
		tons/A					
1	PB 5444	6.5	6.8	7.1	4.9	6.3	4.5
2	PB 526	6.3	6.7	7.5	5.5	6.5	4.4
3	PB 532	5.9	6.6	7.3	5.0	6.2	4.8
4	PB 5432	6.5	6.7	7.2	5.3	6.4	4.7
5	Brute Brand	6.0	6.1	6.6	4.2	5.7	3.5
6	Max 85 Brand	6.0	6.7	6.9	4.8	6.1	4.6
7	Mission 123	6.3	6.0	6.7	4.9	6.0	4.2
8	Commander	6.5	6.7	7.2	5.0	6.4	4.5
9	Pike	6.3	6.3	7.1	4.2	6.0	4.0
10	Drummor	6.4	6.8	7.1	4.9	6.3	4.9
11	NK 83580	6.5	6.5	6.7	5.0	6.2	3.8
12	NK 83632	6.0	6.5	6.8	4.7	6.0	4.6
13	Phytor	6.4	6.5	7.0	4.1	6.0	3.7
14	Spreador II	6.0	6.1	6.7	5.0	6.0	3.6
15	WL 225	6.4	6.7	7.4	5.2	6.4	4.8
16	WL 315	6.6	6.8	7.5	5.3	6.6	4.7
17	WL 316	6.1	6.3	6.5	4.8	5.9	3.8
18	WL 320	6.7	6.8	6.5	4.9	6.3	5.1
19	83-2	6.0	6.4	7.1	5.1	6.2	5.3
20	GT 58	6.4	6.2	6.9	4.6	6.0	4.5
21	Apollo II	5.9	6.5	6.7	5.0	6.1	5.0
22	Arrow	6.6	6.6	7.0	5.4	6.4	4.4
23	Armor	5.8	6.2	7.0	5.4	6.4	4.6
24	Thunder	5.9	6.5	6.8	4.9	6.0	4.1
25	Peak	6.3	6.5	6.9	5.1	6.2	4.6
26	Blazer	6.0	6.4	7.0	4.6	6.0	4.6
27	Epic	6.1	6.6	7.3	5.3	6.4	5.1
28	Sparta	6.4	6.9	7.0	4.7	6.3	4.1
29	RS 3309	6.2	6.5	7.3	5.0	6.3	5.1
30	Excalibur	6.4	6.8	7.2	5.2	6.4	5.4
31	Centurion	6.7	6.5	6.9	4.7	6.2	4.4
32	Flint	5.8	6.2	6.8	4.9	6.0	4.1
33	York	6.0	6.4	6.8	4.8	6.0	4.9
34	Vortex	6.3	6.8	7.1	5.3	6.4	4.9
35	Sutter	5.6	5.9	6.3	4.6	5.6	4.0
36	Vector	6.7	6.7	7.0	5.1	6.4	4.9
37	DK 120	6.4	6.6	6.8	4.8	6.2	4.2
38	DK 135	6.0	6.5	6.8	4.7	6.0	4.5
39	Vernal	6.0	6.0	6.7	4.8	5.9	5.0
40	Guardian	5.9	6.5	6.9	5.2	6.1	5.1
41	Sentinel	5.9	6.2	6.3	5.0	5.8	4.6
42	Sentry	6.0	6.3	6.9	5.0	6.1	4.1
43	Atra 55	6.0	6.5	7.0	5.2	6.2	4.7
44	Ranger	6.5	6.7	7.0	5.1	6.3	4.7
45	Nomad	5.4	6.1	6.3	4.3	5.5	4.2
46	Rambler	6.2	6.5	6.9	4.4	6.0	3.7
47	Iroquois	6.3	6.9	7.4	5.5	6.6	5.5
48	Lahontan	6.0	6.2	7.0	4.6	6.0	4.2
	Mean:	6.2	6.5	6.9	4.9	6.1	4.5
	CV (%)	7.0	5.9	7.1	7.2	7.1	18.0
	LSD (0.05)	0.6	0.5	0.7	0.5	0.4	1.1

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 are grown in the Klamath Basin. Though a few growers consistently produce high yields of weed-free hay, many do not. 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 effects 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 would be better prepared to assist alfalfa growers with weed control decisions directly affecting the economics of the alfalfa enterprise. Field plots were established at two locations in central and southern Oregon to evaluate the economics of chemical weed control in alfalfa.

PROCEDURES

The experiment is being conducted at the Central Oregon Agricultural Research Center's Powell Butte site and at the Klamath Experiment Station. The following treatments are included for both spring and fall established alfalfa:

(1) a. Best herbicide treatment in establishment stage.
    b. Best herbicide treatment every year after establishment.

(2) a. Best herbicide treatment in establishment stage.
    b. Best herbicide treatment one year after establishment.

(3) a. No herbicide treatment in establishment stage.
    b. Best herbicide treatment every year after establishment.

(4) a. No herbicide treatment in establishment stage.
    b. Best herbicide treatment in year three or four or both as a salvage treatment

(5) a. No herbicide treatment in establishment stage.
    b. No herbicide treatment thereafter.

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These treatments are applied to spring and fall seeded alfalfa. Herbicide applications on the plots as of December 1993 are included in Table 1. Each treatment is on a plot 20 ft wide x 40 ft long, replicated four times in a split-plot design. Treatments are being evaluated by measuring alfalfa crown and weed stand counts, yield, and forage quality of all cuttings each year. Sub-samples are hand-separated to determine weed and alfalfa percentages. Quality is being determined with tests for crude protein (CP), acid detergent fiber (ADF), digestible dry matter (DDM), neutral-detergent fiber (NDF), and minerals. An objective/subjective evaluation of forage quality or buyer appeal is made for each plot. Only data from the Klamath Experiment Station 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.

Economic analysis was performed using the assumptions found in Table 2. Gross return after herbicide costs was determined to evaluate the cost-effectiveness of the two planting dates and five weed control scenarios. Gross income was calculated by determining the value of hay produced at each cutting and totaling the value of hay produced throughout the study. Hay value at each cutting was determined by multiplying the yield of hay produced by the price of the hay at each cutting. The price of hay produced was determined by laboratory quality analysis. Hay with less than 33 percent ADF and over 20 percent protein was considered to be dairy quality hay valued at $90/ton. All other hay was considered to be stocker hay and assigned a value of $70/ton. In one case, the presence of toxic weeds caused the hay to be useless as feed, and no value was assigned to that cutting. Gross return less herbicide costs was determined by subtracting estimated costs of the various weed control treatments from the gross income produced. Herbicide costs included both material and application costs (Table 2).

RESULTS AND DISCUSSION

Weed species composition and density greatly affect the benefits of weed control. The major weed species present following fall establishment were redroot pigweed, lambsquarter, and hairy nightshade. A mixture of 2,4-DB and Buctryl was applied 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. Shephardspurse, a common weed in alfalfa fields, was noticeably 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. Weeds were abundant in the first 1991 cutting of treatments 4 and 5, which had received no herbicide treatment (Figure 1). Weeds present included prickly lettuce, mallow, sowthistle, filaree, and smartweed. Despite higher weed content, there was no significant difference in forage quality between herbicide treatments, probably due to the succulent nature of weed species present. However, the presence of several spiny weed species might be objectionable in some applications.

There were very few weeds in any plots after the first cutting, with no differences between treatments. However, hay from all treatments dropped below minimum quality levels to be sold as dairy quality hay in the second cutting. Hay from all treatments in the third cutting was dairy quality. Herbicide treatment of fall established plots did not affect hay yield at any cutting or total hay production in 1991 (Figure 1).

Herbicide treatment at planting significantly reduced the amount of weeds in the establishment year of spring planted plots (Figure 2). The species of weeds 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 reducing the forage quality of hay from untreated plots. Hairy nightshade was not as prevalent as Indian lovegrass, but it had an even more negative effect than the annual grass. The presence of substantial amounts of mature grass and broadleaf weeds significantly reduced forage quality of plots not receiving herbicide treatment at planting. Forage quality of untreated plots dropped below that required for dairy quality (Figure 3). Forage quality in untreated plots was further compromised by the presence of large amounts of hairy nightshade, which can be toxic to livestock. Hay that has a large proportion of this species is not safe for 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 be difficult.

Weed control in the spring of 1992 was not effective (Figures 4 and 5). This was due to untimely application of the material (2,4-DB), because of inclement weather. However, there was a significant difference between planting dates in the amount of weeds present in the first cutting of 1992 (Figures 4 and 5). As seen in 1991, the presence of weeds did not adversely affect forage quality. Hay from all treatments and planting dates met minimum quality requirements to be considered dairy quality. Furthermore, spiny weed species present in the spring of 1991 were not present in 1992 and would not cause a problem in marketing. 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. Second cutting hay was considered to be stock hay, while third cutting hay was dairy quality. In 1992, there was no significant difference in hay yield produced at each cutting; total hay produced due to herbicide treatment; or date of planting (Figures 4 and 5).

Alfalfa yield, weed density, and forage quality trends in 1993 were very similar to those seen in 1992. There were less weeds in spring established than in fall established plots (Figures 6 and 7). Weed density in fall established plots was higher in treatments 4 and 5, which had received no herbicide treatment during the entire study period, than in plots that had received some form of weed control (Figure 6). As seen in the previous two years, the weeds present in this study did not affect forage quality. Second cutting hay was considered to be stock hay, while third cutting hay was dairy quality. As in 1992, there was no significant difference in hay yield produced at each cutting or total hay produced due to herbicide treatment or date of planting (Figures 6 and 7).

The economic effects of differences in yield and quality due to herbicide treatment and planting date are summarized in Figure 8 over the three-year period from 1991 to 1993. In fall planted plots, treatment 3 resulted in the highest gross returns less herbicide costs; however, these returns were not significantly higher than those from plots receiving no herbicide in the first two years of the trial (treatments 4 and 5). Treatments 1 and 2 were slightly lower in economic returns 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 treatments applied to the various weed control regimes at Klamath Experiment Station from 1990 to 1993.

Year	Planting Date	Regimes	Herbicide treatments applied
1990	Fall	1, 2	2,4-DB @ 1.25 lb ae (acid equivalent)/A postemergence
		3, 4, 5	None
1991	Fall	1, 3	2,4-DB @ 1.25 lb ae (acid equivalent)/A postemergence
		2, 4, 5	None
	Spring	1, 2	EPTC @ 3.0 lb ai/A plus Benefin @ 1.23 lb ai/A preplant
		3, 4, 5	None
1992	Fall	1, 3	2,4-DB @ 1.25 lb ae (acid equivalent)/A postemergence
		2, 4, 5	None
	Spring	1, 3	2,4-DB @ 1.25 lb ae (acid equivalent)/A postemergence
		2, 4, 5	None
1993	Fall	1, 3	2,4-DB @ 1.25 lb ae (acid equivalent)/A postemergence
		2, 4, 5	None
	Spring	1, 3	2,4-DB @ 1.25 lb ae (acid equivalent)/A postemergence
		2, 4, 5	None

Table 2. 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	

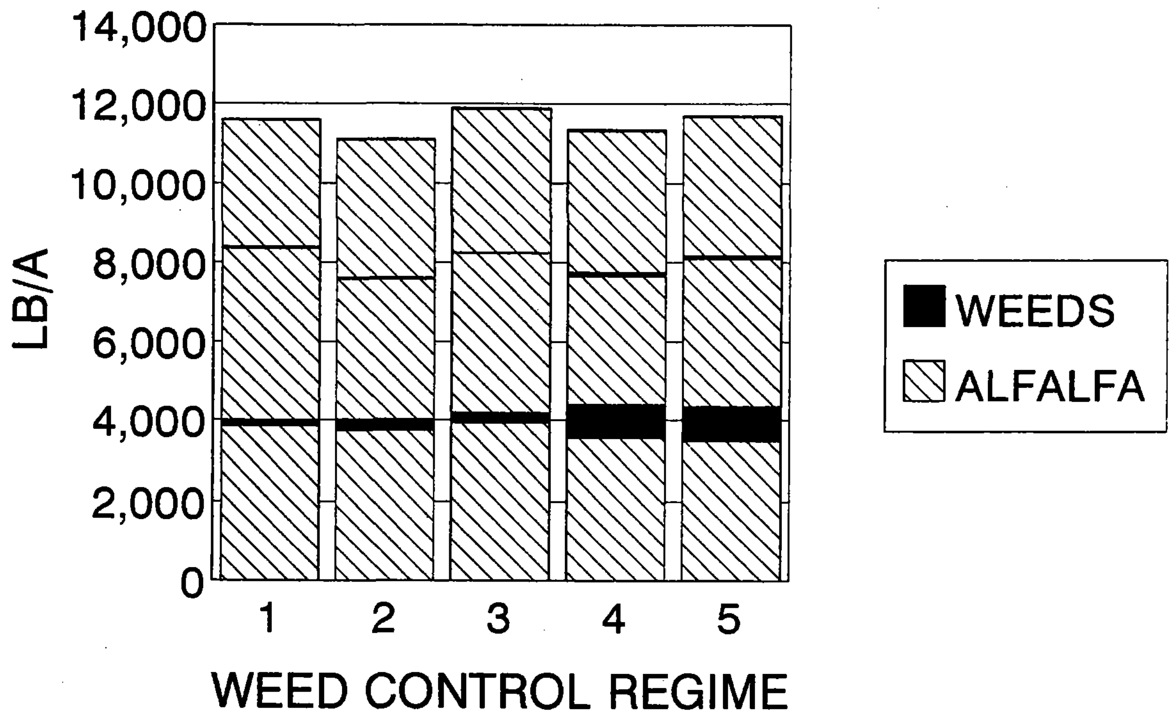

Figure 1. Effect of five weed control regimes on alfalfa and weed production (lb DM/A) of fall planted alfalfa in 1991, the first year following establishment. Bars represent three cutting dates with the first cutting at the bottom. Plots were located at the Klamath Experiment Station, OR.

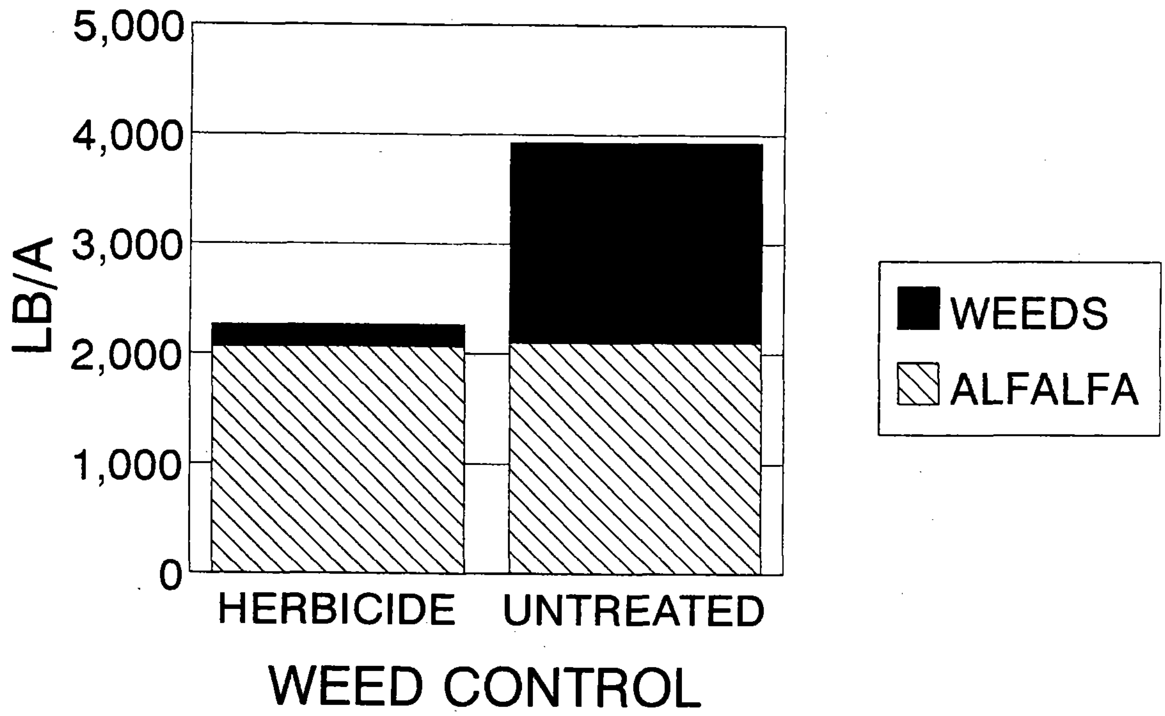

Figure 2. Effect of herbicide treatment on alfalfa and weed production (lb DM/A) of spring planted alfalfa in the establishment year. Bars represent one cutting taken in late August, 1991. Plots were located at the Klamath Experiment Station, OR.

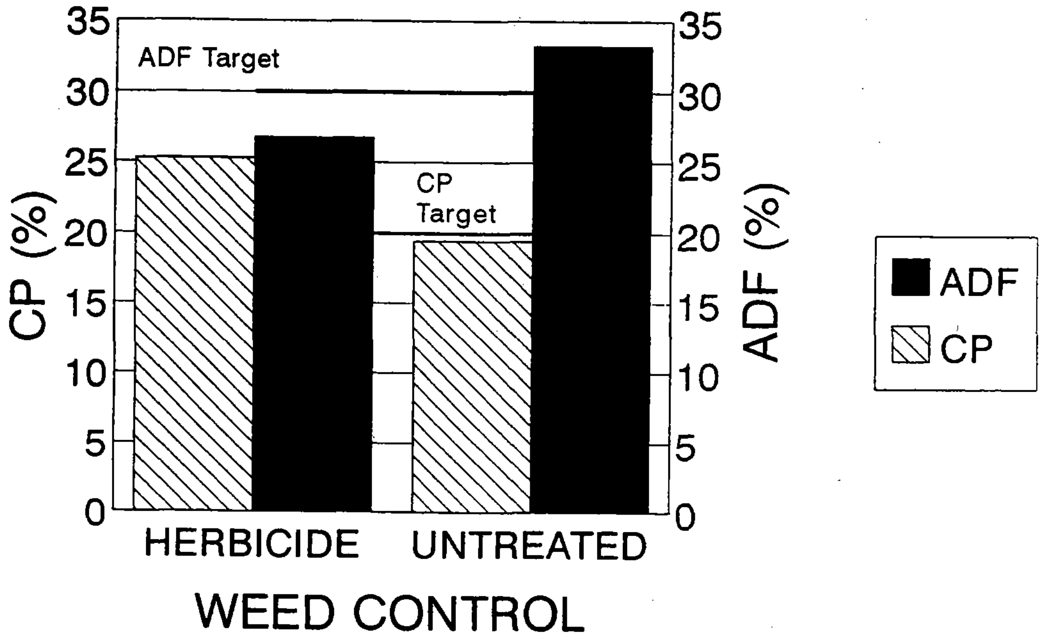

Figure 3. Effect of weed control regimes on alfalfa forage quality in the establishment year of spring established plots. Bars represent one cutting taken in late August, 1991. Plots were located at the Klamath Experiment Station, OR.

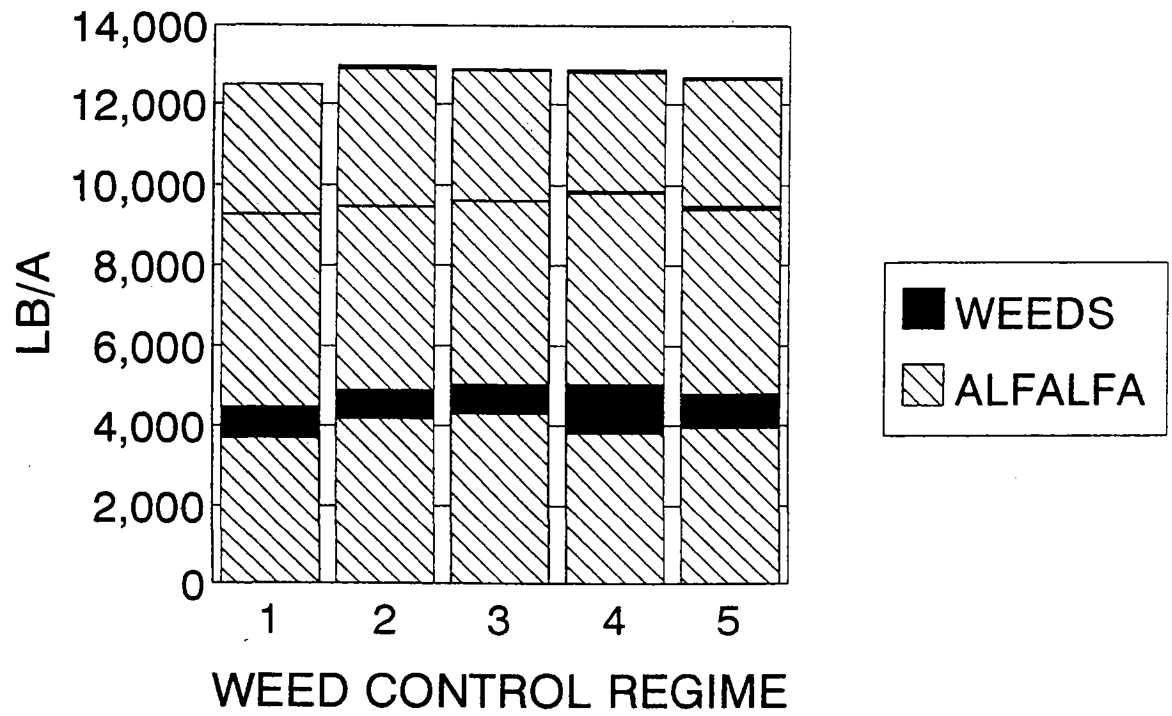

Figure 4. Effect of five weed control regimes on 1992 alfalfa and weed production (lb DM/A) of alfalfa planted in fall 1990. Bars represent three cutting dates with the first cutting at the bottom. Plots were located at the Klamath Experiment Station, OR.

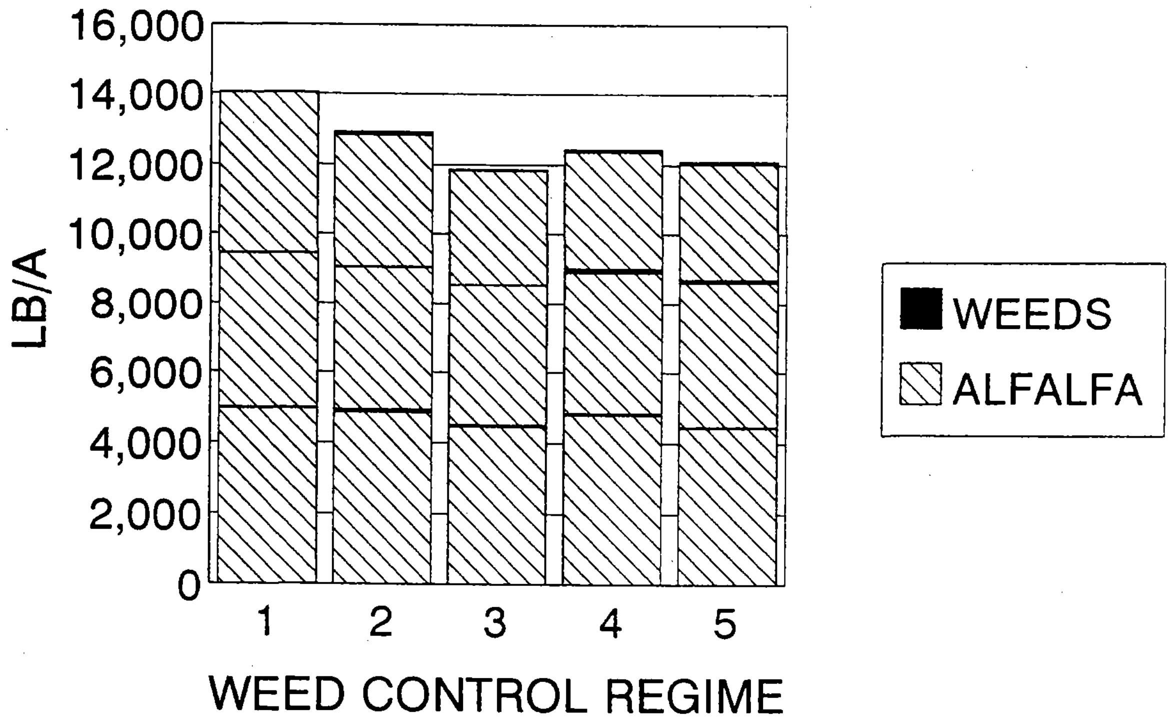

Figure 5. Effect of five weed control regimes on 1992 alfalfa and weed production (lb DM/A) of alfalfa planted in spring 1991. Bars represent three cutting dates with the first cutting at the bottom. Plots were located at the Klamath Experiment Station, OR.

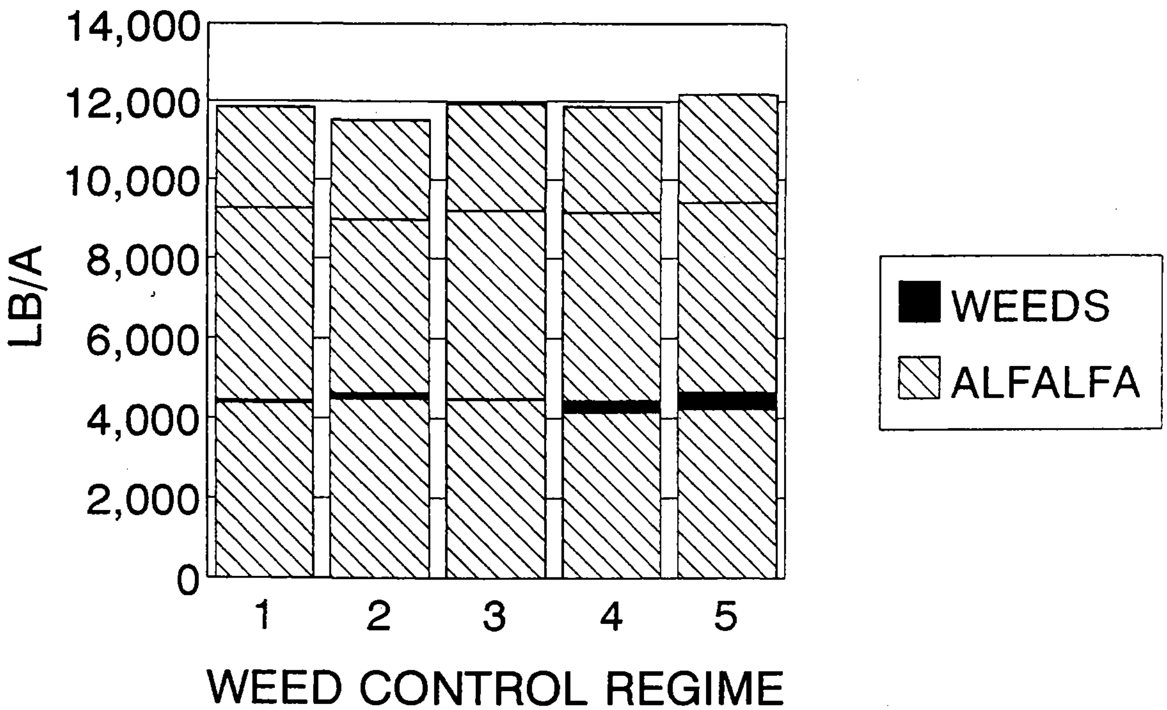

Figure 6. Effect of five weed control regimes on 1993 alfalfa and weed production (lb DM/A) of alfalfa planted in fall 1990. Bars represent three cutting dates with the first cutting at the bottom. Plots were located at the Klamath Experiment Station, OR.

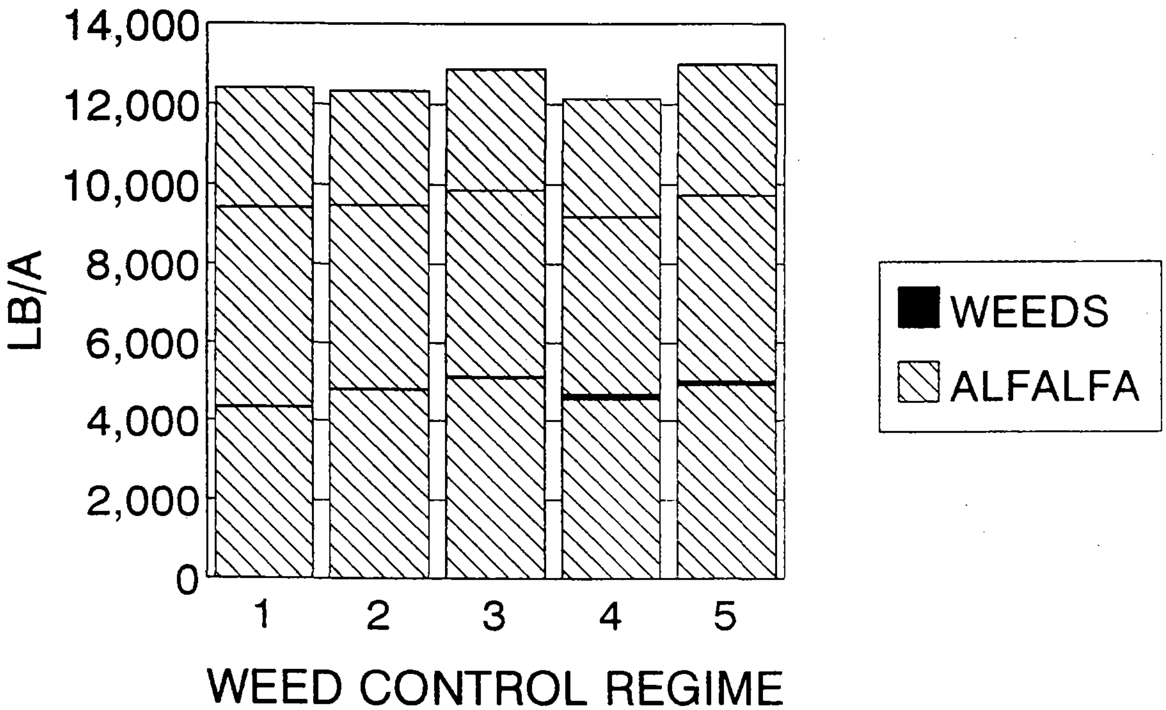

Figure 7. Effect of five weed control regimes on 1993 alfalfa and weed production (lb DM/A) of alfalfa planted in spring 1991. Bars represent three cutting dates with the first cutting at the bottom. Plots were located at the Klamath Experiment Station, OR.

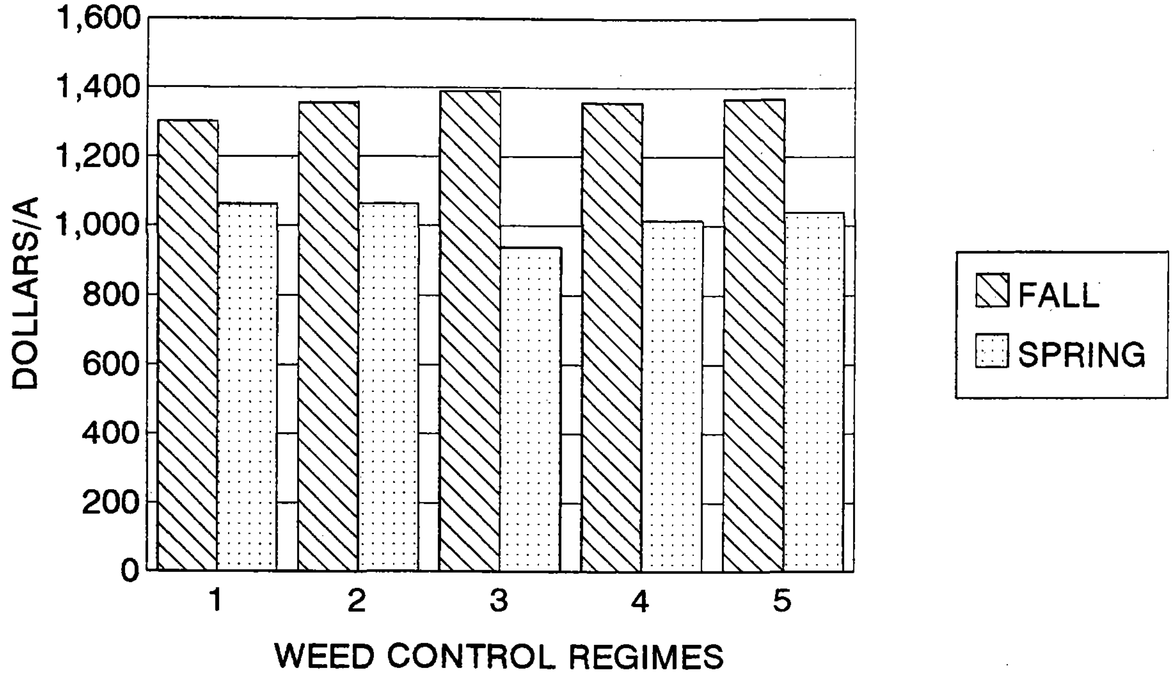

Figure 8. Effects of time of planting and weed control on estimated gross income less herbicide costs from alfalfa grown at the Klamath Experiment Station, OR, 1991-1993.

Oregon Annual Legume Trials - 1993 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.

In 1992 and 1993, field trials were conducted at Powell Butte and Klamath Falls 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 in 1992. In 1993, a 10-entry small seeded trial and a 12-entry large seeded trial were planted at both sites. Objectives of the study were to evaluate forage yield and quality in three Oregon locations, and nitrogen supplying capability for following crops at Powell Butte. Due to similar environments in Klamath Falls and Powell Butte, data from both locations are included in this report.

METHODS

Trials were arranged in a randomized complete block design 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 in 1992. The 1992 small seeded legume trial at KES experienced a stand failure and was abandoned. Regrowth after the first cutting of both the large and small seeded legumes was measured at Powell Butte in 1992, but regrowth was only measured in the large seeded legumes in 1993. At KES, regrowth of the small seeded legumes was measured in 1993.

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Forage quality was determined for both first cutting and regrowth of small seeded legumes and for first cutting of large seeded legumes at KES in 1993. Both crude protein (CP) and acid detergent fiber (ADF) were determined using standard laboratory procedures.

RESULTS

1992 Large Seeded Legumes

Maple pea was the highest yielding entry in the large seeded trial at KES in 1992. It produced significantly more forage than Austrian 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 in 1992, 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.

Hertz freya faba bean and Hairy vetch were the highest yielding entries at Powell Butte in 1992 (Table 1). Maple pea, Sirius field pea, Miranda yellow field pea, and Timeless aladin faba beans produced total yields of 2.0 tons/A or more. Yields of several pea, faba bean, and vetch entries were higher at Powell Butte than at KES. However, the average yield for all entries was about 30 percent higher at KES. The relative ranking of legume species was similar at both locations, with peas the most productive, faba beans and vetches intermediate, and cowpeas the least productive. This is not unexpected in view of similar climatic conditions.

1992 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 the highest yielding entry at Powell Butte in the first cutting (Table 2). Three other medics and two lentils were in the top yielding group in the first cutting. Despite high first cutting yields, regrowth of Sava snail medic was low, resulting in total production that was substantially lower than several clovers included in the trial. The highest yielding entries at Powell Butte in 1992 were Selection 1 berseem clover and Multicut berseem. Maral shaftal and Bigbee berseem clovers also produced over 5,000 lb DM/A. Paraggio barrel medic was the highest yielding medic, with yields not significantly different than Maral shaftal clover.

1993 Large Seeded Legumes

Both magnus pea and Miranda yellow field pea produced significantly more forage at KES in 1993 than Austrian winter pea (Table 3). Magnus pea produced significantly more forage than all other entries except Miranda yellow field pea, Trapper pea, and Procon field pea. The six top yielding entries in the trial were peas. Two chickpea entries were the least productive entries in the trial. Chickpeas require a warmer environment than the Klamath Basin experiences.

At Powell Butte, only Latah pea produced significantly more forage than Austrian winter pea (Table 3). Forage yields of Maple pea, Magnus pea, and Chickling vetch were not significantly lower than that of Latah pea. Trapper and Procon field peas, which performed well at KES, were among the lowest yielding entries at Powell Butte.

1993 Small Seeded Legumes

Paraggio barrel medic was the highest yielding entry at KES in 1993, producing significantly more forage than all entries except Sava snail medic (Table 4). The only entries to produce significant regrowth at KES in 1993 were Nitro alfalfa, Multicut berseem clover, and Selection 1 berseem clover.

Forage yields of the small seeded legumes at Powell Butte were low in 1993 due to poor stands resulting from severe hail damage immediately after emergence. Indianhead lentil was the highest yielding entry in the trial, followed by Hairy vetch and Paraggio barrel medic, which were not significantly lower in yield (Table 4).

Forage Quality

Forage quality of the large seeded legumes was high. Average CP concentration was 16 percent while ADF averaged 34.8 percent (Table 3). There were significant differences in both ADF and CP between entries. Tinga tangier flatpea had the lowest ADF concentration, averaging 31.3 percent, which was significantly lower than all but four entries in the trial. Low ADF concentration was correlated with lower yields. The top six yielding entries in the trial had ADF values above 35 percent (Table 3). There was less variability in CP between varieties than in ADF. Only two entries had significantly lower CP values than the entry with the highest CP concentration. CP values were not correlated with yields.

Forage quality of small seeded legumes was similar to that observed in large seeded legumes. Average ADF and CP concentrations for small seeded legumes at the first harvest were 35.8 percent and 16.6 percent, respectively (Table 5). MTBM-5 black medic had the highest forage quality, but was the lowest yielding entry in the trial. The two highest yielding varieties in the trial, Paraggio barrel medic and Sava snail medic, had ADF values of 37.6 and 33.0 percent, respectively, and CP concentrations of 16.7 and 15.4 percent, respectively. Regrowth was taken at a much earlier stage of development and forage quality values reflect differences in maturity of the two harvests. Average CP concentration of the four small seeded legumes with regrowth was 25.1 percent and ADF values averaged 23.8 percent. This would clearly provide a high quality feed for grazing following an initial hay cutting.

CONCLUSIONS

Several large and small seeded legumes offer a productive alternative to Austrian winter peas in oat hay mixtures. Small seeded forage legumes have lower seed costs. The disadvantage of higher yielding field pea lines would be higher seed costs. Further evaluation of leading lines in mixtures with oat hay is needed.

Table 1. 1992 Large seeded annual legume trial. Forage yield of large seeded annual legumes grown in 1992 at Klamath Falls and Powell Butte, OR.

	Yield			
	Klamath Falls	Powell Butte		
Entry	Total	Harvest one	Harvest two	Total
	---------- lb DM/A ----------			
Maple pea	6600	4040	0	4040
Sirius field pea	5560	4050	0	4050
Austrian winter pea	5080	3240	0	3240
Trapper pea	4800	3930	0	3930
Chickling vetch	4580	2620	650	3270
Ackerperle faba bean	4460	3210	0	3210
Tingata tangier flatpea	4380	2650	0	2650
Miranda yellow field pea	4020	4080	0	4080
Hertz freya faba bean	4020	5220	0	5220
Hairy vetch	3860	1880	2690	4570
UI 114 pinto bean	3720	1730	0	1730
Timeless aladin faba bean	3660	4000	0	4000
Sacramento lt. red kidney bean	3380	1440	0	1440
Dianna faba bean	3210	3620	0	3620
Cahaba white vetch	3020	2100	1470	3570
Green mung bean	2970	1080	0	1080
Mississippi cream cowpea	2690	1120	0	1120
Victor cowpea	2440	1430	0	1430
Mississippi pinkeye cowpea	1930	1160	0	1160
Mean	3910	2610	250	2860
CV(%)	23	14	27	
LSD(.05)	1300	500	744	

Table 2. 1992 Small seeded annual legume trial. Forage yield of small seeded annual legumes grown in 1992 at Powell Butte, OR.

Entry	Yield		
	Harvest 1	Harvest 2	Total
	---------- lb DM/A ----------		
Selection 1 berseem clover	2600	3840	6440
Multicut berseem clover	2440	3760	6200
Maral shaftal clover	2440	3410	5850
Bigbee berseem clover	2090	3300	5390
Paraggio barrel medic	3080	2130	5210
Santiago polymorpha medic	2820	1900	4720
Ascot barrel medic	2720	1910	4630
Moapa alfalfa	1830	2250	4080
Jemalong barrel medic	2050	1970	4020
Nitro alfalfa	1730	1930	3660
Sava snail medic	3280	330	3610
Borung barrel medic	2550	1030	3580
Mt. Barker subterranean clover	1300	2230	3530
Timeless T-2000 green lentil	2850	660	3510
Indianhead lentil	2650	700	3350
Youchi arrowleaf clover	1050	1870	2920
Parabinga barrel medic	2300	550	2850
George black medic	1490	870	2360
MTB MB black medic	1320	820	2140
Check (weeds, no legumes)	1270	320	1590
Mean	2190	1790	3980
CV (%)	24	3	
LSD(.05)	734	593	

Table 3. 1993 Large seeded annual legume trial. Forage yield of large seeded legumes grown in 1993 at Klamath Falls and Powell Butte, OR, and forage crude protein (CP) and acid detergent fiber (ADF) at the Klamath Falls site.

Entry	Powell Butte yield	Klamath Falls Yield	ADF	CP
	------- lb DM/A	--------	--------- %	---------
Magnus pea	5880	9010	36.4	16.8
Miranda yellow field pea	4410	7530	36.0	15.7
Trapper pea	3140	7260	35.5	14.3
Procon field pea	3620	6900	37.9	15.5
Latah pea	6410	6510	35.4	17.4
Maple pea	5930	6390	36.9	16.5
Tinga tangier flatpea	4640	6040	31.3	15.2
WWII pea	4830	6030	31.6	16.8
Chickling vetch	5720	5980	36.1	15.8
Austrian winter pea	5300	5350	33.5	16.4
Kabuli chickpea	4130	4790	32.4	14.5
Desi chickpea	2430	4410	34.9	16.8
Mean	4710	6350	34.8	16.0
CV(%)	14	12	7	9
LSD(.05)	974	2149	3.7	1.9

Table 4. 1993 Small seeded annual legume trial. Forage yield of small seeded annual legumes grown in 1993 at Klamath Falls and Powell Butte, OR.

	Yield			
	Klamath Falls			Powell Butte
Entry	**Harvest 1**	**Harvest 2**	**Total**	**Total**
	---- lb DM/A ----			
Paraggio barrel medic	8400	0	8400	2630
Sava snail medic	7730	0	7730	1620
Ascot barrel medic	6290	0	6290	900
George black medic	5300	10	5310	1370
Indianhead lentil	5020	0	5020	3290
Selection 1 berseem clover	5000	620	5620	1620
Multicut berseem clover	4590	1520	6110	1500
Nitro alfalfa	4510	1980	6490	790
Hairy vetch	4400	70	4470	3010
MTBM-5 black medic	3730	10	3740	1190
Mean	5490	420	5910	1790
CV(%)	9	92	12	330
LSD(.05)	1400	270	1410	859

Table 5. Forage Quality of Small seeded annual legumes. Crude protein (CP) and acid detergent fiber (ADF) of small seeded annual legumes grown in 1993 at Klamath Falls, OR.

	Harvest 1		Harvest 2	
Entry	**ADF**	**CP**	**ADF**	**CP**
	----------------------	%	----------------------	
Paraggio barrel medic	37.6	16.7	------	------
Sava snail medic	33.0	15.4	------	------
Ascot barrel medic	36.3	16.7	21.8	26.1
George black medic	36.4	17.4	26.1	26.0
Indianhead lentil	34.8	15.1	24.6	22.9
Selection 1 berseem clover	36.0	16.7	------	------
Multicut berseem clover	36.5	15.5	------	------
Nitro alfalfa	34.6	16.0	------	------
Hairy vetch	40.5	14.4	------	------
MTBM-5 black medic	31.8	22.1	22.5	25.2
Mean	35.8	16.6	23.8	25.1
CV(%)	7	7	8	4
LSD(.05)	3.5	1.7	3.1	1.7

Alfalfa Date of Planting and Phenological Development

Steve Orloff[1], Randy Dovel[2], and James Rainey[3]

INTRODUCTION

Planting date can have a profound influence on the potential profitability of an alfalfa field. It can affect stand density, seedling development, weed pressure, and eventually, yields. When to plant is a decision that growers must make every time a new field is going to be established. Currently, insufficient information is available for the Intermountain alfalfa production region to adequately advise growers on this critical issue.

Greenhouse studies, conducted at U.C. Davis by Teuber, determined effects of photoperiod and temperature on alfalfa seedling development. Results provided the basis for a model to predict optimum alfalfa planting date using seasonal photoperiod and average soil temperature curves. Research conducted in Yolo and Fresno Counties in California supported the predictions of optimum planting date by this method. This research demonstrated a 1 ton/A per year yield reduction from planting one month late, and this effect continued beyond the first year. The model predicts that the optimum time to plant in the Klamath Basin is from mid-June to the beginning of August. Experience at the U.C. Intermountain Research and Extension Center (IREC) suggests this planting period may be optimum.

Common grower practice is to plant from as early as March to early June, or to plant in August. Hence, growers are currently planting at all possible planting dates during the growing season except those predicted to be the optimum planting dates using this model. Field validation in the Klamath Basin is needed to determine if the model fits the unique environment of this area. Knowing the optimum planting date can improve yields, reduce or possibly negate the need for herbicides, and possibly prolong stand life.

Phenology is the study of the development of an organism as influenced by genotype and the total environment. Since alfalfa forage quality is affected greatly by age or development stage, a 10-stage classification system has been developed to assess alfalfa stage of development. 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

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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 joint project was initiated at both KES and IREC to evaluate the appropriateness of both date of planting and phenological models in the Klamath Basin. Procedures and results reported below are from KES only.

PROCEDURES

Alfalfa was planted at 3-week intervals throughout the summer of 1992 on April 1, April 22, May 14, June 3, June 24, July 15, August 5, and August 26. Three alfalfa cultivars were planted; Vernal, Centurian, and WL 320; with fall dormancy ratings of 2, 3, and 4, respectively. The experimental design was a split-plot, with planting dates as the main plots and cultivars as sub plots, resulting in a total of 24 treatments. Treatments were replicated four times. The plots were seeded using an "experimental scale" grain drill. Plot size was 1.5 X 6 meters. The crop was irrigated by solid set sprinklers.

In 1993, the first cutting was harvested when alfalfa plants for a given planting date were at the 10 percent bloom stage or when they had sufficient crown bud elongation (elongation averages 2 cm). Subsequent cuttings were made when the alfalfa was in the bud stage. Stand density was determined at the first trifoliate leaf stage, after the first alfalfa harvest, and at the end of each production season. Destructive plant sampling was done outside of the harvest area to determine the effect of planting date on crown development. Phenological stage was determined at approximately biweekly intervals in the year following establishment until first harvest. This was done to document planting date effects on phenological development the following year. Forage quality samples were analyzed for crude protein (CP), acid detergent fiber (ADF), and neutral detergent fiber (NDF) using standard laboratory procedures.

RESULTS

Date of planting significantly affected forage yield in the establishment year (Figure 1). There was no difference in yield due to delaying planting from April 24 to May 13; however, delaying planting after May 13 resulted in severe yield reductions. No harvestable hay was produced on plots seeded on July 15 or later. From an economic point of view, either early spring planting or late summer planting seems to be more advantageous. Early spring planting maximizes yield in the planting year, while late summer planting would allow for a short-season grain or hay crop to be grown prior to planting. A mid-summer planting would greatly reduce alfalfa production in the establishment year and preclude planting a short-season crop prior to seeding the alfalfa. There was no difference in forage yield between the three varieties in the establishment year.

It was hypothesized that date of planting the previous year would affect yield in the first cutting the year after planting. First cutting yields of the varieties Centurian and WL 320 were significantly lower in the August 31 planting date than the previous planting dates (Figure 2). First cutting yields of Vernal declined below earlier planted yields in both the August 6 and 31 planting dates. When averaged across all planting dates, yields of the three varieties were not significantly different.

Sampling date had a greater affect on forage quality than either planting date or variety. Average CP concentration declined from 24.0 percent on May 27 to 18.5 percent on June 21 (Figure 3). Average ADF and NDF values increased from 25.7 and 33.3 percent on May 27 to 33.1 and 42.1 percent on June 21, respectively. When averaged over all three sample dates, ADF and NDF values of the last two planting dates were significantly lower than earlier planting dates (Figure 4). Planting date did not have a statistically significant effect on forage CP concentration.

Trends in forage quality parameters were correlated to phenological stage as measured by MSC. Both ADF and NDF increased as MSC increased, and CP decreased with advancing phenological stage (Figure 5). Although correlations were significant, only about 60 percent of the variability in forage quality was accounted for by phenological stage. That is too poor a correlation to depend on for precise forage quality prediction, but could be a useful tool in determining cutting schedules. Further study is needed to determine the usefulness of this management tool in the Klamath Basin.

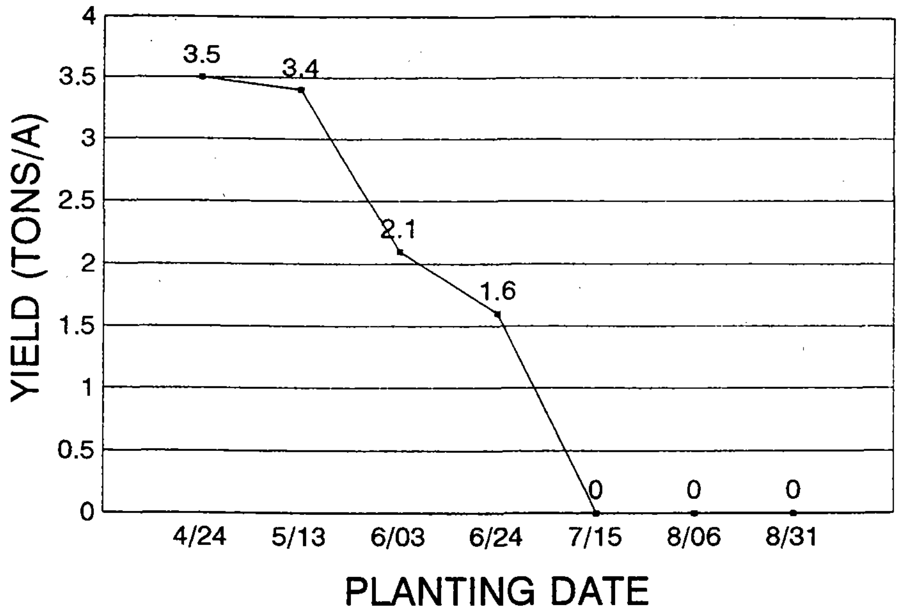

Figure 1. Alfalfa Yield in 1992. Total alfalfa yield (tons dry matter/A) in the establishment year of alfalfa planted at three-week intervals throughout the summer of 1992. Data points represent the average of three varieties. Plots were planted at the Klamath Experiment Station, OR.

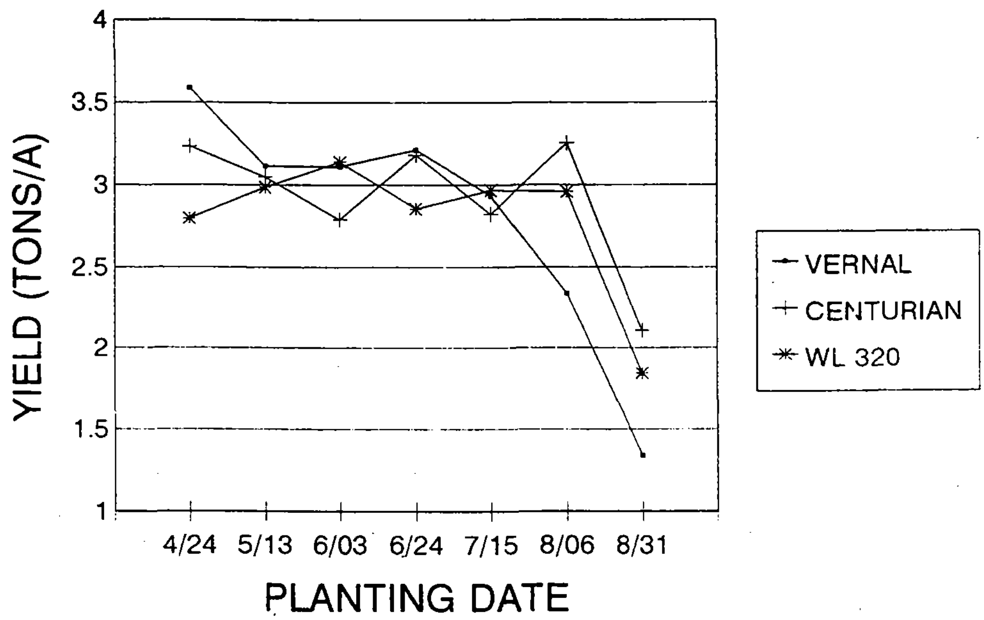

Figure 2. First Cutting Yield in 1993. First cutting yield (tons dry matter/A) in 1993 of three alfalfa varieties planted at three-week intervals throughout the summer of 1992. Plots were planted at the Klamath Experiment Station, OR.

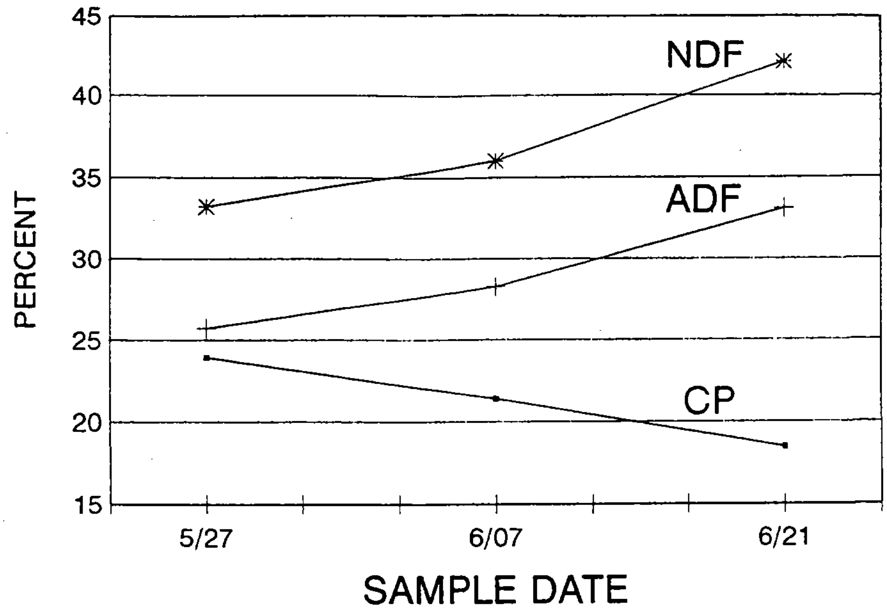

Figure 3. Sample Date Effect on Forage Quality. The effect of sample date on three measures of forage quality, crude protein (CP), acid detergent fiber (ADF), and neutral detergent fiber (NDF) of 1993 first cutting alfalfa. Samples were collected on May 27, June 7, and June 21 prior to first cutting. Data points represent the average of seven planting dates. Plots were established at three-week intervals throughout the summer of 1992 at the Klamath Experiment Station, OR.

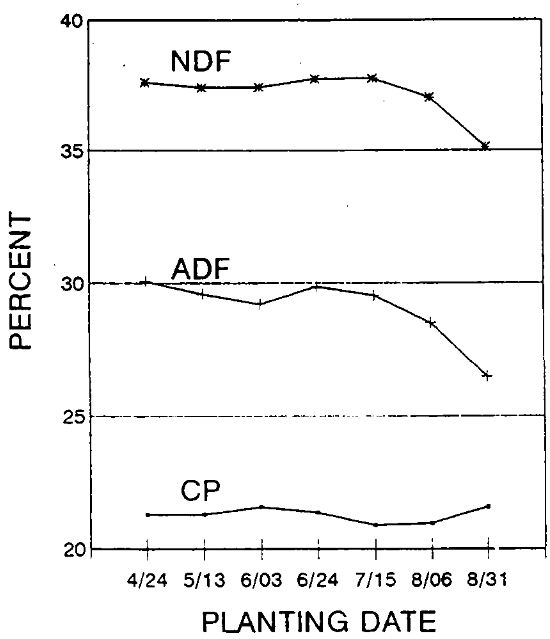

Figure 4. Planting Date Effect on Forage Quality. The effect of date of planting the previous year on three measures of forage quality, crude protein (CP), acid detergent fiber (ADF), and neutral detergent fiber (NDF) on 1993 first cutting alfalfa. Data points represent an average of three sampling dates. Plots were established at three-week intervals throughout the summer of 1992 at the Klamath Experiment Station, OR.

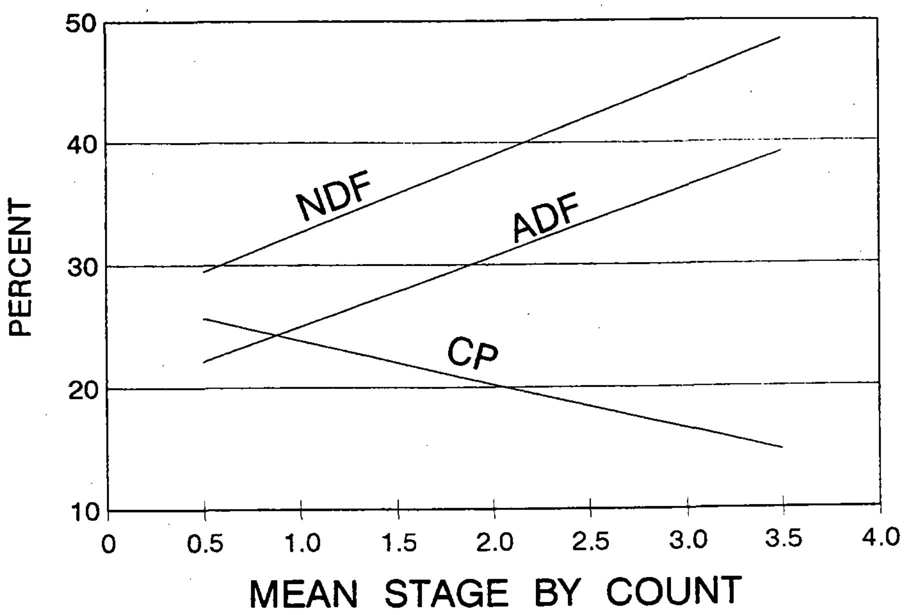

Figure 5. Correlation of Phenological Stage and Forage Quality. Correlation of three measures of forage quality, crude protein (CP), acid detergent fiber (ADF), and neutral detergent fiber (NDF) to phenological stage as determined by mean stage by count (MSCNT). Regression equations and correlation coefficients of forage quality parameters with MSC:

%CP	= 27.537 - MSC * 3.6529	R^2 = 62.3%
%ADF	= 19.344 + MSC * 5.657	R^2 = 68.6%
%NDF	= 26.284 + MSC * 6.329	R^2 = 68.4%