Special Report 949
June 1995

Crop Research in the Klamath Basin, 1994 Annual Report

in cooperation with Klamath County

Agricultural Experiment Station
Oregon State University

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Note From The Superintendent

The Klamath Experiment Station (KES) serves an agricultural industry in Klamath County that generated an estimated farm gate sales of $130 million from 1994 production. Contiguous areas in Northern Modoc and Siskiyou Counties in California produced similar farm revenues. Agriculture and related agri-business is estimated to account for nearly 40 percent of the economic activity in Klamath County. Livestock sales account for about 55 percent of sales in the region. Crop sales are largely derived from potato, forage, cereal, and sugarbeet crops. KES research efforts are concentrated in each of the crop commodities, and contribute indirectly to the livestock industry through efforts in forage production. Much of the research conducted at KES also has application for other areas of the Pacific Northwest, particularly the interior regions east of the Cascade Mountains.

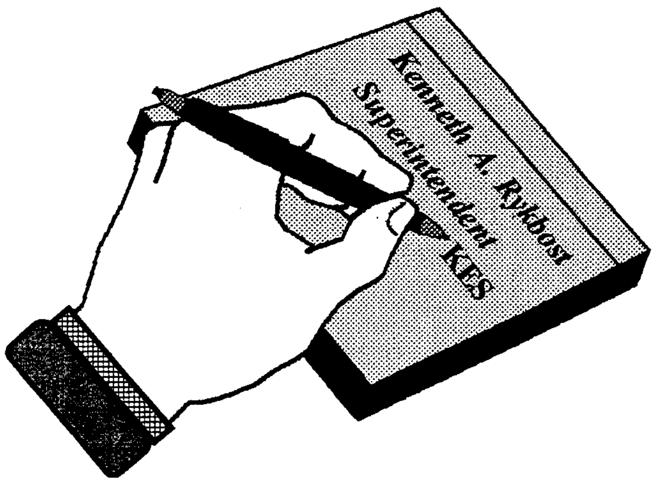
This, the eighth in a current series of annual reports, summarizes research activities at KES in 1994. KES staff wish to recognize the contributions of cooperators; including faculty and staff at Oregon State University (OSU), other branch stations, and other institutions within the region. Their participation broadens the scope of research projects. Financial support from industry is increasingly vital to the ability of the KES to continue research efforts in view of declining resources from federal, state, and county governments. Recognition of these contributions is made in the authorship and acknowledgments of individual reports.

The KES staff experienced one major change in 1994. Our office coordinator, Ms. Betty Bragg, retired in September after 20 years of service at KES. I wish to express my appreciation for her long and dedicated service, and wish her the best in her retirement. Mrs. Gail Quick joined our staff in July, as our new office coordinator. I welcome her very capable contributions to our programs.

Financial support of the KES from the Klamath County Board of Commissioners and the Klamath County Budget Committee is gratefully recognized. Klamath County owns the land and buildings at KES, and provides most of the support for two full-time staff positions. This support is extremely important as the fiscal resources of state agencies is compressed by effects of legislation and other demands on dwindling resources.

I also wish to acknowledge the contributions of the KES Advisory Board in providing guidance for research direction and facility maintenance, and general support of KES programs in the community. Their broad knowledge of the many policy issues affecting the local and regional agricultural industry: water allocations; endangered species; pesticide and safety regulations; and grazing on public lands, to mention a few, helps to keep KES staff current on important issues affecting our industry.

Finally, I wish to express my personal appreciation to the KES staff for their many contributions to the KES facilities and programs. Their dedication, ingenuity, and productivity have enabled the KES to maintain or increase programs during a period of declining financial support at the state and county level. In 1994, they were able to offset the loss of one full-time staff position through innovations in equipment and procedures.



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Weather and Crop Summary, 1994

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

After a one-year reprieve from an extended period of below normal precipitation in 1993, the region experienced one of the driest years on record in 1994. Total snowfall at Klamath Falls in the 1993-1994 winter was about 17 inches compared to a long-term average of 45 inches. The water-year precipitation from October 1, 1993 to September 30, 1994 was less than 60 percent of normal. Water storage was severely depleted to meet needs for irrigation, downstream flows, and wildlife refuges. Klamath Lake was drawn down to the lowest level recorded in the history of the Klamath Project. Fortunately, record snowfall in November, 1994 and above normal rainfall in January and early February, 1995 have restored water supplies to the extent that Klamath Lake levels surpassed the long-term average by mid-February. However prospects for normal deliveries of irrigation water in the Klamath Project remain uncertain for 1995. Increased demands on project water, to meet needs of endangered sucker fish in the Upper Klamath Basin, and salmon species in the Lower Klamath Basin, threaten to reduce deliveries for 1995 irrigation.

The 1994 season also experienced much warmer conditions than 1993, when frosts were recorded at Klamath Falls in each month. Warm spring conditions allowed early planting of crops. The frost-free period at Klamath Falls extended from June 15 to September 12. Average air temperatures from April 1 through late October were approximately 4 °F higher than in 1993. The growing season was generally very favorable for crop production where irrigation was adequate.

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 with the exception that minimum air temperatures are usually 2 to 4 °F lower at KES, due to the proximity of large buildings at the Kingsley Field station. Monthly air and soil temperatures and precipitation are summarized for 1994 and the 10-year period for 1984 to 1993 in Table 1. Weather records are summarized on a weekly basis for the period from April 1 through October 27 in Tables 2 and 3. This 30-week period represents the majority of the local field activity season from early field

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

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 1994 data. The 1994 data are compared with 15-year means for the period from 1979 through 1993. This period includes several of the warmest years since official records began at Klamath Falls in 1949. It also includes several drought years.

Air and soil temperatures in 1994 were quite consistent with means for the previous 10 years (Table 1). Precipitation was less than 10-year means in all months except May and November. Total precipitation was only 66 percent of the average for the previous 10 years. A more detailed analysis of the growing season shows periods of high temperatures in July and September, and very little precipitation from early June through October. Nearly 2.0 inches of rain in May salvaged an otherwise very serious drought situation. Klamath Project irrigation was terminated on September 12, a month earlier than normal. Irrigation of fields after harvest of early crops, a normal practice for field preparation, was not allowed.

Effects of weather conditions on crops were varied. Excellent forage production on irrigated pastures and hay fields was offset by early removal of livestock from range lands due to stock water limitations. Alfalfa yields and quality were good. Cereal yields and grain quality suffered due to high temperatures in July. Cereal harvest was completed nearly a month earlier than in 1993. Low prices combined with lower yields resulted in the lowest returns for cereal crops in recent years.

Potato crops achieved high yields and good quality. Early planting and a major shift to the earlier maturing Russet Norkotah variety resulted in most of the acreage reaching maturity before irrigation was terminated. Yields and size were reduced in a small percentage of Russet Burbank crops that were planted late. Disease problems in isolated fields may have been the result of high temperatures experienced at harvest. Economic returns from potatoes are generally low due to surplus supplies. While prices may increase in late spring, most of the 1994 crop will be sold for returns below production costs.

Sugarbeets benefitted from early planting and favorable weather throughout the growing season. Average yields were about 23 tons/acre, with several fields achieving over 30 tons/acre. The average sugar content of local crops was 18.7 percent, the highest achieved to date. Gross returns from the 9,700 acre crop exceeded $11 million. Weed control continued to be the primary problem. No other serious disease or pest problems were encountered in 1994. The final shipment of beets out of the area was delayed until late January. Quality remained high in spite of weather extremes during the storage period.

Weather and Crop Summary, 1994

In terms of weather conditions, except as they affected water storage and deliveries for irrigation, 1994 was one of the most favorable years on record for Klamath Basin agriculture. Low commodity prices for livestock, cereals, and potatoes offset yield advantages in some crops. The greatest concern for the local agricultural industry continues to be water for irrigation. Uncertainties are more political than climatological.

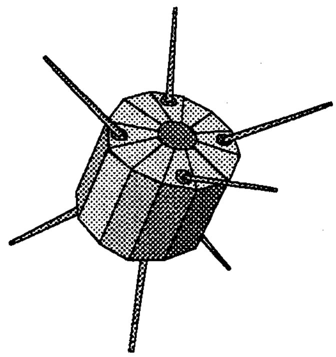

Table 1. Mean monthly maximum, minimum, and mean air and 4-inch soil temperatures, and total monthly precipitation recorded at the Klamath Experiment Station, OR, for 1994 and the 10-year period from 1984 through 1993.

Month	Mean monthly temperature						Total monthly precipitation
	Air			4" Soil			
	Max	Min	Mean	Max	Min	Mean	
	°F						inches
1994							
January	45	23	34	35	35	35	0.39
February	43	20	32	34	34	34	0.68
March	58	24	41	43	40	42	0.23
April	61	29	45	49	45	47	0.54
May	68	39	54	57	53	55	1.87
June	75	40	58	63	58	61	0.55
July	88	50	69	71	66	69	0.02
August	84	42	63	70	65	68	0.00
September	79	41	60	65	60	63	0.44
October	63	27	45	54	50	52	0.18
November	36	18	27	40	38	39	2.04
December	36	17	27	34	34	34	0.78
Mean / Total	61	31	46	51	48	50	7.72
1984 - 1993							
January	38	17	28	32	31	32	1.34
February	44	21	32	34	32	33	1.15
March	51	27	39	40	36	38	1.33
April	60	31	46	49	43	46	0.74
May	66	36	51	56	49	53	1.02
June	75	44	59	64	56	60	0.67
July	82	48	65	70	61	65	0.48
August	83	46	65	70	61	66	0.52
September	76	39	57	62	55	58	0.95
October	66	31	49	53	48	51	0.79
November	48	23	35	42	39	40	1.44
December	38	17	28	34	33	34	1.28
Mean / Total	61	32	46	51	45	48	11.71

Table 2. Weekly maximum, minimum, and mean air temperatures for 1994 and the 15-year period from 1979-1993, and the accumulated departure of 1994 weekly mean from the 15-year average at Klamath Falls, OR.

Weekly period		1994 Weekly average			1979 - 1993 Weekly average		
		Max	Min	Mean	Max	Min	Mean
		°F					
April	1 - 7	57	24	40	55	29	42
	8 - 14	57	25	41	57	30	44
	15 - 21	74	35	55	60	33	47
	22 - 28	55	31	43	59	32	46
	29 -5	63	34	48	63	34	49
May	6 - 12	75	43	59	62	34	48
	13 - 19	62	34	48	66	35	51
	20 - 26	69	41	55	70	40	55
	27 - 2	72	42	57	69	41	54
June	3 - 9	67	36	52	69	42	55
	10 - 16	75	41	58	73	43	58
	17 - 23	78	41	59	76	45	61
	24 - 30	82	44	63	78	47	63
July	1 - 7	79	43	61	78	46	62
	8 -14	90	50	70	81	47	64
	15 - 21	92	56	74	82	49	66
	22 -28	90	51	71	84	50	67
	29 - 4	89	49	69	85	49	67
August	5 - 11	84	42	66	86	50	68
	12 - 18	87	42	65	83	48	66
	19 - 25	82	41	62	81	46	64
	26 - 1	83	41	62	79	43	61
September	2 - 8	81	41	61	80	44	62
	9 - 15	68	37	52	76	40	58
	16 - 22	85	47	66	73	38	55
	23 - 29	86	47	67	73	38	55
	30 - 6	67	31	49	73	36	54
October	7 - 13	67	30	49	68	34	51
	14 - 20	59	27	43	63	30	47
	21 - 27	65	27	46	61	32	47
Mean		75	39	57	72	40	56

Table 3. Weekly minimum air temperatures, frost days, and precipitation for the 1994 growing season and the 15-year period from 1979 to 1993 at Klamath Falls, OR.

Weekly period		Weekly minimum		Frost days/week		Weekly precip.		Accum. precip.	
		1994	15 - year	1994	15 - year	1994	15 - year	1994	15 - year
		°F		%		inches			
April	1 - 7	17	11	86	76	0.16	0.15	0.16	0.15
	8 - 14	20	17	86	64	0.13	0.11	0.29	0.26
	15 - 21	25	17	43	50	0.00	0.23	0.29	0.49
	22 - 28	27	20	71	53	0.22	0.27	0.51	0.76
	29 -5	24	19	43	35	0.37	0.16	0.88	0.92
May	6 - 12	39	23	0	48	0.72	0.15	1.60	1.07
	13 - 19	30	19	57	34	0.54	0.20	2.14	1.27
	20 - 26	30	24	14	17	0.27	0.23	2.41	1.50
	27 - 2	35	27	0	20	0.40	0.33	2.81	1.83
June	3 - 9	27	27	28	8	0.15	0.25	2.96	2.08
	10 - 16	28	27	28	8	0.00	0.11	2.96	2.19
	17 - 23	33	30	0	3	0.00	0.06	2.96	2.25
	24 - 30	35	31	0	0	0.00	0.10	2.96	2.35
July	1 - 7	37	33	0	0	0.00	0.07	2.96	2.42
	8 -14	45	34	0	0	0.00	0.02	2.96	2.44
	15 - 21	50	36	0	0	0.00	0.16	2.96	2.60
	22 -28	43	35	0	0	0.02	0.05	2.98	2.65
	29 - 4	45	36	0	0	0.00	0.07	2.98	2.72
August	5 - 11	35	37	0	0	0.00	0.06	2.98	2.78
	12 - 18	40	37	0	0	0.00	0.11	2.98	2.89
	19 - 25	37	30	0	3	0.00	0.14	2.98	3.03
	26 - 1	36	32	0	1	0.00	0.23	2.98	3.26
September	2 - 8	36	31	0	3	0.01	0.08	2.99	3.34
	9 - 15	30	24	43	11	0.30	0.09	3.29	3.43
	16 - 22	40	26	0	13	0.00	0.40	3.29	3.83
	23 - 29	38	24	0	22	0.13	0.16	3.42	3.99
	30 - 6	24	20	43	21	0.00	0.07	3.42	4.06
October	7 - 13	22	18	71	36	0.00	0.18	3.42	4.24
	14 - 20	21	18	86	66	0.07	0.08	3.49	4.32
	21 - 27	20	20	71	58	0.00	0.36	3.49	4.68

Sugarbeet Variety Evaluations in the Klamath Basin

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

Introduction

The California Beet Growers Association (CBGA) Seed Committee determines suitability of cultivars for commercial production in each district served by the Association. Decisions are based on variety performance in official trials, the severity of various diseases in a district, and varietal response to major diseases. In 1994, official coded variety trials were conducted at the Klamath Experiment Station (KES) in Klamath Falls, OR and at the U. C. Intermountain Research and Extension Center (IREC) in Tulelake, CA. Six sugarbeet seed companies submitted 44 entries for evaluation.

Procedures KES

The trial site was a Poe sandy loam soil that was cropped with various grass forage species and varieties from 1989 to 1993. The field was fumigated with Telone II, shanked in at 17 gallons per acre (gpa) on November 10, 1993. Spring tillage included discing and packing on April 14. Soil analyses indicated medium phosphorus and potassium levels, 2.5 percent soil organic matter content, residual nitrate-nitrogen at 10 lb N/acre, and a pH of 6.5 in the surface foot of soil at the trial site. Fertilizer was broadcast at 50 lb/acre each of N, P_2O_5, and K_2O before discing. The seedbed was firmly packed with a Brillion roller after beds were formed with tool-bar mounted sweeps.

Forty-four varieties were planted in a randomized complete block design with four replications on April 18. Seed was planted at a depth of 0.5 inches at 6 to 8 seeds/foot with a hand operated Planet-Junior type planter in 22-inch rows. Individual plots were two rows wide and 17 feet long. Two border rows were planted on both sides of the experiment and 5-foot borders

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

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

were used on end plots. Stands were hand-thinned to approximately 8-inch plant spacing on June 1.

Flea beetle infestations were controlled with carbaryl applied at 1.0 lb active ingredient (ai)/acre on May 9 and May 23. Weed control was achieved with Betamix applied at 0.25 lb ai/acre on May 11 and 0.33 lb ai/ acre on May 27, followed by hand weeding as necessary to control escapes, primarily redstem filaree, quackgrass, and hairy nightshade. Supplemental nitrogen was applied at 50 lb N/acre as Soln. 32 and incorporated with irrigation on June 24. Irrigation was applied with solid-set sprinklers on a 48- x 40-foot spacing. Total irrigation water plus rainfall for the season was approximately 26 inches.

Beet tops were removed with a flail chopper immediately prior to harvest. Beets were hand harvested on October 18. All beets from both rows of each plot were weighed and counted. Approximately 20 lb of beets from one row were analyzed for percent sucrose and purity by Spreckels Sugar Company. Gross crop value was calculated for each plot based on beet yield and price/ton for beets at the observed sugar content, as determined by terms of the Holly Sugar Corporation contract. The price/ton is described by the equation: Price/ton = -15.4 + (3.418 x % sugar) for a selling price of $23.00/cwt. Yield, sugar content, total sugar production, and gross crop value were analyzed statistically using MSU Stat software.

IREC

The trial was established on Tulebasin fine silty loam soil with approximately 12 percent organic matter content. The soil is highly fertile and near neutral in reaction. The previous crop was spring barley. Field preparation consisted of primary tillage with a roto-harrow. Fertilization included a broadcast application of 100 lb N/acre and a sidedress application of 60 lb/ acre each of N, P_2O_5, and K_2O. Beets were seeded into raised 24-inch wide beds using a research-adapted, small-plot, three-row cone planter on April 15. Seeding rates were adjusted for seed size to achieve a uniform seed spacing of 2.5 inches for all varieties. Planting depth was approximately 0.25 inches. Individual plots were three rows wide, 50 feet long, and arranged in a randomized complete block design with four replications.

Postemergence applications of Betamix herbicide were made at 26 oz/acre rates on May 10, May 26, and June 3. Poast herbicide was applied at 8 oz/acre to control wild oats on May 24. Insect control was achieved with applications of 1.0 lb ai/acre of carbaryl on May 13 and May 21. Powdery mildew infections were controlled with applications of elemental sulfur at 10 lbs/acre on July 30 and September 22. Stands were hand-thinned to final plant spacings of approximately 7 inches on June 8. The trial area was irrigated with solid-set sprinklers. Total irrigation plus rainfall was approximately 26 inches.

Beets were harvested with a modified one-row harvester on October 19. All beets from 46 feet of the center plot row were weighed and counted. Samples of 20 lb/plot were analyzed for sucrose content and purity by Spreckels Sugar Company. Total yields at both sites were adjusted for tare losses determined in laboratory analyses. Recoverable sugar was calculated from laboratory determinations of purity applied to total sugar production calculated from beet yields and sugar content.

Results And Discussion

Crops established rapidly under relatively favorable spring conditions at both sites. With the exception of a few entries, emergence occurred uniformly approximately 8 days after planting. Postemergence frosts were recorded at KES on two dates in April, six dates in May, and three dates in June. Minimum air temperatures of 24 and 26 °F on May 1 and May 2, respectively, did not affect the seedlings. Flea beetle damage at both KES and IREC was minor. Beets at IREC were mildly influenced by powdery mildew. Mild mildew symptoms were observed at KES; however, control measures were not needed or applied. Plant populations after thinning were quite uniform at approximately 27,000 plants/acre at both sites (Table 1).

Beet yields, percent sugar, recoverable sugar, gross crop value, and plant population are presented for both 1994 trials in Table 1. Average yields were similar and high at both locations. Yield differences between varieties were statistically significant at both locations and combined over locations. A significant location by variety interaction was found as in previous years, indicating that soil or microclimate differences between sites affected variety

performance. Sugar content was also high at both locations, comparing favorably to the commercial crop average of 18.7 percent sugar. Sugar content differences between varieties were significant at both locations and combined locations. Location did not affect sugar content.

Recoverable sugar production ranged from 3.9 to 6.8 and 4.5 to 6.0 tons/acre at KES and IREC, respectively. Average sugar production was significantly lower at IREC. Statistical significance was observed between varieties at both locations. The location by variety interaction was highly significant. Gross crop value is the best indication of variety performance as this parameter considers the premium for high sugar content. Significant differences between varieties in gross crop value were observed at both locations. HM 2917, ACH 318, and Beta 1996 achieved the highest crop values at KES. HH 88, HM 7022, and H 91264 were highest in crop value at IREC. HM 2917, HH 88, and H 91264 were included in trials for the first time in 1994. ACH 318 and HM 7022 were also evaluated in 1993.

Poor stands accounted for low yields for a few entries at each location. Low emergence in 94HX 07 and 94HX 21 at both locations resulted in serious yield reductions. Several other varieties produced relatively high yields at populations below 25,000 plants/acre.

Many varieties included in the 1994 trials have been evaluated previously. Two-, three-, and four-year summaries across locations are presented (Tables 2-4). Data for standard varieties Monohikari and HH 55 are included for comparison. Effects of location on performance are apparent in each of the multi-year summaries. Monohikari has consistently achieved high sugar yields in KES trials. It has the highest gross crop value in three- and four-year summaries, and is second only to ACH 318 for comparisons over 1993 and 1994. It was third lowest in crop value over four years at IREC. HH 50 produced the highest crop value over four years at IREC, but was fourth from lowest at KES. These location effects justify continuation of trials at both sites. Commercial crops also show similar variety performance variations between organic soils in the southern end of the region and mineral soils north of the California border.

Sugarbeet Variety Evaluations in the Klamath Basin

Since the introduction of sugarbeet crops to the region in 1989, diseases have been of limited importance. However, acceptance of varieties for commercial production is not based entirely on performance in local variety trials. Variety response to curly top virus is determined in screening trials conducted elsewhere. This devastating disease has resulted in serious crop losses in the Susanville area. To prevent similar losses in the Klamath Basin, varieties accepted for local production must also meet minimum standards for resistance to curly top virus. Several of the varieties that have demonstrated high yield potential in these trials have good disease resistance that may become more important in the future.

Table 1. Beet yield, percent sugar, recoverable sugar production, gross crop value, and plant population for 44 sugarbeet varieties at Klamath Falls, OR (KES) and Tulelake, CA (IREC), 1994.

Variety	Beet yield			Sugar content			Recoverable sugar			Gross crop value			Population		
	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean
	tons/A			%			lb/A			$/A			1000 plants/A		
ACH191	33.6	33.5	33.5	19.1	18.3	18.7	12030	11310	11670	1680	1580	1630	27.8	28.0	27.9
ACH199	33.3	32.6	32.9	18.5	17.9	18.2	11510	10600	11050	1590	1490	1540	28.7	29.1	28.9
ACH203	36.3	32.7	34.5	18.0	18.2	18.1	12030	10770	11400	1670	1530	1600	29.9	32.2	31.1
ACH209	32.6	30.6	31.6	18.5	18.0	18.2	11360	10300	10830	1550	1420	1490	29.8	31.8	30.8
ACH211	34.0	29.7	31.8	18.7	18.3	18.5	11840	9900	10870	1640	1400	1520	27.7	29.6	28.6
ACH304	34.2	30.2	32.2	19.0	18.4	18.7	12200	10280	11240	1690	1430	1560	27.5	24.9	26.2
ACH316	31.4	30.4	30.9	18.5	18.5	18.5	10830	10370	10600	1500	1450	1480	27.5	27.6	27.6
ACH318	39.9	34.4	37.1	17.9	17.9	17.9	13080	11360	12220	1820	1580	1700	28.9	27.9	28.4
Beta1996	35.5	32.4	34.0	19.4	18.6	19.0	12930	11150	12040	1800	1560	1680	28.7	29.4	29.1
Beta8422	36.5	31.4	33.9	18.4	18.0	18.2	12590	10380	11490	1730	1450	1590	29.4	28.9	29.2
Beta8450	33.8	34.3	34.0	17.9	17.4	17.7	11020	10710	10870	1530	1510	1520	26.6	28.6	27.6
KW6000	37.7	32.9	35.3	18.0	18.0	18.0	12570	10510	11540	1730	1520	1630	28.0	25.6	26.8
9G6915	30.8	29.1	29.9	18.6	18.1	18.4	10640	9630	10130	1480	1350	1420	22.6	21.5	22.0
9BG6276	36.0	32.4	34.2	18.6	18.4	18.5	12400	10900	11650	1730	1540	1630	28.5	25.6	27.1
1BG6164	30.5	33.5	32.0	18.2	18.5	18.3	10300	11440	10870	1420	1600	1510	22.9	23.0	23.0
2BG6303	30.5	31.5	31.0	18.7	18.3	18.5	10660	10690	10680	1470	1490	1480	20.8	28.4	24.6
HM2917	39.7	35.3	37.5	18.1	17.9	18.0	13580	11720	12650	1850	1610	1730	28.5	29.9	29.2
HM5892	37.0	31.1	34.1	18.4	18.0	18.2	12710	10340	11520	1760	1430	1600	29.4	30.5	30.0
HM5893	35.9	32.4	34.1	18.5	18.0	18.2	12500	10810	11660	1720	1490	1600	27.7	29.8	28.7
HM7006	35.2	33.1	34.1	18.4	18.0	18.2	12230	10960	11590	1670	1520	1600	28.9	25.9	27.4
HM7022	35.1	33.6	34.3	18.4	18.8	18.6	12040	11800	11920	1660	1640	1650	28.4	30.5	29.4
HMWS-26	33.1	34.3	33.7	18.6	18.3	18.4	11610	11610	11610	1590	1620	1600	26.8	31.1	28.9
HMWS-62	35.5	34.1	34.8	18.2	17.6	17.9	12100	11070	11590	1640	1520	1580	28.7	31.2	29.9
HMWS-91	38.5	33.6	36.0	18.0	18.2	18.1	12900	11340	12120	1770	1580	1670	21.1	28.4	24.7

Table 1. (continued) Beet yield, percent sugar, recoverable sugar production, gross crop value, and plant population for 44 sugarbeet varieties at Klamath Falls, OR (KES) and Tulelake, CA (IREC), 1994.

	Beet yield			Sugar content			Recoverable sugar			Gross crop value			Population		
Variety	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean
	tons/A			%			lb/A			$/A			1000 plants/A		
HH-50	36.6	34.7	35.6	18.2	18.1	18.2	12410	11600	12010	1710	1610	1660	30.1	29.3	29.7
HH-55	37.3	32.2	34.7	17.9	17.5	17.7	12490	10450	11470	1700	1430	1570	29.8	28.8	29.3
HH-86	32.6	30.2	31.4	19.0	18.3	18.6	11570	10110	10840	1620	1420	1520	28.0	27.5	27.8
HH-88	33.3	34.3	33.8	18.6	18.8	18.7	11570	11950	11760	1610	1670	1640	24.2	27.4	25.8
HH-95	32.2	32.1	32.1	18.1	17.6	17.9	11030	10480	10760	1500	1440	1470	20.5	30.7	25.6
93HX29	35.0	34.4	34.7	17.6	17.8	17.7	11520	11340	11430	1570	1570	1570	27.0	33.8	30.4
94HX07	28.7	30.5	29.6	18.1	17.4	17.8	9670	9840	9760	1330	1350	1340	16.6	17.0	16.8
94HX21	22.0	26.9	24.5	18.9	18.0	18.5	7800	8970	8380	1090	1240	1160	15.9	20.0	18.0
Chinook	38.3	33.4	35.8	18.2	17.7	17.9	13110	10780	11950	1780	1510	1650	28.9	26.4	27.6
Monohikari	36.0	32.5	34.3	18.7	18.2	18.5	12650	11070	11860	1740	1520	1630	29.1	29.2	29.1
Ranger	35.5	33.9	34.7	17.8	17.8	17.8	11830	11120	11470	1610	1540	1580	29.8	30.6	30.2
SX-1	37.0	28.7	32.8	18.7	17.8	18.2	12990	9520	11250	1790	1300	1550	29.8	25.9	27.8
SS-502	34.2	32.0	33.1	17.5	17.6	17.5	11080	10280	10680	1510	1430	1470	28.4	29.7	29.0
H90446	34.0	33.4	33.7	17.9	17.8	17.9	11290	10870	11080	1550	1520	1540	28.7	30.2	29.4
H90451	35.4	31.7	33.5	18.6	18.1	18.3	12120	10500	11310	1690	1470	1580	27.1	24.7	25.9
H91264	33.7	35.8	34.8	17.8	17.8	17.8	11190	11620	11400	1540	1630	1580	29.2	29.2	29.2
H92366	33.9	31.8	32.9	17.7	17.7	17.7	11140	10380	10760	1530	1430	1480	27.7	27.9	27.8
H92394	36.0	31.5	33.8	17.8	17.1	17.4	11920	9760	10840	1630	1350	1490	30.1	28.4	29.3
H92488	38.2	33.9	36.1	18.0	17.4	17.7	12680	10890	11790	1760	1500	1630	29.1	31.7	30.4
H92510	34.5	32.5	33.5	18.5	18.0	18.2	11860	10760	11310	1650	1490	1570	27.4	26.8	27.1
Mean	34.6	32.4	33.5	18.3	18.0	18.2	11810	10730	11270	1630	1490	1560	27.1	28.0	27.6
CV (%)	9	8	9	3	2	3	9	9	9	9	9	9	9	13	11
LSD (0.05)	4.3	3.7	2.8	0.7	0.6	0.5	1460	1330	980	200	180	140	3.6	5.1	3.1

Table 2. Two-year summary of performance of 10 sugarbeet varieties in Klamath Falls, OR (KES) and Tulelake, CA (IREC) trials, 1993 - 1994.

Variety	Beet yield KES	Beet yield IREC	Beet yield Mean	Sugar content KES	Sugar content IREC	Sugar content Mean	Sugar yield KES	Sugar yield IREC	Sugar yield Mean	Gross crop value KES	Gross crop value IREC	Gross crop value Mean
	tons/A			%			tons/A			$/A		
ACH318	35.0	31.3	33.1	17.4	18.0	17.7	6.09	5.63	5.86	1540	1470	1500
HM7022	31.6	31.2	31.4	17.9	18.6	18.2	5.64	5.81	5.73	1430	1530	1480
Monohikari	31.9	30.5	31.2	18.2	18.0	18.1	5.81	5.49	5.65	1480	1430	1450
HM5893	31.9	29.6	30.7	18.0	18.0	18.0	5.76	5.30	5.52	1460	1380	1420
IBG6164	28.5	30.6	29.6	17.9	18.6	18.2	5.10	5.67	5.38	1290	1500	1390
H92510	29.9	29.4	29.7	18.1	17.9	18.0	5.43	5.26	5.34	1380	1370	1370
Beta8422	30.5	29.0	29.7	17.9	18.0	17.9	5.48	5.21	5.35	1390	1360	1370
Beta8450	30.6	30.9	30.7	17.4	17.7	17.5	5.31	5.46	5.39	1330	1410	1370
ACH209	30.5	28.2	29.3	18.2	17.9	18.0	5.54	5.05	5.30	1400	1320	1360
HH55	31.8	29.8	30.8	17.3	17.1	17.2	5.52	5.10	5.31	1390	1300	1350
Mean	31.2	30.1	30.6	17.8	18.0	17.9	5.57	5.40	5.48	1410	1410	1410

Table 3. Three-year summary of performance of 12 sugarbeet varieties in Klamath Falls, OR (KES) and Tulelake, CA (IREC) trials, 1992 - 1994.

Variety	Beet yield			Sugar content			Sugar yield			Gross crop value		
	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean
	tons/A			%			tons/A			$/A		
Monohikari	32.8	31.7	32.2	18.4	18.4	18.4	6.04	5.82	5.93	1570	1540	1560
HM7006	32.3	32.0	32.2	18.4	18.3	18.3	5.95	5.85	5.90	1540	1540	1540
KW6000	33.1	32.2	32.7	17.9	17.9	17.9	5.93	5.76	5.85	1530	1510	1520
9BG 6276	32.2	30.7	31.5	18.3	18.4	18.3	5.89	5.67	5.78	1530	1500	1520
SX1402	33.1	32.2	32.6	17.7	18.0	17.8	5.88	5.78	5.83	1510	1510	1510
H90451	31.6	31.0	31.3	18.6	18.2	18.4	5.85	5.64	5.75	1520	1490	1500
ACH316	29.4	30.5	30.0	18.4	18.7	18.6	5.43	5.72	5.57	1410	1520	1470
H90446	31.5	31.1	31.3	17.8	18.1	17.9	5.61	5.62	5.61	1440	1480	1460
HH55	33.4	31.1	32.3	17.5	17.4	17.4	5.88	5.43	5.65	1510	1410	1460
HM5892	31.2	30.8	31.0	17.9	17.8	17.9	5.62	5.49	5.56	1450	1430	1440
9G6915	30.0	29.8	29.9	18.2	18.3	18.3	5.46	5.47	5.47	1410	1450	1430
SX1401	30.1	31.4	30.7	17.8	18.0	17.9	5.36	5.65	5.51	1380	1480	1430
Mean	31.7	31.3	31.5	18.1	18.1	18.1	5.75	5.66	5.70	1490	1490	1490

Table 4. Four-year summary of performance of 13 sugarbeet varieties in Klamath Falls, OR (KES) and Tulelake, CA (IREC) trials, 1991 - 1994.

	Beet yield			Sugar content			Sugar yield			Gross crop value		
Variety	**KES**	**IREC**	**Mean**	**KES**	**IREC**	**Mean**	**KES**	**IREC**	**Mean**	**KES**	**IREC**	**Mean**
	—— tons/A ——			—— % ——			—— tons/A ——			—— $/A ——		
Beta1996	29.3	30.6	29.9	18.5	18.2	18.3	5.42	5.57	5.50	1420	1480	1450
ACH203	30.9	32.0	31.4	17.6	17.6	17.6	5.44	5.63	5.54	1420	1470	1440
Monohikari	30.7	30.1	30.4	18.2	17.7	18.0	5.59	5.33	5.46	1460	1400	1430
HH50	29.8	32.6	31.2	17.5	17.7	17.6	5.22	5.77	5.50	1350	1510	1430
WS91	29.9	31.8	30.8	17.9	17.6	17.7	5.35	5.60	5.47	1390	1460	1430
WS62	29.6	32.4	31.0	17.7	17.5	17.6	5.30	5.67	5.48	1360	1490	1430
WS26	28.2	31.5	29.9	18.1	18.0	18.1	5.10	5.85	5.48	1340	1500	1420
HH55	30.6	32.3	31.4	17.0	17.4	17.2	5.20	5.62	5.41	1350	1470	1410
ACH191	29.2	30.8	30.0	18.1	17.5	17.8	5.29	5.39	5.34	1390	1410	1400
ACH304	29.3	30.1	29.7	18.1	17.8	17.9	5.30	5.36	5.33	1390	1410	1400
ACH199	27.8	31.6	29.7	17.9	17.8	17.9	4.98	5.62	5.30	1300	1480	1390
SX-1	30.8	29.5	30.2	17.6	17.4	17.5	5.36	5.13	5.25	1420	1340	1380
SS502	29.1	30.7	29.9	17.3	17.3	17.3	5.03	5.31	5.17	1300	1380	1340
Mean	29.6	31.2	30.4	17.8	17.7	17.7	5.28	5.53	5.40	1380	1450	1410
CV (%)												
Year			5			6			9			10
Location and variety			9			4			9			10
LSD (0.05)												
Year			0.5			0.3			0.15			50
Location			0.5			NS			0.10			30
Variety			1.3			0.4			0.25			70

Sugarbeet Response to Nitrogen Fertilizer Rates

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

Introduction

Fertilizer requirements for optimum sugarbeet production in the Klamath Basin have not been extensively evaluated to date. Studies in Malheur County have shown crop requirements of 7 to 8 lb N/acre per ton of beets on silt loam soils with organic matter contents of approximately 1.5 percent under long growing season conditions. Excessive nitrogen applications have reduced sugar content and economic returns in Malheur County. A preliminary nitrogen response experiment at the Klamath Experiment Station in 1992, showed poor correlation between nitrogen rate, petiole nitrate-nitrogen content, sugar content of crops, and beet yield. Commercial crops in the Klamath Basin are routinely sampled for petiole nitrate-nitrogen content. At this time, calibration data to relate fertilizer nitrogen rate, petiole nitrate-nitrogen content, beet yield, and sugar content on low organic matter soils in this short-season area are lacking. This experiment was conducted to develop more data on crop response to nitrogen fertilizer rates under local conditions.

Procedures

The experimental site was a Poe sandy loam soil. Grass forage species and variety trials occupied the site from 1989 through 1993. Forage crops were desiccated with Round-up herbicide in August, 1993 and disced three times in the fall prior to the application of Telone II, shanked in at 18-inch depth at 17 gpa in early November, 1993. Spring tillage in 1994 included plowing and discing in early April. A broadcast application of 50 lb/acre each of N, P_2O_5 and K_2O was incorporated during bed forming with tool-bar mounted sweeps, followed by packing with a Brillion roller on April 15. The experimental design was a randomized complete block with five replications. Individual plots were six 22-inch rows wide and 35 feet long.

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Seed of the WS 62 variety was planted 0.5 inches deep at 6 seeds/foot with a Planet-Junior type planter on April 15. Cultural practices for weed and insect control and irrigation were as described for the KES variety trial (page 11). Nitrogen fertilizer rates of 50, 100, 150, and 200 lb N/acre were achieved by application of URAN Soln. 32 with a conventional ground sprayer at rates of 0, 50, 100, or 150 lb N/acre to individual plots, immediately followed by incorporation with 0.5 inches of irrigation on June 24.

Composite soil samples were obtained from each replicate on April 13. Analyses of the top foot of soil showed a pH of 6.2, 1.2 percent organic matter, 10 CEC, 2.0 parts per million (ppm) nitrate-N, 20 ppm phosphorus, 159 ppm potassium, 1,510 ppm calcium, 235 ppm magnesium, 67 ppm sodium, 2.8 ppm zinc, 11 ppm manganese, 1.3 ppm copper, 30 ppm iron, 0.8 ppm boron, and 2 ppm sulfur. Nitrate-N contents of the second and third foot of soil were 3.1 and 3.0 ppm, respectively.

Plant stands were hand thinned to an approximate plant spacing of 9 inches on May 31. Petioles were sampled from the center two rows of each plot on July 15, August 16, and September 14. Nitrate-N content was determined for all samples at each sampling date. Complete analyses were obtained from all replicates of the 100 lb N/acre treatment on July 15 samples.

Beet tops were removed with a flail chopper immediately prior to harvest on October 14. All beets from the center two rows of each plot were hand-harvested, counted, and weighed. Samples of approximately 30 lb/plot were analyzed for tare loss and sugar content by Holly Sugar Corporation laboratory personnel.

Results and Discussion

Uniform emergence occurred about 8 days after planting. Early season crop development was excellent. Effects of nitrogen rate on crop foliage were evident by mid-August. Plants in the low nitrogen treatments were lighter in color for the remainder of the season. Top growth was slightly less vigorous in the two lowest nitrogen rate treatments by early September. The last irrigation was applied on September 12. Tops remained vigorous until harvest in the 150 and 200 lb N/acre treatments.

Petiole nitrate-N content was well correlated with nitrogen rate treatments at each sampling date (Table 1). Commercial experience in the Klamath Basin suggests petiole nitrate levels should fall below 1,500 ppm by mid-September to achieve high beet sugar content and high sugar recovery from roots. At 50 lb N/acre, this level was reached by mid-August. The 100 lb N/acre treatment was at the prescribed level by mid-September. Plants in the highest N rate treatment remained well above 1,500 ppm petiole nitrate-N at mid-September. Sugar content was significantly higher at 50 lb N/acre than at 200 lb N/acre (Table 2). The N rate did not significantly affect beet yield, total sugar production, or gross crop value; however, a trend for higher production at the lowest N rate was observed. Residual soil nitrogen at the site was low due to several years of grass production with relatively low nitrogen fertilizer inputs. Crops of alfalfa or potatoes preceding sugarbeets would be expected to leave higher residual nitrogen levels.

Brei-nitrate levels in roots represent impurities that reduce recovery of sugar from the crop. Tests for brei-nitrates showed average levels of 11, 13, 17, and 27 (ppm) for 50, 100, 150, and 200 lb N/acre treatments, respectively. The higher levels at high fertilizer rates indicate that in addition to reduction in sugar content, high nitrogen rates would have resulted in reduced recovery of sugar.

Petiole analysis for crop nutritional status is routinely conducted on all commercial fields in the Klamath Basin. Lacking locally derived sufficiency range data, results are reported based on criteria established in other beet production regions. Although local analyses have not been formally compiled to date, they consistently show serious nutritional deficiencies in several secondary and minor elements. Complete petiole analysis data were obtained from experiments at KES in both 1992 and 1994, and compared with sufficiency range data routinely used for Idaho crops (Table 3). The data suggest serious deficiencies in sulfur, calcium, zinc, and copper. In both years, the crops sampled produced beet yields well above 30 tons/acre and sugar contents above 18 percent. Several commercial fields where minor element deficiencies were suspected (based on these sufficiency range estimates) have been treated with non-replicated fertilizer supplements. Yield responses have not been observed. However, the consistent observations of low nutrient contents suggest the need for experimental evaluation of crop response to several nutrients in the region. This crop performance data indicates that the sufficiency range values in routine use are probably not appropriate for local conditions.

Summary

The excellent growing season conditions experienced in 1994 resulted in the best sugarbeet crops produced to date in the Klamath Basin. Several commercial fields produced 30 tons/acre with very high sugar content. In this study, conducted on a site with low residual soil nitrate-nitrogen, high yield and sugar content was produced with 50 lb/acre of fertilizer nitrogen. Higher nitrogen rates reduced sugar content and increased production costs with no improvement in yield. Low petiole contents of calcium, sulfur, zinc, and copper, based on sufficiency ranges established in other production regions, did not appear to reduce crop performance, but may indicate the need for development of locally derived nutritional guidelines.

Table 1. Effect of nitrogen fertilizer rate on petiole nitrate-N content of WS-62 sugarbeets at three sampling dates at Klamath Falls, OR, 1994.

Nitrogen rate	Petiole nitrate-N content July 15	August 16	September 14
lb N/A		ppm	
50	7740	1510	900
100	11560	4080	1380
150	16280	5370	1880
200	18660	7320	4420
Mean	13560	4570	2150
CV (%)	16	27	46
LSD (0.05)	3010	1730	1350

Table 2. Effect of nitrogen fertilizer rate on beet yield, sugar content, total sugar production, and gross crop value of WS-62 sugarbeets at Klamath Falls, OR, 1994.

Nitrogen rate	Plant population	Beet yield	Sugar content	Total sugar production	Gross crop value
lb N/A	1000 plants/A	tons/A	%	lb/A	$/A
50	27.2	37.2	18.7	13940	1720
100	26.5	36.8	18.6	13700	1690
150	27.3	36.9	18.2	13460	1660
200	26.9	36.0	18.0	12970	1600
Mean	27.0	36.7	18.4	13520	1670
CV (%)	3	8	2	9	9
LSD (0.05)	NS	NS	0.6	NS	NS

Table 3. Petiole nutrient sufficiency ranges and average values observed in mid-July in samples from 1992 and 1994 nitrogen rate experiments at Klamath Falls, OR.

Nutrient	Sufficiency range[1]	KES samples 1992	1994
NO3-N-ppm	5,000 - 15,000	14,000	11,600
P - %	0.25 - 0.45	0.16	0.28
S - %	0.25 - 0.35	0.04	0.13
K - %	2.5 - 3.8	1.4	3.9
Ca - %	1.0 - 2.5	0.07	0.27
Mg - %	0.3 - 0.8	0.17	0.24
Zn - ppm	25 - 70	8	16
Cu - ppm	8 - 20	3	5
Fe - ppm	50 - 250	83	400
Mn - ppm	30 - 100	17	68

1/ Sufficiency ranges for sugarbeet petioles reported by Basin Agri-Serve, Merrill, OR.

Sugarbeet Planting Date and Plant Population Studies

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

Introduction

This study was initiated in 1994 to determine the effects of a range in plant populations for crops established from early April through May. The objective was to provide a basis for the replant decision in cases where significant, but not total, stand losses are experienced in early planted crops. A three-year study conducted at KES and IREC from 1991 to 1993 showed early sugarbeet crop establishment was required to achieve high yields and economic returns. Averaged over years, locations, and two varieties, planting delays after May 1 reduced beet yield by 1.75 tons/acre and gross crop value by $85/acre/week. Spring frosts, insect damage, and wind damage have resulted in stand losses or reduced stands in commercial fields each year crops have been grown in the region. Crops have been replanted on 5 to 30 percent of the commercial acreage. The decision to replant must consider the consequences of lower yield potential for delayed planting against the potential reduction in yield expected for low populations when only a portion of the stand is lost. In the 1991 experiment at IREC, a stand loss of over 50 percent on an early April planting did not reduce yields below those obtained with a near-perfect stand for May planting.

Procedures

Field studies were established at KES and IREC sites as randomized complete block, split-plot experiments with five replications. Planting date treatments were assigned to main plots. Five plant population levels were randomly assigned to split- plots. The variety WS-62 was used at both locations and all planting dates. Details of the plot layouts and cultural practices are described in Table 1. KES plantings were made with a hand

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operated Planet-Junior type planter. A modified three-row cone planter was used at IREC. The initial planting on April 15 at KES, was followed by three additional plantings at two-week intervals. At IREC, the first planting on April 5 was followed by four plantings on two-week intervals. Solid-set sprinkler irrigation systems were used at both locations. Frequent light water applications were made as necessary during the establishment period. Total irrigation water applied through the season was about 26 inches at both sites.

Plant stands were hand-thinned to achieve desired plant populations about five weeks after planting. Plant population targets were 32,000, 24,000, 16,000, 12,000, and 8,000 plants/acre. Beets were harvested on October 13 at KES and October 15 at IREC. Approximately 30-pound samples from each plot were sent to the Holly Sugar Corporation laboratory within one day of harvest for determination of tare loss, brei-nitrate, and sucrose sugar content. Total sugar production was calculated as the product of yield; adjusted for tare loss and percent sugar. Gross crop values were calculated based on terms of the CBGA-processors contract, yield and sugar content measured in each plot, and a sugar net selling price of $23.00/cwt.

Results and Discussion KES

Crop establishment and development was excellent in the first three planting dates. Minimum air temperatures of 24 and 26 °F recorded on May 1 and May 2, respectively, did not damage recently emerged plants in the earliest planting date. Weaker plants in the latest planting date were probably the result of excess early season irrigation, required to sustain the much larger plants in the earlier planting dates. A prostrate growth habit noted at the lowest populations did not appear to adversely affect root development. The crop remained vigorous until harvest in spite of minimum air temperatures of 24 and 22 °F recorded on October 6 and October 11, respectively.

Each delay in planting date resulted in a significant reduction in beet yield, total sugar production, and gross crop value (Table 2). Beet yield declined by about 1.2 tons/acre for each week delay in planting date from April 15 to May 11. The yield loss for the delay after May 11 was nearly 4.0 tons/acre/week. Sugar content was unaffected by planting date. These results are quite similar to observations from the three-year experiment completed in 1993. The yield reduction from May 11 to May 27 plantings was more severe than previously observed. Since sugar content was constant, the response in total sugar and gross crop value to planting date mirrored the yield response. Brei-nitrate was not affected by planting date.

Actual populations harvested were slightly below target (Table 2). Effects of population were statistically significant for all performance parameters. However, differences between the three highest populations were not significant for any parameter. The interaction between planting date and population was not significant, indicating a consistent response to population over the range of planting dates evaluated.

Sugarbeets are clearly capable of compensating for low populations. In the April 15 planting date, individual beets averaged 2.25 lb/beet at the highest population and 7.6 lb/beet at the lowest population. In the May 27 planting, beets averaged 1.6 and 3.4 lb/beet at highest and lowest populations, respectively. The difference in beet size is associated with the trend for lower sugar content at low populations. Brei-nitrate levels increased significantly as beet size increased.

IREC

Crop development was similar to that experienced at KES. Excellent stands were obtained in the first planting, which was 10 days earlier than the first planting at KES. Lower plant stands in the last two planting dates may be attributable to excess irrigation required for earlier established crops. Averaged over all treatments, beet yields were 1.0 tons/acre higher and sugar content was 0.1 percent higher at IREC than at KES.

Beet yields were nearly identical in the first two planting dates (Table 3). This is in agreement with results observed at IREC over three years in the planting date study conducted from 1991 to 1993. Delaying planting date from mid-April to mid-May resulted in yield losses of about 1.5 tons/acre for each week delay. Yield losses were slightly higher for the period from May 17 to May 31. Each delay after April 19 resulted in a significant decline in yield. Planting date did not affect sugar content or brei-nitrate levels. Effects on total sugar production and gross crop value were the same as effects on beet yield.

The lowest plant population resulted in reduced yields, sugar production, and crop value over all planting dates. Differences in beet yield, sugar production, and crop value between populations from 12,000 to 32,000 plants/acre were relatively minor. Averaged over planting dates, beet yield, total sugar, and gross crop value was significantly lower at the highest population than at 16,000 plants/acre. Brei-nitrates increased slightly with lower populations.

Over Locations

Effects of planting date on beet yield were very similar to results observed in three previous years. Delaying planting after mid-April reduced yield and economic returns substantially. Under the short growing season conditions experienced in the Klamath Basin, plant populations as low as 12,000 plants/acre produced yields nearly as high as those achieved at the recommended population of 32,000 to 35,000 plants/acre. At both locations, replanting would not have been economically justifiable for any planting date as long as 12,000 plants/acre were obtained in the initial planting. For plantings in early May, 8,000 plants/acre produced higher returns than higher populations planted two weeks later. This interpretation must be tempered by the recognition that plants were uniformly spaced in these trials and weed competition was not a factor. This may not be the case in commercial situations.

Table 1. Description of the sugarbeet planting date and plant population experiments at Klamath Experiment Station (KES), Klamath Falls, OR and Intermountain Research and Extension Center (IREC), Tulelake, CA, 1994.

	Location	
Description	**KES**	**IREC**
No. of plantings	4	5
Planting date range	4/15 - 5/29	4/5 - 5/31
Row spacing (inches)	22	24
Size:		
Main plot (feet)	5.5 X 120	6 X 400
Sub-plot (feet)	5.5 X 24	6 X 80
Harvest (feet)	1.8 X 24	2 X 76
Harvest date	10/13	10/15
Replications	5	5
Fertilizer:		
Pre-plant		
Formula	15-15-15	12-12-12
Amount	330 lb/A	500 lb/A
Post-plant		
Formula	N	21-0-0
Amount	50 lb/A	500 lb/A
Previous crop	forage grasses	barley

Table 2. Effects of planting date and plant population on beet yield, sugar content, total sugar production, and gross crop value of WS-62 sugarbeets, Klamath Falls, OR, 1994.

Planting date	Plant population	Beet yield	Sugar content	Total sugar production	Gross crop value
	1000 pl/A	tons/A	%	lb/A	$/A
April 15	29.7	34.2	18.1	12400	1590
	22.3	34.9	17.4	12100	1530
	14.1	34.3	17.5	12000	1520
	10.9	33.2	17.8	11800	1510
	7.9	30.3	17.5	10600	1350
April 29	30.1	34.3	17.7	12200	1550
	24.0	32.8	18.1	11900	1520
	14.9	31.4	17.9	11200	1440
	11.9	31.2	17.4	10800	1370
	8.1	25.9	18.0	9300	1190
May 11	30.9	30.4	18.1	11000	1410
	23.2	30.0	17.9	10700	1370
	15.4	29.9	17.9	10700	1370
	11.5	27.5	17.4	9600	1210
	8.1	24.7	17.5	8600	1090
May 27	28.3	22.5	18.1	8200	1050
	23.4	23.9	17.9	8600	1100
	15.1	23.4	17.8	8300	1060
	12.1	19.1	17.3	6600	840
	8.3	14.1	17.6	5000	630
Planting date main effect (average of five populations)					
April 15	17.0	33.4	17.7	11800	1500
April 29	17.8	31.1	17.8	11100	1410
May 11	17.8	28.5	17.7	10100	1290
May 27	17.4	20.6	17.7	7300	930
CV (%)	8	9	3	9	9
LSD (0.05)	NS	1.5	NS	540	70
Population effect (average of four planting dates)					
	29.8	30.4	18.0	10900	1400
	23.2	30.4	17.8	10800	1380
	14.9	29.8	17.8	10600	1350
	11.6	27.8	17.5	9700	1230
	8.1	23.4	17.7	8400	1070
CV (%)	6	10	3	10	10
LSD (0.05)	0.6	1.8	0.3	650	90

Table 3. Effects of planting date and plant population on beet yield, sugar content, total sugar production, and gross crop value of WS-62 sugarbeets, Tulelake, CA, 1994.

Planting date	Plant population	Beet yield	Sugar content	Total sugar production	Gross crop value
	1000 pl/A	tons/A	%	lb/A	$/A
April 5	36.4	33.4	17.8	11800	1510
	23.2	34.2	17.5	12000	1520
	16.3	35.6	17.8	12600	1610
	10.9	33.4	17.5	11600	1480
	7.3	29.8	17.7	10600	1340
April 19	33.1	33.0	17.8	11800	1500
	23.7	34.6	18.0	12400	1590
	16.3	35.8	17.6	12600	1600
	11.4	34.3	17.8	12200	1560
	7.7	28.9	17.8	10200	1310
May 3	33.5	31.6	17.9	11400	1450
	23.0	32.6	18.0	11800	1510
	15.3	30.4	17.9	10800	1390
	10.9	29.9	18.0	10800	1380
	7.8	27.7	18.1	10000	1280
May 17	27.7	26.3	17.5	9200	1170
	21.9	27.7	17.8	9800	1260
	16.8	27.9	17.6	9800	1250
	11.3	28.4	18.0	10200	1310
	9.0	25.0	17.5	8800	1110
May 31	25.9	23.4	17.8	8400	1060
	22.0	23.8	17.7	8400	1070
	15.7	24.6	17.9	8800	1120
	10.6	23.6	18.0	8400	1090
	7.2	19.4	17.8	6800	880
Planting date main effect (average of five populations)					
April 5	18.8	33.3	17.6	11800	1490
April 19	18.4	33.3	17.8	11800	1510
May 3	18.1	30.4	18.0	10800	1400
May 17	17.3	27.1	17.7	9600	1220
May 31	16.3	22.9	17.8	8200	1040
CV (%)	9	7	3	6	6
LSD (0.05)	0.9	1.1	NS	390	50
Population effect (average of four planting dates)					
	31.3	29.5	17.8	10400	1340
	22.8	30.6	17.8	10800	1390
	16.1	30.9	17.7	11000	1400
	11.0	29.9	17.9	10600	1360
	7.8	26.1	17.8	9200	1180
CV (%)	9	7	2	7	7
LSD (0.05)	0.9	1.1	NS	400	50

Weed Control in Sugarbeets

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

Introduction

Weed control has been a very important factor in commercial success and profitability in sugarbeet crops in the Klamath Basin. Hand labor to salvage problem situations is very expensive and not readily available. Delayed removal of weed competition seriously reduces yield potential. Most of the unprofitable sugarbeet fields in five years of commercial production in the Klamath Basin were caused by weed control failures. A 1993 evaluation of several post-emergence chemical treatments demonstrated a 40 percent yield reduction when weed competition was left uncontrolled through the first 12 weeks of the growing season. The best chemical treatments evaluated provided satisfactory weed control and profitable crop production. The 1993 study was repeated in 1994 with minor changes in procedures.

Procedures

Sugarbeet weed control was studied on a site cropped with alfalfa in the previous four years. Alfalfa was desiccated with Round-up herbicide in August, 1993. Field preparation, fertilization, irrigation, and insect control practices are described on pages 10 and 11. The sugarbeet variety WS 62 was planted in 22-inch rows on April 15 and hand-thinned to approximately 30,000 plants/acre on June 2. Individual three-row plots, 20 feet long were established to accommodate seven weed control treatments and five replications. Chemical treatments were applied with an experimental plot sprayer in 20 gpa of solution on May 13 and May 25. Weeds were identified by species and counted from a 15 square foot quadrant at the center of each plot

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on June 30. All plots, including the untreated control, were hand weeded on July 1.

Beets were harvested by hand on October 12. Yields were measured from the center row of each plot. Approximately 30-pound sugarbeet samples from each plot were analyzed for tare loss and sugar content. Total sugar production and gross crop value were calculated as described on page 11.

Results and Discussion

Sugarbeet plants and weeds were in the cotyledon to two-true-leaf stage at the time of initial herbicide applications. Second herbicide applications coincided with two-to-four-leaf beet seedling development. Herbicide treatments did not appreciably injure beet seedlings.

Weed species composition was influenced by the previous crop history. Sheperdspurse and redstem filaree were the dominant weeds. These species are not as aggressive or competitive as lambsquarter, redroot pigweed, and hairy nightshade, which are more prevalent in a crop rotation including cereals and potatoes. Sheperdspurse was not controlled by Upbeet at either rate (Table 1). Betamix, alone or in combination with Upbeet, and NA308/1 at the high application rate provided satisfactory control of sheperdspurse. Filaree was not well controlled by any of the treatments. Betamix and NA308/1 controlled other species (mostly lambsquarter and redroot pigweed) quite well. Common purslane was the most frequent species that escaped control in these treatments. NA308/1 was more effective at the higher rate. Upbeet was ineffective at either rate and did not improve weed control when combined with Betamix.

In contrast to the 1993 study, where the control treatment experienced a 40 percent yield reduction and a 1.5 percent reduction in sugar content, effects of herbicide treatments on beet yields and sugar content were less in this study (Table 2). The main reason was the difference in weed species between experiments. Lambsquarter and hairy nightshade were very competitive with beet seedlings in the 1993 study. Sheperdspurse and filaree are smaller and were much less competitive. Earlier removal of weeds from the plots in 1994 was also a factor. The four treatments that provided the best weed control were not significantly different in yield, sugar production, or gross value. The control treatment was not significantly different from Upbeet at the low application rate in yield, sugar production, or gross value. The combination of Betamix and Upbeet and both rates of NA308/1 produced among the highest beet yields.

In two years of evaluations under very different weed species pressure, Betamix and NA308/1 have provided acceptable control of most weeds except redstem filaree. Upbeet has not been effective, and has not improved weed control significantly when used in combination with Betamix. The most difficult weed species in local sugarbeet crops, kochia and thistles, have not occurred in these studies. Where weed distribution is similar to conditions in these experiments, post-emergence applications of Betamix or NA308/1 offer a cost-effective approach for weed management. When chemical controls fail, hand weeding should be employed as early as possible to reduce competition effects.

Table 1. Effects of repeated herbicide treatments on weed density in WS-62 sugarbeets at Klamath Falls, OR, 1994.

Treatment	Rate on May 13 and May 25	Weed density[1]			
		Sheperdspurse	Filaree	Other	Total
	ai / A	plants / sq. ft.			
Control	0	1.8	1.4	2.6	5.8
Betamix	0.33 lb + 0.50 lb	0.2	1.4	0.4	2.0
Upbeet & Betamix	0.50 oz + 0.33 lb 0.50 oz + 0.33 lb	0.2	1.1	0.4	1.7
Upbeet[2]	0.50 oz + 0.50 oz	2.0	1.8	2.0	5.8
Upbeet[2]	0.75 oz + 0.75 oz	1.5	1.8	1.8	5.1
NA 308 / 1	0.25 lb + 0.33 lb	0.6	1.0	0.5	2.1
NA 308 / 1	0.375 lb + 0.50 lb	0.2	1.3	0.2	1.7

1/ Weed density on June 30

2/ Included 0.25% surfactant

Table 2. Effects of repeated herbicide treatments on yield, sugar content, total sugar production, and gross value of WS-62 sugarbeets at Klamath Falls, OR, 1994.

Treatment	Rate on May 13 and May 25	Beet yield	Sugar content	Sugar production	Gross value
	ai / A	tons /A	%	lb / A	$ / A
Control	0	26.7	18.2	9700	1250
Betamix	0.33 lb + 0.50 lb	30.1	17.9	10740	1370
Upbeet & Betamix	0.50 oz + 0.33 lb 0.50 oz + 0.33 lb	33.1	17.0	11180	1400
Upbeet	0.50 oz + 0.50 oz	28.6	17.9	10240	1310
Upbeet	0.75 oz + 0.75 oz	29.5	18.0	10620	1360
NA 308 / 1	0.25 lb + 0.33 lb	31.0	17.4	10740	1360
NA 308 / 1	0.375 lb + 0.50 lb	30.6	17.3	10520	1330
Mean		29.9	17.7	10530	1340
CV (%)		9	4	6	6
LSD(0.05)		3.4	1.0	860	110

Potato Variety Screening Trials, 1994

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

Introduction

The Klamath Experiment Station participates in Oregon and regional potato variety development programs from the third year of field evaluations of Oregon selections through regional trials. Oregon obtains true seed from the USDA-ARS Aberdeen, Idaho potato breeding program to produce approximately 60,000 clones in greenhouse culture for first-year field selection at the Central Oregon Agricultural Research Center (COARC) and the Malheur Experiment Station (MES). Additional clones from Colorado and North Dakota breeding programs are also screened as single-hill selections. Selections that are saved from second-year screening trials are evaluated in a preliminary yield trial conducted at KES, COARC, MES, and the Hermiston Agricultural Research and Extension Center (HAREC). Clones retained from this trial are advanced to the Oregon statewide trial for up to three years at the same four locations. Lines promoted beyond the statewide trial are evaluated for two or three years in tri-state trials conducted at one or two locations in Oregon, Washington, and Idaho. The final stage of formal evaluation is regional trials conducted in seven western states at 13 locations. The KES participates in the regional trial, but not the tri-state trial.

Most of the breeding lines passing through this sequence are russet types. The program emphasis is on dual purpose selections, suitable for French fry processing and fresh market use. At early stages of the program, yield, tuber type and appearance, and important processing characteristics (dry matter content and fry color) are the main selection criteria. From the tri-state level forward, disease response, chemical characteristics, storage quality, and culinary quality receive greater emphasis. The KES contributions to the program include evaluation of culinary quality for fresh market preparation

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methods for material in statewide or regional trials, screening for root-knot nematode and tobacco rattle virus resistance at the regional level, and evaluation of agronomic practices for optimum performance of advanced selections. This report summarizes performance of selections in preliminary, statewide, and regional trials conducted at KES in 1994. Response of advanced selections to cultural management practices and nematodes and related diseases is reported elsewhere.

Procedures

Variety screening trials were conducted in a two-year grain-potato rotation with randomized complete block experimental designs. The field was fumigated with Telone II applied at 18 gpa in early November, 1993, plowed in late April, and final seedbed preparation was completed on May 9. All seed was hand cut to 1.5 to 2.0 ounces/seedpiece, treated with thiophanate-methyl (Tops 2.5) fungicide at 1 lb/cwt of seed, and suberized at approximately 55 °F and 90 percent relative humidity for 10 days prior to planting. Potatoes were planted with a two-row, assisted-feed planter in 32-inch rows at 8.7-inch seed spacing. Di-Syston was applied at 3.0 lb ai/acre in the seed furrow. Fertilizer included 730 lb/acre of 16-8-8-14S banded at planting and 50 lb N/acre applied as solution 32 and incorporated immediately with a rolling cultivator on May 25.

The preliminary yield trial included five standard varieties and 70 numbered selections in single-row, 20-hill plots with two replications. The statewide trial included five standard varieties and 26 numbered selections in single-row, 30-hill plots with four replications. Four standard varieties and 22 numbered selections were included in single-row, 30-hill plots with four replications in the western regional trial. All trials were planted on May 11.

Crops were irrigated twice weekly with solid-set sprinklers on a 40-foot by 48-foot spacing. Total water applied, including rainfall, from planting to harvest was approximately 25 inches. Weeds were controlled with 3.5 lb ai/acre Eptam applied with a conventional ground sprayer on May 25 and 0.6 lb ai/acre Sencor applied aerially on June 29. Fungicide aerial applications included 2.0 lb ai/acre Ridomil-Copper on July 8 and 2.0 lb ai/acre Kocide on August 6. Monitor insecticide was included with both fungicide applications at 0.75 lb ai/acre. Vines were desiccated with Diquat applied with a conventional ground sprayer at 1 pt/acre on September 4. Potatoes were harvested with a one-row digger-bagger on September 23, 26, and 27. All tubers from each plot were stored at 55 to 45 °F and 90 to 95 percent relative humidity until samples were graded in late October.

Emergence data were recorded on June 15 and June 27. Vine vigor was rated on June 27 and vine maturity was evaluated on August 26. External tuber characteristics were noted for each replication during grading. Ten large tubers (usually over 10 ounces) from each plot were cut longitudinally and inspected for internal defects. Specific gravity was determined by the weight-in-air, weight-in-water method on a 10-pound sample of U.S. No. 1s in the 6- to 10-ounce size fraction. USDA grade standards were used to separate B size (under 4 ounces), U.S. No. 1s (4 to 12 ounces and over 12 ounces), U.S. No.2s, and culls. Yields of U.S. No. 1s were not adjusted for external blemishes such as rhizoctonia or scab, or internal defects such as hollow heart or brown center. Samples of 6- to 10-ounce No. 1s were saved from one replication of each selection in all trials for culinary evaluations.

Culinary evaluations included French fry tests to determine fry color on selections in all trials. Samples from statewide and regional trials were also evaluated for boiling, oven baking, and microwave preparation methods. These tests are designed to detect serious deficiencies such as after-cooking darkening, flavor problems, poor texture, or sloughing. All culinary tests were performed in late November and early December.

Since the preliminary yield trial was limited to two replications, data were not subjected to statistical analyses. All yield and specific gravity data from statewide and regional trials was statistically analyzed using MSUSTAT software. While only a portion of data collected is reported, other characteristics are carefully considered in determining disposition of selections at each level of evaluation.

Results and Discussion

Preliminary Yield Trial:

Favorable weather conditions through June resulted in excellent crop establishment and early growth. Emergence was rapid and uniform for most selections (Table 1). Sencor injury was noted in Shepody, Atlantic, and several numbered clones. Yields were generally high and internal defects were minimal in most lines. Data is only presented for selections that were advanced to the statewide trial for 1995 (Tables 1 and 2).

Relatively high specific gravity was observed in Russet Burbank and many of the numbered lines. Hollow heart, brown center, and other internal defects were limited in most selections except Lemhi. Most of the clones retained for further evaluation produced much higher yields of U.S. No.1s than Russet Burbank, which had extensive secondary growth (Table 2). Heat stress in July contributed to secondary growth in Russet Burbank and a few numbered selections. The high proportion of misshapen tubers in Shepody may have been the result of herbicide injury, heat stress, or both.

Several selections performed well at all locations. Outstanding fresh market clones included COO90071-1 and AO90007-11. Excellent processing quality and high yields were observed in AO90045-13, AO90072-3, and AO90088-1. The selection AO90319-1 produced very attractive russet-skinned, yellow-fleshed tubers and high yields. All of these selections exceeded Russet Burbank in yield of U.S. No.1s by more than 100 cwt/acre at Klamath Falls.

Statewide Trial:

Crop development was similar to that in the preliminary yield trial (Tables 3 and 4). Russet Burbank and Shepody produced relatively high yields of U.S. No.2s. Lemhi and several numbered selections exhibited a high internal defect incidence. The low yield for Atlantic was due to severe herbicide injury. Century Russet achieved the highest yield of U.S. No.1s at three locations and was second highest at Hermiston. This selection is being released in early 1995. Other potential Oregon releases that have completed three years of evaluation in the western regional trials include COO83008-1, AO82611-7, and NDO2904-7. Each of these produced high yields in this trial. High yields and excellent appearance was also observed in AO85165-1, a fresh-market russet included in the regional trial for the first time in 1994.

Six additional selections were retained for further evaluation. The lines AO84022-108 and AO87018-23 are being advanced to the tri-state trial in 1995. Both are attractive russets with lighter fry color and higher dry matter content than Russet Burbank. AO84022-108 produced higher No.1 yields than Russet Burbank at all locations except Powell Butte in 1994. Yields were similar for AO87018-23 and Russet Burbank at all locations. AO87119-3 and AO89142-2 are fresh-market lines that produced high yields and good appearance in both 1993 and 1994 at Klamath Falls. The selections AO87277-6 and AO89128-4 demonstrated excellent processing quality and intermediate yields at all locations in 1994.

Culinary tests were performed on all selections in this trial. Low scores were recorded for boiling tests on AO87018-23, AO87119-3, AO87277-6, and AO89128-4. No deficiencies were noted for these selections in oven baking or microwave tests. High scores were observed in all tests for AO84022-108 and AO89142-2.

Western Regional Trial:

Seed supplies were only sufficient to plant two replications of four entries (Table 5). Less than 90 percent emergence affected performance of NDO2904-7 and AO80432-1. Russet Burbank was less affected by heat stress than in the preliminary and statewide trials, and produced a higher yield of U.S. No.1s (Table 6). Shepody and Norkotah produced similar yields in all three trials. Very high No.1 yields were observed in A8333-5 and AO85165-1. They were among the highest yielding selections averaged over nine late harvest locations. The clone A8333-5 is being discarded due to a serious blackspot bruise problem. Other selections discarded for various reasons included COO8390-1, AO8478-1, RB/M-12, and RB/M-15. The latter two line selections of Russet Burbank had high yields of misshapen tubers and lower No.1 yields than Russet Burbank at several locations.

Four selections completed three years of evaluation in the regional trials and have graduated from the formal evaluation program. They included

NDO2904-7, AO84275-3, A81286-1, and A8390-3. NDO2904-7, an early maturing fresh market selection, has consistently produced higher yields than Russet Norkotah with excellent appearance. However, tests at Aberdeen, Idaho have found high levels of glycoalkaloids in NDO2904-7 each year. Additional sampling in January confirmed unacceptable glycoalkaloid levels and the selection will be discarded.

The selection AO84275-3 has been similar to Russet Burbank in marketable yield. It has good resistance to verticillium wilt and may have potential as a home garden or organic variety. Tuber shape is too round for commercial acceptance. The line A81286-1 had serious vascular discoloration in two lots evaluated for processing in 1994 and will probably be discarded. A8390-3 is an early maturing fresh market selection. Final disposition of this selection has not been determined.

Two Idaho selections, A8495-1 and A84180-8, produced exceptionally attractive tubers and No. 1 yields similar to Russet Burbank. These dual purpose russets were rated high in culinary quality tests at KES and Washington. Both appear to be outstanding candidates for fresh market production in the Klamath Basin. If sufficient seed can be obtained, they will be included in KES management trials in 1995.

Advanced Oregon Selections:

Formal release of A74212-1E as Century Russet is anticipated in early 1995. This is the first potato variety released by the Oregon potato variety development program. The second release, expected in 1996, will be COO83008-1, a multi-purpose russet with good processing quality. This selection has demonstrated resistance to sugar end and other manifestations of heat and moisture stress in the Treasure Valley areas of eastern Malheur County, Oregon and Southwestern Idaho. Small lots were successfully marketed in fresh market packs from Idaho in 1994. COO83008-1 has also demonstrated moderate resistance or tolerance to late blight in screening trials conducted in Washington and New York. Tuber shape of this selection tends to be more round and flat than the ideal shape for processing, but other attributes are expected to offset this limitation.

AO82611-7 is also a multi-purpose russet with good processing quality. It has not received as much interest as COO83008-1 by the processing industry, but is still being evaluated for this use. Experience at KES indicates that tuber appearance is not acceptable for fresh market use under local conditions. This selection is at least two years from release.

NDO2904-7 is a fresh market russet with many of the characteristics of Norkotah, which is one of the parents in the cross from which it was selected. It has consistently produced higher marketable yields than Norkotah in trials at KES and many other locations. In tests of samples from regional trials over three years, NDO2904-7 glycoalkoloid content has been well above levels observed in Russet Burbank, which is considered marginally acceptable in this regard. Additional samples tested in January 1995 had very high glycoalkaloid content. This selection will be discarded.

Yield comparisons of several selections with Russet Burbank and Norkotah in KES trials over five years are presented in Table 7. Century Russet produced significantly higher yields than Russet Burbank in nearly every trial conducted. NDO2904-7 and COO83008-1 usually produced significantly higher No.1 yields with more large tubers. The clone AO82611-7 has not been superior to Russet Burbank at Klamath Falls.

The Oregon statewide potato variety development program is also considering the release of a chipping selection, NDO1496-1. It produces high dry matter content and will chip with acceptable color out of 45 °F storage. Yields have been similar to Snowden in several trials at KES. A serious shatter bruise problem was observed in NDO1496-1 grown in the Willamette Valley in 1994. This selection is being evaluated in the Snack Food Association national chipping trials. The decision to release will await further evaluation of the shatter bruise problem and performance in chipping trials.

Summary

Dominance of Russet Burbank in the Western United States potato industry appears to be waning. The 1994 Klamath Basin crop included nearly 50 percent of varieties other than Russet Burbank. Shepody has become the dominant variety in the Treasure Valley. Shepody and Ranger Russet are gaining increasing shares of the Columbia Basin production. Industry acceptance of new varieties is increasing. The Oregon potato variety development program has reached the stage of offering new varieties at an opportune time. Successful introduction of several Oregon selections appears likely.

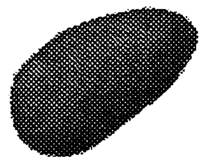

Table 1. Characteristics of entries selected from the Preliminary Yield Trial for further evaluation, Klamath Falls, OR, 1994.

Variety / selection	Percent stand	Vigor rating[1]	Vine maturity[2]	Specific gravity	Percent H.H. & B.C.[3]	Comments[4]
Russet Burbank	95	4.5	3.0	1.094	5	Rough, ugly
Lemhi	98	3.0	3.0	1.091	55	Coarse
Shepody	93	4.0	4.0	1.082	10	Rough
Norkotah	100	3.0	1.8	1.069	20	EH
Atlantic	93	3.5	3.0	1.091	0	
COO90071-1	100	4.0	2.5	1.090	0	Rough
AO85058-10	100	2.0	3.5	1.088	5	Red eyes, fair
AO89396-3	100	3.0	3.0	1.082	10	Nice
AO90007-1	100	2.5	2.5	1.092	0	Heavy net, coarse
AO90007-11	95	4.0	2.5	1.080	15	Heavy net
AO90014-1	100	3.5	3.0	1.089	0	Nice
AO90017-4	100	4.5	3.0	1.094	0	Small, fair
AO90021-9	98	4.0	2.0	1.091	0	Small
AO90033-6	98	2.5	2.5	1.077	10	Not bad
AO90033-7	100	3.0	2.5	1.082	0	Fair
AO90036-5	98	4.5	1.8	1.097	0	Fair
AO90045-13	98	2.5	3.5	1.087	5	Huge, coarse
AO90051-1	98	3.0	2.5	1.088	0	Nice
AO90072-3	95	4.0	2.0	1.101	10	Fair
AO90087-3	100	3.0	3.5	1.090	10	Coarse, GC, flat
AO90088-1	100	3.5	2.5	1.098	10	Fair
AO90089-5	100	3.5	3.0	1.107	0	Small
AO90310-2	100	3.0	3.5	1.089	0	Nice
AO90319-1	100	4.0	2.5	1.082	0	Nice, yellow flesh
AO90321-1	100	3.0	2.0	1.097	5	
Mean	98	3.4	2.7	1.089	7	

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

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

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

4/ Comments: EH - elephant hide, GC - growth cracks

Table 2. Tuber yield by grade for entries selected from the Preliminary Yield Trial for further evaluation, Klamath Falls, OR, 1994.

Variety / selection	Yield U.S. No. 1s 4 -12 oz	Yield U.S. No. 1s > 12 oz	Yield U.S. No. 1s Total	Yield Bs	Yield No. 2s	Yield Culls	Yield Total
	cwt/A						
Russet Burbank	325	56	381	64	95	37	577
Lemhi	365	134	499	46	16	0	559
Shepody	234	66	300	9	158	0	467
Norkotah	225	56	281	52	22	0	355
Atlantic	256	117	373	50	9	3	435
COO90071-1	539	147	686	65	69	0	820
AO85058-10	317	22	339	25	5	0	369
AO89396-3	487	103	590	37	16	0	643
AO90007-1	443	46	489	43	34	0	566
AO90007-11	366	150	516	53	32	0	601
AO90014-1	436	53	489	93	0	0	582
AO90017-4	555	30	585	155	21	0	761
AO90021-9	360	0	360	148	0	0	508
AO90033-6	335	164	499	16	37	0	552
AO90033-7	388	142	530	26	8	0	564
AO90036-5	542	68	610	112	8	0	730
AO90045-13	138	443	581	9	61	0	651
AO90051-1	397	83	480	29	27	0	536
AO90072-3	461	150	611	51	11	0	673
AO90087-3	367	242	609	9	190	0	818
AO90088-1	483	35	518	95	22	0	635
AO90089-5	372	18	390	162	5	0	557
AO90310-2	438	96	534	32	26	0	592
AO90319-1	501	82	583	57	11	0	651
AO90321-1	352	77	429	35	44	0	508
Mean[1]	387	103	490	59	37	1	588

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

Table 3. Characteristics of entries in the Oregon Statewide Trial, Klamath Falls, OR, 1994.

Variety / selection	Percent stand	Vigor rating[1]	Vine maturity[2]	Specific gravity	Percent H.H. & B.C.[3]	Comments
Russet Burbank	98	4.0	2.5	1.090	3	Rough, dumbells
Lemhi	90	2.5	3.5	1.092	43	Coarse
Shepody	94	4.0	3.3	1.084	10	Rough, ugly
Norkotah	93	3.0	3.0	1.071	8	Fair
Atlantic	77	2.8	2.4	1.091	10	No yield
A74212-1E**	95	4.0	2.8	1.084	0	Too round, light
AO82611-7*	99	3.8	3.0	1.096	0	Pointy, coarse
COO83008-1*	97	3.0	3.8	1.093	5	Fair
NDO2904-7*	92	3.8	2.8	1.067	0	Nice
AO85165-1*	95	2.8	3.5	1.084	10	Coarse, fair
AO84022-108*	95	3.3	3.3	1.089	3	Pointy, long, nice
AO85436-1	91	4.3	3.0	1.091	8	Sprouting
AO87011-10	99	3.5	3.8	1.088	3	Rough, flat
AO87018-20	99	3.8	3.0	1.099	10	Fair
AO87018-23*	97	3.5	1.8	1.088	8	Nice
AO87032-4	98	2.8	3.5	1.089	15	Rough, Fair
AO87119-3*	98	4.5	2.3	1.075	0	Nice, long
AO87206-3	88	2.0	4.0	1.083	5	Small, poor
AO87212-3	93	4.5	1.4	1.078	0	Flat
AO87218-13	90	3.5	3.0	1.081	5	Rough, skinning
AO87224-5	92	4.0	4.0	1.085	28	Fair
AO87234-6	95	3.3	4.0	1.090	3	Rough, ugly
AO87245-9	94	2.5	2.8	1.081	3	Coarse, flat
AO87257-1	94	3.3	2.5	1.076	0	Coarse, fair
AO87277-6*	93	3.0	4.3	1.090	0	Fair, pointy
AO89113-1	93	4.3	3.5	1.091	45	Poor
AO89128-4*	97	3.3	4.0	1.097	0	Fair, pointy
AO89142-2*	97	2.3	4.3	1.087	0	Very nice
AO89142-6	97	3.0	3.5	1.088	20	Skinning, coarse
COO89003-2	97	2.8	3.0	1.083	0	Pointy, fair
COO89065-2	98	3.8	2.4	1.087	28	
Mean	94	4.3	3.2	1.086	9	

* Selections retained for further evaluations

** To be officially released in 1995 as Century Russet

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

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

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

Table 4. Tuber yield by grade for entries in the Oregon Statewide Yield Trial, Klamath Falls, OR, 1994.

Variety / selection	Yield U.S. No. 1s			Yield			
	4 - 12 oz	> 12 oz	Total	Bs	No. 2s	Culls	Tota
	cwt/A						
Russet Burbank	276	32	308	94	109	48	559
Lemhi	315	188	503	29	53	0	585
Shepody	221	140	361	33	150	2	546
Norkotah	280	49	329	37	19	2	386
Atlantic	187	27	214	38	0	4	257
A74212-1E**	537	167	704	51	15	0	770
AO82611-7*	381	64	445	57	52	0	554
COO83008-1*	342	163	505	21	29	6	561
NDO2904-7*	321	118	439	33	5	2	479
AO85165-1*	357	212	569	31	35	0	635
AO84022-108*	291	197	488	23	26	3	540
AO85436-1	448	183	631	41	31	20	723
AO87011-10	329	156	485	57	96	5	643
AO87018-20	424	24	448	121	18	0	587
AO87018-23*	310	28	338	65	6	0	409
AO87032-4	310	144	454	27	65	7	553
AO87119-3*	368	138	506	47	95	3	651
AO87206-3	248	5	253	89	4	0	346
AO87212-3	249	46	295	47	34	0	376
AO87218-13	317	167	484	27	65	17	593
AO87224-5	326	69	395	61	18	1	474
AO87234-6	236	183	419	9	142	29	599
AO87245-9	256	276	532	10	22	8	572
AO87257-1	273	140	413	20	15	0	448
AO87277-6*	310	160	470	26	72	1	569
AO89113-1	364	71	435	45	29	2	512
AO89128-4*	371	76	447	59	37	0	543
AO89142-2*	298	285	583	18	31	5	637
AO89142-6	393	135	528	34	17	1	578
COO89003-2	293	154	447	22	51	0	520
COO89065-2	305	161	466	46	31	5	548
Mean	321	128	448	42	44	5	540
CV (%)	20	46	20	39	51	233	15
LSD (0.05)	88	82	126	23	32	18	114

* Selections retained for further evaluations

** To be officially released in 1995 as Century Russet

Table 5. Characteristics of entries in the Western Regional Trial, Klamath Falls, OR, 1994.

Variety / selection	Percent stand	Vigor rating	Vine maturity[2]	Specific gravity	Percent H.H. & B.C.	Culinary quality[3] Boil	Bake	Micro
Russet Burbank	99	5.0	3.0	1.092	8	20	22	23
Ranger Russet	100	4.0	3.5	1.085	5	23	22	19
Norkotah	96	3.0	1.9	1.072	3	14	20	22
Shepody	98	3.5	3.0	1.083	5	22	20	23
A81286-1*	95	2.8	4.0	1.085	3	16	21	20
A8333-5	98	4.3	3.3	1.085	8	13	17	16
A8390-3*	90	2.5	2.0	1.087	0	17	17	20
A8495-1	95	2.0	3.8	1.091	3	22	25	25
A84180-8	98	3.0	2.5	1.085	0	17	21	22
AC83064-1	96	3.3	3.8	1.083	0	20	22	23
AC83064-6	96	3.3	2.8	1.081	3	22	24	23
AC84487-1	99	4.3	2.0	1.069	0	18	22	22
AO85165-1	98	3.0	4.0	1.084	15	15	20	19
ATX84706-2Ru*	96	3.5	2.0	1.080	3	21	22	21
CO84074-2	91	3.0	3.0	1.075	13	17	19	20
NDO2904-7	87	3.0	3.0	1.072	0	21	22	19
TX1229-2Ru*	98	3.0	1.5	1.086	0	14	17	17
A81386-1	97	3.0	3.5	1.083	0	22	22	22
A83115-12	93	3.8	4.0	1.079	0	22	24	19
A84118-3	96	3.0	4.3	1.098	3	23	23	24
AO80432-1	79	2.3	3.8	1.094	18	19	23	20
AO8478-1	98	4.5	2.5	1.088	18	22	23	23
AO84275-3	97	3.5	3.8	1.098	5	16	19	19
COO8390-1	94	4.0	3.0	1.088	0	22	23	23
RB/M-12	100	4.3	3.5	1.092	8	20	20	20
RB/M-15	98	4.5	3.0	1.091	10	21	23	22
Mean	95	3.5	3.1	1.085	5	19	21	21
CV (%)				1				
LSD (0.05)				0.005				

* Less than 4 replicates, not included in statistical analyses

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

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

3/ Culinary quality: (0 to 25; higher score indicate better quality)

Table 6. Tuber yield by grade for entries in the western regional variety trial, Klamath Falls, OR, 1994.

Variety / selection	Yield U.S. No. 1s 4 - 12 oz	Yield U.S. No. 1s >12 oz	Yield U.S. No. 1s Total	Yield Bs	Yield No. 2s	Yield Culls	Yield Total
	cwt/A						
Russet Burbank	446	52	498	78	62	2	640
Ranger Russet	363	111	473	41	74	3	591
Norkotah	286	35	320	37	5	1	362
Shepody	269	135	405	21	148	8	580
A81286-1*	323	280	603	18	25	21	666
A8333-5	474	188	662	55	28	2	747
A8390-3*	252	52	304	43	16	0	363
A8495-1	351	111	462	31	7	4	503
A84180-8	435	70	505	34	25	5	568
AC83064-1	384	113	497	43	16	0	555
AC83064-6	314	99	412	31	19	0	462
AC84487-1	341	82	423	41	27	2	493
AO85165-1	401	233	634	38	18	1	690
ATX84706-2Ru*	253	192	445	15	7	4	470
CO84074-2	347	140	487	33	16	1	537
NDO2904-7	254	152	406	28	8	8	450
TX1229-2Ru*	277	197	474	16	0	0	490
A81386-1	372	133	504	52	17	0	573
A83115-12	384	119	503	28	51	5	586
A84118-3	418	21	439	97	22	0	558
AO80432-1	350	64	413	61	12	0	486
AO8478-1	358	44	402	70	34	44	550
AO84275-3	327	24	351	95	16	21	483
COO8390-1	383	17	400	97	15	1	513
RB/M-12	283	43	326	68	138	5	536
RB/M-15	375	28	402	100	77	10	590
Mean	347	105	452	49	34	6	540
CV (%)	18	44	15	37	78	212	14
LSD (0.05)	91	56	96	28	42	17	105

* Less than 4 replicates, not included in statistical analyses

Table 7. Five-year, seven-trial summary of tuber yields by grade for Russet Burbank, Norkotah, and four advanced Oregon potato selections grown at Klamath Falls, OR in 1990-1994.

Variety/	Yield U.S. No. 1s			Yield		
selection	4 - 12 oz	> 12 oz[1]	Total	Bs	No. 2s & Culls	Total
	cwt/A					
Russet Burbank	309	41	350	79	72	501
Norkotah	256	83	339	38	20	397
A74212-1E	426	141	567	47	20	634
NDO2904-7	275	152	427	30	12	469
COO83008-1	283	156	439	30	29	498
AO82611-7	306	80	386	66	33	485

1/ Size fractions were separated at 10 oz. in 1990 and 12 oz in 1991 - 1994.

Red-skinned Potato Variety Development, 1994

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Introduction

Red-skinned potato varieties account for over 7,000 acres of the California crop and continue to provide the highest economic returns in the potato industry. Interest in reds stimulated the establishment of a small scale selection program at KES in 1988. Breeding lines from the North Dakota State University and USDA-ARS, Aberdeen, Idaho potato breeding programs were screened as single-hill selections at KES in 1994. Advanced selections from the KES program were evaluated at KES, Corvallis, Sherwood, and two California sites. Regional red-skinned variety trials conducted at locations in Oregon, Washington, Idaho, California, Texas, and Colorado included three KES selections. Data from all locations were compiled and summarized at KES.

Procedures

I. SINGLE-HILL SEEDLING SCREENING

The North Dakota State University potato breeding program provided 2,000 first-generation mini-tubers from 22 crosses. The USDA-ARS Aberdeen, Idaho program supplied 1,640 mini-tubers from seven crosses. Preselection on the basis of skin color, size, and condition of greenhouse-produced mini-tubers, reduced the number of clones planted to 2,448.

All early generation screening trials at KES were conducted in a field that was cropped with spring barley in 1993 and sugarbeets in 1992. The

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field was treated with 18 gpa Telone II fumigant in November, 1993 to control nematode infestations. Pest control and other cultural practices applied are described on pages 38 and 39. Sencor was not used on any red-skinned potatoes.

Clones were planted at 36-inch spacing in 32-inch rows with a two-row assisted- feed planter on May 16. Vines were desiccated with 1.0 pint/acre Diquat applied with a conventional ground sprayer on August 28. Tuber families were dug with a two-row digger and displayed for selection on September 19.

Results and Discussion

Mini-tubers provided by the North Dakota State University breeding program were 25 to 75 percent smaller than those obtained from the Idaho breeding program. North Dakota selections emerged later, produced smaller, less vigorous plants, and generally produced lower tuber yields than Idaho selections. However, this did not appear to influence the selection process. Skin color, tuber shape and conformation, and tuber numbers per plant are considered important criteria at the single-hill selection stage. Over 6 percent of North Dakota clones were selected at harvest compared with over 5 percent for Idaho lines (Table 1).

Five or more tubers from lines selected at harvest were stored under conditions described on page 39. Each line was examined and compared with samples of standard varieties stored in the same conditions by a team including research personnel and growers on December 5. Color retention, tuber firmness, freedom from tuber rot, and lack of sprouting were considered as additional selection criteria. Approximately 2 percent of the clones planted were retained for further evaluation (Table 1). Five tubers of each clone selected were eye-indexed and tested for virus. Virus-free lines will be planted in 12-hill plots at KES in 1995.

Procedures

II. SECOND GENERATION SEEDLING SCREENING

Thirty clones from 1993 single-hill selections were planted in 12-hill plots on May 16. Seedpieces were spaced at 9 inches in 32-inch rows. Cultural practices used were as described for single-hill selections. Plant stands and vine vigor ratings were recorded on July 11. Vine maturity ratings were noted on August 25. Tubers were dug and displayed for selection on September 19. Selection criteria were as described for single-hill lines, but with more emphasis on yield.

Results and Discussion

Seven selections were saved at harvest. Approximately 25 pounds of each selection were stored and evaluated on December 5. Four lines were kept for further testing in 1995 (Table 2). Thirty tubers of each clone were eye-indexed for greenhouse virus tests. Virus-free tubers will be provided to the seed increase program at COARC. Five pounds of each were sent to Kern County, California for evaluation in the Bakersfield area. Fifty-hill plots will be planted at KES in 1995. Preliminary virus test results indicate excessive potato virus Y may require discarding NDO5003-1R.

Procedures

III. THIRD GENERATION SEEDLING SCREENING

Thirteen clones selected from single-hills at KES in 1990 or 1991 were planted in 50-hill plots at KES on May 16. All selections were planted at Bakersfield, California on February 7 in 27- or 54-hill plots. Eight of the clones were planted in 27-hill plots at Tulelake, California on May 10. Standard cultural practices were followed at each location. Plant emergence, virus disease content, plant vigor, and vine maturity data were recorded at each location. Crops were harvested at Bakersfield on June 20, and at Tulelake and KES on September 19. Seed was increased for each of these selections at Madras, Oregon (COARC).

Results And Discussion

Eight selections were considered acceptable for further evaluation at one or more locations (Table 3). The lines NDO4300-1R, NDO4323-2R, NDO4333-1R, and NDO4578-1 were selected at all locations. NDO4592-3R, NDO4615-1R, and NDO4784-2R were selected at two locations. Any of these selections that have adequate seed supplies from increase plots at COARC will be included in replicated yield trials at KES, Bakersfield, and Corvallis in 1995. Thirty tubers of six of the clones from KES plots have been eye-indexed and tested for viruses in the greenhouse. The line NDO4784-2R had a very high incidence of potato virus Y.

Procedures KES

IV. ADVANCED REPLICATED YIELD TRIALS

Three standard red-skinned varieties, one selection from the Oregon statewide program, and nine advanced KES selections were planted at KES in a randomized complete block design with four replications on May 11. Individual plots were one row, 22 feet long, with 30 hills spaced at 8.7 inches in 32-inch rows. Seed was hand cut to 1.5 to 2.0 ounces per seedpiece, treated with Tops 2.5, and suberized for 10 days before planting. Cultural practices described on pages 38 and 39 were applied except Sencor herbicide was not used. Vines were desiccated with 1 pint/acre Diquat applied on August 28.

Potatoes were harvested with a one-row digger-bagger on September 20. All tubers from each plot were stored and graded in late October according to USDA standards. Tuber appearance ratings were scored for skin color, eye depth, shape, shape uniformity, and skinning damage. Ten large tubers from each plot were cut longitudinally and inspected for internal defects. Specific gravity was determined by the weight-in-air, weight-in-water method using approximately 10-pound samples of 6- to 10-ounce U.S. No.1s from each plot. Sub-samples of 6- to 10-ounce No.1s were saved from one replication for culinary evaluations in late November.

Procedures Corvallis

Three standard varieties and nine numbered selections were planted in a randomized complete block design with four replications on May 19. The trial also included a number of other red-skinned and russet varieties and selections. Individual plots were single rows with 30 hills, 9.5-inch seed spacing, and 34-inch row spacing. Standard cultural practices were followed for disease and pest control. Vines were removed mechanically on September 7, eight days after application of 1.0 pint/acre of Diquat. Tubers were harvested on September 13 and graded in late September. Specific gravity was determined by the weight-in-air, weight-in-water method on 10-pound samples of 8- to 12-ounce U.S. No.1s. Twenty-five U.S. No.1 tubers from each plot were cut and inspected for internal defects. Size grades included; Cs (<1.75-inch diameter), Bs (1.75- to 2.25-inch diameter), 4- to 12-ounce, and over 12-ounce for U.S. No.1s. Tubers not meeting U.S. No.1 grade standards were lumped together as culls.

Procedures Sherwood

Varieties and selections, experimental design, plot size, and other procedural details were the same as described for the Corvallis experiment. Potatoes were planted on May 25 and harvested on September 6.

Procedures Bakerfield

Ten KES advanced red-skinned clones were planted with other selections in a randomized complete block design experiment with four replications in the Bakersfield, California area on February 7. Individual plots were one row, 27-hills, with 11-inch seed spacing in 32-inch rows. Standard local cultural practices were followed. Tops were removed mechanically three weeks prior to harvest on June 20. All tubers from each plot were graded the day after harvest. Size grades included; Bs (under 4 ounces), 4- to 6-ounce, 6- to 10-ounce, and over 10-ounce for No.1s. Specific gravity was determined with the hydrometer method.

Procedures Tulelake

Advanced KES selections were included in two separate experiments that also included other red-skinned varieties and selections. In both studies, individual plots were one row, 27-hills, with 9-inch seed spacing in 34-inch rows and four replications. Potatoes were planted on May 10 and harvested on September 20. Standard cultural practices were followed. Vines were desiccated with 1.0 pint/acre of Diquat applied on September 3. All tubers from each plot were graded as described for Bakersfield.

Results and Discussion

Due to the inclusion of other selections not derived from the KES program in the Willamette Valley and California trials, data were not subjected to statistical analysis. However, general trends in relative yields, tuber size distribution, and other important characteristics over a wide range of soil and climatic conditions, provided sufficient information for decisions on disposition of selections.

Seed sources for the KES advanced selections included KES, COARC, and two California seed increase plots. Several of the seed lots had up to 10 percent virus content and also experienced seedpiece decay problems. Reduced emergence and plant vigor affected performance of several clones at each site. The problems experienced were related to seed production management, but also are an indication of genetic weaknesses. They provided an opportunity to eliminate several selections that would probably experience similar problems in commercial production in the future.

Plant and tuber characteristics were monitored at each location. Data are only presented for the KES trial (Table 4). Five of the advanced selections experienced reduced emergence at KES and at other sites. Standard varieties achieved excellent emergence and normal vigor. Most of the selections exhibited better skin color, shallower eyes, and better tuber size and shape uniformity than Red LaSoda.

Yield, tuber size and grade, and specific gravity data from each trial site are presented in Tables 5, 6, and 7, and summarized over locations for two standard varieties and seven numbered selections in Table 8. Red LaSoda produced high yields, but excessive tuber size at all locations. NDO2438-6R and COO86107-1R were the most consistent selections across locations, with relatively high yields and smaller tuber size than Red LaSoda. Both selections were rated among the best in tuber appearance at each location. These selections will be advanced to the regional red-skinned trials in 1995. All other selections will be discarded.

Procedures

V. REGIONAL RED-SKINNED VARIETY TRIAL

Three standard varieties and 11 numbered selections were planted in a randomized complete block design with four replications on May 11. Individual plots were single rows, 22 feet long, with 30 hills spaced at 8.7 inches in 32-inch rows. All cultural practices and other procedures were the same as described for the KES advanced red-skinned variety trial.

Results and Discussion

Most of the selections emerged rapidly with final stands above 90 percent (Table 9). Sangre-14 was slow to emerge due to long dormancy.

Delayed emergence, reduced stands, and poor early season vigor were observed in the three KES selections, NDO2438-7R, NDO2469-1R, and NDO2686-6R. About 10 percent of plants in NDTX8-731-1R and NDO2469-1R expressed potato virus Y infection symptoms. Similar observations were noted at other trial locations. The average emergence over eight locations was 72, 76, and 62 percent for NDO2438-7R, NDO2469-1R, and NDO 2686-6R, respectively. These problems were apparently related to seed production management in the COARC seed increase plots at Madras, Oregon. This will be discussed further at the end of this report.

Typical vine maturity differences were observed in the three standard varieties. Two numbered selections, CO86142-3R and NDO2686-6R, appeared to be earlier than Dark Red Norland. Late maturity was noted for A83359-5R and AD82745-1R. Tuber appearance ratings indicated better skin color and shallower eyes in most selections than in Red LaSoda. A83359-5R had relatively deep eyes and was the only selection that had a serious skinning problem. The KES maturity and appearance ratings were quite consistent with ratings reported at seven other locations in five states.

Red LaSoda produced very high yields, but tuber size was excessive (Table 10). Several other selections also had high yields of tubers over 10 ounces. ND1871-3R produced the best combination of yield and size distribution. CO86142-3R and NDO2686-6R had the highest yields of tubers under 6 ounces, the most desirable size for red-skinned markets. The poor stand in NDO2686-6R undoubtedly reduced its yield and resulted in larger tuber size than would have occurred with better plant populations.

Most of the selections will remain in the regional trial for at least one more year. A83359-5R will be discarded due to deep eyes, late maturity, and skinning damage. These characteristics were all noted in the 1993 trials. ND1871-3R is expected to be named and released from the North Dakota program in the near future. It produced high yields with size distribution similar to Dark Red Norland in 1993. It had moderately deep eyes but excellent skin color in both years at KES. It will remain in trial for one more year if it is not released.

NDTX8-731-1R is being discarded. It has relatively deep eyes, produces excessive size, experiences growth cracks in large tubers, and is susceptible to hollow heart and brown center. It had the lowest culinary quality score of all red-skinned entries in KES tests in both 1993 and 1994.

Uncertainty about the origin of AD82745-1R surfaced in 1993. This clone may actually be A82705-1R. Data averaged over all locations in both 1993 and 1994 suggest this may be the case. Further investigation of this possibility is in progress.

NDO2438-7R demonstrated tolerance to late blight in a 1993 trial conducted at Sherwood, Oregon. It was included in a 1994 late blight screening trial conducted in Washington. Foliage infection was less severe in NDO2438-7R than in most other selections in the trial and no tuber infection was detected in NDO2438-7R. A high level of tolerance to late blight would be a very significant attribute for this clone, which also has good yield and appearance characteristics.

Summary

Improvements in uniformity of data across locations occurred in the second year of the regional red-skinned variety trial. New sites were established at Aberdeen, Idaho and Corvallis, Oregon, increasing the number of locations to eight. The 1994 results indicate the need for improved trial management to avoid excessive tuber size. Markets for reds pay significantly higher prices for tubers under 6 ounces. There is little demand for reds over 10 ounces. Earlier vine desiccation and higher plant populations would be beneficial at most locations, including KES.

In 1993, the COARC seed increase program for red selections was moved from Powell Butte to Madras to avoid an intermittent powdery scab problem. The result appears to be increased risk for virus infections in an area with greater aphid activity. Seed production practices were modified in 1994 to increase roguing, conduct more leaf testing, and kill vines earlier. Greenhouse testing of 1994 seed lots will determine the success of these efforts. If virus infection levels are not reduced it may be necessary to move the seed increase back to Powell Butte in 1995.

The regional red-skinned variety trials have identified several selections that consistently produce acceptable yields with better tuber size distribution and appearance than Red LaSoda, the standard variety grown in the western states. The release of one or more superior red-skinned varieties from this program within two or three years seems quite likely.

Table 1. Single-hill red-skinned potato seedlings selected at Klamath Falls, OR, 1994.

	Parents		Number of	No. selected	
Family No.	**female**	**male**	**plants**	**fall**	**winter**
NDO5122	Fontenot	Reddale	30	0	0
NDO5148	Reddale	1618-13R	19	1	0
NDO5149	Reddale	1871-3R	19	1	1
NDO5150	Reddale	3630-17R	50	3	1
NDO5179	Minn15620	3994-2R	24	0	0
NDO5181	Minn15622	4001-1R	13	1	0
NDO5182	Minn15622	4407-8R	30	1	0
NDO5197	W1100R	2050-1R	21	1	0
NDO5220	1618-13R	2225-1R	43	2	1
NDO5222	1871-3R	Reddale	78	4	1
NDO5224	2050-1R	Reddale	33	0	0
NDO5226	2224-5R	Reddale	29	2	0
NDO5228	2225-1R	Reddale	40	0	0
NDO5229	2225-1R	1871-3R	57	10	1
NDO5230	2225-1R	3630-17R	23	1	0
NDO5289	3630-17R	1618-13R	16	0	0
NDO5290	3630-17R	1871-3R	98	13	3
NDO5291	3630-17R	4001-1R	74	7	6
NDO5407	4224-1R	3630-17R	15	1	0
NDO5434	4332-4R	1618-13R	74	0	0
NDO5437	4339-10R	1618-13R	152	13	8
NDO5464	4398-1R	1618-13R	142	9	3
NDO Sub-Total			**1,130**	**70**	**25**
AO92653	A82705-1R	NDO2686-6R	100	3	1
AO92654	A82705-1R	NDO3503-2R	122	7	2
AO92655	COA87154-1R	TW4	326	21	9
AO92656	NDO2686-6R	COA87154-1R	64	4	1
AO92657	NDO2686-6R	NDO3503-2R	118	16	7
AO92658	NDO2686-6R	TW4	277	11	3
AO92659	NDO3503-2R	TW4	247	9	4
AO Sub-Total			**1,318**	**71**	**27**
Total			**2,448**	**141**	**52**

Table 2. Second-year red-skinned potato selections retained for further evaluation out of 30 tested at Klamath Falls, OR, 1994.

Clone	Parents female	Parents male	Vine vigor [1]	Vine maturity [2]
NDO5003-1R	3504-3R	2050-1R	3	2
NDO5082-1R	4035-1R	1871-3R	4	4
NDO5108-1R	4128-5R	2225-1R	4	2
AO91852-2R	ND2224-5R	NDO2438-7R	3	1

1/ Vigor: 1 - small plant; 5 - large plant

2/ Maturity: 1 - early; 5 - late

Table 3. Third and fourth-year red-skinned potato selections retained for further evaluation from the 13 clones evaluated at Klamath Falls, OR and Tulelake and Bakersfield, CA in 1994.

Clone	Parents female	Parents male	Vine vigor	Vine maturity
NDO4300-1R	1196-2R	2225-1R	3	2
NDO4323-2R	1871-3R	LA 12-59	4	3
NDO4333-1R	2050-1R	NDTX9-1068-11R	4	5
NDO4578-1R	Norland	1196-2R	5	2
NDO4588-5R	Reddale	2050-1R	5	3
NDO4592-3R	Reddale	3198-1R	5	2
NDO4615-1R	LA 12-59	2050-1R	4	4
NDO4784-2R	3574-5R	2050-1R	4	3

Table 4. Plant and tuber characteristics of red-skinned potato varieties and advanced selections grown at Klamath Falls, OR, 1994.

Variety / selection	Percent stand	Vine vigor[1]	Vine maturity[2]	Appearance ratings[3]				
				color	eyes	shape	uniformity	skinning
Red LaSoda	100	4.5	2.9	3.8	1.3	1.5	1.5	4.0
Sangre-14	98	2.3	3.0	4.3	4.0	2.2	4.0	5.0
D.R. Norland	100	4.5	1.6	3.5	4.0	2.0	2.0	4.0
NDO2438-6R	96	2.8	2.1	4.8	4.3	1.3	3.5	4.2
NDO2438-9R	91	3.8	1.6	4.8	5.0	1.0	4.0	3.5
NDO2686-4R	80	3.3	1.9	4.5	5.0	1.0	4.0	4.0
NDO3846-3R	63	1.3	2.2	4.0	4.0	2.0	3.0	3.5
NDO3846-9R	67	1.3	1.9	3.8	5.0	1.0	2.0	3.8
NDO3849-12R	92	2.8	2.0	5.0	5.0	1.0	4.8	4.5
NDO3994-2R	79	2.8	3.0	4.8	4.5	1.0	3.5	2.5
NDO4001-2R	94	2.5	3.2	5.0	3.5	1.0	3.8	4.8
NDO4030-12R	83	3.3	2.5	4.5	5.0	1.0	3.5	2.8
COO86107-1R	95	4.0	1.9	5.0	5.0	2.0	4.5	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 grown at Klamath Falls, OR, 1994.

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	103	255	365	723	49	115	886	1.077
Sangre-14	170	207	129	506	103	13	622	1.073
D.R. Norland	127	212	137	476	78	25	580	1.064
NDO2438-6R	131	223	225	578	49	34	661	1.067
NDO2438-9R	142	119	39	300	102	17	418	1.059
NDO2686-4R	116	106	36	258	116	12	386	1.071
NDO3846-3R	75	138	108	321	33	34	387	1.063
NDO3846-9R	81	116	80	276	40	63	379	1.065
NDO3849-12R	146	172	90	407	96	7	510	1.064
NDO3994-2R	161	188	130	478	121	35	633	1.072
NDO4001-2R	150	217	78	445	77	41	563	1.077
NDO4030-12R	112	152	132	395	95	31	521	1.073
COO86107-1R	129	220	170	518	58	7	584	1.079
Mean	126	179	132	437	78	33	548	1.069
CV (%)	19	19	33	13	21	57	11	0.2
LSD (0.05)	33	49	62	79	24	27	84	0.003

Table 6. Yield and specific gravity of red-skinned potato varities and advanced selections grown at Corvallis and Sherwood, OR, 1994.

Variety / selection	Yield U.S. No. 1s 4-12 oz	Yield U.S. No. 1s > 12 oz	Yield U.S. No. 1s Total	Yield Cs	Yield Bs	Yield Culls	Yield Total	Specific gravity
	cwt / A							
Corvallis								
Red LaSoda	313	283	596	9	25	35	664	1.066
Sangre-14	308	249	557	7	23	54	642	1.069
D.R. Norland	475	199	674	10	38	37	759	1.067
NDO2438-6R	327	233	560	16	43	39	657	1.059
NDO2438-9R	322	32	354	14	71	13	452	1.063
NDO2686-4R	317	20	337	12	47	9	405	1.068
NDO3846-3R	248	83	331	12	34	29	405	1.061
NDO3849-12R	181	44	225	5	19	3	251	1.060
NDO3994-2R	258	74	332	28	60	17	436	1.063
NDO4001-2R	275	104	379	8	23	136	546	1.060
NDO4030-12R	219	108	327	17	34	11	389	1.064
COO86107-1R	337	155	492	15	39	36	580	1.075
Mean	298	132	430	13	38	35	516	1.065
Sherwood								
Red LaSoda	379	53	432	7	33	75	547	1.069
Sangre-14	228	38	266	9	40	38	353	1.072
D.R. Norland	383	21	404	11	72	34	521	1.075
NDO2438-6R	272	35	307	15	48	13	382	1.063
NDO2438-9R	229	2	231	28	87	16	362	1.061
NDO2686-4R	216	3	219	16	87	6	328	1.070
NDO3846-3R	152	9	161	6	32	11	209	1.054
NDO3994-2R	140	2	142	14	60	7	221	1.054
NDO4001-2R	208	4	212	7	35	22	276	1.065
NDO4030-12R	184	11	195	12	44	8	259	1.064
COO86107-1R	288	10	298	11	68	29	406	1.082
Mean	244	17	261	12	55	24	351	1.066

Table 7. Yield and specific gravity of red-skinned potato varieties and advanced selections grown at Bakersfield and Tulelake, CA, 1994.

Variety / selection	Yield U.S. No. 1s 4-6 oz	Yield U.S. No. 1s 6-10 oz	Yield U.S. No. 1s > 10 oz	Yield U.S. No. 1s Total	Yield Bs	Yield Culls	Yield Total	Specific gravity
	cwt / A							
Bakersfield								
Red LaSoda	42	196	218	455	17	41	514	1.076
Sangre-14	49	168	63	281	23	39	343	1.077
NDO2438-6R	93	205	127	425	33	32	489	1.069
NDO2438-9R	44	158	19	220	33	20	273	1.058
NDO2686-4R	88	134	5	227	44	7	278	1.079
NDO2686-10R	106	150	72	329	41	24	394	1.069
NDO3846-3R	86	149	27	263	61	21	345	1.074
NDO3846-9R	98	142	14	255	37	19	312	1.073
NDO3849-12R	73	184	58	314	52	6	372	1.073
NDO4001-2R	112	304	112	529	32	13	573	1.083
NDO4030-12R	128	200	82	410	66	29	505	1.077
COO86107-1R	83	216	87	386	29	20	436	1.086
Mean	84	184	74	341	39	23	403	1.075
Tulelake								
Red LaSoda	56	168	319	543	4	42	590	1.073
Sangre-14	82	212	209	503	15	72	590	1.077
NDO2438-6R	86	158	297	541	15	11	567	1.070
NDO2438-9R	85	156	104	345	18	6	369	1.069
NDO2686-4R	59	136	66	261	12	13	286	1.076
NDO2686-10R	86	204	153	443	27	49	519	1.069
NDO3846-3R	29	107	123	259	9	10	278	1.069
NDO3846-9R	73	155	121	349	13	15	377	1.073
NDO3849-12R	68	197	153	418	17	3	438	1.071
NDO4001-2R	98	237	64	399	26	10	435	1.082
NDO4030-12R	72	182	207	461	17	4	482	1.083
COO86107-1R	93	169	184	446	13	4	463	1.078
Mean	74	173	167	414	16	20	450	1.074

Table 8. Mean yield and specific gravity of red-skinned potato varieties and advanced selections over 5 locations, 1994.

Variety / selection	Yield						Specific gravity
	Bs	4-10 oz[1]	Marketable[3]	> 10 oz[2]	Culls	Total	
	cwt/A						
Red LaSoda	29	302	331	248	62	641	1.072
Sangre-14	44	285	329	138	43	510	1.074
NDO2438-6R	48	299	347	183	26	556	1.066
NDO2438-9R	70	251	321	39	14	374	1.062
NDO2686-4R	67	234	301	26	9	336	1.073
NDO3846-3R	37	197	234	70	21	325	1.064
NDO4001-2R	42	320	362	72	44	478	1.073
NDO4030-12R	57	270	327	108	17	452	1.072
COO86107-1R	47	307	354	121	19	494	1.080
Mean	49	274	323	112	28	463	1.071

1/ 4 -12 oz at Corvallis and Sherwood locations

2/ > 12 oz at Corvallis and Sherwood locations

3/ Bs plus U.S. No. 1s 4 - 10 oz

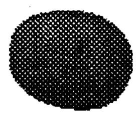


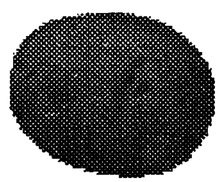
Table 9. Plant and tuber characteristics of red-skinned potato varieties and advanced selections in the western regional red variety trial at Klamath Falls, OR, 1994.

Variety /	Percent	Vine	Vine	Appearance rating[3]				
selection	stand	vigor[1]	maturity[2]	Color	Eyes	Shape	Uniform	Skin
Red LaSoda	100	5.0	2.6	3.0	1.0	2.0	2.5	4.5
Sangre-14	97	2.8	3.2	3.5	3.8	1.5	3.8	5.0
Dark Red Norland	97	4.0	2.0	4.5	3.8	2.0	3.0	4.8
A82705-1R	98	2.8	3.2	5.0	3.8	1.8	3.8	4.3
AD82745-1R	98	2.3	4.0	5.0	4.0	2.0	2.8	4.0
A83359-5R	94	2.8	5.0	4.5	2.3	1.0	2.3	2.0
CO86142-3R	100	4.8	1.5	4.0	5.0	1.0	4.0	4.5
CO86218-2R	97	3.0	3.0	3.0	5.0	1.0	4.0	5.0
COTX86146-2R	93	2.8	2.5	4.5	4.5	1.0	3.0	3.0
ND1871-3R	99	3.8	2.5	5.0	3.0	1.0	4.5	4.5
NDTX8-731-1R	93	3.5	2.9	4.5	3.0	1.0	4.0	4.5
NDO2438-7R	83	3.3	2.5	4.8	4.0	2.0	3.5	4.5
NDO2469-1R	88	3.0	3.0	4.5	4.0	1.8	4.5	4.0
NDO2686-6R	78	3.3	1.8	5.0	5.0	1.0	4.8	4.5

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

Table 10. Yield and specific gravity of red-skinned potato varieties and advanced selections in the western regional red variety trial at Klamath Falls, OR, 1994.

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	107	225	371	703	49	75	827	1.076
Sangre-14	150	201	91	442	86	2	530	1.071
Dark Red Norland	114	182	135	432	67	22	521	1.066
A82705-1R	124	247	203	574	66	22	661	1.071
AD82745-1R	84	187	370	642	46	17	704	1.072
A83359-5R	108	198	315	621	45	24	689	1.074
CO86142-3R	168	155	50	373	126	26	525	1.078
CO86218-2R	130	164	119	413	69	14	495	1.075
COTX86146-2R	83	151	360	594	42	21	657	1.071
ND1871-3R	145	231	134	510	106	18	634	1.072
NDTX8-731-1R	81	182	307	569	48	18	635	1.069
NDO2438-7R	102	183	217	502	34	18	554	1.069
NDO2469-1R	170	177	114	460	92	20	571	1.082
NDO2686-6R	159	121	55	334	117	4	456	1.071
Mean	123	186	203	512	71	21	604	1.073
CV (%)	23	24	34	14	28	67	11	0.3
LSD (0.05)	41	63	99	103	28	21	97	0.003



Potato Cultivar Response to Seed Spacing and Nitrogen Fertilizer Rate

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

Introduction

New potato varieties are gradually replacing the dominant Russet Burbank variety in the Klamath Basin and other areas in the northwest. Russet Norkotah acreage increased to at least 30 percent of the Klamath Basin crop in 1994. Chipping varieties are also on the increase and will account for over 1,000 acres of the 1995 crop. Several advanced selections from the Oregon and regional variety development programs nearing release appear to have potential for local production for fresh market use. These new varieties may have different cultural management requirements than Russet Burbank for optimum performance. Experiments were initiated at KES in 1988 to evaluate the response on new varieties and advanced selections to plant population and nitrogen fertilizer rates. In 1994, five varieties and five advanced selections were evaluated.

Procedures

Ten varieties or advanced selections were evaluated in two separate split-plot design experiments with four replications. Standard practices were followed for pest and disease control, and irrigation (pages 38 and 39). Weed control practices included Eptam applied at 3.0 lb ai/acre on May 25 and metribuzin applied aerially at 0.6 lb ai/acre on June 29. Potatoes were planted with a two-row assisted-feed planter in 32-inch rows on May 12 and May 13. Vines were desiccated with Diquat applied at 1.0 pint/acre with a ground sprayer on September 12.

In the seed spacing experiment, main plots were spacings of 6.8, 8.7, or 12.0 inches. Split-plots were two rows, 30 feet long. Fertilizer included 730 lb/acre of 16-8-8-14S banded at planting and 30 lb N/acre applied as Solution 32 with a ground sprayer and incorporated with a rolling cultivator on May 25. Potatoes were harvested with a one-row digger-bagger on

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September 28. Field weights were determined for all tubers from both rows. Approximately 120-pound samples from each plot were stored and graded to USDA standards in late October. 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. Ten large tubers from each plot were cut longitudinally and inspected for internal defects.

The nitrogen fertilizer rate experiment included main plot treatments of 130, 160, or 190 lb N/acre and split-plot treatments of ten varieties or advanced selections. Fertilizer was banded at planting at 730 lb/acre of 16-8-8-14S. Solution 32 was applied at rates of 0, 30, or 60 lb N/acre with a ground sprayer and incorporated with a rolling cultivator on May 25. Individual plots were four rows, 30 feet long. The outside two rows were planted with Russet Burbank with seedpieces spaced at 12 inches. Varieties or advanced selections were planted at 8.7-inch seed spacing in the center two rows. Seed for both experiments was hand cut to 1.5 to 2.0 ounces/seedpiece, treated with Tops 2.5 fungicide, and suberized for 10 days prior to planting. Potatoes were harvested from the center two rows on October 5. Harvest and grading procedures were the same as described for the seed spacing experiment.

Results and Discussion

Response to seed spacing

Plant emergence data were recorded on June 6 and June 16. Most of the selections reached 75 and 95 percent emergence at 24 and 34 days after planting, respectively. NDO2904-7 and AO85165-1 were 50 and 40 percent emerged on June 6, and 80 and 90 percent emerged on June 16, respectively. AO85165-1 eventually achieved 95 percent emergence. NDO2904-7 remained at about an 80 percent stand due to seedpiece decay. Percent emergence was not affected by seed spacing. The poor stands in NDO2904-7 resulted in reduced yields and larger tuber size in this selection. This selection also was affected by virus Y infection in about 10 percent of the plants.

A generally favorable growing season resulted in relatively high total and U.S. No. 1 yields in all selections (Tables 1 and 2). Response to increased seed spacing followed expected trends including; reduced yields of tubers under 6 ounces, increased yield of tubers over 10 ounces, and only minor changes in total yield. Total No.1 yields increased numerically up to the 12-inch seed spacing in all selections except Century Russet, COO83008-1, and NDO2904-7. The 12-inch seed spacing produced substantially higher No.1 yields than higher plant populations in Russet Burbank and Snowden (Table 1). Plant population had little effect on total U.S. No.1 yield for Century Russet, COO83008-1, and NDO2904-7. Other selections produced marginally higher No.1 yields at 12-inch spacing. Excessive tuber size was observed at the 12-inch seed spacing in NDO2904-7 and AO85165-1. Seed spacing did not affect yields of No.2 tubers or specific gravity. Averaged over all selections, differences between seed spacing treatments were statistically significant for yield of 4- to 6-ounce, over 10-ounce, total No.1s, Bs, and culls (Table 2). Few internal defects were found in any of the selections. AO85165-1 had nearly 10 percent hollow heart in tubers examined. Hollow heart incidence was less than 3 percent in all other selections and was not affected by seed spacing.

Century Russet produced significantly higher total No.1 and total yield than all other selections (Table 2). AO85165-1 achieved significantly higher yields than all others except Century Russet. COO83008-1 was third highest in No.1 yields. Russet Norkotah, Goldrush, and AO82611-7 were similar in yield of No.1s, but AO82611-7 produced more small tubers than Goldrush or Norkotah. Snowden and NDO1496-1 were very similar in yield and size distribution, with a high yield of small tubers. The poor stands and virus infection in NDO2904-7 probably contributed to the significantly lower yields in this selection than in Russet Norkotah. In previous years this selection has produced higher yields than Norkotah. Russet Burbank was significantly lower in No.1 yields than all other selections and had the highest yield of No.2s and culls.

Response to nitrogen rate

Plant stands were similar to those observed in the seed spacing experiment. NDO2904-7 and AO85165-1 achieved 78 and 88 percent emergence, respectively. All other selections exceeded 90 percent emergence 33 days after planting. Poor stands affected yield and size distribution in NDO2904-7.

The relative ranking of varieties and selections was the same as in the seed spacing trial (Tables 3 and 4). Russet Burbank, Snowden, and NDO1496-1 produced high yields of Bs and relatively low yields of 10-ounce tubers. Russet Burbank was significantly higher in No.2 and cull yields than all other selections. Averaged over all selections, nitrogen rate had little effect on yield or size distribution. Nitrogen rate was statistically significant only for yield of Bs and specific gravity. The interaction between nitrogen rate and variety was not significant for any parameter. In general, the nitrogen rates evaluated had little effect on yield, grade, or tuber size distribution for any of the varieties.

The incidence of hollow heart and brown center was similar to observations in the seed spacing experiment. AO85165-1 had approximately 20 percent hollow heart in the tubers inspected, all of which were over 16 ounces in weight. All other selections had less than 5 percent hollow heart or brown center. Corky ringspot (CRS), caused by tobacco rattle virus, was observed in all selections except Russet Norkotah. The site for this experiment was adjacent to a field that has been used for nematode research for several years. This was the first time CRS has been observed in crops grown at this location. Apparently, stubby-root nematodes, the vector for tobacco rattle virus, have recently moved to this area. Century Russet had the highest incidence of CRS. Over 40 percent of the tubers examined were infected. About 25 percent infection was observed in COO83008-1, AO82611-7, and NDO1496-1, and 10 percent or less in the remaining selections.

Three-year Summary

The 1994 experiments completed three years of evaluation for COO83008-1 and AO82611-7. The response of these selections and Russet Burbank and Russet Norkotah to seed spacing and nitrogen rates over 1992, 1993, and 1994 are shown in Tables 5 and 6. Averaged over years, Russet Burbank and AO82611-7 produced the numerically best yield and tuber size at 12-inch seed spacing. The 8.7-inch spacing appeared to be optimum for Norkotah and COO83008-1. Differences were not statistically significant. Both Norkotah and COO83008-1 produced excessive tuber size at 12-inch spacing. Effects of nitrogen rate on yields and size were inconsistent from year to year and were not significant averaged over years.

Summary

These experiments have provided an opportunity to compare the performance of many new varieties and advanced selections to standard varieties over a range of growing season conditions. Seed spacing responses have been quite consistent from year to year for most selections. Nitrogen rate responses over the limited range of rates evaluated have been quite inconclusive. In consideration of declining resources to support this research, and the relative value of data obtained, the nitrogen rate study will be discontinued. Promising clones from Oregon and regional variety development programs will continue to be evaluated for response to seed spacing.

Table 1. Effects of seed spacing on performance of 10 potato selections, Klamath Falls, OR, 1994.

Variety / selection	Seed spacing	Yield U.S. No. 1s 4-6 oz	6-10 oz	>10 oz	Total	Yield Bs	2s	Culls	Total	Specific gravity
	inches	cwt /A								
R. Burbank	6.8	141	114	25	281	163	60	21	525	1.089
	8.7	117	122	56	295	109	98	46	548	1.091
	12.0	125	145	78	347	82	68	9	506	1.092
R. Norkotah	6.8	115	179	89	382	83	8	0	472	1.072
	8.7	94	178	145	417	47	13	4	481	1.070
	12.0	61	162	220	442	29	14	4	488	1.072
Century R.	6.8	159	277	128	564	85	9	6	664	1.086
	8.7	148	272	153	573	78	6	0	657	1.088
	12.0	116	235	209	559	40	8	0	607	1.087
Goldrush	6.8	86	150	114	350	77	65	6	496	1.073
	8.7	89	159	154	401	53	55	3	512	1.072
	12.0	68	132	221	421	39	57	0	517	1.072
Snowden	6.8	156	146	41	343	171	5	2	520	1.092
	8.7	154	148	22	323	165	2	0	490	1.092
	12.0	153	215	58	425	115	3	2	544	1.094
COO83008-1	6.8	79	187	176	442	44	13	0	499	1.095
	8.7	70	179	212	461	33	17	2	512	1.095
	12.0	58	123	246	427	27	26	5	485	1.098
AO82611-7	6.8	152	194	64	409	102	25	0	536	1.089
	8.7	147	180	84	410	63	40	2	515	1.094
	12.0	111	193	117	421	52	40	2	514	1.093
NDO2904-7	6.8	54	114	171	339	57	9	2	406	1.068
	8.7	60	93	192	344	36	8	1	388	1.067
	12.0	54	79	206	338	22	12	4	376	1.070
AO85165-1	6.8	108	193	191	492	79	7	1	579	1.086
	8.7	105	207	202	514	51	15	1	580	1.086
	12.0	83	176	291	550	31	30	1	613	1.084
NDO1496-1	6.8	123	150	42	315	151	1	4	470	1.089
	8.7	127	178	66	370	130	8	3	510	1.089
	12.0	115	188	82	385	89	6	1	480	1.095

Table 2. Effects of variety and seed spacing on performance of potato selections, Klamath Falls, OR, 1994.

Variety / selection	Seed spacing	Yield U.S. No. 1s				Yield				Specific gravity
		4-6 oz	6-10 oz	>10 oz	Total	Bs	2s	Culls	Total	
	inches	cwt /A								
Variety effect (average of three spacings)										
R. Burbank		128	127	53	308	118	75	25	526	1.091
R. Norkotah		90	173	151	414	53	11	3	480	1.071
Century R.		141	261	163	565	68	8	2	643	1.087
Goldrush		81	147	163	391	56	59	3	509	1.072
Snowden		154	169	40	364	150	3	1	518	1.093
COO83008-1		69	163	211	443	35	18	2	499	1.096
AO82611-7		136	189	88	413	72	35	1	521	1.092
NDO2904-7		56	95	190	340	38	9	2	390	1.068
AO85165-1		99	192	228	519	54	17	1	590	1.085
NDO1496-1		122	172	63	356	123	5	3	487	1.091
CV (%)		17	16	21	8	21	60	155	5	0.3
LSD (0.05)		15	22	23	25	13	12	5	22	0.002
Seed spacing main effect (average of ten selections)										
	6.8	117	170	104	392	101	20	4	517	1.084
	8.7	111	171	129	411	76	26	6	519	1.084
	12.0	94	165	173	431	52	26	3	513	1.086
CV (%)		17	13	27	14	21	75	102	8	0.4
LSD (0.05)		10	NS	20	32	9	NS	3	NS	NS

Table 3. Effects of nitrogen fertilizer rate on performance of 10 potato selections, Klamath Falls, OR, 1994.

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
	lb N/A	cwt/A								
R. Burbank	130	99	161	71	330	141	65	1	537	1.089
	160	127	138	67	332	141	54	17	545	1.088
	190	124	154	45	323	122	64	28	537	1.087
Norkotah	130	97	205	165	467	71	11	1	549	1.068
	160	104	186	154	444	76	6	0	526	1.067
	190	116	193	137	446	70	8	3	527	1.067
Century R.	130	153	263	151	566	84	14	3	667	1.081
	160	161	238	169	568	95	4	1	668	1.081
	190	156	265	185	605	83	15	1	705	1.079
Goldrush	130	99	160	120	379	53	54	4	490	1.069
	160	79	155	165	398	62	40	0	500	1.069
	190	88	155	155	399	50	59	6	513	1.070
Snowden	130	161	181	89	431	139	4	5	578	1.090
	160	166	209	56	430	154	3	2	589	1.092
	190	161	246	83	490	113	7	6	615	1.089
CO083008-1	130	89	171	190	451	48	15	1	515	1.088
	160	88	175	182	445	50	8	1	504	1.092
	190	92	150	163	405	51	28	8	491	1.088
AO82611-7	130	130	211	116	457	92	21	5	574	1.088
	160	118	185	134	437	94	31	5	567	1.089
	190	132	172	149	453	79	32	3	568	1.087
NDO2904-7	130	67	120	186	373	45	14	5	436	1.063
	160	65	103	214	357	42	12	3	439	1.067
	190	76	106	213	395	41	8	1	445	1.066
AO85165-1	130	74	192	291	582	54	8	0	619	1.080
	160	86	182	268	536	65	13	1	615	1.083
	190	93	201	271	564	64	16	4	648	1.078
NDO1496-1	130	145	168	69	382	126	0	5	512	1.089
	160	127	178	66	370	130	8	3	510	1.089
	190	115	156	119	390	104	5	3	502	1.090

Table 4. Effects of variety and nitrogen fertilizer rate on performance of potato selections, Klamath Falls, OR, 1994.

Variety / selection	Yield U.S. No 1s				Yield				Specific gravity
	4-6 oz	6-10 oz	>10 oz	Total	Bs	No. 2s	Culls	Total	
	cwt/A								
Variety effect (average of three nitrogen fertilizer rates)									
R. Burbank	117	151	61	328	134	61	15	539	1.088
Norkotah	106	195	152	452	72	8	1	534	1.067
Century R.	157	255	168	580	87	11	2	680	1.080
Goldrush	89	157	147	392	55	51	3	501	1.069
Snowden	163	212	76	450	135	5	4	594	1.090
COO83008-1	90	165	178	433	49	17	3	503	1.089
AO82611-7	126	190	133	449	88	28	5	570	1.088
NDO2904-7	69	110	204	375	43	11	3	440	1.065
AO85165-1	84	191	277	561	61	12	2	627	1.080
NDO1496-1	129	167	85	381	120	4	4	508	1.089
CV (%)	17	13	17	7	16	68	206	6	0.3
LSD (0.05)	16	20	21	26	11	12	7	25	0.002
N-Rate main effect (average of ten selections)									
130 lbs N/A	111	183	145	442	85	21	3	548	1.080
160 lbs N/A	112	175	147	432	91	18	3	546	1.082
190 lbs N/A	115	180	152	447	78	24	6	555	1.080
CV (%)	25	15	19	9	22	65	186	7	0.3
LSD (0.05)	NS	NS	NS	NS	8	6	3	NS	0.001

Table 5. Effects of seed spacing on yield, grade, and specific gravity of Russet Burbank, Russet Norkotah, COO83008-1, and AO82611-7 potatoes grown at Klamath Falls, OR in 1992, 1993, and 1994.

Variety / selection	Seed spacing	Yield U.S. No. 1s				Yield			Specific gravity
		4-6 oz	6-10 oz	> 10 oz	Total	Bs	No. 2s	Total	
	inches	cwt / A							
Russet Burbank	6.8	167	107	32	306	124	34	500	1.085
	8.7	157	124	47	327	104	46	518	1.087
	12.0	149	134	68	350	77	35	483	1.086
	Mean	158	122	49	328	102	38	500	1.086
Russet Norkotah	6.8	141	167	89	397	73	9	489	1.072
	8.7	127	167	124	418	50	12	463	1.073
	12.0	95	155	151	401	36	10	463	1.072
	Mean	121	163	121	405	53	10	472	1.072
COO83008-1	6.8	94	185	171	450	42	7	513	1.089
	8.7	89	173	204	466	35	11	526	1.088
	12.0	76	126	255	457	20	13	505	1.089
	Mean	86	161	210	458	32	10	515	1.089
AO82611-7	6.8	170	184	73	427	92	10	538	1.084
	8.7	154	170	91	415	66	19	512	1.086
	12.0	122	170	137	429	48	17	507	1.087
	Mean	149	175	100	424	69	15	519	1.086

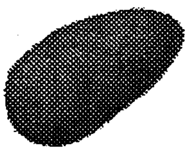
Table 6. Effects of nitrogen fertilizer rate on yield, grade, and specific gravity of Russet Burbank, Russet Norkotah, COO83008-1, and AO82611-7 potatoes grown at Klamath Falls, OR, 1992, 1993, and 1994.

Variety / selection	Nitrogen rate	Yield U.S. No. 1s				Yield			Specific gravity
		4-6 oz	6-10 oz	> 10 oz	Total	Bs	No. 2s	Total	
	lb N/A	cwt / A							
Russet Burbank	130	157	122	55	334	118	36	514	1.086
	160	160	125	62	346	107	36	519	1.083
	190	148	127	57	332	98	31	499	1.082
	Mean	155	125	58	337	108	34	511	1.084
Russet Norkotah	130	112	168	126	406	57	14	492	1.071
	160	121	161	111	393	69	10	483	1.070
	190	115	181	123	419	58	10	496	1.069
	Mean	116	170	120	406	61	11	490	1.070
COO83008-1	130	97	163	189	449	35	10	503	1.086
	160	104	170	172	446	39	8	509	1.087
	190	99	166	189	454	39	10	514	1.084
	Mean	100	166	183	450	38	9	506	1.086
AO82611-7	130	152	183	102	437	77	16	537	1.083
	160	145	173	108	426	78	17	532	1.083
	190	133	172	147	452	60	22	548	1.081
	Mean	143	176	119	438	72	18	539	1.082

Potato Response to Seedpiece Treatment and Cutting Management

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

Introduction



Weather conditions at planting resulted in potato seedpiece decay and stand losses in several fields in the Klamath Basin in both 1992 and 1993. Very dry soil and high soil temperatures in May, 1992 led to seedpiece dehydration when fresh-cut seed was planted and irrigation was not applied within two to four days. Stand losses were over 50 percent in several cases. Cold and wet soil conditions in May, 1993 also produced seedpiece decay problems in several local fields. In both situations, pre-cut and well suberized seed would have been less susceptible to these adverse conditions.

Rhizoctonia is a common problem that affects local crops to varying degrees depending on weather conditions. In the cold and wet spring of 1993, stem and root damage due to Rhizoctonia lesions were common in potato crops. Black scurf on mature tubers, caused by Rhizoctonia sclerotia, is commonly observed, even in years when stem and root lesions are absent. Rhizoctonia can be endemic in soils or introduced on seed. When Rhicoctonia is present on the seed, seedpiece fungicide treatment may reduce damage.

Silver scurf is becoming a serious problem for stored potatoes held for late season fresh market use or seed. Applications of Mertect to tubers going into storage provided good control of silver scurf in some areas in prior years. The pathogen has developed resistance to Mertect in some production areas. Mertect has not been used extensively in the Klamath Basin. It is not known whether local strains of silver scurf are resistent to Mertect. The fungal disease that causes silver scurf can be introduced on seed or persist in the soil from year to year. Fungicidal treatment of infected seed may reduce the incidence of silver scurf.

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Potato Response to Seedpiece Treatment and Cutting Management

This study was initiated in 1994 to evaluate the effects of several commercially available seed treatment fungicides on pre-cut and suberized versus fresh-cut tubers of Russet Norkotah. Russet Norkotah was used because recent experience in the Klamath Basin suggests it is more susceptible to silver scurf infection than Russet Burbank. The seed lot used exhibited a minor level of Rhizoctonia black scurf, but no silver scurf infections.

Procedures

Russet Norkotah tubers were hand cut to 1.5 to 2.0 ounces/seedpiece on May 3 and May 13. Approximately 50 pound samples were treated at each cutting date with Tops 5.0 at 0.5 lb/cwt, Tops 2.5 - MZ at 1.0 lb/cwt, TBZ - Firbark at 1.0 lb/cwt, or Dithane F45 (1.6 fluid ounces/2.5 gal) - Agrimycin 17 (48 ml/2.5 gal) dip. Tubers were immersed in the dip treatment for five minutes. Additional samples were left untreated. Both cut and uncut tubers were stored at approximately 50 °F and 95 percent relative humidity from May 3 to May 13. Treatments were arranged in a 2 X 5 factorial design with four replications of single-row, 42-hill plots. Potatoes were planted with a two-row assisted-feed planter on May 13. Other cultural practices are described on pages 38 and 39.

Emergence data were recorded 21, 24, 28, and 34 days after planting. Vines senesced uniformly in all treatments in late August. Potatoes were harvested with a one-row digger-bagger on September 22. All tubers from each plot were stored and graded in mid-October. Fifty-tuber subsamples were saved from one replication of each treatment and evaluated visually for silver scurf infection in mid-February and mid-March.

Results and Discussion

Soil conditions were excellent at and after planting. Soil temperatures at four inches ranged from 50 to 60 °F throughout May. Precipitation recorded at KES in May included 1.06 inches from May 4 to May 8 and 0.81 inches from May 15 to May 20. Rapid emergence occurred in this experiment with little evidence of Rhizoctonia damage to stems or roots. Effects of cutting time and fungicide treatments on emergence were minor except that the pre-cut untreated control seed was slower to emerge (Table 1). Final stands were above 90 percent for all treatments.

Cutting time did not affect yield, tuber size distribution, or grade (Table 2). Yield differences between fungicide treatments were statistically significant for 8- to 12-ounce No.1s, total No.1s, No.2s, and total yield. The Tops 5.0 treatment was among the lowest in each of these parameters. Tops 2.5 - MZ and TBZ - Firbark treatments produced among the highest yields. Intermediate yields were observed for control and dip treatments. Rhizoctonia black scurf was observed to a minor extent on tubers from all treatments. Differences were not sufficient to make visual ratings of infection levels.

Fifty tubers from each treatment were scored for visual symptoms of silver scurf under a magnifying lamp on February 16 and March 20 (Table 3). With no replication, data must be interpreted with caution. There may have been some suppression of silver scurf by both Tops 2.5 - MZ and TBZ - Firbark treatments. Suberizing seed may have slightly reduced infection levels.

Table 1. Effect of cutting time and fungicide treatments on emergence of Russet Norkotah potatoes at Klamath Falls, OR, 1994.

Cutting time	Fungicide treatment	Percent emergence			
		June 3	June 6	June 10	June 16
May 3	Control	10	37	64	81
	Tops 5.0	25	71	90	96
	Tops 2.5 - MZ	26	58	85	94
	TBZ-Firbark	19	55	81	93
	Dip	17	50	80	95
May 13	Control	22	68	89	94
	Tops 5.0	29	63	88	96
	Tops 2.5-MZ	26	58	78	91
	TBZ-Firbark	21	56	90	98
	Dip	22	54	81	93
Treatment main effects:					
Cutting time:					
May 3		19	54	80	92
May 13		24	60	85	94
Fungicide:					
	Control	16	53	77	88
	Tops 5.0	27	67	89	96
	Tops 2.5-MZ	23	58	82	93
	TBZ-Firbark	20	56	86	96
	Dip	20	52	81	94

Table 2. Effect of cutting time and fungicide treatment on yield and grade of Russet Norkotah potatoes at Klamath Falls, OR, 1994.

Cutting time	Fungicide treatment	Yield U.S. No. 1s				Yield			
		4-8 oz	8-12 oz	>12 oz	Total	Bs	No. 2s	Culls	Total
		cwt/A							
May 3	Control	179	146	88	413	68	35	6	522
	Tops 5.0	225	162	50	436	61	22	0	520
	Tops 2.5 - MZ	212	150	82	444	64	37	4	549
	TBZ-Firbark	195	170	77	441	64	31	1	536
	Dip	199	164	55	417	77	25	3	521
May 13	Control	198	161	65	424	83	21	3	530
	Tops 5.0	178	137	68	382	93	29	1	504
	Tops 2.5-MZ	197	171	74	442	64	43	3	551
	TBZ-Firbark	217	180	64	460	62	29	1	552
	Dip	197	156	73	425	74	41	2	541
Treatment main effects:									
Cutting time:									
May 3		202	158	70	430	67	30	3	529
May 13		197	161	69	427	75	32	2	536
LSD (0.05)		NS	NS	NS	NS	NS	NS	NS	NS
Fungicide:									
	Control	188	154	76	418	75	28	5	526
	Tops 5.0	201	149	59	409	77	26	1	512
	Tops 2.5-MZ	205	160	78	443	64	40	4	550
	TBZ-Firbark	206	175	71	451	63	30	1	544
	Dip	198	160	64	421	75	33	2	531
LSD (0.05)		NS	25	NS	39	NS	12	NS	34
CV (%)		12	15	41	9	27	36	177	6

Table 3. Effect of cutting time and fungicides on incidence of silver scurf in Russet Norkotah potatoes in Klamath Falls, OR, 1994.

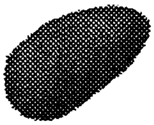
Cutting time	Fungicide treatment	Silver scurf infection[1] February 16	Silver scurf infection[1] March 20
		%	%
May 3	Control	34	48
	Tops 5.0	28	50
	Tops 2.5 - MZ	20	30
	TBZ-Firbark	16	34
	Dip	18	28
May 13	Control	48	68
	Tops 5.0	44	60
	Tops 2.5-MZ	26	36
	TBZ-Firbark	14	18
	Dip	44	74
Treatment main effects:			
Cutting time:			
May 3		23	38
May 13		35	51
Fungicide:			
	Control	41	58
	Tops 5.0	36	55
	Tops 2.5-MZ	23	33
	TBZ-Firbark	15	26
	Dip	31	51

1/ Percent of tubers with any visual symptoms of silver scurf,

Russet Burbank Response to Seedpiece Size

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

Introduction



Numerous studies have demonstrated the importance of seedpiece size to potato performance in production areas across North America. Observations of commercial cut seed lots in the Klamath Basin over several years have shown a lack of uniformity in seed size and a trend for use of smaller than desirable seed. The Russet Burbank variety has plentiful eyes and seedpieces without eyes (blind seed) are uncommon. Most newer varieties have fewer eyes which are less well distributed. It is commonly recommended that larger seedpieces should be used for Russet Norkotah, Shepody, Century Russet, and other varieties with fewer eyes. This study was established to survey local commercial seed cutting practices and conduct a controlled experiment to determine the effects of a range of seedpiece sizes on Russet Burbank performance under Klamath Basin conditions.

Procedures

Approximately 40-pound samples of cut seed were obtained from seven commercial potato growers during the 1994 planting season. Each lot was sorted to seedpiece sizes of: <1.0 oz.; 1.0 to 1.5 oz.; 1.5 to 2.0 oz.; 2.0 to 2.5 oz.; and >2.5 oz. Weight and number of seedpieces in each size fraction were recorded.

A Russet Burbank seed lot was sorted by tuber size to obtain 48 mother tubers weighing approximately 3, 5, 7, 9, and 11 ounces. Tubers were hand cut into four equal sections to provide 192 seedpieces weighing 3/4, 1-1/4, 1-3/4, 2-1/4, and 2-3/4 ounces. Cut seed was treated with Tops 2.5 - MZ and suberized for two weeks prior to planting. Potatoes were planted in randomized complete block design single-row, 32-hill plots with six replications on May 12. Seed was spaced at 12 inches in 32-inch rows.

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Border rows on each side of test rows were planted with 1.5- to 2.0-ounce seedpieces cut from the same Russet Burbank seed lot. Cultural practices are described on pages 38 and 39. Vines were desiccated with Diquat applied at 1.0 pint/acre on September 15. Potatoes were harvested with a one-row digger-bagger on September 26. All tubers from each plot were stored and graded in late October.

Emergence data were recorded on June 3, June 10, and June 16. Stem numbers were counted on 10 consecutive plants in the center of each plot on June 30. An economic interpretation of results was based on the following assumptions:

1. Seed costs, including cutting and treating - $12/cwt.
2. 17,424 seedpieces/acre based on 10-inch seed spacing in 36-inch rows.
3. Crop values: Bs and culls - $1.00/cwt; No.2s - $3.00/cwt; 4- to 8-ounce No.1s - $4.00/cwt; 8- to 12-ounce No.1s - $10.00/cwt; >12-ounce No.1s - $8.00/cwt.
4. Yield of commercial seed lots would be proportional to ratio of seed sizes and experimental yields for comparable seed sizes.
5. Seed costs for commercial seed lots based on average weight of seedpieces in each size fraction.

Results and Discussion

Slightly earlier emergence was observed in plants with larger seedpieces (Table 1). Final stands were unaffected by seed size. Plant size during the first four weeks after emergence was directly correlated with seedpiece size. Stem numbers increased as seedpiece size increased. All of these characteristics were consistent with reports of other studies.

Yields and tuber size distribution were significantly affected by seedpiece size (Table 2). The greatest yield increase occurred between 3/4- and 1-1/4-ounce seed. The maximum tuber yield of No.1s over 8 ounces was observed for 1-3/4-ounce seed. Larger seedpieces produced higher yields of small tubers. Using crop values assumed for the various yield components, the highest gross crop value occurred at the 1-3/4-ounce seedpiece size.

Crop value estimates are based on approximate 1994-1995 fresh market prices for product at the packing shed less some of the costs for processing. However, the average return of about \$6.00/cwt estimated using these prices is nearly 50 percent above average returns received by local growers on 1994 crops. The \$6.00/cwt returns to growers would be a reasonable long term average for fresh market crops.

Data from the grower seed lot survey shows a very wide range in seedpiece size distribution (Table 3). Sample numbers 1 and 2 represent seed lots with excessive numbers of small seedpieces. Excessively large seedpieces were observed in sample number 3. Sample numbers 6 and 7 were clearly the best in size distribution. Seed costs were calculated for each seed lot assuming one seedpiece for each hill at 10-inch spacing. In fact, very small seed often drops as doubles or triples. This would result in higher seed costs than reported for lots with a high ratio of seedpieces under 1.0 ounces. Samples evaluated included four machine cut lots (sample numbers 1, 2, 4, and 6), and three hand cut lots. Better seed size distribution occurred in hand cut lots, except in the case of sample number 3.

Gross crop returns for grower seed lots were estimated based on the percent of each seedpiece size fraction, the yields observed for that size fraction in the experiment, and values assigned for yield components (Table 3). The estimates show a range of over \$300/acre in gross crop value. When seed costs are subtracted, the estimated returns are about \$200/acre higher for seed lots 5, 6, and 7 than for sample number 1.

The results observed in this experiment are quite consistent with research reported elsewhere for the Russet Burbank variety. Quite different results would be expected for varieties with low numbers and poor distribution of eyes. Adverse soil conditions during the early part of the growing season would also change the results as small seedpieces would be less able to withstand environmental stress. Additional research in this area and more extensive surveys of grower seed cutting practices is planned. Seed management is clearly an important aspect of crop management. The preliminary findings of this research suggest there is a need for improvement in commercial seed cutting practices.

Russet Burbank Response to Seedpiece Size

Table 1. Effect of seedpiece size on emergence and stem numbers in Russet Burbank potato plants at Klamath Falls, OR, 1994.

Seed size	Emergence June 3	Emergence June 10	Emergence June 16	Stems/Plant June 30
oz	%	%	%	
3/4	44	92	97	1.63
1-1/4	55	96	100	2.00
1-3/4	56	94	100	2.38
2-1/4	66	97	99	2.65
2-3/4	69	98	100	2.73
Mean	58	95	99	2.28

Table 2. Effect of seedpiece size on yield, grade, and value of Russet Burbank potatoes at Klamath Falls, OR, 1994.

Seed size	Yield U.S. No. 1s 4-8 oz	8-12 oz	>12 oz	Total	Yield Bs	No. 2s	Culls	Total	Crop value
oz	cwt/A								$/A
3/4	145	108	65	318	31	25	18	391	2300
1-1/4	204	138	77	419	43	36	5	503	3010
1-3/4	199	154	90	442	55	49	5	551	3260
2-1/4	233	108	68	408	61	52	11	531	2780
2-3/4	293	109	50	452	79	40	6	577	2870
Mean	215	123	70	408	54	40	9	510	
CV (%)	15	28	40	13	31	47	121	13	
LSD (0.05)	38	42	33	63	20	23	NS	80	

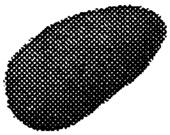
Table 3. Seedpiece size distribution, estimated seed costs, and estimated economic returns for seven commercial seed lots evaluated at Klamath Falls, OR, 1994.

Sample number	Seedpiece size > 1 oz	1-1.5 oz	1.5-2 oz	2-2.5 oz	> 2.5 oz	Seed cost[1]	Gross return[2]	Net return[3]
	% (number basis)					$/A		
1	46.0	28.8	17.2	8.0	0	148	2708	2560
2	29.5	20.5	20.2	15.9	13.9	195	2796	2601
3	1.9	6.9	15.9	33.7	41.6	303	2901	2598
4	16.5	29.7	26.1	19.5	8.2	196	2902	2706
5	13.8	24.0	37.6	18.5	6.1	207	2954	2747
6	9.0	36.9	29.1	18.3	6.7	212	2968	2756
7	5.9	14.1	47.9	20.5	11.6	231	3025	2794

1/ Based on seed price of $12/cwt and 10-inch spacing in 36-inch row.

2/ Based on yields, grade, and values from the replicated experiment with controlled seedpiece size.

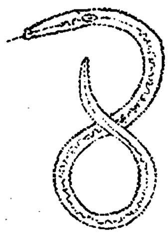
3/ Gross return less seed costs.



Control of Nematodes and Related Diseases in Potatoes

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

Introduction



Nematodes and related diseases continue to present challenges to the potato industry. Several fields in Northern California have been taken out of potato production since Telone products were banned in 1990. The loss of aldicarb has resulted in abandoning several Klamath County fields for potato production due to corky ringspot disease. Columbia root-knot (Meloidogyne chitwoodi) nematode control research in the Hermiston, Oregon area has demonstrated some measure of success using non-host rotational crops. In most cases, the crops evaluated are not suited to climatic conditions in the Klamath Basin. Combinations of available fumigant and non-fumigant nematicides and one new experimental nematicide have also shown promise for improved control in the Columbia Basin. The experimental nematicide, Fosthiazate (ASC-66824), had not been evaluated in the Klamath Basin.

Stubby-root (Paratrichodorus allius) nematodes serve as the vector for tobacco rattle virus (TRV), which causes corky ringspot disease (CRS). This disease has been more difficult to control with available chemicals. KES research in 1992 demonstrated fairly good CRS control with a combination of Telone II (1-3, dichloropropene) and Mocap (ethoprop) when low stubby-root nematode populations were present. However, no cost-effective alternative to aldicarb has been demonstrated to date.

Root-lesion (Pratylenchus neglectus) nematodes are believed to interact with verticillium wilt and promote the potato early dying complex, reducing yields and quality of crops in the region. All of these nematode species occur in one field at KES. Research was conducted at this site in 1993-1994 to

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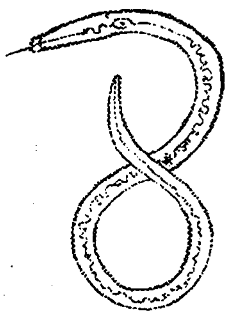
evaluate standard and alternative chemical control measures. Objectives were to improve understanding of nematode population biology, compare control of nematodes with standard and experimental chemicals, develop additional information on the timing of CRS infection, and improve sample evaluation techniques for CRS detection in tubers.

Procedures

The field selected for this study has a history of root-knot and stubby-root nematodes and CRS infections in potatoes grown in a two-year rotation with spring cereal crops. Spring barley was grown on most of the field in 1993. A small area was used for production of annual legumes that included several varieties or types of peas, medics, clovers, and vetches. Soil samples revealed high nematode populations in November, 1993, indicating that these legume crops were excellent hosts for both stubby-root and root-knot nematode species.

Six-row plots 40 ft long were established in November, 1993. Plots were arranged in a randomized complete block design to accommodate 10 treatments and 5 replications. Treatments of Telone II at 15, 20, and 25 gpa, and Telone C17 at 27.5 gpa were applied with a V-ripper at 18-inch shank spacing and 16-inch depth on November 9. Vapam (metham-sodium) was applied at 55 gpa in 1.0 inch of water with a portable irrigation system on April 25, 1994. Mocap EC, at 12 lb ai/acre, and Fosthiazate 900EC, at 6 lb ai/acre, were applied with a conventional ground sprayer and incorporated immediately with a disc to a depth of 6 inches on May 9. Russet Burbank potatoes were planted with a two-row assisted-feed planter at 12-inch seed spacing in 32-inch rows on May 17. Admire (NTN 33289) 2F insecticide was applied at 0.33 lb ai/acre as a band spray in the seed furrow during planting, to three replications of 40-foot, four-row plots. Standard weed control and other cultural practices were followed.

Composite soil samples were collected from each plot prior to fumigation (November 3, 1993), prior to planting (May 16, 1994), and after harvest (October 11, 1994). Soil depths of 0-8 inches and 8-16 inches were sampled in November, 1993 and May, 1994. October, 1994 samples were obtained from 0-12 inches. Additional soil samples were obtained from the



untreated control plots on a biweekly or weekly basis from June 9 to September 12. These samples were from 0-12 inches. Two composite samples were taken from each replication. All nematode samples were sieved and a 250 g soil sample extracted with wet sieving-sucrose centrifugation by personnel in the nematology laboratory at the OSU Department of Botany and Plant Pathology (OSUNP).

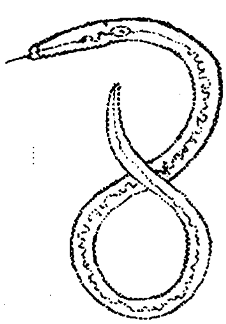
Tuber samples from plants in the untreated control and Mocap treated plots were obtained on August 15, August 29, and September 12 to determine the timing of CRS infection. Ten tubers from the center two rows in each replication were randomly extracted from the side of the hill with minimum soil disturbance. The samples were stored for 14 days before inspection. CRS infections were evaluated by inspecting one surface of the interior exposed by a longitudinal cut. All plots were harvested on October 10. Harvest areas included 30-foot sections of the center two rows. Total weights were determined in the field. Approximately 100-pound samples were saved from each plot for grading and stored under typical conditions until initial grading was done on October 21.

Tuber samples from the final harvest were inspected for visible signs of root-knot nematode blemish. Blemished tubers were removed and weighed separately. Remaining unblemished tubers were graded according to USDA standards to No.1s, No.2s, Culls, and Bs (< 4 ounces). Internal defects, including CRS infections, were not considered in this grading. Two 25-tuber subsamples were randomly selected from each plot for CRS inspections at KES. An attempt was made to include proportional amounts of blemished and unblemished tubers, including all sizes and grades. An additional 25-tuber subsample from five of the treatments was saved for analysis by the OSU nematology program (OSUNP). These samples were also comprised of blemished (based on visual inspection of unpeeled tubers) and unblemished tubers, but were restricted to tubers that would be classified as No.1s except for nematode blemish symptoms.

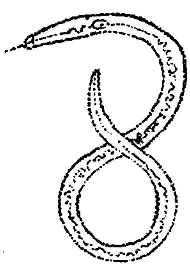
KES inspections for CRS infection were made on October 21 and December 2. Tubers were cut longitudinally and one cut surface of each tuber was examined. Four severity classifications were used, including: no damage - no CRS diffuse spots or arcs observed; slight damage - 1-5 diffuse spots or arcs representing < 5 percent of the cut surface; moderate damage - 6-10 diffuse spots or arcs representing < 10 percent of the cut surface; and severe damage - > 10 diffuse spots or arcs representing > 10 percent of the cut surface. A CRS rating index (RI) was calculated as follows: RI = (1 x % of undamaged tubers + 2 x % of slightly damaged tubers + 3 x % of moderately damaged tubers + 4 x % of severely damaged tubers)/100. The index allows comparison between treatments using a single number rather than percentages in four severity classes. When RI = 1 all tubers in the sample are free of CRS symptoms. When RI = 4 all tubers have severe symptoms. RI values above 1.50 would probably represent unmarketable potatoes.

OSUNP examination of tubers was done in two stages. All tubers were peeled and examined for root-knot nematode infection under a magnifying lamp. Data recorded included percent tuber infection, percent culls (tubers with six or more nematodes), and infection index (0 = 0, 1 = 1-3, 2 = 4-5, 3 = 6-9, 4 = 10-49, 5 = 50-99, 6 = 100+ nematodes/tuber). Each tuber was then cut longitudinally and one surface was inspected for CRS infections. If no or only slight symptoms were found, the tubers were further sliced into 1/2-inch transverse slices. Only diffuse brown spots or arcs exceeding 1/8-inch diameter were counted. Tubers were classified as follows: a. "negligible damage" - up to 5 percent waste or up to 1 spot or arc/2 ounces, b. "serious damage" - up to 10 percent waste or up to 1-2 spots or arcs/2 ounces, or c. "culls" with over 10 percent waste. In this classification system, tubers with negligible damage were considered No.1s, and those with serious damage were considered No.2s.

All percent damage and root-knot infection data were transformed to arcsin square root and examined by analysis of variance (ANOVA). Nematode density data were adjusted for soil moisture content and transformed to log (x+1) before analysis (ANOVA). A least significant differences (LSD) analysis was used to separate means only when ANOVA was significant at the 5 percent probability level ($P < 0.05$).



Results and Discussion



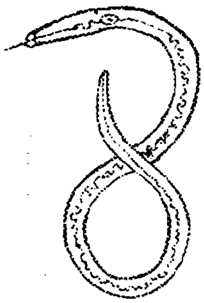
Nematode populations

Prior to fumigation, the Columbia root-knot nematode populations averaged over all plots were 138 and 27/250 g dry soil in 0-8-inch and 8-16-inch soil layers, respectively. Stubby-root nematode populations were more uniformly distributed between soil layers, at 202 and 186/250 g dry soil, respectively. These populations were several-fold higher than previously observed at this site. Root-lesion nematode populations averaged 34 and 19/250 g dry soil in top and lower soil layers, respectively. Distribution patterns within the experimental area were not uniform. Root-knot nematode populations were much higher in the area where annual legumes had been grown in 1993. Populations of root-lesion nematodes were generally lower in the legume site. Previous nematicide studies in 1990 and 1992 in this field may have also contributed to spatial differences in nematode populations.

Although prefumigation root-knot nematode populations varied among treatments by nearly ten-fold, the differences were not statistically significant, due to the high variability (Table 1). All Telone fumigation treatments reduced root-knot nematode populations below the detection level in May. Untreated control plot populations experienced 75 percent winter mortality of root-knot nematodes in the surface soil layer. Mocap did not effectively reduce root-knot nematode populations one week after application.

Stubby-root nematode populations were more uniformly distributed among treatments in the fall (Table 1). All Telone fumigation treatments except the combination of Telone plus Mocap significantly reduced populations compared to the control treatment in both soil layers in May. None of the nonfumigant nematicides significantly reduced populations compared to the untreated control. There may have been some suppression of stubby-root populations in the surface layer by Vapam and perhaps Mocap and Fosthiazate. These treatments did not reduce populations of stubby-root nematodes in the 8 to 16-inch layer within one week of application. Winter mortality in control plots was about 70 percent in both soil layers.

Root-lesion nematode populations were not uniform in the surface layer prior to fall fumigation (Table 1). Significantly lower populations were found in two treatments than in four other treatments. All treatments except Mocap



and Telone C17 reduced root-lesion populations in the surface layer in May. Winter mortality was about 50 percent.

Postharvest nematode populations followed the same trends observed in May samples. All Telone treatments reduced populations of root-knot and stubby-root nematodes compared with the untreated control. Telone II at 15 gpa did not provide control of root-lesion nematodes. Telone II at 20 and 25 gpa provided the best control of stubby-root and root-lesion populations. The Telone C17 treatment had among the lowest populations of root-knot nematodes, even though the population was among the highest observed prior to fumigation.

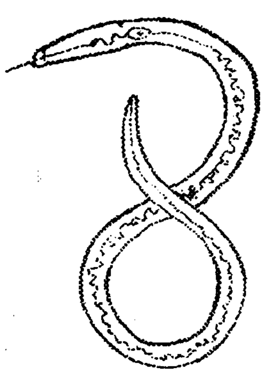
Mid-season population dynamics

Research in other areas has indicated Columbia root-knot nematodes produce a second generation after about 1,000 heat units based on a 42 °F soil temperature threshold. Subsequent generations are produced after about 600 additional heat units. Little is known about the population dynamics of stubby-root nematodes. Soil samples from the untreated control plots were assayed throughout the summer to observe changes in nematode populations in an attempt to correlate major population increases with soil temperature. A companion study was also conducted at Hermiston, Oregon, where temperatures are considerably higher throughout a longer growing season.

Four-inch maximum and minimum daily soil temperatures measured at the KES weather station were used to calculate soil heat unit accumulation from May 16 through October 11 (Table 2). Heat units were based on a 42 °F threshold temperature. Root-knot nematode populations in untreated control plots declined to a minimum on July 18. This decline is thought to be due to movement of nematodes into host-plant roots. Populations increased in late July and again in late August. The increases corresponded with heat unit accumulations of approximately 1,200 and 2,000. Similar correlations were observed at Hermiston, except that they occurred several weeks earlier in the season. The soil temperature from a relatively dry grass sod site may have indicated more heat units than actually existed within a crop canopy. Populations of stubby-root and root-lesion nematodes remained relatively constant throughout the growing season.

Crop development

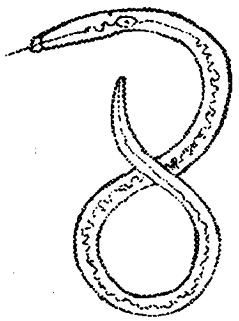
Emergence was normal with plant stands over 90 percent in all treatments, but plant vigor was poor throughout the growing season. Crop development was poor in all treatments, particularly in the untreated control plots. In early spring, 1994, soil was too dry for application of Vapam. Approximately 1.5 inches of irrigation water was applied with solid-set sprinklers on April 21. Rainfall totaling 1.6 inches during the next three weeks, resulted in tillage and planting operations being performed under high soil moisture conditions. Irrigation water penetration appeared to be impaired by soil compaction. Although Pratylenchus neglectus nematodes generally do not interact strongly with Verticillium dahliae, these nematodes may have encouraged the development of Verticillium wilt under the wet soil conditions. Early dying symptoms were prominent in the control treatment in July and plants in these plots were dead by mid-August. Plants in other treatments were more vigorous, but early dying symptoms appeared in all plots by late August. Yields in treatments with the best canopy vigor were only 50 to 60 percent of yields of Russet Burbank in most other experiments at KES in 1994.



Corky Ringspot

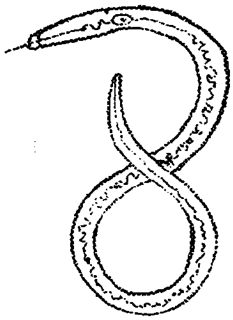
Preliminary harvest of tubers from untreated and Mocap treated plots began on August 15 when most tubers were less than 1.5 inches in diameter. Ten-tuber samples from each replication were stored for 14 days at room temperature before being examined for CRS infection. Tubers harvested on August 15 exhibited CRS infection levels equal to or higher than levels observed in all later harvests (Table 3). This confirms observations from a 1992 study at KES, where Russet Burbank tubers harvested on August 12 had 58 percent CRS infection, compared to 78 percent infection for tubers harvested on September 30. The transmission of TRV to potato plants by stubby-root nematodes, and CRS symptom expression in tubers, occurs too early in the season to avoid CRS by early harvest. The Mocap treatment neither reduced nor delayed CRS infection levels compared to the untreated control (Table 3). The trend for lower CRS infection levels in second and third harvest dates for the Mocap treatment was probably due to the relatively small sample size.

CRS infection data from the final harvest indicate that all Telone treatments significantly reduced CRS infections (Table 3). Telone II at 25 gpa provided better control than Telone II at 15 gpa when tubers were evaluated in December. Vapam and Mocap were ineffective. Fosthiazate reduced infection levels in October evaluations. The trends observed are consistent with post-harvest stubby-root nematode populations (Table 1). However, none of the treatments reduced serious CRS infections sufficiently to meet acceptable grade standards for market requirements. As observed in previous experiments conducted in the Klamath Basin, any detectable populations of stubby-root nematodes at harvest are likely to result in unmarketable crops.



Good correlation in CRS infection ratings was found between independent sets of tuber samples from the final harvest evaluated by KES and OSUNP personnel (Table 3). OSUNP techniques were more labor intensive as tubers with few infection sites in the initial longitudinal cut, were further sliced transversely into 1/2-inch sections. The more intensive examination of individual tubers probably accounts for slightly higher serious infection levels reported for samples from the Telone II 20 gpa treatment in the OSUNP data (Table 3). At the level of infections observed in these samples, single longitudinal cuts and evaluation of one cut surface provided an adequate assessment of CRS infection.

Data on the severity of CRS infections based on KES evaluations were very similar for October 21 and December 2 evaluations. Data are presented for the October evaluation (Table 4). Telone II at 20 and 25 gpa and Telone C17 treatments significantly reduced the percent of moderate and severe damage compared to the untreated control, Vapam, Mocap, and Fosthiazate treatments. Nonfumigant nematicides and Vapam were not significantly different than the control in any of the severity categories. Fosthiazate reduced CRS severity slightly. The severity rating index indicated similar CRS damage in tubers from Vapam, Mocap, and control treatments. Telone C17 was the only treatment with RI < 1.50 and the only treatment with no tubers in the severe damage classification.



Crop yield and grade

Russet Burbank produced over 500 cwt/acre total yields in all other 1994 KES experiments. Total yields in Telone treatments in this experiment were about 60 percent of that level (Table 5). Total yields were very similar for all Telone treatments, slightly lower for nonfumigant nematicide treatments, and significantly lower in the control treatment. The differences in total yield between treatments corresponded to plant vigor differences which appeared to be related to early dying symptoms. Soil compaction and high soil moisture content during the growing season undoubtedly contributed to low yields. Tubers in all treatments had enlarged lenticels at harvest, indicating excess soil moisture in spite of reduced irrigation in this field.

Columbia root-knot nematode blemished tubers accounted for about 75 and 60 percent of the total yield in control, Mocap, and Admire treatments, respectively, based on visual evaluation of surface appearance at KES (Table 5). Percent of blemished tubers was significantly less for all other treatments. Differences among these treatments were quite large, but not statistically significant. The amount of blemish observed correlated quite well with root-knot nematode populations in October, 1994 samples. Telone II at 20 and 25 gpa produced among the lowest percent of blemished tubers. No.1 yields were significantly higher in all fumigant treatments and in the Fosthiazate treatment than in the untreated control.

Twenty-five tuber subsamples from each replication of five treatments were evaluated by OSUNP staff. These samples did not include Bs or culls, but were intended to be comprised of proportional amounts of blemished and unblemished tubers as separated in the KES grading. Considerable discrepancies were found between KES and OSUNP ratings for nematode blemish (Table 6). OSUNP data showed less blemish in control, Mocap, and Fosthiazate treatments, and more blemish in Telone II at 20 gpa, and Vapam treatments than KES data. Different samples explain some, but not all of the differences. Inspection of peeled versus unpeeled samples should tend to increase detection of infected tubers. Both evaluation methods would lead to a conclusion of unacceptable quality for control, Vapam, and Mocap treatments. However, the Fosthiazate treatment would be considered acceptable based on OSUNP data, but unacceptable based on KES data. The reverse conclusion would be made for Telone II at 20 gpa. October, 1994 root-knot nematode population data are in better agreement with KES blemish data (Table 5).

OSUNP data on root-knot culls (6 or more nematode infection sites/tuber) show significant differences between Fosthiazate and the four other treatments evaluated. Infection index ratings follow a similar trend. Index ratings were all less than 2.0, indicating fewer than 5 infection sites on most tubers. This seems quite low in view of root-knot nematode populations in the Mocap and control treatments.

Summary

Relatively high populations of Columbia root-knot and stubby-root nematodes were exposed to a range of Telone II application rates, Telone C17, and three nonfumigant nematicide treatments. Telone products significantly reduced populations of root-knot and stubby-root nematode species compared to an untreated control. Vapam and nonfumigant nematicides were in effective against these nematodes. Mocap in combination with a low rate of Telone II did not improve nematode control over Telone II alone, except in the case of root-lesion nematodes at harvest. Vapam and Fosthiazate significantly reduced root-lesion nematode populations compared to the control.

Columbia root-knot nematode populations in untreated control plots produced generation increases at approximately 1,200 and 2,000 heat units (based on 42 °F threshold soil temperatures). A companion study at Hermiston, Oregon found generation increases several weeks earlier in the season, but at similar heat unit accumulations. Changes in stubby-root and root-lesion nematode populations were minor throughout the season.

CRS infection was well established in Russet Burbank potatoes by mid-August. CRS can not be avoided by early harvest of early maturing varieties. None of the treatments reduced CRS infections to levels that would allow marketing of the Russet Burbank crop. The lowest CRS infection levels were observed for Telone treatments. Vapam and nonfumigant nematicides were ineffective in controlling CRS at the stubby-root nematode populations found at the site. Evaluation of CRS infections by inspection of one surface of a longitudinally cut tuber was well correlated with results obtained from more intensive examination of numerous transverse slices.

Low yields in all treatments were probably due to high soil moisture content and soil compaction during tillage and planting operations. Fumigant treatments produced significantly higher total yields than the control treatment. This may have been due to suppression of root-lesion nematodes and early dying disease.

All treatments except Mocap significantly reduced root-knot nematode infections. Higher rates of Telone II were most effective in control of tuber blemish. Discrepancies between KES and OSUNP blemish ratings were found, but with one possible exception, treatments did not provide acceptable control of blemish under either rating system.

The new insecticide, Admire was evaluated in only three replications. It did not appear to provide control of any of the nematode species or related diseases compared to the control treatment. Statistical evaluation of this treatment was not possible due to limited replication.

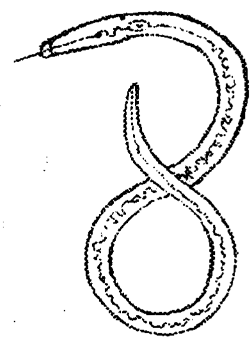


Table 1. Populations of Columbia root-knot (Meloidogyne chitwoodi), stubby-root (Paratrichodorus allius), and root lesion (Pratylenchus neglectus) nematodes in 0 to 8 inch and 8 to 16 inch soil depths at the Klamath Experiment Station at three sampling dates.

	Root-knot			Stubby-root			Root-lesion		
Treatment	11/3/93	5/16/94	10/11/94	11/3/93	5/16/94	10/11/94	11/3/93	5/16/94	10/11/94
	nematodes/250 g dry soil								
				0 - 8 inch soil depth[1]					
Untreated Control	43	10	211 de[2]	224	70 c	43 d	51 b	26 c	56 c
Telone II 15 gpa	105	0	28 abc	164	2 a	13 abc	41 b	4 ab	54 c
Telone II 20 gpa	207	0	21 ab	214	1 a	3 a	17 a	1 a	7 a
Telone II 25 gpa	75	0	12 ab	229	2 a	7 ab	24 ab	1 a	7 a
Telone C 17 27.5 gpa	408	0	4 a	198	3 a	8 abc	15 a	20 bc	10 ab
Vapam 55 gpa	262	4	170 cde	156	25 bc	34 bcd	27 ab	4 ab	19 b
Mocap 12 lb ai/A	93	18	354 e	235	41 c	36 cd	50 b	18 bc	37 bc
Fost. 6 lb ai/A	209	8	86 bcd	168	45 c	18 abcd	22 ab	11 b	12 ab
Telone II 15 gpa + Mocap 12 lb ai/A	79	0	63 ab	233	21 ab	13 abc	60 b	5 ab	19 b
				8 - 16 inch soil depth[1]					
Untreated Control	9	12		321	112 c		12	4 ab	
Telone II 15 gpa	46	0		161	10 b		29	2 a	
Telone II 20 gpa	35	0		160	1 a		14	1 a	
Telone II 25 gpa	10	0		136	3 ab		8	1 a	
Telone C 17 27.5 gpa	55	0		211	4 ab		15	2 a	
Vapam 55 gpa	28	10		226	87 c		16	9 bc	
Mocap 12 lb ai/A	8	4		128	100 c		24	26 c	
Fost. 6 lb ai/A	34	62		114	83 c		28	22 c	
Telone II 15 gpa + Mocap 12 lb ai/A	18	0		214	21 b		26	4 ab	

1/ October 11, 1994 soil samples were from 0 -12 inches only.

2/ Means within the same column which are followed by the same letter are not significantly different at $p < 0.05$.

Table 2. Population of Columbia root-knot (Meloidogyne chitwoodi), stubby-root (Paratrichodorus allius),and root-lesion (Pratylenchus neglectus) nematodes in untreated control plots at the Klamath Experiment Station from November, 1993 to October, 1994, and accumulated heat units at 4-inch soil depth at the KES weather station.

Sampling date	Nematode populations[1] Root-knot	Stubby-root	Root-lesion	Accumulated heat units[2]
	nematode/250 g dry soil			
Nov. 3, 1993	43	224	51	---
May 16, 1994	10	70	26	0
June 9, 1994	6	76	43	350
June 23, 1994	4	48	45	600
July 11, 1994	3	48	33	1020
July 18, 1994	1	25	18	1210
July 25, 1994	10	47	27	1420
Aug 1, 1994	16	44	21	1630
Aug 8, 1994	27	19	20	1840
Aug 15, 1994	28	39	31	2020
Aug 29, 1994	184	26	45	2380
Sept 12, 1994	205	19	37	2700
Oct 11, 1994	211	43	56	3500

1/ November, 1993 and May, 1994 data based on one 0-8 inch composite soil sample per replication (n=5).
June through September, 1994 data based on two 0-12 inch composite soil samples per replication (n=10).
October, 1994 data based on one 0-12 inch composite soil sample per replication (n=5)

2/ Based on daily maximum and minimum 4-inch soil temperatures observed at the KES weather station and a threshold base temperature of 42° F.

Table 3. Effect of fumigant and nonfumigant nematicides on the incidence of serious corky ringspot (CRS) infection of Russet Burbank potatoes at the Klamath Experiment Station at various sampling dates, 1994.

Treatment	Serious CRS infection levels[4]					
	8/15[1]	8/29[1]	9/12[1]	10/21[2]	11/16[3]	12/2[2]
	% of tubers infected					
Untreated Control	68	62	62	62 c[5]	69 b	55 c
Telone II 15 gpa	--	--	--	23 ab	--	33 b
Telone II 20 gpa	--	--	--	15 a	32 a	29 ab
Telone II 25 gpa	--	--	--	16 a	--	16 a
Telone C 17 27.5 gpa	--	--	--	14 a	--	10 a
Vapam 55 gpa	--	--	--	65 c	77 b	56 c
Mocap 12 lb ai/A	70	62	50	78 c	74 b	59 c
Fost. 6 lb ai/A	--	--	--	41 b	41 ab	42 bc
Telone II 15 gpa + Mocap 12 lb ai/A	--	--	--	25 ab	--	21 a

1/ 10 tuber samples per replication were evaluated 14 days after the harvest date shown (Control and Mocap treatments only).

2/ 25 tubers per replication from final harvest samples evaluated by KES staff on date indicated.

3/ 25 tubers per replication from final harvest samples evaluated by OSU nematology program staff.

4/ More than one 1/8-inch diameter spot or arc / 2 oz of tuber (tubers would be considered U.S. No. 2s or culls).

5/ Means in the same column followed by the same letter are not significantly different at $p<0.05$.

Table 4. Effect of fumigant nematicides on the severity of corky ringspot (CRS) symptoms in Russet Burbank potatoes harvested on October 10 at the Klamath Experiment Station and evaluated by KES staff on October 21, 1994.

	Severity of CRS infection				
Treatment	**No damage**[1]	**Slight damage**[2]	**Moderate damage**[3]	**Severe damage**[4]	**Severity rating**[5]
	% of tubers infected				
Control	14 ab[6]	24	33 bc	29 cd	2.76 c
Telone II 15 gpa	53 b	24	16 ab	7 ab	1.78 ab
Telone II 20 gpa	58 b	27	12 a	3 a	1.58 a
Telone II 25 gpa	58 b	26	14 a	2 a	1.58 a
Telone C 17 27.5 gpa	64 b	22	14 a	0 a	1.48 a
Vapam 55 gpa	7 a	28	34 bc	31 cd	2.88 c
Mocap 12 lb ai/A	3 a	19	43 c	35 d	3.10 c
Fost. 6 lb ai/A	25 ab	34	23 abc	18 bc	2.34 b
Telone II 15 gpa + Mocap 12 lb ai/A	59 b	16	16 ab	9 ab	1.74 ab
Admire[7] 0.33 lb ai/A	12	27	16	45	2.95

1/ No visible symptoms of CRS infection.

2/ < 1 1/8-inch diameter spot or arc/ 2 ounces of tuber.

3/ > 1 < 2 1/8-inch diameter spots or arcs / 2 ounces of tuber.

4/ >2 1/8-inch diameter spots or arcs / 2 ounces of tuber.

5/ RI= (1 x % no damage + 2 x % slight damage + 3 x % moderate damage + 4 x % severe damage) / 100.

6/ Means in the same column followed by the same letter are not significantly different at $p<0.05$.

7/ Not included in statistical analysis.

Table 5. Effects of fumigant and nonfumigant nematicides on yield, grade, and Columbia root-knot nematode blemish of Russet Burbank potatoes at the Klamath Experiment Station, 1994.

	Yield unblemished				
Treatment	**< 4 oz**	**No. 1s**	**Culls & No. 2s**	**Yield blemished**	**Total yield**
	cwt / A				
Untreated Control	17 a[1]	22 a	6 a	162 b	207 a
Telone II 15 gpa	83 cd	158 c	23 ab	46 a	329 b
Telone II 20 gpa	99 cd	166 c	25 ab	21 a	310 b
Telone II 25 gpa	112 d	180 c	15 ab	8 a	314 b
Telone C 17 27.5 gpa	81 cd	177 c	15 ab	45 a	318 b
Vapam 55 gpa	80 cd	121 bc	25 ab	52 a	279 ab
Mocap 12 lb ai/A	32 ab	58 ab	15 ab	163 b	267 ab
Fost. 6 lb ai/A	66 bc	133 bc	23 ab	70 a	291 b
Telone II 15 gpa + Mocap 12 lb ai/A	73 bcd	144 c	32 b	82 a	331 b
Admire[2] 0.33 lb ai/A	34	22	5	190	251

1/ Means within a column followed by the same letter are not significantly different at $p<0.05$.

2/ Data not included in the statistical analysis.

Table 6. Effects of fumigant and nonfumigant nematicides on October, 1994 Columbia root-knot nematode populations and tuber infection as evaluated by Klamath Experiment Station (KES) and Oregon State University Nematology Program (OSUNP) personnel.

Treatment	KES root-knot blemish[1]	OSUNP root-knot infection	OSUNP root-knot culls[3]	OSUNP inf. index[4]	October, 1994 root-knot populations
	%	%	%		nem. / 250 g
Untreated Control	78 c[5]	55 b	34 b	1.55	211 de
Telone II 15 gpa	14 ab	---	---	---	28 abc
Telone II 20 gpa	7 ab	34 b	11 b	0.69	21 ab
Telone II 25 gpa	3 a	---	---	---	12 ab
Telone C 17 27.5 gpa	14 ab	---	---	---	4 a
Vapam 55 gpa	19 ab	39 b	20 b	1.05	170 cde
Mocap 12 lb ai/A	61 c	46 b	27 b	1.31	354 e
Fost. 6 lb ai/A	24 ab	5 a	0 a	0.05	86 bcd
Telone II 15 gpa + Mocap 12 lb ai/A	25 ab	---	---	---	63 bc

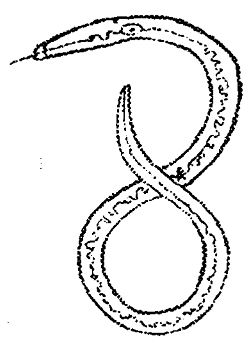
1/ Percent (by weight) of all tubers with visible external symptoms (detected without peeling) of Columbia root-knot nematode infection.

2/ Percent (by number) of > 4 oz tubers with 1 or more M. chitwoodi detected by peeling.

3/ Percent (by number) of > 4 oz tubers with 6 or more M. chitwoodi detected by peeling.

4/ Measure of intensity of infection (ranges from 1 - 6).

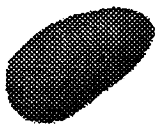
5/ Means within the same column followed by the same letter are not significantly different at $p<0.05$.



Screening Potato Selections for Resistance to Corky Ringspot Disease

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

Introduction



Since the loss of availability of the insecticide/nematicide aldicarb for potato production, several production areas in the Pacific Northwest have experienced crop losses due to corky ringspot disease (CRS) infections in fields where potatoes were previously grown without CRS infections. Variety susceptibility to CRS infections is quite variable. Russet Burbank, Century Russet, standard red-skinned varieties, and many white-skinned varieties are very susceptible to CRS infection. Results of a screening trial conducted at KES in 1992, showed considerable variability in the severity of CRS symptoms among standard varieties and numbered selections, but none of 24 entries screened had less than 30 percent infection. Russet Norkotah and the numbered selection AO82283-1 were among selections with the least severe symptoms. In a 1992 KES study on the timing of CRS infections, these selections also had significantly less CRS infection than either Russet Burbank or Century Russet in both untreated and Telone II and Mocap-treated soil.

The growing importance of CRS has encouraged the USDA-ARS potato breeding program at Aberdeen, Idaho to include CRS resistance as a priority for genetic crosses. The Aberdeen breeding and selection team have screened for CRS resistance for several years. However, screening sites available for this effort do not have sufficient stubby-root nematode populations or disease levels to provide consistent infections in susceptible standard varieties.

A KES field with a known infestation of stubby-root and Columbia root-knot nematodes was selected for evaluation of CRS and Columbia root-knot nematode resistance in 45 named varieties or numbered selections.

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

Acknowledgments: Partial financial support was provided by the CSRS, ARS, and the Oregon Potato Commission. OSU Nematology Program personnel in the Department of Botany and Plant Pathology provided analysis of soil samples for determination of nematode populations. Dr. Stephen Love, University of Idaho, Aberdeen Research and Extension Center, coordinated the provision of breeding selections for inclusion in the screening trial.

Entries included all selections in 1994 western regional russet-skinned variety trials, and 15 breeding lines from the Aberdeen, Idaho breeding program. Superior, a round white variety with known CRS resistance, was included as a control.

Procedures

Composite soil samples were collected from each half of the trial site at depths of 0 to 8 and 8 to 16 inches on November 3, 1993 and May 16, 1994, and at 0 to 12 inches on October 11, 1994 to determine nematode population densities. The field was adjacent to the site described on page 93. It had a similar crop history of spring cereals and potatoes in alternate years and had not been fumigated since 1988. Soil conditions were described on page 98.

Plot size was limited to two replications of 20 hills due to seed availability of numbered selections. Plots were arranged in a randomized complete block design with each selection paired with an adjacent row of Russet Burbank. Entries and Russet Burbank controls were planted with an assisted feed planter on May 16. Seed was hand cut, treated with Tops 2.5 fungicide, and suberized for two weeks prior to planting. Entries were spaced at 8.7 inches and Russet Burbank at 12 inches between seedpieces in 32-inch rows. Standard cultural practices were followed for fertilization, irrigation, and control of weeds, insects, and fungal diseases. Vines were desiccated with Diquat applied at 1.0 pint/acre on September 12. Potatoes were harvested with a single-row digger-bagger on October 10. All tubers from each plot, including Russet Burbank controls, were stored at approximately 50 °F and 95 percent relative humidity until samples were evaluated on November 9.

Intact tubers were inspected for visible root-knot nematode blemish symptoms. Blemished and unblemished tubers were weighed. A 25-tuber subsample, comprised proportionally of blemished and unblemished tubers, was selected for inspection of CRS symptoms. Each tuber was cut longitudinally to bisect the greatest width. One cut surface was inspected for CRS symptoms as described on pages 94 and 95. Data were not subjected to statistical analyses due to limited replication.

Results and Discussion

Columbia root-knot (Meloidogyne chitwoodi) nematode populations at depths of 0 to 8 and 8 to 16 inches were 70 and 4 per 250 g dry soil, respectively, in November, 1993, and 3 and 1 per 250 g dry soil, respectively, in May, 1994. Postharvest population in samples from 0 to 12 inches was 660 per 250 g dry soil. Stubby-root (Paratrichodorus allius) nematode populations at upper and lower depths were 300 and 400 per 250 g, respectively, in November, 1993, and 136 and 44 per 250 g, respectively, in May, 1994. In October, 1994, mean population at 0 to 12 inches was 41 per 250 g dry soil. Postharvest populations represented about 300 percent of root-knot populations in control treatments in the previously described study, but similar stubby-root nematode populations.

Crop development was affected by adverse soil conditions. Emergence was nearly 100 percent in all Russet Burbank plots, but much less in several of the numbered selections. Early plant death occurred in some selections. Russet Burbank plants remained more vigorous than most of the selections, but were clearly affected by soil conditions and early dying. Yields were low in general and a few selections produced very low yields. Because of poor performance in general, no effort was made to determine relative yields.

Root-knot nematode blemish was very extensive in all samples. Over 70 percent of the Russet Burbank samples exhibited 100 percent blemish. All entries had over 50 percent blemish in at least one replication. Therefore, it was concluded that a uniform infestation of root-knot nematodes was present and none of the entries evaluated were resistant to Columbia root-knot nematode blemish.

CRS infection data, by severity classification, are presented for each entry (Table 1). The RI value (see page 95), averaged for two replications, is compared with RI calculated for the adjacent Russet Burbank control plots. CRS infection levels were uniformly high in most of the Russet Burbank control plots. This indicates a uniform infestation of stubby-root nematodes throughout the plot area. Russet Burbank's susceptibility to CRS infections is demonstrated by the fact that all entries had lower RI values than the adjacent Russet Burbank control.

The resistent variety, Superior, was completely free of CRS symptoms in both replications. Four selections from the Aberdeen, Idaho breeding program: A8259-3; A8259-5; A77715-6; and NZA8904-2, were also free of infections. Several breeding lines had only slight infection symptoms, including two siblings from the cross that produced AO82283-1, which was moderately resistent to CRS infections in the 1992 KES study. These findings indicate that high levels of CRS resistance are available in Idaho breeding lines.

Two russet-skinned selections in the western regional lines: A81286-1; and A84118-3, had only slight infections. The KES red-skinned selection, NDO2469-1, also had only slight infections. Under low stubby-root nematode population pressure, these selections would probably produce acceptable crops.

Table 1. Corky ringspot (CRS) infection percentage by severity classification for 45 potato varieties and selections and CRS rating index for entries and adjacent Russet Burbank controls screened at the Klamath Experiment Station, 1994.

	Severity of CRS infection[1]				CRS rating index (RI)[2]	
Entry	None	Slight	Moderate	Severe	Selection	R. Burbank
	% of tubers					
R. Norkotah	30	18	26	26	2.5	3.1
Ranger R.	14	24	38	24	2.8	3.0
Shepody	62	24	14	0	1.5	3.4
M-12	44	28	18	10	2.0	3.2
M-15	20	34	22	24	2.5	3.1
A81286-1	44	56	0	0	1.6	3.2
A81386-1	10	18	56	16	2.8	3.2
A83115-12	20	44	8	28	2.5	3.1
A8333-5	10	32	32	26	2.8	3.3
A8390-3	36	54	6	4	1.8	3.1
A84118-3	86	14	0	0	1.2	2.9
A84180-8	32	26	26	16	2.3	3.2
A8495-1	12	48	28	12	2.4	3.0
AC83064-1	40	34	16	10	2.0	3.3
AC83064-6	50	30	20	0	1.7	2.7
AO80432-1	68	28	4	0	1.4	2.1
AO84275-3	32	48	14	6	2.0	2.9
AO8478-1	10	38	22	30	2.8	3.4
AO85165-1	14	50	30	6	2.3	3.3
ATX84706-2	72	22	6	0	1.4	2.3
COO8390-1	54	10	12	24	2.1	2.4
NDO2904-7	52	22	18	8	1.8	2.2
TX1229-2	36	56	8	0	1.8	2.9
CO84074-2	54	30	16	0	1.7	3.1
AC84487-1	60	38	0	2	1.5	2.9

Table 1. (continued) Corky ringspot (CRS) infection percentage by severity classification for 45 potato varieties and selections and CRS rating index for entries and adjacent Russet Burbank controls screened at the Klamath Experiment Station, 1994.

	Severity of CRS infection[1]				CRS rating index (RI)[2]	
Entry	None	Slight	Moderate	Severe	Selection	R. Burbank
	——— % of tubers ———					
NDO2438-7R	30	38	32	0	2.0	3.6
NDO2469-1R	78	22	0	0	1.2	3.1
NDO2686-6R	48	28	20	4	1.8	3.1
NDO3849-12R	32	42	16	10	2.1	3.4
A8258-1	24	24	24	28	2.6	3.1
A8259-3	100	0	0	0	1.0	3.2
A8259-5	100	0	0	0	1.0	3.0
A8261-4	60	32	8	0	1.5	2.7
A82283-CN3	60	40	0	0	1.4	3.2
A82283-CN10	86	14	0	0	1.2	2.3
A8712-4	40	52	6	2	1.7	3.2
A77715-6	100	0	0	0	1.0	2.3
A82790-2	20	52	20	8	2.2	3.2
A85519-6	20	26	26	28	2.7	3.2
A85536-1	20	60	16	4	2.1	3.2
A85542-9	78	22	0	0	1.2	2.9
A88529-6	38	20	26	16	2.3	2.3
A89875-5	90	10	0	0	1.1	2.6
NZA8904-2	100	0	0	0	1.0	3.3
Superior	100	0	0	0	1.0	2.5

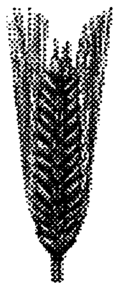
1/ See definition of severity classes on pages 94 and 95.

2/ See definition of RI on page 95.

Spring Barley Variety Screening

R.L. Dovel, R.S. Karow, 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 1994 included: the western regional spring barley nursery 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 also screened in nonreplicated trials.

Procedures

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

All trials were arranged in a randomized complete block design with four replications. Crops at the KES were planted on April 21 and 22. Irrigated and unirrigated organic soil sites were planted on May 13 and 16, respectively. Seed was planted to a depth of one inch at a seeding rate of 100

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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.

lb/acre. All plots were fertilized with 100 lb N, 60 lb P_2O_5, and 44 lb S/acre at time of seeding. Plots measured 5 x 20 feet, with a row spacing of 6 inches (10 rows). At KES, bromoxynil and MCPA were applied at labeled rates to control broadleaf weeds. Weed control at organic soil sites was achieved with a mixture of 2,4-D and Banvel. Plots were harvested in late September at the KES and in late October at off-station sites using a plot combine with a 5-foot wide header. Grain yield was recorded for all plots. Test weight, percent plumps, and percent thins were measured in only one replication.

Results and Discussion

Western Regional Spring Barley Nursery

The three highest yielding entries in the 1994 western regional spring barley nursery, UT 1705D, BU 585-82, and UT 2144, produced over 7000 lb of grain per acre, which was significantly higher than Steptoe and other check varieties (Table 1). When averaged over 1994 and 1993, these same entries were among the top four producing varieties in the nursery. None of these entries have been in the trial for three years. Additional testing of these lines is warranted and may result in a varietal release. Over a three-year period, WA 9593-87 produced the highest grain yields; however, there was no significant difference between it and Steptoe over that period. Another promising entry which has been in the trial for the last three years, 86Ab2317, was not significantly different than Steptoe. Both experimental lines are being considered for release and may be available to seedsmen in the near future.

Grain yields in the Western Regional Spring Barley Nursery were much higher in 1994 than in 1993, and slightly better than in 1992 (Table 2). This is partially due to high infestations of both wheat stem maggot and common root rot in 1993. Spring in 1993 was unusually wet, encouraging the development of common root rot and delaying planting by over three weeks. In 1993, wheatstem maggot infestation at KES was severe with over 50 percent of tillers affected in most small grain trials. In contrast, the spring of 1994 was one of the driest on record and fields were planted earlier than normal. Common root rot and wheat stem maggot were not serious problems in 1994. Although dry weather and higher than normal temperatures facilitated early planting, low yields and tests weights were generally seen throughout the Klamath Basin due to irrigation shortages and high temperature stress.

OSU Spring Barley Trials

OSU spring barley variety trials were established at three different locations in 1994. The 8-entry trial was located at the KES on mineral soil, and on two organic soil locations in the Lower Klamath Lake area (Tables 3-5). In general, the yield potential of the two irrigated sites is similar, as is reflected in the three-year trial means at each site (Table 6). In contrast, the unirrigated organic soil site is less productive and has a trial mean yield which is only 85 percent of the irrigated organic soil site. Although the two irrigated sites have similar yields, the relative performance of varieties at the two sites is quite different.

Irrigated Mineral Soil Site

Yield trends over the past three years at KES were similar to those seen in the western regional spring barley nursery discussed above. Barley yields in 1994 were significantly higher than in 1993 and 1992 (Table 6). Wheat stem maggot damage was extensive in 1992 and 1993, and undoubtedly reduced yields. Yields were further reduced in 1993 by late planting and a severe infestation of common root rot. Although Baroness was the highest yielding entry in 1993, it produced significantly less grain in 1994 than most entries in the trial. Baroness was less effected by wheatstem maggot and possibly common root rot than other varieties in 1993. In 1994, when higher yields were possible due to favorable weather and the absence of pests, the relative ranking of Baroness was reduced. Over a three-year period, Maranna produced significantly more grain than all other entries except Columbia.

Irrigated Organic Soil Site

Colter was the highest yielding entry at the irrigated organic soil site for four years in a row prior to 1994. In 1994, it was the second highest yielding variety and its yield was not significantly lower than Crest, the highest yielding variety in 1994 (Table 4). Over a three-year period at the irrigated organic soil site, Colter was the highest producing variety, producing an average of 500 lb/acre more than Russell, the second highest yielding entry in the trial (Table 6). Test weights of Colter have been higher than Steptoe for the past three years at this site. However, Colter usually produces test weights slightly lower than the trial average.

Unirrigated Organic Soil Site

Baroness was the highest yielding variety at the unirrigated organic soil site in 1994 (Table 5). Baroness was ranked second at this site over a two-year period, yielding only slightly less than Steptoe (Table 6). The difference was not statistically significant. However, test weights of Baroness have been consistently superior to Steptoe and most six-row feed varieties (Tables 3-5). Russell, a six-row malt variety has also produced well at this site. Over a two-year period, yields of Russell were not significantly different from Steptoe or Baroness and test weights were comparable to or better than Baroness. Columbia, a late maturing variety that produces well at the irrigated sites, was the lowest producing entry at the unirrigated site.

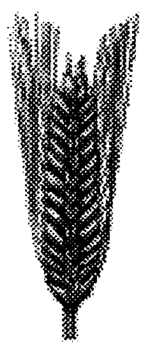


Table 1. Grain yield, test weight, percent thins, percent lodging, plant height, and heading date of spring barley varieties planted in the 1994 western regional spring barley nursery at the Klamath Experiment Station, OR.

Entry	Variety/ selection	Yield	Test weight	Thins 6/64	Thins 5.5/64	Thins Pan	Lodge	Height	Heading date
		lb/A	lb/bu	%	%	%	%	inches	Julian
1	Trebi	3910	50.5	85.2	10.2	4.7	90	38	178
2	Steptoe	4420	51.5	83.8	10.1	6.1	83	42	174
3	Klages	4980	54.5	90.5	5.7	3.8	63	44	182
4	Morex	4640	53.0	85.7	9.3	5.0	65	47	174
5	Excel	5430	52.5	85.9	10.2	3.9	65	46	175
6	86Ab2317	5880	54.5	87.4	9.0	3.6	15	43	177
7	WA 9593-87	6560	53.5	92.8	5.7	1.4	30	42	179
8	ND 11231-11	5850	56.5	96.5	2.1	1.4	13	41	173
9	UT 1705L	6490	52.0	95.4	3.7	0.9	25	41	171
10	UT 1705D	7370	53.0	94.0	4.6	1.3	0	39	173
11	UT 2144	7000	51.0	90.0	7.2	2.8	1	38	172
12	WA 9589-87	5870	53.5	91.7	5.6	2.6	20	42	179
13	WA 16227-85	5440	55.0	92.9	5.0	2.1	30	42	180
14	DA 587-170	6350	55.0	92.5	5.2	2.3	15	31	180
15	BU 585-82	7250	53.5	96.2	2.7	1.1	0	33	178
16	MT 890008	5000	54.5	94.6	3.7	1.7	83	41	182
17	BA 2B89-4311	5380	57.0	98.0	1.5	0.6	43	43	180
18	BA 2B91-4947	5660	54.0	89.6	7.1	3.4	40	42	181
19	ND 11055	4770	53.0	89.1	7.8	3.1	53	45	177
20	ND 13299	5350	56.0	97.9	1.3	0.9	0	39	173
21	ND 13300	5900	55.0	96.2	2.6	1.2	23	41	173
22	ID 86326	5040	55.5	91.5	5.4	3.1	60	42	179
23	WA 9605-87	6720	54.5	90.8	6.7	2.5	0	41	177
24	WA 7758-89	5590	54.0	95.0	3.6	1.3	45	43	179
25	WA 9908-89	5340	51.0	86.1	9.4	4.5	60	47	176
26	SDM 306B	6710	54.0	87.9	8.2	3.9	5	38	173
27	UT 1705	6860	52.0	95.8	3.3	0.9	1	40	172
28	UT 706A315	6310	54.0	90.8	6.1	3.0	15	41	174
29	UT 3999	5350	50.0	86.7	8.3	5.0	26	42	174
30	UT 4011	5810	52.0	92.0	5.4	2.5	15	42	175
31	MT 886610	5300	54.0	89.0	6.7	4.2	58	43	178
32	MT 889106	5870	54.0	95.2	3.3	1.4	38	43	173
Mean		5760	53.6	91.5	5.8	2.7	34	41	176
CV (%)		12					75	6	0.6
LSD (0.05)		970					35	4	1.5

Table 2. Three-year summary of the western regional spring barley nursery, Klamath Experiment Station, OR, 1992-1994.

Entry	Variety/ selection	Yield 1994	1993	1992	2-year avg		3-year avg	
		lb/A	lb/A	lb/A	lb/A	rank	lb/A	rank
1	Trebi	3910	3800	5390	3850	15	4370	7
2	Steptoe	4420	4730	5740	4570	12	4960	2
3	Klages	4980	4070	5090	4520	13	4710	5
4	Morex	4640	3520	5020	4080	14	4390	6
5	Excel	5430	3980	5360	4700	10	4920	3
6	86Ab2317	5880	4110	4670	4990	8	4890	4
7	WA 9593-87	6560	4140	5360	5350	5	5360	1
8	ND 11231-11	5850	4280		5070	6		
9	UT 1705L	6490	4580		5540	3		
10	UT 1705D	7370	4450		5910	1		
11	UT 2144	7000	4110		5550	2		
12	WA 9589-87	5870	4140		5010	7		
13	WA 16227-85	5440	3720		4580	11		
14	DA 587-170	6350	3580		4970	9		
15	BU 585-82	7250	3580		5410	4		
16	MT 890008	5000						
17	BA 2B89-4311	5380						
18	BA 2B91-4947	5660						
19	ND 11055	4770						
20	ND 13299	5350						
21	ND 13300	5900						
22	ID 86326	5040						
23	WA 9605-87	6720						
24	WA 7758-89	5590						
25	WA 9908-89	5340						
26	SDM 306B	6710						
27	UT 1705	6860						
28	UT 706A315	6310						
29	UT 3999	5350						
30	UT 4011	5810						
31	MT 886610	5300						
32	MT 889106	5870						
Mean		5760	4050	5230	4940		4800	
CV (%)		12.0	9.1	11.9	12.0		12.8	
LSD (0.05)		970	520	860	590		500	

Table 3. Performance of OSU spring barley varieties at the Klamath Experiment Station irrigated mineral soil site, 1994.

Entry	Variety	Heading date	Height	Lodging	Yield	Test weight
		Julian	inches	%	lb/A	lb/bu
1	Baroness	178	41	17	6010	53.9
2	Colter	171	44	53	6410	49.6
3	Crest	174	43	13	7290	52.0
4	Crystal	178	40	43	6280	53.7
5	Maranna	180	36	0	8620	52.2
6	Russell	173	42	0	7340	53.9
7	Steptoe	173	42	70	5040	49.9
8	Columbia	182	34	0	8090	49.9
Mean		176	40	25	6890	51.9
CV (%)		1	5	110	11	2
LSD (0.05)		1	4	47	1270	1.9

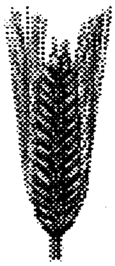


Table 4. Performance of OSU spring barley varieties at the Lower Klamath Lake area irrigated organic soil site, 1994.

Entry	Variety	Yield	Test weight	Thins 6/64	Thins 5.5/64	Thins Pan
		lb/A	lb/bu	%	%	%
1	Baroness	5450	52.5	95.3	3.3	1.4
2	Colter	6770	52.0	91.1	6.2	2.6
3	Crest	6900	51.5	92.4	5.5	2.1
4	Crystal	5700	59.0	95.9	3.0	1.0
5	Maranna	5310	50.0	88.3	8.7	3.1
6	Russell	6000	53.0	96.2	2.8	1.0
7	Steptoe	6570	50.0	96.5	2.5	1.0
8	Columbia	6590	49.5	96.6	2.7	0.7
Mean		6160	52.2	94	4.3	1.6
CV (%)		6.5				
LSD (0.05)		700				

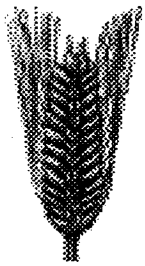


Table 5. Performance of OSU spring barley varieties at the Lower Klamath Lake area unirrigated soil site, 1994.

Entry	Variety	Yield	Test weight	Thins 6/64	Thins 5.5/64	Thins Pan
		lb/A	lb/bu	%		
1	Baroness	4320	52.5	97.2	2.0	0.8
2	Colter	3860	51.5	94.5	4.0	1.5
3	Crest	4030	51.0	93.6	4.7	1.7
4	Crystal	3570	52.5	94.0	4.8	1.2
5	Maranna	3390	50.0	85.5	10.8	3.7
6	Russell	3330	53.5	95.5	3.3	1.2
7	Steptoe	4010	50.5	97.0	2.1	0.9
8	Columbia	2880	45.0	94.9	3.8	1.4
Mean		3670	50.8	94	4.4	1.6
CV (%)		7.7				
LSD (0.05)		500				

Table 6. Three-year summary of OSU spring barley variety grain yields at three Klamath County locations, 1992-1994.

	Yield							
Selection	**Irrigated mineral soil**		**Irrigated organic soil**		**Unirrigated organic soil**		**Average of locations**	
	3-year average							
	lb/A	**rank**	**lb/A**	**rank**	**lb/A**	**rank**	**lb/A**	**rank**
Colter	4990	5	6340	1	3820	2	5050	1
Crystal	4730	6	4560	6	2690	5	3990	6
Maranna	5920	1	4920	5	2950	4	4600	4
Russell	5000	4	5840	2	3810	3	4880	2
Steptoe	5030	3	5070	4	3940	1	4680	3
Columbia	5530	2	5200	3	2120	6	4280	5
Mean:	5200		5320		3220		4580	
CV (%)	12		11		9		11	
LSD (0.05)	660		440		140		400	
	2-year average							
Baroness	5350	3	4530	7	3340	2	4410	5
Colter	4790	6	6490	1	3030	4	4770	3
Crystal	5000	5	4910	6	2460	6	4120	7
Maranna	6240	1	5230	4	2950	5	4800	1
Russell	5210	4	5810	2	3301	3	4770	2
Steptoe	4750	7	5220	5	3670	1	4550	4
Columbia	5860	2	5630	3	1690	7	4400	6
Mean:	5310		5400		2920		4550	
CV (%)	11		10		9		10	
LSD (0.05)	820		750		410		510	

Spring Wheat Variety Screening

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

Introduction

Spring wheat is grown on approximately 8,500 acres annually in the Klamath Basin. Soft white (SW) and hard red (HR) selections predominate; however, interest has grown recently in the hard white (HW) class. In 1994, 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. Wheat stem maggot is endemic in the area and generally causes only slight damage at the KES. Under mild winter and warm spring conditions in 1992 and 1993, significant damage to cereal crops was experienced, with up to 50 percent of the tillers affected at KES and with serious crop losses in several commercial fields in the Lower Klamath Lake area.

Procedures

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

All trials were arranged in a randomized complete block design with three or four replications. Plots at the KES were planted on April 21. Seed was planted at a depth of 1 inch. The seeding rate for wheat trials was 80 lb/acre. All plots were fertilized with 100 lb N, 60 lb P_20_5, and 44 lb S/acre at time of seeding. Plots measured 5 x 20 feet, with 10 rows at 6-inch spacing.

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

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

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

Western Regional Spring Wheat Nursery

Penawawa was the highest yielding entry in the western regional spring wheat nursery (Table 1). Penawawa has consistantly been a top yielding variety for several years and is the highest yielding variety over a three-year period (Table 2). Centennial, a recently released SW variety, produced yields which were not significantly different from Penawawa. Further investigation of Centennial is warrented due to its performance in this and other trials. Other entries with yields not significantly different than Penawawa in 1994 include OR 895181, ID 450, ID 448, SDM 405, and SDM 406. Alpowa is a recent SW release from Washington State. It produced yields lower than Penawawa in 1994 and over a three-year period, but more than the trial average.

The HW line ID 377S was the second highest yielding entry in the trial over a three-year period. It has good milling and baking quality and is being considered for release by the University of Idaho.

OSU Hard White Spring Wheat Variety Trial

The highest producing entry in the OSU hard red spring wheat variety trial in 1994 was SERI 82 (Table 3). This was the only entry in the trial to produce significantly more grain than Klasic, the HW industry standard. Other high yielding lines not significantly different from SERI 82 in 1994 included: OR4870453, ID377S, OR918049, OR4870255, and OR4895181. Both SERI 82 and OR4870453 produced significantly more grain than Westbred 906R and Westbred 926, the two HR standards included in the trial. SERI 82 has only been in the trial for two years, but over that period it has produced more grain than any other entry in the trial (Table 4). Other entries which produced significantly more grain than Klasic over the same two-year period included: OR4870453, OR918049, OR4895181, OR918050, and OR918085. Over a three-year period, OR4870453 and OR4895181 yielded significantly more than Klasic (Table 4). OR 4870279 produced yields equivalent to Klasic in this trial over a three-year period, and much higher yields in the western regional trial. This HW line has good baking quality and may be released if yields in other areas of the Pacific Northwest justify it.

OSU Hard Red Spring Wheat Variety Trial

Standard HR spring wheat varieties in the Klamath Basin are Westbred 906R and Yecora Rojo. Spillman, a recently released variety, is increasing in acreage. There was not a significant difference in grain yield among these varieties in the 1994 trial (Table 5). Yields of nine entries, including McKay and Spillman, were not significantly less than OR 4920002, the highest yielding entry in the 1994 trial. Yecora Rojo and Klasic reached 50 percent heading earlier than all other entries in the trial. Over a three-year period, only OR4870400 produced significantly higher yields than Spillman and McKay, the two highest yielding standard varieties in the trial (Table 6). Grain baking quality is an important consideration in the selection of HR wheat varieties. Further testing examining baking quality of top yielding entries will be needed prior to release of these lines.

Soft White Spring Wheat Variety Trial

Centennial was the highest yielding entry in the trial in both 1993 and 1994 (Tables 7 and 8). Centennial is a recent release from the University of Idaho, which 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. This new SW variety produced significantly more than all other entries in the trial over that two-year period. Centennial is also an earlier maturing variety. It reached 50 percent heading earlier than any other entry in the trial in 1994 (Table 7) and was second earliest in 1993. SW wheat varieties have been slow to mature in the cool fall conditions common in the Klamath Basin. The development of a earlier maturing, high yielding SW variety should help producers who choose to grow this commodity in the Basin. Further plot scale testing and small field scale testing is warrented and should be undertaken prior to large field scale planting of this variety.

OSU State Wide Spring Wheat Variety Trial

Centennial was the highest producing entry in this trial at KES over the last two years (Table 9). As in the trial mentioned above, Centennial produced significantly more grain than any other entry in the trial over a two-year period. The next highest producing group of entries included Owens, a SW wheat, Klasic, a HW wheat, and Treasure, a SW wheat. This trial was also established on two organic soil sites in 1994. Centennial was the highest producing entry at all three sites in 1994 (Table 10). The two triticale entries in the trial failed to produce grain yields equal to the higher producing SW or HW entries at any location.

Table 1. Grain yield, test weight, lodging, plant height, and days to 50 percent heading of western regional spring wheat nursery varieties at Klamath Experiment Station, OR, 1994.

Entry	Variety/ selection	Class	Yield	Test weight	Lodge	Height	Heading date
			lb/A	lb/bu	%	inches	Julian
1	McKay	HR	6230	60.5	0	36	180
2	Federation	SW	4940	60.5	0	52	185
3	Penawawa	SW	7750	63.5	0	35	179
4	Klasic	HW	6270	64.0	0	28	175
5	Serra	HR	6500	62.0	0	36	179
6	ID 377S	HW	7000	64.5	0	37	179
7	Alpowa (WA7677)	SW	7020	64.0	0	38	182
8	ID 439	HR	5720	62.0	0	34	179
9	ID 429	SW	7000	61.5	0	39	178
10	UT 1597	HR	6910	63.0	0	39	180
11	UT 850646	HR	6900	61.5	0	35	182
12	Sunstar 2	HR	6720	63.5	0	35	178
13	ML 42	SW	6540	63.0	0	37	182
14	Wawawai (WA7712)	SW	6310	63.0	0	39	180
* 15	Dirkwin	SW	6040	59.0	0	37	182
16	UT 1117	HR	6550	63.5	0	41	181
17	ID 448	SW	7320	62.5	0	36	182
18	ID 452	HR	6500	62.5	0	36	184
19	OR 487374	HW	5350	61.5	0	26	179
20	OR 487410	HR	6790	62.0	0	36	181
21	OR 895224	SW	5720	60.5	0	32	182
22	FM 5702	HR	6220	63.0	0	28	175
23	FM 8631	HR	6100	63.0	0	27	176
24	SDM 405	SW	7280	62.5	0	36	180
25	SDM 406	SW	7190	63.0	0	36	179
26	ID 450	SW	7360	63.5	0	35	178
27	ID 456	SW	6460	61.0	0	37	178
28	ID 462	HR	6360	63.0	0	37	178
29	ID 463	HR	5560	63.0	0	35	178
30	OR 488372	HW	6320	64.0	0	36	182
31	OR 895181	HW	7670	61.5	0	37	180
32	OR 895207	HW	4870	61.5	0	31	181
33	UT 2464	HR	6240	62.5	0	38	181
34	UT 1146	HR	6980	62.0	0	39	181
35	UT 1175	HR	6660	63.0	0	39	181
36	Centennial	SW	7320	64.0	0	36	179
Mean			6520	62.5	0	36	180
CV (%)			7.2		0	4.2	0.5
LSD (0.05)			660		0	2.1	1.3

*Entry 15, Dirkwin was substituted For Wadual 94.

Table 2. Three-year summary of spring wheat yields at the Klamath Experiment Station, OR, 1992-1994.

Variety/ selection	Class	Yield 1994	1993	1992	2-yr avg		3-yr avg	
		lb/A				rank	lb/A	rank
McKay	HR	6230	5500	5480	5860	11	5740	7
Federation	SW	4940	4980	4940	4960	23	4950	13
Penawawa	SW	7750	6120	6600	6930	1	6820	1
Klasic	HW	6270	4900	5170	5580	18	5450	9
Serra	HR	6500	5060	4540	5780	14	5370	11
ID 377S	HW	7000	6010	6200	6500	4	6400	2
Alpowa (WA7677)	SW	7020	5270	6160	6140	9	6150	4
ID 439	HR	5720	5250	4940	5490	19	5300	12
ID 429	SW	7000	5490	5730	6240	7	6070	6
UT 1597	HR	6910	5600	6010	6250	6	6170	3
UT 850646	HR	6900	5510	6030	6200	8	6150	5
Sunstar 2	HR	6720	4990	5170	5860	12	5630	8
ML 42	SW	6540	4930	4770	5740	15	5420	10
Wawawai	SW	6310	4900		5600	17		
UT 1117	HR	6550	5190		5870	10		
ID 448	SW	7320	5950		6640	3		
ID 452	HR	6500	4720		5610	16		
OR 487374	HW	5350	4380		4870	24		
OR 487410	HR	6790	4910		5850	13		
OR 895224	SW	5720	4640		5180	22		
FM 5702	HR	6220	4690		5460	20		
FM 8631	HR	6100	4590		5340	21		
SDM 405	SW	7280	6190		6740	2		
SDM 406	SW	7190	5800		6490	5		
ID 450	SW	7360						
ID 456	SW	6460						
ID 462	HR	6360						
ID 463	HR	5560						
OR 488372	HW	6320						
OR 895181	HW	7670						
OR 895207	HW	4870						
UT 2464	HR	6240						
UT 1146	HR	6980						
UT 1175	HR	6660						
Centennial	SW	7320						
Dirkwin	SW	6040						
Mean		6520	5230	5520	5880		5820	
CV (%)		7.2	6.0	8.0				
LSD (0.05)		660	460	610				

Table 3. Grain yield, test weight, lodging, plant height, and days to 50 percent heading of OSU hard white spring wheat varieties at the Klamath Experiment Station, OR, 1994.

Entry	Variety/ selection	Yield	Test weight	Lodge	Height	Heading date	Bird damage
		lb/A	lb/bu	%	inches	Julian	%
1	Klasic	5780	63.5	0	25	173	0
2	OR484013	5910	62.0	0	34	184	13
3	OR4870279	5860	61.5	0	33	179	5
4	OR4870453	6570	61.5	0	33	183	4
5	OR4870255	6150	64.0	0	37	178	0
6	OR4870374	5970	62.0	0	26	179	0
7	OR4880372	5780	63.5	0	34	182	13
8	OR4895181	6120	61.0	0	35	180	10
9	OR4895207	4800	61.5	0	31	181	0
10	ID377S	6400	64.0	0	37	179	8
11	OR4880348	5360	61.5	0	31	180	3
12	OR488528	5720	63.0	0	30	179	5
13	SERI 82	7150	62.0	0	33	180	3
14	OR918062	5610	61.0	0	34	187	15
15	OR918063	4860	60.0	0	32	184	15
16	OR918085	5140	60.5	0	32	187	19
17	OR918090	5390	62.5	0	35	184	1
* 18	Westbred 906R	5340	62.5	0	35	178	5
19	OR4900157	4160	61.0	0	31	181	0
20	OR918049	6230	60.5	0	35	187	8
21	OR918050	5600	61.0	0	36	187	5
22	OR4920096	4430	62.5	0	33	182	5
23	OR9437536	5210	60.0	0	35	182	21
24	Westbred 926	5420	63.0	0	35	180	5
Mean		5620	61.9	0	33	181	6.5
CV (%)		13.8		0	4.7	0.5	179
LSD (0.05)		1100		0	2.2	1.4	17

*Entry 18 was changed from Wadual to Westbred 906R

Table 4. Three-year summary of grain yields of OSU hard white spring wheat varieties at the Klamath Experiment Station, OR, 1992-1994.

Entry	Variety/ selection	Yield 1994	1993	1992	2-year avg		3-year avg	
		lb/A	lb/A	lb/A	lb/A	rank	lb/A	rank
1	Klasic	5780	2960	5340	4370	15	4690	9
2	OR 484013	5910	4100	4970	5000	7	4990	4
3	OR 4870279	5860	3590	5440	4720	12	4960	5
4	OR 4870453	6570	4530	5820	5550	2	5640	1
5	OR 4870255	6150	3800	5090	4980	8	5010	3
6	OR 4870374	5970	2960	5210	4460	14	4710	8
7	OR 4880372	5780	3950	5000	4870	10	4910	7
8	OR 4895181	6120	4600	5170	5360	4	5300	2
9	OR 4895207	4800	3610	4530	4210	17	4320	11
10	OR 4880348	5360	3350	4650	4360	16	4450	10
11	OR 488528	5720	3850	5220	4790	11	4930	6
12	SERI 82	7150	4310		5730	1		
13	OR 918062	5610	4270		4940	9		
14	OR 918063	4860	4490		4670	13		
15	OR 918085	5140	5070		5110	6		
16	OR 4900157	4160	3790		3980	18		
17	OR 918049	6230	4700		5460	3		
18	OR 918050	5600	4820		5210	5		
19	ID 377S	6400						
20	OR 918090	5390						
21	Westbred 906R	5340						
22	OR 4920096	4430						
23	OR 9437536	5210						
24	Westbred 926	5420						
Mean		5620	4040	5130	4880		4900	
CV (%)		13.8	11.8	17.3	13.2		14.8	
LSD (0.05)		1100	680	1210	640		590	

Table 5. Grain yield, test weight, lodging, plant height, and days to 50 percent heading of OSU hard red spring wheat varieties at the Klamath Experiment Station, OR, 1994.

Entry	Variety/ selection	Yield	Test weight	Lodge	Height	Heading date	Bird damage
		lb/A	lb/bu	%	inches	Julian	%
1	McKay	6270	62.5	0	36	180	0
2	Westbred 906R	5790	62.0	0	36	178	5
3	Yecora Rojo	6050	63.5	0	25	175	0
4	Spillman	6340	61.5	0	34	180	3
5	OR 485010	5880	63.5	0	35	180	1
6	Klasic	6020	64.0	0	28	175	0
7	OR 4870456	5880	63.0	0	33	178	0
8	OR 4870400	6560	64.5	0	37	185	5
9	OR 4870401	5970	65.0	0	36	184	10
10	OR 4880189	6160	63.0	0	32	180	0
11	OR 4870410	6400	63.0	0	36	180	0
12	OR 4895019	6900	63.5	0	35	177	0
13	OR 4895103	6110	63.0	0	35	183	5
14	OR 4895011	6030	64.0	0	34	180	4
15	OR 4895014	5390	63.0	0	34	178	6
16	OR 4930032	5290	63.0	0	34	181	6
17	OR 4930033	5890	64.0	0	32	181	0
18	OR 4920002	6950	63.0	0	34	182	1
19	OR 4910028	6120	61.5	0	34	178	0
20	OR 4900041	6590	64.5	0	34	182	1
21	OR 4900050	6590	62.0	0	35	181	0
22	Star"S"	5600	62.0	0	31	185	0
23	Express	6050	63.0	0	31	181	0
24	WPB 926	5770	62.0	0	36	178	3
25	WPB 936	6400	61.5	0	33	178	0
26	OR 4930034	6200	63.0	0	28	179	0
27	OR 4930035	6250	63.0	0	28	180	0
28	OR 4880287	6930	63.5	0	28	182	0
Mean		6160	63.0	0	33	180	1.8
CV (%)		7.9		0	4.7	0.4	252
LSD (0.05)		680		0	2.2	1.1	6.3

Table 6. Three-year summary of grain yields of OSU hard red spring wheat varieties at the Klamath Experiment Station, OR, 1992-1994.

Entry	Variety/ selection	Class	Yield 1994	1993	1992	2-year avg		3-year avg	
			lb/A	lb/A	lb/A	lb/A	rank	lb/A	rank
1	McKay	HR	6270	4550	5130	5410	9	5320	7
2	Westbred 906R	HR	5790	3950	4560	4870	16	4760	14
3	Yecora Rojo	HR	6050	4060	4990	5060	15	5040	11
4	Spillman	HR	6340	4560	4990	5450	8	5300	8
5	OR 485010	HR	5880	4280	4650	5080	14	4940	12
6	Klasic	HW	6020	3260	4520	4640	19	4600	15
7	OR 4870456	HR	5880	3770	4820	4830	17	4830	13
8	OR 4870400	HR	6560	4860	5890	5710	3	5770	1
9	OR 4870401	HR	5970	5140	5010	5550	5	5370	3
10	OR 4880189	HR	6160	4410	4650	5290	13	5070	10
11	OR 4870410	HR	6400	4360	5210	5380	10	5320	6
12	OR 4895019	HR	6900	4510	4560	5710	4	5320	5
13	OR 4895103	HR	6110	4500	5470	5310	11	5360	4
14	OR 4895011	HR	6030	4550	4790	5290	12	5120	9
15	OR 4895014	HR	5390	4010	4370	4700	18	4590	16
16	OR 4920002	HR	6950	4680	5620	5810	1	5750	2
17	OR 4910028	HR	6120	4950		5530	6		
18	OR 4900041	HR	6590	4970		5780	2		
19	OR 4900050	HR	6590	4430		5510	7		
20	OR 4930032	HR	5290						
21	OR 4930033	HR	5890						
22	Star"S"	HR	5600						
23	Express	HR	6050						
24	WPB 926	HR	5770						
25	WPB 936	HR	6400						
26	OR 4930034	HR	6200						
27	OR 4930035	HR	6250						
28	OR 4880287	HW	6930						
Mean			6160	4410	4950	5310		5150	
CV (%)			7.9	10.6	12.4	9.7		10.8	
LSD (0.05)			680	650	860	510		450	

Table 7. Grain yield, test weight, lodging, plant height, and days to 50 percent heading of OSU soft white spring wheat varieties at the Klamath Experiment Station, OR, 1994.

Entry	Variety/ selection	Yield	Test weight	Lodge	Height	Heading date
		lb/A	lb/bu	%	inches	Julian
1	Dirkwin	6280	59.5	0	38	182
2	Centennial	7420	64.0	0	36	178
3	Penawawa	6810	61.5	0	40	184
4	WA 7677	7080	64.0	0	41	182
5	ORS 8501	7340	64.0	0	38	180
6	ORS 8427	5730	61.5	0	38	179
7	OR 487503	5610	61.0	0	37	187
8	OR 487570	5350	61.5	0	37	187
9	OR 4880013	7330	63.0	0	42	182
10	WUC 657	6490	63.0	0	34	179
11	OR 4900154	5900	61.0	0	33	187
12	OR 4900085	5920	63.5	0	35	178
13	OR 4895224	5320	61.0	0	47	182
14	OR 4920094	5870	62.0	0	33	180
15	OR 4920098	5950	63.0	0	35	178
16	OR 9437474	6500	63.0	0	40	180
17	OR 9437475	5580	62.0	0	42	184
18	OR 9437539	5180	62.0	0	37	179
19	Juan	6810	54.5	0	41	183
20	M92-1535	6900	60.5	0	44	179
21	OR 4920021	6540	64.0	0	36	187
22	OR 4920095	6510	65.0	0	36	185
23	OR 4920111	6290	61.5	0	32	183
24	OR 9437538	5410	61.0	0	34	180
25	OR 9437546	6770	61.5	0	36	186
Mean		6280	61.9	0	38	182
CV (%)		9.3		0	12	0.6
LSD (0.05)		820		0	6.4	1.4

Table 8. Two-year summary of grain yields of OSU soft white spring wheat varieties at the Klamath Experiment Station, OR, 1993-1994.

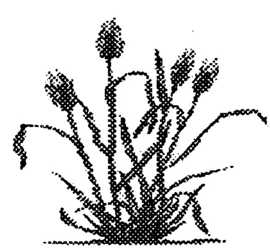
Variety/ selection	Yield					
	1994		1993		2-yr avg	
	lb/A	rank	lb/A	rank	lb/A	rank
Dirkwin	6280	14	4930	6	5600	6
Centennial	7420	1	5450	2	6440	1
Penawawa	6810	7	4960	5	5880	4
ORS 8501	7340	2	5310	3	6320	2
ORS 8427	5730	19	4380	10	5050	9
OR 487503	5610	20	4740	7	5180	8
OR 487570	5350	23	4670	9	5010	10
OR 4880013	7330	3	5280	4	6300	3
OR 4900154	5900	17	5500	1	5700	5
OR 4900085	5920	16	4710	8	5310	7
OR 4895224	5320	24	4340	11	4830	11
OR 4920094	5870	18				
OR 4920098	5950	15				
OR 9437474	6500	11				
OR 9437475	5580	21				
OR 9437539	5180	25				
Juan	6810	6				
M92-1535	6900	5				
OR 4920021	6540	9				
OR 4920095	6510	10				
OR 4920111	6290	13				
OR 9437538	5410	22				
OR 9437546	6770	8				
WA 7677	7080	4				
WUC 657	6490	12				
Mean	6280		4930		5600	
CV (%)	9.3		6.0			
LSD (0.05)	820		430			

Table 9. Two-year summary of yield and test weight of OSU spring wheat varieties at the Klamath Experiment Station, OR, 1993-1994.

Variety/ selection	Class	1994 Test weight	1994 Yield		1993 Test weight	1993 Yield		Average Test weight	Average Yield	
		lb/bu	lb/A	rank	lb/bu	lb/A	rank	lb/bu	lb/A	rank
Calorwa	Club	60.2	5560	11	59.9	3600	10	60.1	4580	10
Centennial	SW	62.8	7300	1	61.3	5210	1	62.1	6250	1
Dirkwin	SW	58.1	4800	15	58.0	3420	11	58.1	4110	11
Klasic	HW	63.1	6720	2	62.1	4170	4	62.6	5440	3
Juan	Triticale	55.0	5440	13	51.1	3790	9	53.1	4610	9
Owens	SW	61.5	6130	4	60.9	4960	2	61.2	5540	2
Penawawa	SW	61.0	6120	5	59.9	3790	6	60.5	4960	6
Treasure	SW	60.8	6120	6	57.2	4350	3	59.0	5240	4
Victoria	Triticale	53.9	5910	9	51.8	3790	8	52.9	4850	7
Westbred 926R	HR	60.3	5450	12	60.1	3880	5	60.2	4670	8
Yecora Rojo	HR	62.8	6200	3	61.1	3790	7	62.0	4990	5
ID 392	SW	61.8	6010	8						
Wawawai	SW	61.3	4500	16						
Alpowa (WA 7677)	SW	62.8	5360	14						
ID 377S	HW	62.4	6050	7						
Wakanz	SW	61.2	5700	10						
Mean		60.6	5840		58.5	4070		59.2	5020	
CV (%)		---	9.3		---	6.0		---	7.4	
LSD (0.05)		---	820		---	430		---	480	

Table 10. Summary of grain yield and test weight of OSU spring wheat varieties at three locations in Klamath County, OR, 1994.

			Irrigated mineral soil		Irrigated organic soil		Unirrigated organic soil	
Entry	Variety	Class	Yield	Test weight	Yield	Test weight	Yield	Test weight
			lb/A	lb/bu	lb/A	lb/bu	lb/A	lb/bu
1	Alpowa (WA7677)	SW	5360	62.8	5800	61.0	2740	59.0
2	Calorwa	CLUB	5560	60.2	4970	58.5	2590	58.0
3	Centennial	SW	7300	62.8	5950	61.0	3060	61.0
4	Dirkwin	SW	4800	58.1	4870	53.0	2460	52.0
5	ID 377S	HW	6050	62.4	5800	60.0	2220	55.0
6	Klasic	HW	6720	63.1	4880	59.0	2270	60.0
7	Juan	Triticale	5440	55.0	4240	47.0	1040	45.5
8	Owens	SW	6130	61.5	5290	58.0	2670	60.5
9	Penawawa	SW	6120	61.0	5220	58.5	1890	57.0
10	Treasure	SW	6120	60.8	6800	58.0	2860	56.0
11	Victoria	Triticale	5910	53.9	4650	48.0	2190	50.5
12	Wakanz	SW	5700	61.2	4750	53.0	2060	52.5
13	Westbred 926R	HR	5450	60.3	4630	57.0	2160	55.5
14	Yecora Rojo	HR	6200	62.8	4450	57.0	2060	57.0
15	Whitebird (ID392)	SW	6010	61.8	4920	58.0	2170	57.0
16	Wawawai (WA7712)	SW	4500	61.3	5410	59.5	1710	53.5
Mean			5840	60.6	5160	56.7	2260	55.6
CV (%)			16	1	8.1		11.4	
LSD (0.05)			NS	1.0	690		430	



Oat Variety Screening in the Klamath Basin

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

Introduction

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

Procedures

The uniform northwestern states oat nursery was established at KES on Fordney fine sandy loam that is moderately deep and somewhat poorly drained. The previous crop was potatoes. The crop was irrigated by a solid set sprinkler system. The trial was arranged in a randomized complete block design with four replications. Seed was planted on April 20 at a depth of 1 inch and a seeding rate of 100 lb/acre. All plots were fertilized with 80 lb N, 100 lb $P_2 0_5$, and 60 lb S/acre at time of seeding. Plots measured 5 x 20 feet with a row spacing of 6 inches. Bromoxynil and MCPA were applied at labeled rates to control broadleaf weeds. Plots were harvested 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.

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Results and Discussion

The uniform northwestern states oat nursery produced a higher average grain yield than most other variety trials at KES in 1994. In 1993, oat yields were higher than other small grains at the station due to infestations of wheat stem maggot and common root rot in barley, wheat, and triticale, while oats were relatively unaffected. Oat yields in 1994 were significantly higher than in 1992 and slightly higher than in 1993 (Tables 1 and 2).

The highest yielding entry in the trial in 1994, 83Ab3250, produced 7,200 lb of grain per acre followed closely by 90Ab1322 and Border, which produced 7,170 and 7,110 lb/A, respectively. Rio Grande, a newly released oat variety developed in Idaho, produced yields which were not significantly lower than the top three producing entries. Over a three-year period from 1992 to 1994, 83Ab3250 was the highest producing variety in the trial; however, yields of several experimental lines as well as Border and Rio Grande were not significantly different than 83Ab3250. The highest yielding commercially available variety from 1992 to 1994 was Border. Yields of Appaloosa, Ogle, Rio Grande, and Ajay were not significantly lower than Border.

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

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

Ajay is another variety that may fit some production niches. It is a semi-dwarf line recently released by the University of Idaho. Commercial quantities of this variety are now available. It is generally 8-12 inches shorter than

Cayuse and is very resistant to lodging, even at high N fertilization rates. In a N fertility management study conducted at KES, Ajay produced equivalent or superior grain yields as Cayuse and Monida at all fertilization rates, and was much less prone to lodging (see 1990 Crop Research at KES, Special Report 876). 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.

Table 1. Grain yield, test weight, percent lodging, plant height, and heading date of spring oat varieties planted in the northwestern uniform oat nursery at the Klamath Experiment Station, OR, 1994.

Entry	Variety/ selection	Yield	Test weight	Lodge	Height	Heading date
		lb/A	lb/bu	%	inches	Julian
1	Park	5730	40.5	8	51	188
2	Cayuse	6520	39.5	0	47	185
3	Otana	5880	43.0	0	51	187
4	Appaloosa	6690	39.0	0	45	186
5	Border	7110	41.0	0	45	186
6	Monida	6400	40.0	4	52	189
7	Ogle	6370	39.0	0	45	182
8	Calibre	5580	43.0	0	54	189
9	Rio Grande (81Ab5792)	6970	41.0	0	46	183
10	Valley (ND820603)	6510	44.0	0	46	186
11	82Ab248	6880	39.5	0	45	189
12	82Ab1178	6280	40.5	0	40	182
13	Ajay (82Ab1142)	6100	40.0	0	37	185
14	83Ab3119	6100	37.0	0	43	188
15	83Ab3250	7200	40.0	0	44	189
16	86Ab664	6700	40.0	0	46	187
17	86Ab1867	6630	42.0	0	43	182
18	Newdak	6100	39.5	0	45	182
19	ND 860416	6350	42.5	0	50	187
20	ND 852107	5640	40.0	0	49	185
21	87Ab5125	6870	41.5	0	44	188
22	84Ab825	6690	39.5	0	45	186
23	88Ab3073+ (Nude)	4500	46.5	0	44	189
24	Derby	5530	44.0	0	56	187
25	86Ab1616+ (Nude)	5180	46.0	0	48	189
26	87Ab4983	6790	41.0	0	43	183
27	89Ab6153	5780	42.0	0	40	182
28	IA H61-3-3	6540	41.0	0	52	187
29	Whitestone (ND870258)	5520	42.5	8	47	187
30	Paul (ND862915)(Nude)	4380	47.0	0	52	187
31	89Ab1545	6840	41.0	0	44	182
32	90Ab1322	7170	40.0	0	44	187
Mean		6240	41.3	0.6	46	186
CV (%)		8.4		660	4.1	0.4
LSD (0.05)		730		5.4	2.7	1

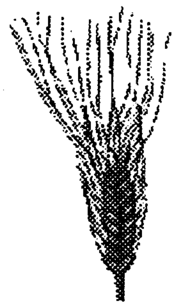
Table 2. Three-year summary of grain yields of spring oat varieties planted at the Klamath Experiment Station, OR, 1992-1994.

Entry	Variety/ selection	Yield 1994	1993	1992	2-year avg		3-year avg	
		lb/A	lb/A	lb/A	lb/A	rank	lb/A	rank
1	Park	5730	4580	3260	5160	24	4520	21
2	Cayuse	6520	5660	2980	6090	12	5060	17
3	Otana	5880	5220	3050	5550	22	4720	19
4	Appaloosa	6690	5470	3860	6080	14	5340	13
5	Border	7110	5970	4220	6540	5	5770	6
6	Monida	6400	5500	3290	5950	19	5060	16
7	Ogle	6370	5800	3840	6080	13	5340	14
8	Calibre	5580	3760	2350	4670	25	3900	23
9	Rio Grande (81Ab5792)	6970	6460	3680	6720	3	5700	9
10	Valley (ND820603)	6510	5480	4500	5990	18	5490	12
11	82Ab248	6880	5460	4180	6170	11	5510	10
12	82Ab1178	6280	6110	4980	6200	10	5790	5
13	Ajay (82Ab1142)	6100	5950	4460	6020	15	5500	11
14	83Ab3119	6100	6680	4730	6390	7	5840	4
15	83Ab3250	7200	6340	4500	6770	2	6020	1
16	86Ab664	6700	6140	4840	6420	6	5890	3
17	86Ab1867	6630	5950	4710	6290	8	5760	7
18	Newdak	6100	5910	3990	6000	17	5330	15
19	ND 860416	6350	4870	3320	5610	21	4850	18
20	ND 852107	5640	5320	3050	5480	23	4670	20
21	87Ab5125	6870	6430	4640	6650	4	5980	2
22	84Ab825	6690	5880	4600	6290	9	5720	8
23	88Ab3073+	4500	4100	4040	4300	28	4210	22
24	Derby	5530	3450	2420	4490	27	3800	24
25	86Ab1616+	5180	4140		4660	26		
26	87Ab4983	6790	7120		6950	1		
27	89Ab6153	5780	6250		6020	16		
28	IA H61-3-3	6540	4900		5720	20		
29	Whitestone (ND870258)	5520						
30	Paul (ND862915)	4380						
31	89Ab1545	6840						
32	90Ab1322	7170						
Mean		6240	5530	3900	5910		5050	
CV (%)		8.4	11.5	14.6	8.8		11.2	
LSD (0.05)		730	1030	790	520		470	

Triticale Variety Trial in the Klamath Basin

R.L. Dovel and Greg Chilcote[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 triticale 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 was conducted in 1994 to positively identify high yielding triticale varieties for this region.

Procedures

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 April 22 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_2O_5, and 44 lb S/acre at time of seeding. Plots measured 5 x 20 feet with a row spacing of 6 inches. Bromoxynil and MCPA were applied at

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

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

labeled rates to control broadleaf weeds. Plots were harvested using a plot combine with a 5-foot wide header. Grain yield was recorded for all plots. Test weight was measured in only one replication. Lodging, plant height, and heading date were recorded for each plot prior to harvest. Heading date was determined by estimating the date of 50 percent head emergence.

Results and Discussion

Grain yields were higher in 1994 than in the two previous years, although test weights were similar for all three years (Tables 1 and 2). Average triticale yield over a three-year period was higher than the average wheat and slightly lower than the average barley yield. An experimental line, 91F 26016, was the highest yielding entry in the trial over a three-year period. However, yields of Juan, Eronga 93, and 91F 25012 were not significantly lower than 91F 26016. The two most locally available triticale varieties in the trial are Juan and Victoria, which produced an average of 680 lb/acre less than Juan. Yields of Juan were comparable to barley yields and superior to wheat yields throughout the trial. Yield potential of triticale lines was quite variable with Whitman averaging less than 4,000 lb/acre and Juan averaging over 6,000 lb/acre.

Quality of newer triticale varieties, as measured by test weight, is superior to older varieties such as Whitman and Karl. Average test weight for all triticale varieties was 55.8, 55.3, and 56.0 lb/bu in 1992, 1993, and 1994, respectively. Average test weight ranged from 49.0 lb/bu for Whitman to 59 lb/bu for Rhino. However, higher yielding varieties ranged between 51 and 57 lb/bu, which is comparable to or higher than barley test weights in the trial.

Analysis of grain protein content is not complete at this time. However, initial results show a wide range in protein content between varieties. It will be interesting to see if relative protein contents of the various varieties is 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 any year. Triticale plant height in 1994 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. Lodging of Juan and other commercially available varieties has been noted in commercial operations.

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 commodities, triticale grain protein concentration appears to be inversely proportional to yield. Unless price incentives for growing triticale exceed current prices for barley, it is doubtful that this new commodity will replace currently planted commodities. However, if a viable market develops for triticale, high yielding varieties are currently available.

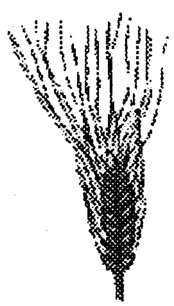


Table 1. Grain yield, test weight, lodging, plant height, and days to 50 percent heading of spring triticale, barley, and wheat lines in the triticale variety trial at the Klamath Experiment Station, OR, 1994.

Entry	Variety/ selection	Yield	Test weight	Lodge	Height	Heading date
		lb/A	lb/bu	%	inches	Julian
1	Steptoe	6770	53.0	0	40	173
2	Gustoe	7990	53.5	0	31	179
Barley Mean		7380	53.3	0	36	176
3	Fieldwin	5960	62.0	0	39	182
4	Yecora Rojo	5510	63.5	0	28	173
5	Westbred 926	5910	62.0	0	35	177
Wheat Mean		5800	62.5	0	34	177
6	Juan	7150	54.5	0	46	182
7	Stier	5110	57.5	0	42	180
8	Rhino "S"	6760	57.0	0	43	177
9	UC 84	5980	56.0	0	40	178
10	Hippo "S"	5290	58.0	0	37	177
11	UC 86	5930	57.0	0	36	177
12	Grace	5210	47.0	0	49	185
13	Victoria	6350	54.0	0	42	179
14	RSI 2700	6500	50.0	0	60	182
15	91F 26016	7100	56.5	0	44	179
16	91F 25003	6100	58.0	0	41	178
17	91F 25001	6620	57.0	0	39	182
18	91F 25007	6650	57.5	0	44	177
19	91F 25012	6570	53.0	0	44	180
20	91F 26102	6270	58.5	0	40	178
21	Karl	6190	52.5	0	37	178
22	Eronga 83	6820	55.5	0	47	179
23	Alamos 83	6400	57.0	0	38	178
24	Sunland	6510	58.0	0	42	181
25	Florida 201	6890	55.0	0	46	181
26	Whitman	4820	49.0	0	43	189
27	Frank	5050	52.0	0	43	182
28	Pika	4850	58.5	0	48	182
29	Norico	5850	57.0	0	52	178
30	16-A	5700	58.0	0	48	179
31	16-12	6450	57.0	0	41	178
32	16-13	6700	58.0	0	36	182
Triticale Mean		6140	55.5	0	43	180
Overall Mean		6190	56.0	0	42	179
CV (%)		9.4		0	9.6	0.5
LSD (0.05)		820		0	5.7	1.3

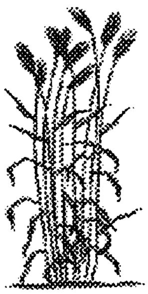
Table 2. Three-year summary of grain yield and test weight (TWT) of spring triticale, wheat, and barley lines planted at the Klamath Experiment Station, OR, 1992-1994.

Entry	Variety/ selection	1992 Yield	1992 TWT	1993 Yield	1993 TWT	1994 Yield	1994 TWT	Average Yield	Average TWT	
		lb/A	lb/bu	lb/A	lb/bu	lb/A	lb/bu	lb/A	lb/bu	rank
1	Steptoe	6030	51.5	5100	50.0	6770	53.0	5970	51.5	5
2	Gustoe	5000	52.0	4410	47.0	7990	53.5	5800	50.8	6
Barley Mean		5520	51.8	4760	48.5	7380	53.3	5890	51.2	
3	Fieldwin	4490	64.0	4990	59.5	5960	62.0	5150	61.8	20
4	Yecora Rojo	3050	61.5	3970	61.5	5510	63.5	4180	62.2	30
5	Westbred 926	4520	63.5	3980	61.5	5910	62.0	4800	62.3	26
Wheat Mean		4020	63.0	4310	60.8	5790	62.5	4710	62.1	
6	Juan	5100	55.0	6230	52.5	7150	54.5	6160	54.0	2
7	Stier	4740	58.0	4550	57.0	5110	57.5	4800	57.5	27
8	Rhino "S"	5050	60.0	5160	60.0	6760	57.0	5660	59.0	8
9	UC 84	5210	59.0	4800	59.5	5980	56.0	5330	58.2	16
10	Hippo "S"	3740	57.0	4300	56.5	5290	58.0	4440	57.2	28
11	UC 86	4450	57.5	4970	59.0	5930	57.0	5110	57.8	21
12	Grace	4860	53.0	5440	51.0	5210	47.0	5170	50.3	18
13	Victoria	4690	51.0	5400	54.5	6350	54.0	5480	53.2	11
14	RSI 2700	5120	52.0	5480	51.5	6500	50.0	5700	51.2	7
15	91F 26016	5400	56.0	6280	57.0	7100	56.5	6260	56.5	1
16	91F 25003	5070	57.5	5110	56.5	6100	58.0	5430	57.3	12
17	91F 25001	4450	57.0	4390	56.0	6620	57.0	5160	56.7	19
18	91F 25007	4810	57.5	5260	59.0	6650	57.5	5570	58.0	10
19	91F 25012	5430	55.5	5910	55.0	6570	53.0	5970	54.5	4
20	91F 26102	5030	57.5	5510	58.0	6270	58.5	5600	58.0	9
21	Karl	3880	52.5	4460	52.0	6190	52.5	4840	52.3	24
22	Eronga 83	5920	55.0	5660	54.0	6820	55.5	6130	54.8	3
23	Alamos 83	4840	54.5	4320	51.0	6400	57.0	5190	54.2	17
24	Sunland	3600	58.0	4370	54.5	6510	58.0	4830	56.8	25
25	Florida 201	3920	54.5	5460	53.0	6890	55.0	5430	54.2	13
26	Whitman	3570	51.0	3480	47.0	4820	49.0	3960	49.0	31
27	Frank	4890	55.0	5290	57.0	5050	52.0	5080	54.7	23
28	Norico	5100	56.0	4360	56.5	5850	57.0	5100	56.5	22
29	16-A	3870	58.0	3750	59.0	5700	58.0	4440	58.3	29
30	16-12	4660	55.0	5110	54.0	6450	57.0	5410	55.3	14
31	16-13	4710	57.0	4690	58.0	6700	58.0	5370	57.7	15
Triticale Mean		4700	55.8	4990	55.3	6190	55.4	5390	55.5	
Mean		4680	56.2	4910	55.4	6230	56.0	5270	55.9	
CV (%)		11.6		10.5		7.2		9.8		
LSD (0.05)		890		720		660		420		

Barlely Seed Treatment, 1994

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

Introduction



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

Baytan is a fungicidal seed treatment which may be effective in controlling early season infestation by barley stripe rust. Barley stripe rust has been introduced into the United States from Europe and was found in neighboring states in 1993. Baytan was included in the trial to test its effectiveness against this new fungal organism if it appeared in the Klamath Basin.

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

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

Gaucho is a systemic insecticide which will soon be labeled for use as a seed treatment on small grains. It has proven very effective in control of Russian wheat aphid and other pests. There is also some indication that it

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

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

may be effective in controlling Hession fly, which is similar to the wheat stem maggot (WSM), a significant pest of grain in Klamath County. The use of the chemical as labeled has little impact on the environment because the use of a seed treatment delivers a very small amount of material in a way that is relatively unavailable to non-target species and Gaucho has a relatively low acute toxicity (very high LD_{50}) in non-target species. It is not known if Gaucho seed treatment on small grains is effective in controlling WSM.

Procedures

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

Seed of Gus barley was treated with 8 seed treatments prior to planting. Treatments included: two rates of Baytan and Captan, two rates of Imazalyl and RTU, one Kodiak treatment, two rates of Gaucho and RTU, and one RTU treatment, which is the industry standard. All seed treatment rates are reported in ounce product/cwt of seed in Table 1. All trials were arranged in a randomized complete block design with four replications. The trial at KES was planted on April 22. Irrigated and unirrigated organic soil sites were planted on May 13 and 16, respectively. Seed was planted to a depth of one inch at a seeding rate of 100 lb/acre. All plots were fertilized with 100 lb N, 60 lb P_2O_5, and 44 lb S/acre at time of seeding. Plots measured 5 x 20 feet, with a row spacing of 6 inches (10 rows). At KES, bromoxynil and MCPA were applied at labeled rates to control broadleaf weeds. Weed control at organic soil sites was achieved with a mixture of 2,4-D and Banvel. Plots were harvested using a plot combine with a 5-foot wide header. Grain yield was recorded for all plots. Test weight, percent plumps, and percent thins were measured in only one replication.

Results and Discussion

Barley stripe rust was not evident in Oregon in 1994 and the effectiveness of Baytan against this pest was not evaluated. In the absence of barley stripe rust or other rust species, yields of plots treated with Baytan were not significantly different than the control, RTU VT, at any test site (Tables 1-3). The spring of 1994 was one of the driest on record and common root rot infestation was very low. There was no significant difference in grain yield or quality parameters between Imazalyl or Kodiak treated plots and the RTU VT treated control at any test site (Tables 1-3).

Yields of Gaucho treated plots were significantly higher than the control at both irrigated sites (Tables 1 and 2) but not at the unirrigated site (Table 3). Although infestation of wheat stem maggot was very light in 1994, there was a low level of Russian wheat aphid at the experiment station and a high level of infestation of corn leaf aphids at the irrigated organic soil site. It appears that the Gaucho seed treatment was effective in maintaining these insects at lower levels than the non-insecticide treatments, resulting in higher yields. Grain quality parameters such as test weight and percent plumps (percent above 6/64 screen) were also higher for the Gaucho treatment than the control at the two organic soil sites (Tables 2 and 3).

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

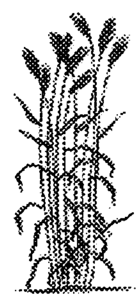


Table 1. Effect of seed treatment on grain yield and quality of irrigated Gus barley planted in mineral soil in Klamath County, OR, 1994.

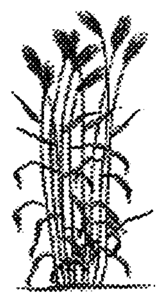
Entry	Treatment	Rate	Yield	Test weight	Thins 6/64	Thins 5.5/64	Thins Pan	Lodge	Height	Heading date
		oz/cwt	lb/A	lb/bu	%	%	%	%	inches	Julian
1	Baytan/Captan	0.75/2.0	8080	53.3	91.8	6.3	1.9	0	33	178
2	Baytan/Captan	1.25/2.0	8070	53.0	92.3	6.1	1.6	0	34	178
3	Imazalyl/RTU VT	0.25/5.0	8200	53.3	91.2	6.8	2.0	0	36	178
4	Imazalyl/RTU VT	0.05/5.0	8100	53.0	91.2	6.7	2.1	0	34	178
5	Kodiak	0.1	8180	53.0	92.1	6.2	1.7	0	35	178
6	Gaucho	2.0	8610	52.6	91.4	6.6	2.0	0	35	178
7	Gaucho	4.0	8540	53.5	93.3	5.3	1.3	0	35	178
8	Control - RTU VT	5.0	7930	53.3	91.3	6.8	1.9	0	35	178
Mean			8210	53.1	91.8	6.4	1.8	0	35	178
CV (%)			4.4	1.0	1.9	20	27	0	5.1	0
LSD (0.05)			530	0.8	2.5	1.8	0.7	0	2.6	0

Table 2. Effect of seed treatment on grain yield and quality of irrigated Gus barley planted in organic soil in Klamath County, OR, 1994.

Entry	Treatment	Rate	Yield	Test weight	Thins 6/64	Thins 5.5/64	Thins Pan
		oz/cwt	lb/A	lb/bu	%	%	%
1	Baytan/Captan	0.75/2.0	5840	51.3	93.9	4.6	1.4
2	Baytan/Captan	1.25/2.0	6030	51.3	94.2	4.4	1.4
3	Imazalyl/RTU VT	0.25/5.0	5850	51.1	93.4	5.0	1.6
4	Imazalyl/RTU VT	0.50/5.0	5800	51.0	93.2	5.3	1.5
5	Kodiak	0.1	6090	51.8	94.4	4.4	1.3
6	Gaucho	2.0	6990	52.5	97.0	2.3	0.6
7	Gaucho	4.0	7140	52.6	96.8	2.6	0.6
8	Control - RTU VT	5.0	5990	51.0	93.3	5.1	1.6
Mean			6210	51.6	94.5	4.2	1.3
CV (%)			4.6	1.1	1.0	16.0	26.0
LSD (0.05)			420	0.8	1.5	1.0	0.5

Table 3. Effect of seed treatment on grain yield and quality of unirrigated Gus barley planted in organic soil in Klamath County, OR, 1994.

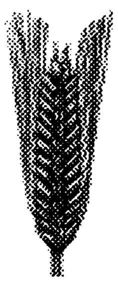
Entry	Treatment	Rate	Yield	Test weight	Thins 6/64	Thins 5.5/64	Thins Pan
		oz/cwt	lb/A	lb/bu	%	%	%
1	Baytan/Captan	0.75/2.0	3850	51.4	94.8	4.0	1.2
2	Baytan/Captan	1.25/2.0	4420	51.5	95.9	3.1	0.9
3	Imazalyl/RTU VT	0.25/5.0	4030	51.0	95.6	3.4	1.0
4	Imazalyl/RTU VT	0.50/5.0	4080	51.1	95.4	3.4	1.1
5	Kodiak	0.1	4130	50.9	95.7	3.2	1.0
6	Gaucho	2.0	3720	52.0	96.5	2.8	0.7
7	Gaucho	4.0	4570	51.6	96.4	2.8	0.8
8	Control - RTU VT	5.0	4210	51.1	95.7	3.4	1.0
Mean			4130	51.3	95.8	3.3	1.0
CV (%)			8.4	0.9	0.5	9.8	21.0
LSD (0.05)			510	0.7	0.7	0.5	0.3



Intercropping Annual Forage Species With Spring Planted Barley

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

Introduction



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

Under continuous cropping, diseases and pests such as wheat stem maggot, common root rot, and barley root knot nematode have become serious problems in some areas. Wind erosion is also a problem on some soils. Much of the cropland in the lower Klamath Basin is reclaimed lake bottom. Some of these soils have very poor structure and poor aggregate strength. The inclusion of legumes and forage grasses in a rotation has been shown to improve soil structure, soil aggregate strength, and other measures of soil health.

The production of other commodities such as canola, dry peas, and lentils in the Klamath Basin is being investigated. However, commercial production of these commodities in the Klamath Basin does not appear to be economically viable at this time. It may be possible to intercrop forage legumes and grasses with spring planted barley and derive some of the benefits of a legume or forage rotation as well as provide late season grazing and ground cover to prevent fall and early spring erosion.

Interseeding of legumes into small grains has increased grain yield in some locations. Increased yield has been attributed to nitrogen transfer from the legume, weed suppression, and improved soil conditions. The effects of legume interseeding on the subsequent year's crop is attributable to residual nitrogen transfer from decaying plant material and improved soil conditions. It seems that indeterminate legumes with lower seed yield potentials are more

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

beneficial to associated cereals in terms of nitrogen transfer in the current season and as residual nitrogen for subsequent crops. The production of a second grain crop by interseeding is impossible in the Klamath Basin due to an extremely short growing season; however, it is possible to prolong the growing season past grain harvest date by interseeding a forage species for either hay or pasture. Interseeding a forage legume would enhance nitrogen transfer to the associated cereal and maximize residual nitrogen for the following crop.

Annual forage legume variety trials have been conducted at KES over the past three years. In 1992 and 1993, legumes were planted in monoculture and total biomass production and forage quality were monitored. Several annual medic, rose clover, and sub clover species showed promise for interseeding in barley for grain. In an annual legume trial in central Oregon, good fall regrowth was seen in plots interseeded with annual medic species; however, regrowth of berseem clover entries was roughly twice that of annual medic entries. Further testing of annual forage legumes is needed to determine which is appropriate for inclusion in a small grain-forage intercropping system in the Klamath Basin. A trial to evaluate annual legumes for interseeding in spring-planted barley was established at the Klamath Experiment Station in 1994.

Procedures

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

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

Results and Discussion

Clean grain yield of interseeded plots were not superior to the control (Table 1). All interseeded annual medic entries and berseem clover decreased grain yield when compared to the non-interseeded control. Depression of cereal grain yield by interseeded legumes has also been seen in other areas. Lodging was increased by several of the most productive annual medic entries in the trial. Increased lodging in interseeded plots was also reported by other researchers. Barley grain was significantly contaminated with legume seed of all barrel medic, burr medic, and black medic entries at KES in 1994. Sava snail medic, Multicut berseem clover, and all sub and rose clover entries were not significant seed contaminants. Only the sub and rose clovers were shorter than grain harvest height at grain harvest. Berseem clover was the only entry with substantial fall growth at KES in 1994. In an annual legume trial in central Oregon, good fall regrowth was seen in plots interseeded with annual medic species; however, regrowth of berseem clover entries was roughly twice that of annual medic entries.

The seeding rate of the two species included in an intercropping system will determine the relative competitiveness of the two species. In the intercropping system which we are examining, seeding rates of the two components should be adjusted to optimize grain yield and have enough interseeded legume for ground cover and regrowth following grain harvest. Nitrogen fertilization management will also affect the relative competitiveness of the grain and legume components. Competition of the interseeded component with the primary crop may be affected by the planting date of the two components. When the planting date of the interseeded species is delayed until after that of the primary crop the competitive ability of the interseeded species is reduced. This may reduce any negative effect of interseeding on primary crop yield; however, yield of the interseeded species will be reduced. By delaying interseeding the legume component until after chemical weed control, control of broadleaf weeds in a small grain-legume intercropping system may be simplified. In a trial at KES, legumes interseeded by broadcast seeding with no incorporation following broadleaf weed control (about six weeks after planting the small grain component) failed to establish. No information is currently available on seeding rate, nitrogen fertilization, and planting date effects on a grain-legume intercropping system in the Klamath Basin. More information about species and variety selection as well as seeding rate, nitrogen fertilization, and planting date is needed.

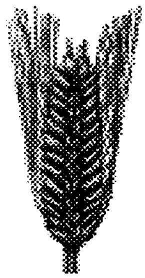


Table 1. Grain Yield and quality, lodging, and crop compatability measurements of Gustoe barley interseeded with various annual legumes at Klamath Experiment Station, OR, 1994.

		Yield			Test	Thins				Height[1]		
Entry	**Legume**	**Total**	**Clean**	**Removed**	**weight**	**6/64**	**5.5/64**	**Pan**	**Lodge**	**rating**	**Maturity[2]**	**Contamination[3]**
		lb/A	lb/A	lb/A	lb/bu				%			
1	Ascot Barrel Medic	4180	3630	550	49.6	79.7	13.9	6.5	30	1	0	1
2	Borung Barrel Medic	4350	3900	460	50.0	82.2	12.3	5.5	16	1	0	1
3	Caliph Barrel Medic	4560	4230	330	51.4	89.5	8.0	2.5	0	1	0	1
4	Mogui Barrel Medic	4230	3820	410	49.6	83.0	12.1	4.9	6	1	0	1
5	Parabinga Barrel Medic	5120	4780	340	51.5	89.3	8.0	2.7	0	0.8	0	1
6	Parraggio Barrel Medic	4220	3750	470	50.6	83.6	11.4	5.0	14	1	0	1
7	George Black Medic	4790	4190	600	49.9	85.0	11.1	4.0	1	1	1	1
8	Santiago Burr Medic	4180	3850	330	48.8	87.5	8.9	3.6	11	1	0	1
9	Sava Snail Medic	4560	4340	220	51.3	85.1	10.8	4.1	6	1	0	1
10	Berseem Clover Multicut	4650	4400	250	50.9	85.8	10.6	3.7	0	1	1	0
11	Clare Sub Clover	5370	5190	190	52.0	91.5	6.5	2.0	0	0.3	0.8	0
12	Karridale Sub Clover	5340	5130	210	51.8	91.0	6.8	2.2	0	0.3	1	0
13	Monte Frio Rose Clover	5020	4740	280	51.5	90.6	6.9	2.5	0	1	1	1
14	Overton Rose Clover	5530	5340	190	51.4	91.2	6.7	2.1	0	0.3	1	0
15	Trikkala Sub Clover	5460	5210	250	51.6	91.1	6.8	2.1	3	0	0.5	0
16	No Legume (Control)	5420	5220	190	51.6	90.3	7.3	2.3	0	NA	NA	NA
Mean		4810	4480	330	50.8	87.3	9.3	3.5	5.5	0.8	0.4	0.6
CV (%)		8.2	8.8	27	1.6	2.6	15	25	155			
LSD (0.05)		560	560	130	1.10	3.20	2.0	1.2	12			

1/ Height rating - Legume height data: 1= High, 0= Low

2/ Maturity - Legume maturity: 1= Green, 0= Mature

3/ Contamination - Legume seeds in barley: 1= Contamination, 0= No contamination

Intercropping Oat Hay and Annual Legumes

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

Introduction

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

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

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Procedures

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

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

Results and Discussion

Interseeding forage legumes into oats for hay at KES did not affect forage production (Table 1). However, interseeding with four different legume entries (Austrian winter peas, Maple peas, Magnus field pea, and Ascot barrel medic) produced significantly higher CP levels than the non-interseeded control. Only Austrian winter peas produced significantly lower ADF and NDF values than the control. Similarly, only Austrian winter peas produced significantly higher RFV than the non-interseeded control. Although Magnus field pea and maple pea produced significantly higher yields than Austrian winter pea when grown in monoculture in 1993 and 1992, there was no yield or quality advantage of any entry over Austrian winter pea when grown in an oat-legume mixture. Fall regrowth following cutting was visually monitored and only Multicut berseem clover produced significant regrowth. Barrel medic, burr medic, and snail medic entries had set seed and were senescing due to their determinate growth habit. Although they were green, black medic, sub clover, and rose clover entries did not regrow following cutting.

This may have been due to drought stress or, in the case of sub clover, it may have been due to low fall temperatures. Where fall growth following hay harvest is important, berseem clover may be the best choice. It produced forage yields and forage quality equivalent to Austrian winter pea and produced the best fall regrowth.

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

Table 1. Forage yield, crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), and relative feed value (RFV) of oat-legume mixtures planted at Klamath Experiment Station, OR, 1994.

Variety	Yield	CP	ADF	NDF	RFV
	tons/A	(%)	(%)	(%)	
Ascot Barrel Medic	6.07	8.6	39.3	55.1	99
Borung Barrel Medic	6.05	7.8	40.2	56.8	95
Caliph Barrel Medic	6.45	8.1	39.8	56.1	97
Mogui Barrel Medic	5.57	8.4	41.0	58.4	91
Parrabinga Barrel Medic	6.69	7.1	42.0	60.3	87
Parraggio Barrel Medic	6.19	8.3	38.9	55.7	99
George Black Medic	6.06	7.3	40.2	58.7	91
Santiago Burr Medic	5.75	7.2	42.3	59.8	87
Sava Snail Medic	6.41	7.7	39.0	55.9	97
Berseem Clover Multicut	6.40	8.3	37.7	55.1	101
Clare Sub Clover	6.43	6.2	41.4	59.8	89
Karridal Sub Clover	5.84	7.7	38.5	56.1	98
Monte Frio Rose CLover	6.46	6.7	39.7	57.9	94
Overton Rose Clover	5.96	6.3	42.4	61.2	85
Trikkala Sub Clover	6.89	7.4	38.4	55.9	98
Austrian Winter Pea	6.10	9.5	37.0	53.3	106
Magnus Field Pea	6.10	8.7	38.4	56.0	99
Maple Pea	6.67	8.8	39.1	56.4	97
Border Oats (control)	6.35	6.8	41.5	59.9	88
Mean	6.23	7.7	39.8	57.3	95
CV (%)	12.1	15	7.6	7.2	11.8
LSD (0.05)	NS	1.7	4.3	5.9	16

Oat Hay Variety Trial

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

Introduction

Oat hay is an important commodity in the Klamath Basin. An increasing acreage of oat hay is being produced in the basin. Oat hay variety trials were conducted at KES in 1989 and 1990. Since that time, several new oat varieties have been released for grain production and some oat varieties have been released specifically for hay production. A variety trial examining the hay yield potential and forage quality of standard and newly developed varieties is needed to provide producers with a basis for variety selection. An oat hay variety trial was established at KES in 1994 to examine the forage yield and quality of 12 oat hay varieties.

Procedures

The trial was established at KES on Fordney fine sandy loam that is moderately deep and somewhat poorly drained. The previous crop was potatoes. The crop was irrigated by a solid set sprinkler system. The trial was arranged in a randomized complete block design with four replications. Seed was planted on April 20 at a depth of 1 inch and a seeding rate of 100 lb/acre. All plots were fertilized with 50 lb N, 62 lb P_20_5, and 37 lb S / acre at time of seeding. Plots measured 5 x 20 feet with a row spacing of 6 inches. Bromoxynil and MCPA were applied at labeled rates to control broadleaf weeds.

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

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Results and Discussion

Variability was high in the trial in 1994, making variety separation difficult. The highest yielding variety, Magnum, was not significantly different than eight other varieties (Table 1). The only two entries with significantly lower yield than Magnum were Magnum II and Dusty. These two varieties are very short season while Magnum is a late maturing variety. Harvesting all entries when Magnum was at soft dough resulted in the early varieties reaching stages too advanced for optimal production. This is reflected in the lower CP and higher fiber content of the earlier maturing varieties. Additional testing is required to reliably identify the best variety for forage production. In future trials, the use of multiple harvest dates where individual varieties are harvested as they reach the soft dough stage would be advisable.

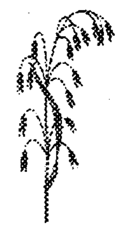

Table 1. Forage yield and quality of oat varieties grown at Klamath Experiment Station, OR, 1994.

Variety/ selection	Yield	Protein	ADF	NDF	RFV
	tons/A	(%)	(%)	(%)	
Cayuse	6.8	7.3	40.2	58.3	92
Border	6.3	8.6	38.8	55.6	99
Ajay	5.9	7.5	39.0	57.9	95
Magnum II	5.7	6.9	42.3	61.4	85
83Ab3250	5.8	7.2	41.0	59.2	90
Rio Grande	5.8	6.6	42.5	61.6	84
Monida	6.1	7.8	41.0	59.5	91
Magnum	7.3	8.8	38.5	57.0	97
B-3	5.0	7.2	43.7	63.9	80
DU-1	5.5	6.7	44.2	64.6	79
Magnum/Magnum II	6.0	6.4	44.4	63.3	80
Otana	6.8	7.2	39.4	57.3	95
Mean	6.1	7.3	41.3	60.0	89
CV (%)	18.7	19.7	8.8	7.8	13
LSD (0.05)	1.5	2.1	5.2	6.6	17

Alfalfa Variety Trial 1991-1994

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

Introduction

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

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

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alfalfa producers locally developed data on the yield potential and persistence of new alfalfa varieties. An alfalfa variety trial established at KES in 1991 is the main subject of this report.

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 eptam (EPTC) and Benefin was applied prior to planting at 3 and 1.2 lb ai/acre, 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/acre 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 subsequent years 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. In 1993, the growing season was cooler than normal. Three cuttings were taken and fall regrowth documented by a fourth harvest after plants had gone dormant. Three cuttings were also taken in 1994.

Results and Discussion

Forage yields in the establishment year ranged from 0.86 to 1.52 tons/acre. 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 present but a large number of varieties were in the top yielding group (Tables 1 and 2). Average forage yield in 1992 was 7.44 tons/acre and only 5.02 tons/acre in 1933 (Table 1). This drop in yield was partly due to a cooler than normal year in 1993 and to moisture stress caused by irrigation scheduling conflicts. The trial average yield increased slightly in 1994 to 5.37 tons/acre. Identification of differences in forage yield between varieties was no better when three-year total forage production, 1992 to 1994 average production, and total four-year production were examined. Twenty four entries were in the top yielding group when the three-year average yield was examined. The relative ranking of varieties when examining three-year average yield and four-year total yield 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.

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, verticilium wilt, and in some areas stem nematode. Resistance to root-knot nematode may also be a factor when in rotation with potatoes. In the past, fall dormancy ratings of 2 to 3 have been recommended for the Klamath Basin; however, recent varieties in groups 4 and 5 have persisted over a four- year period.

Table 1. Forage yield summaries of 48 alfalfa varieties grown at the Klamath Experiment Station, OR, 1991-1994.

Entry	Variety/ selection	Yield 1991	1992	1993	1994	Total	4 - yr	3 - yr avg 92 - 94	3 - yr
		tons/A					rank	tons/A	rank
1	DK 122	1.34	7.75	5.02	5.16	19.27	18	5.37	25
2	DK 120	1.10	8.12	5.26	6.10	20.58	1	5.93	1
3	DK 135	1.19	7.38	4.47	5.33	18.37	36	5.18	37
4	DK 125	1.52	7.22	4.46	5.67	18.87	30	5.27	35
5	Asset	1.21	7.93	5.31	5.51	19.96	4	5.69	4
6	Centurion	1.14	7.54	5.04	5.39	19.11	25	5.43	20
7	Multistar	1.18	7.72	4.92	5.92	19.74	8	5.62	8
8	Majestic	1.06	7.09	5.43	5.93	19.51	13	5.53	14
9	Sabre	1.06	7.36	4.69	5.00	18.11	42	5.15	40
10	Webfoot	1.12	7.19	4.63	5.39	18.33	37	5.30	30
11	MS 90	1.21	7.61	4.99	5.09	18.90	28	5.31	29
12	UN-74	1.28	7.78	5.02	5.08	19.16	22	5.39	24
13	Legend	1.31	7.75	4.90	4.54	18.50	35	5.18	36
14	Apollo Supreme	1.13	7.45	4.97	5.38	18.93	27	5.42	23
15	Arrow	1.30	7.32	4.83	5.38	18.83	32	5.29	31
16	Agressor	1.03	7.40	4.71	6.27	19.41	15	5.57	12
17	Archer	1.12	8.08	4.64	5.88	19.72	10	5.61	10
18	Husky	0.98	7.17	4.87	5.17	18.19	41	5.16	38
19	GS-88	1.17	7.17	5.10	4.80	18.24	40	5.14	41
20	Ultra	1.34	7.69	4.89	5.41	19.33	16	5.37	26
21	Expt. 91-01	0.97	7.23	5.22	5.79	19.21	20	5.52	15
22	Max 85	1.41	7.41	4.28	5.19	18.29	39	5.08	43
23	87-201	1.36	7.64	5.22	4.47	18.69	34	5.28	32
24	WL-317	0.97	6.90	4.50	4.93	17.30	46	4.97	45
25	WL-320	1.17	7.36	4.95	4.63	18.11	43	5.10	42
26	WL-225	1.44	7.21	5.00	5.41	19.06	26	5.27	34
27	WL316	1.28	7.23	5.48	5.83	19.82	7	5.57	13
28	Vernal	1.02	6.93	4.67	5.21	17.83	44	5.06	44
29	Sparta	1.18	7.28	5.17	6.04	19.67	11	5.58	11
30	Champ	1.05	7.18	5.20	5.84	19.27	17	5.47	18

Table 1. (continued) Forage yield summaries of 48 alfalfa varieties grown at the Klamath Experiment Station, OR, 1991-1994.

	Variety/	Yield						3 - yr avg	
Entry	selection	1991	1992	1993	1994	Total	4 - yr	92 - 94	3 - yr
		tons/A					rank	tons/A	rank
31	Fortress	1.24	7.70	5.43	5.99	20.36	2	5.77	2
32	Multileaf II	1.22	7.63	4.94	5.09	18.88	29	5.34	27
33	Excaliber	1.24	8.02	5.10	5.37	19.73	9	5.61	9
34	Blazer	1.33	7.77	5.17	5.62	19.89	6	5.67	6
35	Belmont	1.14	7.26	5.18	5.54	19.12	24	5.43	19
36	Cimmaron VR	1.36	7.38	5.40	6.05	20.19	3	5.68	5
37	Columbo	1.33	7.42	4.86	5.23	18.84	31	5.32	28
38	9047IV	1.24	7.54	4.79	5.26	18.83	33	5.28	33
39	Milkmaker II	1.28	7.37	4.16	4.67	17.48	45	4.91	46
40	Flint	1.26	7.28	4.96	5.67	19.17	21	5.42	21
41	PB 5364	1.26	7.42	5.20	5.26	19.14	23	5.42	22
42	SCO 0042	1.03	6.72	4.69	4.50	16.94	47	4.77	47
43	SCO 0043	0.96	6.20	4.35	4.10	15.61	48	4.38	48
44	Rancher Special	1.15	7.78	4.79	5.52	19.24	19	5.49	16
45	Apollo Ii	1.26	7.43	4.97	5.78	19.44	14	5.47	17
46	Atra 55	0.86	8.51	5.29	5.26	19.92	5	5.76	3
47	Vector	1.17	7.33	4.48	5.31	18.29	38	5.16	39
48	LM331	1.14	7.38	5.17	5.95	19.64	12	5.62	7
	Mean	1.19	7.44	4.93	5.37	18.94		5.36	
	CV (%)	16	9	12	14	8		12	
	LSD (0.05)	0.30	0.90	1.40	1.08	2.01		0.54	

Table 2. 1994 dry matter yield of all three cuttings and total yield of alfalfa varieties established at Klamath Experiment Station in 1991.

Entry	Variety/ selection	Yield Cut 1	Cut 2	Cut 3	Total	Rank
		(ton/A)				
1	DK 122	1.5	2.14	1.54	5.16	36
2	DK 120	2.04	2.26	1.80	6.10	2
3	DK 135	1.6	2.23	1.48	5.33	27
4	DK 125	1.6	2.34	1.69	5.67	15
5	Asset	1.7	2.21	1.64	5.51	19
6	Centurion	1.5	2.19	1.66	5.39	22
7	Multistar	1.8	2.40	1.73	5.92	8
8	Majestic	2.00	2.19	1.74	5.93	7
9	Sabre	1.6	2.02	1.41	5.00	40
10	Webfoot	1.7	2.10	1.61	5.39	23
11	MS 90	1.5	2.05	1.52	5.09	38
12	UN-74	1.4	2.11	1.54	5.08	39
13	Legend	1.5	1.92	1.17	4.54	45
14	Apollo Supreme	1.7	2.12	1.59	5.38	25
15	Arrow	1.65	2.08	1.65	5.38	24
16	Agressor	1.9	2.53	1.82	6.27	1
17	Archer	1.7	2.29	1.94	5.88	9
18	Husky	1.6	1.98	1.57	5.17	35
19	GS-88	1.4	1.89	1.48	4.80	42
20	Ultra	1.7	2.10	1.63	5.41	21
21	Expt. 91-01	1.7	2.21	1.90	5.79	12
22	Max 85	1.50	2.08	1.61	5.19	34
23	87-201	1.4	2.10	1.02	4.47	47
24	WL-317	1.6	2.01	1.32	4.93	41
25	WL-320	1.3	1.80	1.52	4.63	44
26	WL-225	1.7	2.11	1.62	5.41	20
27	WL316	1.80	2.15	1.89	5.83	11
28	Vernal	1.8	2.01	1.45	5.21	33
29	Sparta	2	2.23	1.83	6.04	4
30	Champ	1.9	2.14	1.79	5.84	10

Table 2. (continued) 1994 dry matter yield of all three cuttings and total yield of alfalfa varieties established at Klamath Experiment Station in 1991.

Entry	Variety/ selection	Yield Cut 1	Cut 2	Cut 3	Total	Rank
		(ton/A)				
31	Fortress	1.8	2.27	1.91	6.00	5
32	Multileaf II	1.6	2.00	1.51	5.09	37
33	Excaliber	1.8	2.17	1.38	5.37	26
34	Blazer	1.7	2.17	1.78	5.62	16
35	Belmont	1.8	2.19	1.59	5.54	17
36	Cimmaron VR	1.9	2.21	1.91	6.05	3
37	Columbo	1.6	2.10	1.51	5.23	32
38	9047IV	1.7	2.03	1.55	5.26	31
39	Milkmaker II	1.50	2.03	1.14	4.67	43
40	Flint	1.9	2.06	1.76	5.67	14
41	PB 5364	1.7	2.05	1.55	5.26	29
42	SCO 0042	1.2	1.64	1.64	4.50	46
43	SCO 0043	1.1	1.37	1.60	4.10	48
44	Rancher Special	1.8	2.10	1.64	5.52	18
45	Apollo Ii	1.9	2.14	1.76	5.78	13
46	Atra 55	1.7	1.99	1.57	5.26	30
47	Vector	1.7	1.94	1.69	5.31	28
48	LM331	1.8	2.23	1.88	5.95	6
	Mean	1.7	2.1	1.62	5.37	
	CV (%)	10	6	10	7	
	LSD (0.05)	0.5	0.35	0.45	1.08