Forage, Cereal, and Potato Research, 1987

Klamath Agricultural Experiment Station

in cooperation with

Klamath County

Special Report 825

April 1988

Agricultural Experiment Station
Oregon State University
Corvallis, Oregon 97331

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Introduction

In 1939 the Oregon Legislature established the Klamath Experimental Area in response to a request from local growers to address the problem of severe damage to potato crops in the Klamath Basin caused by root-knot nematodes. Oregon State College leased an 80-acre tract of saline and saline-sodic soils from the Bureau of Reclamation, Klamath County provided funds for buildings and equipment, and a new branch experiment station was born.

Soils at the site were representative of some 10,000 acres in the Klamath Irrigation District that were at that time considered to be too poor for crop production. A major thrust of early work was development of practices to reclaim saline-sodic soils, a successful effort that eventually brought most of these soils into the production base of the Basin's agricultural industry.

From that beginning the program expanded to off-station locations to cover all soil types found in the Basin. Many aspects of production of the major crops--potatoes, cereals, and forages--were investigated. At times a significant portion of the program has been devoted to livestock production research. Much progress has been made in all of these areas in the 48 years since the station was established. While accomplishments and contributions of the station and its staff to local and regional agriculture are numerous, much remains to be done.

Potato research has led to better control of root-knot nematodes, verticillium wilt, and other pest-related problems. Crop management in terms of fertility, irrigation, and storage has been improved. Much has been done in searching for a replacement for the Russet Burbank variety which has serious limitations due to disease susceptibility and physiological disorders. Yet all of these areas are still under investigation.

Several cereal varieties developed and released by the station have made significant contributions to local grain growers. The identification of micronutrient imbalances in the Basin's organic soils, and development of practices to remedy them has led to substantial yield enhancement. Work continues in these areas, with several improved cereal varieties offering promise for the near future.

The forage and livestock sector has benefited from the introduction of new species and varieties of forages, improved forage management practices, and the identification of and solution to nutritional deficiency problems. In the near future biotechnology will have a major impact on both forages and livestock. Developing or adopting new technology to local conditions will be vital to maintaining a competitive position in this sector.

The emphasis of the station's programs has shifted from time to time in response to staffing changes, emerging technology, and policy changes at government or university levels. In 1957 the name was changed from the Klamath Experimental Area to the Klamath Experiment Station (KES). Financial support for programs has varied, but Klamath County has maintained a significant role in funding for staff and programs. At present nearly 25 percent of funding is derived from Klamath County, a situation somewhat unique in the Oregon Agricultural Experiment Station network, and a very positive factor in the operation of the station.

The Klamath Experiment Station experienced a major transition in 1987. George Carter retired as superintendent on June 30, a post he had held since 1971. George has devoted 27 years to potato and cereal development programs at the station and remains on staff in a part-time role as associate professor.

Dr. Ken Rykbost joined the staff in May as associate professor of crop science, assuming responsibility for potato research programs, and as superintendent on July 1. Ken received his doctorate in the Department of Soil Science at OSU in 1973. His most recent eleven years were spent as crop scientist with McCain Foods Ltd. in Florenceville, New Brunswick, Canada, where he conducted an applied research and extension program largely devoted to potato production for processing.

Dr. Randy Dovel completed the transition by joining the staff as assistant professor of crop science on July 1. Randy completed his doctorate in the Department of Soil and Crop Sciences at Texas A & M University in May 1987. With a background in forage management, Randy assumes responsibility for forage and cereal programs at KES.

In this, our first in a series of annual reports, we hope to communicate the highlights of the KES research efforts for 1987 and provide interested readers an opportunity to keep abreast of programs, developments, and challenges for agriculture in the Klamath Basin.

Ken Rykbost, Superintendent
KLAMATH EXPERIMENT STATION

Appreciation

The assistance of growers, individuals, and companies who contributed in various ways to KES programs in 1987 is gratefully recognized. In particular we wish to thank: Sam Henzel, Dan Chin, and James and Vincent Cheyne for use of off-station sites and routine care of crops at these sites; Klamath County personnel of the OSU Extension Service Ron Hathaway (Chairman), Dale Beck, and Rodney Todd for cooperation and help in numerous areas; the Klamath County Board of Commissioners for financial and other assistance; the Basin Fertilizer and Chemical Company, Dow Chemical Company, Chevron Chemical Company, and Unocal Chemicals Division of Unocal Corporation for product or financial contribution and technical assistance in support of projects; the Oregon Potato Commission for financial support; many of the staff at Oregon State University and Branch Experiment Stations who have assisted Randy and me in our transition into the system; and Betty Bragg for the preparation of this report.

Staff at KES

Dr. Kenneth A. Rykbost.. Superintendent, Associate Professor of Crop Science
Dr. Randy L. Dovel...... Assistant Professor of Crop Science
George E. Carter........ Superintendent Emeritus, Associate Professor

Betty Bragg....... Clerical Specialist
Jerry Maxwell..... Experimental Biology Technician (potatoes)
James Rainey III.. Experimental Biology Technician (forages)
Philip G. Wilson.. Farm Unit Foreman
Greg Chilcote..... Research Aide (grain) - (Klamath County)
Larry Johnson..... Facility Maintenance - (Klamath County)

Advisory Committee

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Sam Henzel (Chairman)
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LaVerne Hankins
Kenneth Jespersen
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Lynn Pope
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Ex Officio Members

Ken Rykbost, Superintendent, KES
Ron Hathaway, Chairman, Klamath County Extension Service
Roger Hamilton, Klamath County Board of Commissioners

Weather and Crop Summary

K.A. Rykbost and G. Chilcote [1]

Long-term climatic conditions and seasonal patterns determine the suitability of a region to crops, the occurrence or severity of numerous pest problems, and the physiological performance of crops grown. At 4,100 feet elevation, and lying in the rain shadow of the Cascade Mountain Range, the Klamath Basin experiences a high desert climate. The 30-year average annual rainfall at Klamath Falls is less than 11 inches. Frost is possible in every month. Daily temperature extremes of 50° F are not uncommon. These conditions preclude the production of crops requiring a long growing season, an extensive frost-free period, or a more moderate climate. They account to a large extent for the agricultural base of spring grains, hay and pasture crops, cattle, and potatoes that dominate the Basin's agricultural economy.

To provide a summary of weather during the growing season, data were compiled on a weekly basis for the 10-year period from 1978 to 1987 for April through October. Data were obtained from the National Oceanic and Atmospheric Administration publication, Climatological Data, Oregon. The official weather station is located at Kingsley Field, one-half mile from the Klamath Experiment Station. It is at 4,090 feet elevation, 42° 10' N latitude, and 121° 45' W longitude. A station is also maintained at KES. Where Kingsley Field observations were missing, KES data have been substituted for them. Pan evaporation data from KES were used where available (1984-1987). In general there is excellent agreement in data with the exception that daily temperature lows are consistently lower at KES by 1 to 3° F.

Weekly average maximum, minimum, and mean daily temperatures are presented for 1987 and for the most recent 10-year period (Table 1). The departure of 1987 mean daily temperature from the 10-year average is also presented on a weekly accumulated basis. The 1987 season was unusually warm from mid-April through early July and from mid-August through October. For the 30-week period, daily mean temperatures averaged 2.6° F higher in 1987 than the 10-year norm.

Frosts have important consequences for all crops in the Klamath Basin. Weekly low temperatures and the number of frost days per week on a percentage basis for the 10-year period portray 1987 as a warmer than average season, with a longer frost-free period and fewer and less severe frosts in late spring and early fall (Table 2). Southern regions of the Klamath Basin often

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1/ Superintendent/Associate Professor and Klamath County Research Aide, respectively, Klamath Experiment Station.

experience minimum temperatures of 5 to 7° F lower than those recorded at Klamath Falls. On this basis it is likely that frosts have occurred in portions of the basin at least once in 10 years during each week except two or three weeks in mid-summer. In 1987 the Basin was frost free from late June through mid-September.

Over the past 10 years weekly precipitation has averaged 0.15 inches, and has been quite uniformly distributed throughout the season (Table 3). In 1987 the total precipitation for the season was 66 percent of normal, and 56 percent of the total occurred in a two-week period in mid-July. Both spring and fall were unusually dry, favoring farming activities in these critical periods.

The 1987 season experienced typical evaporation except during the two weeks of cool and wet weather in mid-July (Table 4). This was offset by dryer than normal conditions in the spring which required increased irrigation in late May to recharge dry soil.

The 1987 weather conditions greatly impacted crops grown in the region. Hay crops, largely alfalfa, benefited from an early and warm spring and a dry and late fall. First cuttings were generally one week to 10 days ahead of schedule and four cuttings were taken on some crops. Rains in early June and mid-July coincided with harvest of much of the hay crop, resulting in poor quality due to either the wetting of cut hay or delays in cutting. On the other hand, unirrigated pastures and grass hay crops benefited from the timely rains in early June and mid-July.

Cereal crops were among the best in many years. Early planting, minimal frost damage at the crucial boot stage, high rainfall just prior to head fill, and excellent harvesting conditions all contributed to a good crop. The July rains were particularly beneficial to unirrigated crops on organic soils in the lower lake region. Quality was generally good to excellent.

Potato crops were planted early and experienced little, if any, frost damage. The rainfalls and cool temperatures of mid-July probably contributed to a higher than normal tuber set which resulted in smaller size in some crops killed down relatively early. It also favored the development of sclerotinia or white mold in some crops in the lower lake region. Dry and warm weather in September and October favored harvest and minimized soft rot problems experienced in several recent years. High daytime temperatures during harvest resulted in delays in cooling down storages which may hasten sprouting of seed and untreated tablestock crops in the spring of 1988. With the exception of small size in some lots, potato quality was generally good and yields were above average.

Table 1. Weekly average maximum, minimum, and mean temperatures for 1987 and the 10-year period from 1978 to 1987 and the accumulated departure of 1987 weekly means from the 10-year average at Klamath Falls.

Weekly Period		1978 - 1987 Weekly Average Max	Min	Mean	1987 Weekly Average Max	Min	Mean	1987 Accumulated Departure [1]
				° F				
April	1- 7	51	28	40	61	30	46	6
	8-14	56	30	43	61	25	43	6
	15-21	58	31	45	68	28	48	9
	22-28	59	33	46	77	39	58	21
	29- 5	62	34	48	64	35	50	23
May	6-12	60	32	46	83	45	64	42
	13-19	67	37	52	75	40	58	48
	20-26	70	41	56	64	37	51	43
	27- 2	71	41	56	64	35	50	37
June	3- 9	71	43	57	79	51	65	45
	10-16	73	43	58	80	48	64	51
	17-23	75	45	60	70	41	56	47
	24-30	79	48	64	89	54	72	55
July	1- 7	79	47	63	80	45	63	55
	8-14	80	47	64	83	53	68	59
	15-21	83	50	67	71	46	59	51
	22-28	85	50	68	71	43	57	40
	29- 4	85	49	67	83	48	66	39
Aug.	5-11	87	51	69	88	49	69	39
	12-18	82	47	65	78	44	61	35
	19-25	80	46	63	84	49	67	39
	26- 1	79	45	62	89	51	70	47
Sept.	2- 8	78	44	61	82	44	63	49
	9-15	73	40	57	80	42	61	53
	16-22	71	36	54	77	35	56	55
	23-29	69	39	54	78	39	59	60
	30- 6	72	36	54	83	38	61	67
Oct.	7-13	67	34	51	76	38	57	73
	14-20	61	30	46	70	28	49	76
	21-27	61	32	47	69	30	50	79

1/ Accumulated difference between 1987 and 10-year mean weekly temperatures.

Table 2. Weekly minimum temperatures and percent of days with frost for 1987 and the 10-year period from 1978 to 1987 at Klamath Falls.

Weekly Period		Weekly Minimum		Frost days/Week	
		Ten Year	1987	Ten Year	1987
		° F		%	
April	1- 7	11	26	80	71
	8-14	17	17	70	100
	15-21	17	20	63	86
	22-28	21	32	47	14
	29- 5	22	29	33	29
May	6-12	22	36	51	0
	13-19	24	30	30	14
	20-26	24	31	13	14
	27- 2	27	27	11	43
June	3- 9	28	43	7	0
	10-16	30	42	3	0
	17-23	33	33	0	0
	24-30	33	52	0	0
July	1- 7	33	40	0	0
	8-14	35	45	0	0
	15-21	36	39	0	0
	22-28	40	40	0	0
	29- 4	39	40	0	0
Aug.	5-11	37	42	0	0
	12-18	34	37	0	0
	19-25	39	43	0	0
	26- 1	35	48	0	0
Sept.	2- 8	32	42	1	0
	9-15	29	40	14	0
	16-22	24	32	21	14
	23-29	26	34	23	0
	30- 6	22	35	19	0
Oct.	7-13	18	31	27	14
	14-20	20	26	67	86
	21-27	20	26	66	71

Table 3. Weekly and accumulated precipitation for 1987 and the 10-year period from 1978 to 1987 at Klamath Falls.

Weekly Period		1978 - 1987 Weekly	1978 - 1987 Accumulated	1987 Weekly	1987 Accumulated
			inches		
April	1- 7	.28	.28	0	0
	8-14	.10	.38	0	0
	15-21	.13	.51	0	0
	22-28	.15	.66	0	0
	29- 5	.26	.92	.27	.27
May	6-12	.14	1.06	0	.27
	13-19	.13	1.19	0	.27
	20-26	.09	1.28	.22	.49
	27- 2	.14	1.42	.02	.51
June	3- 9	.22	1.64	.23	.74
	10-16	.13	1.77	.29	1.03
	17-23	.05	1.82	.04	1.07
	24-30	.15	1.97	.15	1.22
July	1- 7	.12	2.09	.02	1.24
	8-14	.02	2.11	0	1.24
	15-21	.17	2.28	1.14	2.38
	22-28	.07	2.35	.52	2.90
	29- 4	.10	2.45	0	2.90
Aug.	5-11	.01	2.46	0	2.90
	12-18	.07	2.53	0	2.90
	19-25	.19	2.72	0	2.90
	26- 1	.23	2.95	.04	2.94
Sept.	2- 8	.15	3.10	0	2.94
	9-15	.16	3.26	0	2.94
	16-22	.20	3.46	0	2.94
	23-29	.20	3.66	0	2.94
	30- 6	.05	3.71	0	2.94
Oct.	7-13	.22	3.93	0	2.94
	14-20	.17	4.10	0	2.94
	21-27	.35	4.45	0	2.94

Table 4. Weekly and accumulated pan evaporation for 1987 and the 10-year period from 1978 to 1987 at Klamath Falls.

Weekly Period		1978 - 1987 Weekly	1978 - 1987 Accumulated	1987 Weekly	1987 Accumulated
			inches		
June	3- 9	1.85	1.85	1.82	1.82
	10-16	1.96	3.81	1.69	3.51
	17-23	2.15	5.96	1.86	5.37
	24-30	2.11	8.07	1.95	7.32
July	1- 7	2.08	10.15	2.01	9.33
	8-14	2.21	12.36	2.43	11.76
	15-21	2.32	14.68	1.66	13.42
	22-28	2.29	16.97	1.40	14.62
	29- 4	2.27	19.24	2.13	16.75
Aug.	5-11	2.34	21.58	2.57	19.32
	12-18	2.19	23.77	2.15	21.47
	19-25	1.86	25.63	2.28	23.75
	26- 1	1.73	27.36	2.14	25.89
Sept.	2- 8	1.61	28.97	1.43	27.32
	9-15	1.45	30.42	1.30	28.62

Alfalfa Variety Trial
Klamath Experiment Station, 1987

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

Introduction

This trial was established to evaluate the ability of alfalfa varieties to yield and persist in the Klamath Basin. Yield and persistence will be monitored over a five-year period.

Procedures

Plots were established in August 1986. The trial consists of 48 released and experimental varieties arranged in a randomized complete block design with four replications. Soil samples from the plots were analyzed and the appropriate fertilizer applied prior to planting. A tank mix of EPTC and benefin was applied prior to planting at 3 and 1.2 lb a.i./A, respectively. Immediately after application the herbicide was incorporated by disking. Seed was drilled to a depth of 1/4 inch using a modified Kincaid drill at a rate of 20 lbs/A. Plots were 5 x 30 feet with 5-foot borders and alleyways. Irrigation was supplied with a solid set sprinkler system during establishment and throughout the first and second growing seasons.

The plants were allowed to grow uncut through the first growing season. Three harvests were taken in 1987 when plants reached late bloom. Plots were harvested using a flail harvester with a three-foot wide head. All yields are reported on a dry weight basis.

Results and Discussion

Little difference in yield occurred between most varieties during the first harvest year. Most higher-yielding varieties were intermediate types with less-dormant types yielding higher than more dormant varieties. The difference between winter-dormant and less-dormant types was more pronounced in the first and third cuttings when dormancy affected growth. The yields observed in 1987 reflect the ability of these varieties to establish and grow over a short period of time. The winter of 1986 was very mild by Klamath Basin standards. The relative ranking of these varieties will undoubtedly change as harsher winter conditions are encountered.

1/ Assistant Professor and Experimental Biology Technician, respectively, Klamath Experiment Station.

Acknowledgements: Appreciation is expressed to the following companies for financial support for this trial: Allied Seed, DeKalb Seed, North American Plant Breeders, Northrup King Co., Pioneer Hi-Bred International, Plant Genetics, Union Seed Co., W-L Research.

Alfalfa Variety Trial; forage yields during 1987 on plots established in August 1986. Klamath Experiment Station, Oregon State University.

VARIETY	HARVEST DATE: June 18 (Tons/A)	HARVEST DATE: Aug.3 (Tons/A)	HARVEST DATE: Sept.14 (Tons/A)	Total (Tons/A)	Percent of Vernal[1]
1) WL 320	2.8	2.1	1.7	6.7	112
2) CENTURION	2.9	2.0	1.8	6.7	112
3) 83B32	2.9	2.1	1.7	6.7	112
4) ARROW	2.8	2.1	1.7	6.6	110
5) WL 315	2.8	2.2	1.5	6.6	110
6) NK 83580	2.7	2.0	1.8	6.5	110
7) COMMANDER	2.7	2.0	1.8	6.5	109
8) PB 5444	2.8	2.0	1.6	6.5	108
9) RANGER	2.6	2.1	1.7	6.5	108
10) PB 5432	2.7	2.0	1.7	6.4	108
11) EXCALIBUR	2.9	1.9	1.6	6.4	108
12) SPARTA	2.7	2.1	1.6	6.4	107
13) DK 120	2.6	2.0	1.7	6.4	107
14) WL 225	2.8	1.9	1.6	6.4	107
15) GT 58	2.7	1.9	1.8	6.4	106
16) DRUMMOR	2.7	2.0	1.7	6.4	106
17) PHYTOR	2.7	2.0	1.7	6.4	106
18) PEAK	2.7	2.0	1.6	6.3	106
19) IROQUOIS	2.6	2.0	1.7	6.3	106
20) PB 526	2.7	2.0	1.6	6.3	106
21) 83B27	2.7	1.9	1.7	6.3	105
22) MISSION 123 BRAND	2.6	2.0	1.6	6.3	105
23) PIKE	2.5	1.9	1.8	6.3	104
24) RS 3309	2.7	1.9	1.6	6.2	104
25) RAMBLER	2.8	1.9	1.5	6.2	103
26) WL 316	2.6	2.0	1.6	6.1	103
27) EPIC	2.6	1.9	1.6	6.1	101
28) DK 135	2.5	1.9	1.7	6.0	101
29) MAX 85 BRAND	2.5	1.9	1.6	6.0	101
30) LAHONTAN	2.5	1.8	1.7	6.0	101
31) ATRA 55	2.6	1.9	1.6	6.0	101
32) SENTRY	2.6	1.8	1.6	6.0	100
33) BRUTE BRAND	2.4	1.9	1.7	6.0	100
34) SPREADER II	2.6	1.9	1.5	6.0	100
35) VERNAL	2.6	1.9	1.5	6.0	100
36) NK 83632	2.6	1.9	1.6	6.0	100
37) BLAZER	2.5	1.9	1.6	6.0	100
38) 83B35	2.5	1.9	1.5	6.0	100
39) 83-2	2.5	1.9	1.5	6.0	100
40) THUNDER	2.5	1.9	1.5	5.9	99
41) PB 532	2.5	1.9	1.5	5.9	99
42) 005-S	2.6	1.8	1.6	5.9	99
43) APOLLO II	2.5	1.8	1.6	5.9	99
44) 003-G	2.4	1.9	1.6	5.9	98
45) ARMOR	2.3	2.0	1.5	5.8	97
46) 83B37	2.5	1.7	1.5	5.8	96
47) 83C63	2.3	1.8	1.5	5.6	94
48) NOMAD	2.5	1.6	1.3	5.4	90
Mean	2.6	1.9	1.6	6.2	103
CV	11.3	10.7	9.6	7.0	
LSD(0.05)	.4	.3	.2	.6	

1/ Based on Total Yield

Chemical Hay Preservation

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

Introduction

The hay producer is faced with the task of removing large quantities of water from fresh cut forage to produce dry hay. This energy intensive process is greatly affected by environmental conditions. The evaporation of seven tons of water to produce one ton of hay requires 15 million BTU's. Field hay drying can be a protracted process with loss of both quality and production because of variable environmental conditions. Each day that cut hay lays in the field drying is estimated to reduce seasonal yields in alfalfa by 6-7 percent.

Hay drying progresses in stages. The initial two stages are characterized by rapid drying until the forage reaches a moisture content of about 45 percent. The final stage is more sensitive to environmental conditions than the first two phases and is often slow. The ability to bale hay with a higher moisture content would shorten drying time and allow the removal of drying hay from the field to avoid inclement weather.

Preservatives such as propionic acid and ammonia applied at baling or shortly thereafter act to inhibit microbial activity. Anhydrous ammonia has been used to preserve and enhance the quality of lesser quality hay. However, the disadvantages of anhydrous ammonia are numerous. It is hazardous and care must be taken to avoid breathing ammonia vapor. Ammonia treatments require a post-baling treatment using plastic wraps to contain the ammonia until it is incorporated into the hay. This is an added expense and an inconvenience. Also, highly ammoniated hay has produced "crazy cattle syndrome" which results from toxins produced when ammoniated bales are heated over 160°F. Ammoniation may also be achieved by the incorporation of urea into the bale. The conversion of urea to ammonia by plant and microbial ureases results in the slow release of ammonia.

The objectives of this study were to compare three aqueous solutions which result in the release of ammonia in the bale.

1/ Assistant Professor and Experimental Biology Technician, respectively, Klamath Experiment Station.

Acknowledgement: Appreciation is expressed to Unocal Corporation for financial support of this study and providing fungal spore counts.

Experiment I
Forage Moisture Content and Hay Preservative

Materials and Methods

Alfalfa was cut, mechanically conditioned, and swathed in a six-foot windrow on three successive days (July 27-29). Forage cut on all three days was baled on July 30, one, two, and three days after cutting. The moisture content of the forage was approximately 50, 35, and 27 percent moisture at one, two, and three days after cutting, respectively. During baling the forage was untreated, or treated, with an ammonia/urea/urease mixture, or a urea/urease mixture. The chemicals were applied using a pressurized spray system with nozzles mounted in the throat of the baler. Immediately after baling, six bales from each treatment were stacked separately in an open-sided barn. Bale temperatures were monitored for a two-week period using a dial type metal thermometer. On September 1 core samples were taken from each bale. The ability of the two chemical treatments to suppress fungal growth was assessed by counting spores in the forage. The effects of drying time before baling, and chemical treatments on forage quality were determined by analyzing the samples for N concentration and acid detergent fiber (ADF).

Results and Discussion

Although forage was baled at moisture contents far higher than is recommended for hay production, spore counts were low (below 0.5 million spores/gm of hay) in the chemically treated bales which were baled one and two days after cutting (Table 1). This is in contrast to the bales receiving no chemical treatment, which averaged 2.94 and 2.95 million spores/gm of hay when baled one and two days after cutting, respectively. Spore counts were higher than controls in the ammonia/urea/urease bales which were baled three days after cutting, while spore counts in the urea/urease treated bales remained below 0.7 million spores/gm of hay. This is at variance with results of other studies conducted using the same chemical formulation (T. Jackson personal communication). High variability in the ammonia/urea/urease spore counts in the bales baled three days after cutting indicates that the higher spore counts for the treatment combination in question may be due to experimental error.

Bale temperature is also an indication of the amount of microbial activity in a bale. Both chemical treatments significantly reduced bale temperatures. In general, the ammonia/urea/urease treatment produced the lowest bale temperatures.

Both chemical treatments significantly improved forage quality by raising the N concentration and lowering the percent ADF when compared to untreated bales (Table 1). Moisture content of the forage at baling had a significant impact on forage quality. High moisture bales had a lower N concentration and a higher percent ADF than drier bales.

Experiment II
Comparison of Formulations and Application Rates

Materials and Methods

Alfalfa hay was cut, conditioned, and swathed into six-foot windrows. The hay dried to 20 percent moisture or lower but was rehydrated with rain. Weather conditions were favorable for drying the day after the rain. The second morning after the rain, the hay was baled as the dew dried off. Baling was initiated when the swath dried to 25 percent moisture. By the end of the operation the swath had dried to about 22 percent moisture. Moisture content was determined at the beginning and end of the baling operation. Chemical preservatives were added using a pressurized spray system in the throat of the baler. Three chemical formulations were used: a saturated solution of urea and urease; a saturated solution of ammonia, urea, and urease; and an ammonium carbonate, urea, and urease solution. The urea/urease treatment was applied at a rate of 19 gal/ton of forage. Due to lower viscosity, 25 gal/ton of forage of the ammonium carbonate/urea/urease treatment was applied. The ammonia/urea/urease treatment was applied at two rates - 19 and 12 gal/ton of forage.

Immediately after baling, the bales were stacked according to treatment in a common stack. Treatments were separated from each other by polyethylene sheeting. The treated and check bales were surrounded by other bales to provide insulation and an environment similar to the interior of a large stack. The entire stack was covered with polyethylene sheeting to exclude rain.

After seven weeks the stack was opened up and two core samples were taken from each bale. The N content and percent acid detergent fiber (ADF) was determined. Spore counts were also measured.

Results

Due to varying moisture content as chemicals were applied, spore count data is expressed as percent of the control which was most similar in moisture content. All chemical treatments decreased fungal activity (Table 2); however, both ammonia/urea/urease treatments were significantly better at reducing spore counts than the other chemical treatments. Reducing the application rate of the ammonia/urea/urease formulation from 19 to 12 gal/ton of forage resulted in a 36 percent increase in spores when compared to the control. The poorest control of fungal growth was by the ammonium carbonate/ urea/ urease treatment.

All chemical treatments increased the N content and lowered the ADF of the treated forage. This should result in a greater feed value of the resultant hay. Although the ammonium carbonate/urea/urease formulation was not effective in suppressing fungal growth, it proved to be the most effective treatment for improving both forage quality parameters tested. Forage treated with ammonia/urea/urease and the urea/urease did not differ in quality. Decreasing the application rate of the ammonia/ urea/urease formulation from 19 to 12 gal/ton of forage did not decrease forage quality as assessed by N content and ADF.

Conclusions

The application of urea/urease and ammonia/urea/urease solutions to wet hay reduces heating due to microbial activity and fungal spore numbers in the preserved forage. The use of such solutions appears to be a viable alternative in hay preservation. Further study is needed to compare the effectiveness of these materials to other hay preservatives, such as propionic acid, inoculants, and pelleted urea.

The increase in forage N content and reduction in ADF due to treatment with the hay preservatives indicates that they can improve forage quality as well as reduce microbial activity. These solutions or similar treatments may provide the advantages of ammoniation in low-quality forage without the inconvenience of a post-baling treatment. Further research on the production of the toxins responsible for "crazy cattle syndrome" using these slow release formulations is needed.

Table 1. Effect of Chemical Hay Preservatives and Time After Cutting on Alfalfa Quality and Microbial Activity.

Baled July 30, 1987 - Sampled September 1, 1987

Days After Cutting	Chemical Treatment	N Content %	ADF %	Spore Counts Million/gram
1	none	2.85	48.2	2.94
2	none	2.92	43.4	2.95
3	none	2.98	40.5	12.47
1	ammonia/urea/urease	3.62	45.8	0.10
2	ammonia/urea/urease	4.00	42.1	0.12
3	ammonia/urea/urease	4.51	37.6	5.21
1	urea/urease	3.65	44.8	0.21
2	urea/urease	3.73	40.3	0.49
3	urea/urease	4.34	39.6	0.69
LSD(0.05)		0.15	1.2	2.18

Table 2. Effect of Chemical Hay Preservatives on Alfalfa Forage Quality and Microbial Activity.

Baled September 4, 1987 - Sampled October 23, 1987

	% Moisture at Baling	% N	ADF	Spore Count % of Check [1]
Check I	24.8	3.6	31.3	100
Check II	22.3	3.6	30.5	100
Ammonia/urea/urease	26.8	4.2	28.9	50
Ammonia/urea/urease (1/2 rate)	19.0	4.2	25.9	68
Ammonium Carbonate/urea/urease	22.2	5.1	26.3	95
Urea/urease	24.8	4.2	29.0	71
LSD(0.05)	----	0.5	1.5	30

1/ Treatments were compared to the check with the most similar moisture content.

Spring Small Grains Variety Trials in the Klamath Basin, 1987

R.L. Dovel, G.E. Carter, and G. Chilcote [1]

Introduction

Spring barley, wheat, and oats varieties were evaluated at the Klamath Experiment Station (KES) in cooperation with plant breeding programs at Oregon State University, Tulelake Field Station, University of California, and regional evaluation programs. The various yield trials were conducted to identify released and soon-to-be released varieties best adapted to the Klamath Basin and aid in evaluation of germ plasm to be used throughout the western region. There is little insect or disease pressure imposed on small grains in the Klamath Basin; however, the high spring winds, short growing season, and late spring frost typical of the area require the development of cold tolerant, lodging resistant, short season small grain varieties.

Procedures

Most trials were established at the KES; however, the commercial source spring wheat and barley trials were established at three sites - the KES on mineral soil and at two locations on organic soils. All small-grain trials at the KES were planted on ground previously planted to potatoes. Although soil type varies at the KES, all have fine loamy to sandy texture and are moderately deep and somewhat poorly drained. Trials off the station were on organic soils described as very deep, poorly drained, lake bottom soils. Both sites are continuously planted to small grains. All plots at the KES were irrigated, while only one organic soil site was irrigated.

All spring small-grain variety trials were arranged in a randomized complete block design with four replications. All trials at the KES were planted between April 27 and 29 using a modified Kincaid planter. Cereals were planted on the irrigated organic soil site on May 19, while the non-irrigated organic soil site was not planted until June 8. Seed was planted to a depth of one-inch at a rate of 100 lbs/A. All plots were fertilized with 100 lbs. N, 60 lbs. P_2O_5, and 44 lbs. S at time of seeding. Plots measured 5 x 20 feet with a row spacing of 6 inches. Bromoxynil was applied at the labelled rate to control broadleaf weeds.

1/ Assistant Professor, Associate Professor Emeritus, Research Aide, respectively, Klamath Experiment Station.

Acknowledgements: Sam Henzel provided off-station sites and crop care throughout the season.

Results

Commercial Source Spring Barley Variety Trial - Mineral Soil (Table 1)

Although this trial was designed to test the productivity of released varieties on mineral soils in the Klamath Basin, some promising numbered varieties were included. The OSU variety OSB 763128 gave the highest yield over a three-year period. It outyielded Steptoe, the standard variety in the Klamath Basin, by an average of almost 500 lbs/A. OSB 763128 also exhibited a higher resistance to lodging than Steptoe (0 and 29 percent lodging in 1987, respectively). Released varieties which exceeded or equalled Steptoe over a three-year period included Gustoe, Gus, Blazer, and Teton. Cougbar, which has been in the study for only two years, looks promising in the Klamath Basin. It produced an average of over 600 lbs/A more than Steptoe with only 5 percent lodging in 1987.

Commercial Source Variety Trials (Table 2)

A reduced number of released varieties of spring barley were planted at three different sites. The relative performance of the taller varieties, especially Steptoe and Teton, was better on organic soils compared to the mineral soil site. In contrast, the shorter varieties, Gustoe and Gus, were ranked first and second on the mineral soil, but dropped to 10 and 8 on the irrigated organic soil site and 7 and 8 on the non-irrigated organic soil site.

Spring Malting Barley Elite Yield Trial (Table 3)

All but one numbered variety outyielded both Morex and Klages and most showed an improvement over these two standard varieties in lodging resistance. OSB 783063 demonstrated a yield potential that exceeded that of Steptoe by 11 percent in 1987. This variety also outyielded Steptoe in trials planted on the station in 1985 when it exceeded Steptoe by 15 percent. OSB 783063 may prove to be a useful feed barley for the Klamath Basin even if it is not accepted as a malting variety.

Early Spring Barley Elite Yield Trial (Table 4)

OSB 783063 grain yields exceeded Steptoe by 22 percent. Other varieties to outyield Steptoe by more than 15 percent included Mex 793023X-F4K1, OSB 763058, and IBON 82029.

Western Spring Barley Yield Trial (Table 5)

Three lines outyielded Steptoe by over 15 percent, OR 8408, SF 8623, and SM 8618. Interestingly, OR 8408 was tested in 1985 and yielded only 3 percent more than Steptoe. All three lines appear to be more lodging resistant than Steptoe.

Commercial Source Spring Wheat Variety Trial - Mineral Soil (Table 6)

The Oregon State University experimental line PC 790647 has been the highest yielding hard red spring wheat in this study over a three-year period. It outyielded Yecoro Rojo, the standard variety in this area, by over 37 percent. The second highest yielding variety, Sawtell, appears to have low quality as indicated by test weight and initial protein content determination. Powell is another variety that may be a good choice for the Klamath Basin. However, further quality testing is needed to determine if high yielding lines are of adequate quality to meet market requirements to qualify for the higher prices currently given for high protein hard red spring wheat.

The soft white wheats generally outyielded the hard red varieties. Waverly was the highest-yielding released variety in this trial. It outyielded Fieldwin, the standard white wheat for this area, by over 6 percent. The highest-yielder in the trial was a Washington numbered variety, WA 6298, which outyielded Fieldwin by over 13 percent.

Commercial Source Spring Wheat Variety Trial (Table 7)

ORS 8511 was the highest-yielding hard red spring wheat at all three sites in 1987. However, data on ORS 8511 has been collected at the mineral soil site for only one year and was not included in the table. Over a two-year period ORS 8511 was the highest-yielding hard red spring wheat on the non-irrigated organic soil site and the second-highest yielder on the irrigated organic soil site. Although Sawtell was the highest-yielding hard red spring wheat, excluding ORS 8511, at all three sites, low quality will probably prevent the adoption of this variety. Further quality testing is needed to ascertain if ORS 8511 has the quality required to command the premium prices obtained by lower-yielding varieties such as Yecoro Rojo and 906R.

Twin appeared to have a distinct yield advantage over the other two soft white wheats on both organic soil sites. No significant differences in yield between the three white wheat varieties were observed at the mineral site.

Intermountain Spring Wheat Variety Trial (Table 8)

This trial was conducted in cooperation with the Tulelake Field Station and included released and numbered spring wheat varieties currently being tested in Northern California which were not incorporated into existing trials on the KES. Spillman was the highest-yielding hard red spring wheat. It is a quality hard red spring wheat which outyielded 906R, the standard hard red spring wheat in this trial, by over 21 percent.

This trial included several very promising white wheats including, in order of yield, Treasure, Discovery, Bliss, Fieldwin, and Blanca.

Hard Red Spring Wheat Elite Variety Trial (Table 9)

The highest-yielding variety, MPC791432, outyielded Yecoro Rojo by over 52 percent. MPC770062 and 16IBWSN83 both outyielded Yecoro Rojo by more than 42 percent. Although there is only one year of data on these three lines, the yields are impressive. Further yield testing and quality analysis are needed to ascertain if these lines are capable of consistently producing high yields of quality wheat in the Klamath Basin.

Western Regional Spring Wheat Trial (Table 10)

Spillman, which was the highest-yielding hard red winter wheat in the Intermountain Spring Wheat Trial, was the seventh-highest hard red spring wheat in this study. The lines outyielding Spillman, in order of yield, were ID 365, OR 8511, UT 461941, ID 303, ORS 8512, and ID 366.

Spring Oats Variety Trial (Table 11)

In this trial the three leading lines over a three year period were numbered lines. In order of yield they were WA6160, 76AB6843, and WA6166. Appaloosa and Cayuse were fourth and fifth, respectively, and are the main cultivars currently planted in the Klamath Basin.

Uniform Northwestern States Oat Trial (Table 12)

The highest-yielding varieties in this trial were Steele and Riel, yielding over 30 and 24 percent more than Cayuse, respectively. These varieties also showed a marked improvement over Appaloosa in lodging resistance. However, both Steele and Riel had lower test weights than other high-yielding varieties in the trial. Further testing is needed to substantiate the yield potential, lodging resistance, and quality of these promising lines in the Klamath Basin.

Table 1. **Commercial Source Spring Barley Variety Trial**; a three-year yield summary, and 1987 observations of percent lodging and plant height of spring barley varieties grown on mineral soil at the Klamath Experiment Station, Klamath Falls, Oregon.

VARIETY	ROWS	1987 LBS/A	1986 LBS/A	1985 LBS/A	2 YR AVG.[1] RANK	2 YR AVG.[1] LBS/A	3 YR. AVG. RANK	3 YR. AVG. LBS/A	PERCENT LODGING	HEIGHT cm
STEPTOE	6	7410	4852	6006	11	6131	7	6089	29	89
KLAGES	2	6042	3877	4771	36	4960	34	4897	13	89
ADVANCE	6	6444	4644	4860	29	5544	28	5316	13	88
MOREX	6	6206	4494	4760	31	5350	30	5153	36	104
MANKER	6	5517	4773	4943	35	5145	32	5078	0	101
LUD	2	6528	5093	5446	21	5811	15	5689	1	89
SUMMIT	2	6212	5102	4742	26	5657	27	5352	8	96
KARL	6	6733	4998	4837	18	5866	24	5523	8	96
GLEN	6	7130	4588	5037	19	5859	20	5585	0	98
BLAZER	6	7009	5350	5941	9	6180	5	6100	28	99
COUGBAR	6	7526	5958	—	3	6742	–	—	5	98
GUS	6	7345	5215	5766	8	6280	4	6109	23	89
TRIUMPH	2	6607	5066	4973	20	5837	23	5549	0	90
LEWIS	2	6880	4358	5504	27	5619	21	5581	24	85
GUSTOE	6	7853	5585	5714	4	6719	2	6384	0	68
TETON	6	7215	5424	5637	6	6320	6	6092	18	91
LARKER	6	5241	4044	4560	38	4643	36	4615	38	94
HAZEN	6	5885	5200	5044	30	5543	25	5376	1	105
WOCUS 71	6	6656	2996	4540	37	4826	35	4731	28	89
COLOMBIA	2	6186	5374	5616	24	5780	14	5725	5	90
MICAH (M3)	6	6842	5309	5893	13	6076	9	6015	0	88
OSB 77289-5W	6	7773	4316	6307	14	6045	3	6132	13	95
OSB 74289-5K	6	8697	4991	4126	1	6844	10	5938	0	89
OSB 763128	6	8127	5507	6080	2	6817	1	6571	0	91
OSB 753315	2	7241	5328	—	7	6285	–	—	8	95
WHITFORD	6	6590	3868	4972	34	5229	31	5143	1	95
UT 65471	6	7285	4623	5666	17	5954	12	5858	25	93
PREMIER	2	6900	4240	4975	28	5570	26	5372	45	96
501 NAPB	6	7749	5098	5336	5	6424	8	6061	5	78
MINUET	2	6533	5031	5334	23	5782	17	5633	0	94
PISTON	2	6558	5059	5186	22	5809	19	5601	30	93
LINDY	6	7348	4587	5737	16	5968	11	5891	29	94
SPIRIT	2	6467	4957	5292	25	5712	22	5572	25	100
WEIBULLS ROLAND	2	6551	5787	5029	10	6169	13	5789	0	89
NADIA (OSB 74165)	6	7030	5135	4901	12	6083	15	5689	0	93
WEIBULLS ALBERT	2	6411	4109	5415	33	5260	29	5312	19	89
NK 80W41558	6	6651	5293	4925	15	5972	18	5623	18	90
BA 7937	2	6194	4365	4468	32	5280	33	5009	48	89
MEAN		6831	4858	5232		5845		5615	14	92
CV		8	15							
LSD(0.05)		787	998							

1/ Yield comparisons for the same years grown.

Table 2. Commercial Source **Spring Barley Trials**; summary of yield data over three years at three different sites in the Klamath Basin. Klamath Experiment Station, Klamath Falls, Oregon.

Location	VARIETY	ROWS	1987 LBS/A	1986 LBS/A	1985 LBS/A	2 YR. AVG.[1] RANK[2]	2 YR. AVG.[1] LBS/A	3 YR. AVG. RANK	3 YR. AVG. LBS/A	PERCENT STEPTOE[3]
Mineral Soil - Irrigated										
	STEPTOE	6	7410	4852	6006	6	6131	5	6089	100
	KLAGES	2	6042	3877	4771	16	4960	15	4897	80
	ADVANCE	6	6444	4644	4860	13	5544	12	5316	87
	MOREX	6	6206	4494	4760	14	5350	13	5153	85
	MANKER	6	5517	4773	4943	15	5145	14	5078	83
	LUD	2	6528	5093	5446	10	5811	6	5689	93
	SUMMIT	2	6212	5102	4742	11	5657	11	5352	85
	KARL	6	6733	4998	4837	7	5866	10	5523	91
	GLEN	6	7130	4588	5037	8	5859	7	5585	92
	BLAZER	6	7009	5350	5941	5	6180	3	6100	100
	COUGBAR	6	7526	5958	--	1	6742	-	--	110
	GUS	6	7345	5215	5766	4	6280	2	6109	100
	TRIUMPH	2	6607	5066	4973	9	5837	9	5549	91
	LEWIS	2	6880	4358	5504	12	5619	8	5581	92
	GUSTOE	6	7853	5585	5714	2	6719	1	6384	105
	TETON	6	7215	5424	5637	3	6320	4	6092	100
Organic Soil - Non-Irrigated										
	STEPTOE	6	4639	6804	6006	1	5722	1	5816	100
	KLAGES	2	3788	5189	4771	13	4489	13	4583	79
	ADVANCE	6	4875	6303	4860	3	5589	3	5346	92
	MOREX	6	3915	5863	4760	6	4889	10	4846	83
	MANKER	6	3813	5317	4943	12	4565	11	4691	81
	LUD	2	4081	5611	5446	8	4846	6	5046	87
	SUMMIT	2	2987	5435	4742	15	4211	15	4388	75
	KARL	6	3659	5269	4837	14	4464	12	4588	79
	GLEN	6	4526	5171	5037	7	4849	9	4911	84
	BLAZER	6	3659	6206	5941	5	4933	4	5269	91
	COUGBAR	6	4030	6615	--	4	5323	-	--	93
	GUS	6	3628	6010	5766	9	4819	5	5135	88
	TRIUMPH	2	2621	5722	4973	16	4172	14	4439	76
	LEWIS	2	3779	5465	5504	10	4622	8	4916	84
	GUSTOE	6	3078	6132	5714	11	4605	7	4975	86
	TETON	6	4707	6642	5637	2	5675	2	5662	97
Organic Soil - Irrigated										
	STEPTOE	6	4765	4346	4548	3	4556	2	4553	100
	KLAGES	2	3641	3436	3965	15	3539	14	3681	81
	ADVANCE	6	4684	3754	4279	6	4219	4	4239	93
	MOREX	6	4289	3926	3678	7	4103	9	3961	87
	MANKER	6	4115	3783	3488	13	3949	13	3795	83
	LUD	2	4198	3701	4523	12	3950	5	4141	91
	SUMMIT	2	4014	3568	4795	14	3791	6	4126	91
	KARL	6	4029	4058	4136	9	4044	7	4074	89
	GLEN	6	4092	4015	3288	8	4054	12	3798	83
	BLAZER	6	4856	4377	4321	2	4617	3	4518	99
	COUGBAR	6	4908	3904	--	4	4406	-	--	97
	GUS	6	4738	3731	3441	5	4235	8	3970	87
	TRIUMPH	2	3598	3286	3787	16	3442	15	3557	78
	LEWIS	2	4046	4025	3669	10	4036	11	3913	86
	GUSTOE	6	4387	3587	3852	11	3987	10	3942	87
	TETON	6	4897	4502	4665	1	4700	1	4688	103

1/ Based on 1987 and 1986 grain yields.
2/ Rank within each location.
3/ Yield comparisons are for the same years grown.

Table 3. 1987 Spring Malting Barley Elite Yield Trial; yield, test weight, percent thins, percent lodging and plant height observations for spring planted barley on mineral soil at the Klamath Experiment Station, Klamath Falls, Oregon.

	ENTRY	YIELD RANK	YIELD LBS/A	TEST WT LBS/BU	PERCENT THINS 5-1/2/64	PERCENT THINS PAN	PERCENT LODGING	HEIGHT cm
1)	STEPTOE	7	7318	49	4.7	4.0	20	89
2)	KLAGES	20	6072	55	4.0	2.7	50	95
3)	ADVANCE	12	6965	53	4.0	1.8	8	83
4)	MOREX	23	5852	53	4.0	2.5	39	98
5)	ANDRE	24	5344	54	9.2	8.2	55	84
6)	OSB 783016	22	5981	55	3.2	3.6	44	91
7)	OSB 783012	21	6067	52	4.1	4.1	53	84
8)	OSB 783015	10	7030	54	9.1	8.5	1	69
9)	OSB 783063	4	7955	54	7.3	4.4	0	71
10)	OSB 783063	3	8054	53	6.6	4.1	5	75
11)	OSB 783063	1	8501	52	11.4	10.9	1	79
12)	OSB 783015	5	7759	54	6.5	6.6	21	81
13)	OSB 783016	19	6117	55	3.5	2.6	58	88
14)	OSB 783015	17	6550	53	4.9	4.0	43	83
15)	OSB 793208	15	6600	55	2.3	1.4	0	51
16)	OSB 793208	14	6616	55	2.2	1.2	0	61
17)	OSB 793208	6	7382	52	5.3	5.7	0	74
18)	OSB 793208	11	7012	55	2.0	1.7	0	69
19)	SWB793208+-HRH-HKK33	16	--	55	3.3	2.4	-	--
20)	SWB793208+-HRH-HKK38	9	7033	55	4.0	3.5	0	68
21)	SWB793208+-HRH-HKK41	13	6788	56	1.9	1.6	0	69
22)	SWB793208+-HRH-HKK41	8	7084	54	3.5	4.4	0	74
23)	SWB793208+-HRR-HKK41	2	8331	55	2.4	1.3	0	75
24)	OSB 813019F03ME08	18	6539	56	3.0	3.1	0	66
	MEAN		6898		4.7	3.9	17	76
	CV		9					
	LSD(0.05)		901					

Table 4. 1987 Spring Barley Elite Yield Trial; grain yield, test weight, percent thins, and plant height observations of spring planted barley on mineral soil at the Klamath Experiment Station, Klamath Falls, Oregon.

	SELECTION	YIELD RANK	YIELD LBS/A	TEST WT. LBS/BU	PERCENT THINS 5-1/2/64	PERCENT THINS PAN	HEIGHT cm
1)	STEPTOE	23	6462	51	2.6	2.3	78
2)	KOMBAR	27	6288	50	2.0	1.1	70
3)	GUS	32	5394	51	3.8	2.8	69
4)	ADVANCE	21	6553	53	3.9	1.7	75
5)	OSB 763390	14	6976	50	4.8	3.2	74
6)	MEX 76K081	15	6917	53	4.7	2.1	75
7)	OSB 783074	12	7024	51	5.4	3.1	76
8)	SWG 793019	17	6753	54	3.5	2.6	74
9)	OSB 793018	28	6051	56	4.2	3.2	63
10)	OSB 783015	29	5933	55	11.1	9.7	59
11)	SWG 793047	30	5794	54	10.2	4.8	64
12)	OSB 773285N	20	6589	54	4.9	3.2	76
13)	IBON 82082	26	6294	56	2.4	1.5	79
14)	SWB 793208	31	5505	56	2.4	1.9	56
15)	OSG 803008	13	7015	51	3.8	2.2	75
16)	OSG 803018	24	6413	49	8.4	7.9	65
17)	OSB 783063	1	7897	54	6.4	3.8	67
18)	DR 591	25	6375	51	2.6	1.5	79
19)	MEX 793023X-F4K1	11	7057	51	7.1	4.5	74
20)	MEX 793023X-F4K1	2	7765	51	4.9	4.2	71
21)	MEX 793023X-F4K1	9	7117	50	6.1	4.1	78
22)	MEX 793023X-F4K1	4	7572	50	11.5	7.8	81
23)	IBON 82029	7	7195	53	10.0	5.4	74
24)	IBON 82029	5	7510	53	6.8	4.1	84
25)	OSB 74039F6-D26	22	6542	54	2.0	2.1	79
26)	OSB 793118X-F3K1	16	6790	49	4.7	2.4	71
27)	OSB 793118X-F3K1	10	7058	51	4.7	2.5	74
28)	OSG 803008*-HRKK31	8	7118	52	2.5	1.7	80
29)	OSG 803018*-HRKK34	6	7304	49	4.9	3.1	71
30)	OSG 803018*-HRKK32	18	6701	53	7.1	5.2	84
31)	OSG 803040*-HRKK32	19	6642	52	4.7	3.4	75
32)	OSB 763058	3	7608	54	4.6	2.9	86
	MEAN		6757	52	5.3	3.5	74
	CV		14				
	LSD(0.05)		1328				

Table 5. 1987 Western Spring Barley Variety Trial; yield, bushel weight, percent thins, lodging, and height data for spring barley planted in mineral soil at the Klamath Experiment Station, Klamath Falls, Oregon.

	ENTRY	YIELD RANK	YIELD LBS/A	TEST WT. LBS/BU	PERCENT THINS	PERCENT LODGING	HEIGHT cm
1)	TREBI	30	5282	50.5	4.7	42	91
2)	STEPTOE	18	6650	51.0	4.3	34	91
3)	KLAGES	27	5929	52.0	5.9	25	92
4)	MOREX	25	5984	51.0	11.0	1	95
5)	BA 280529	13	6706	56.0	3.2	15	99
6)	BA 814038	10	6937	53.5	4.9	10	97
7)	ID 910740	29	5517	57.0	4.7	5	91
8)	MT 81161	14	6694	54.0	2.5	0	96
9)	MT 81616	19	6627	52.0	5.3	17	89
10)	OR 8408	1	7747	52.0	10.7	10	89
11)	BA 680761	28	5822	51.0	8.3	20	96
12)	ID 223222	21	6414	52.0	5.2	10	77
13)	MT 81143	9	6977	56.0	1.8	27	96
14)	MT 81502	24	6035	54.0	7.8	67	90
15)	ND 7961	16	6681	55.0	3.8	46	92
16)	OR 8432	6	7134	57.0	5.3	0	74
17)	PB 29	23	6325	54.0	5.6	45	92
18)	VD 403582	17	6650	55.0	3.0	0	84
19)	WA 800780	4	7449	51.5	3.1	5	97
20)	BA 280350	15	6693	57.0	7.2	50	90
21)	PB 265	26	5971	52.0	10.9	7	97
22)	SF 8623	2	7729	52.0	7.6	5	89
23)	SM 8618	3	7725	53.0	13.9	7	84
24)	UT 1848	5	7167	50.0	6.0	17	99
25)	UT 2793	11	6813	51.0	5.1	2	100
26)	UT 2780	22	5744	48.5	8.0	32	99
27)	WA 701883	12	6753	54.0	4.3	10	101
28)	WA 877178	20	6557	55.0	5.7	17	91
29)	WA 102178	7	7055	53.0	3.3	17	90
30)	WP 85350	8	7010	50.5	5.4	0	86
	MEAN		6647				
	CV		9.1				
	LSD(0.05)		853				

Table 6. Commercial Spring Wheat Variety Trial; summary of three years grain yield for spring wheat planted in mineral soil at the Klamath Experiment Station, Klamath Falls, Oregon.

Class VARIETY	1987 LBS/A	1985 LBS/A	1984 LBS/A	2 YR. AVG. RANK	2 YR. AVG. LBS/A	3 YR. AVG. RANK	3 YR. AVG. LBS/A	Test Wt. LBS/BU	Height cm
Hard Red									
BORAH	5242	4983	2702	9	5113	10	4309	61	64
SAWTELL	5981	5395	3622	3	5688	2	4999	58	74
ANZA	5743	5249	3273	6	5496	5	4755	60	63
SHASTA	5751	4680	2648	8	5216	9	4360	62	69
NK 1651	6035	5108	3372	4	5572	4	4838	60	71
SUCCESS	5214	3676	-	12	4445	-	—	61	84
1859	6615	3904	2623	7	5260	8	4381	59	83
WESTBRED 906 R	5078	4286	3786	11	4682	7	4383	62	69
POWELL	6739	4779	3410	2	5759	3	4976	61	76
McKAY	6249	4819	2823	5	5534	6	4630	61	70
YECORA ROJO	5090	4513	2552	10	4802	11	4052	61	49
PC 790647	6622	5892	4222	1	6257	1	5579	64	78
W-444	3516	—	—	—	—	—	—	60	61
RAMBO	6804	—	—	—	—	—	—	61	78
ORS 8511	6901	—	—	—	—	—	—	62	74
ORS 8509	5892	—	—	—	—	—	—	62	63
Soft White									
FIELDWIN	6846	5215	3256	5	6031	8	5106	59	85
WALLADAY	6031	5381	4457	8	5706	5	5290	55	80
TWIN	6342	4993	3443	9	5668	9	4926	57	71
STERLING	5639	5196	3064	11	5418	11	4633	61	71
FIELDER	6033	5280	3306	10	5657	10	4873	57	75
FEDERATION	4703	4761	2765	12	4732	13	4076	59	96
DIRKWIN	6837	5231	3487	4	6034	6	5185	59	75
ID 233	3818	5211	4189	13	4515	12	4406	58	86
ID 236	7082	5409	3457	3	6246	4	5316	62	81
WA 6298	7285	5715	4409	1	6500	1	5803	61	83
WA 6276	6724	4904	4434	6	5814	3	5354	60	85
OWENS	6414	5152	3803	7	5783	7	5123	60	73
WAVERLY	7403	5350	3535	2	6377	2	5429	59	85
ID 201	7340	—	—	—	—	—	—	60	71
EDWALL	5580	—	—	—	—	—	—	58	78
PENAWAWA	6679	—	—	—	—	—	—	60	70
Overall Mean	6181	5003	3443		5593		4908		
CV	10	14	19						
LSD(0.05)	890	1442	2130						

Varieties are ranked within each grain class.
The two-year average is based on 1987 and 1985 grain yields.

Table 7. Spring Wheat Variety Trials; a three-year summary of grain yield of spring wheat varieties planted at three different locations in the Klamath Basin. Klamath Experiment Station, Klamath Falls, Oregon.

Location	VARIETY	CLASS[1] TYPE	1987 LBS/A	1985 LBS/A	1984 LBS/A	2 YR. AVG. RANK	2 YR. AVG. LBS/A	3 YR. AVG. RANK	3 YR. AVG. LBS/A	% of YECORO ROJO[2]	TEST WT. LB/BU
Mineral Soil - Irrigated											
	BORAH	H	5242	4983	2702	5	5113	6	4309	106	61
	FIELDWIN	S	6864	5215	3256	1	6040	2	5112	126	59
	WALLADAY	S	6031	5381	4457	2	5706	1	5290	131	55
	TWIN	S	6342	4993	3443	4	5668	4	4926	122	57
	SAWTELL	H	5981	5395	3622	3	5688	3	4999	123	58
	906 R	H	5078	4286	3786	7	4682	5	4383	108	62
	YECORA ROJO	H	5090	4513	2552	6	4802	7	4052	100	61
	MEAN		5804	4967	3403		5386		4724		
Organic Soil - Non-Irrigated											
	BORAH	H	2534	5080	—	4	3807	-	—	152	44
	FIELDWIN	S	2082	4495	—	7	3289	-	—	132	41
	WALLADAY	S	2254	4806	—	5	3530	-	—	141	40
	TWIN	S	3520	5398	—	2	4459	-	—	179	45
	SAWTELL	H	2904	5974	—	3	4439	-	—	178	40
	906 R	H	2526	4300	—	6	3413	-	—	137	47
	YECORA ROJO	H	2061	2932	—	8	2497	-	—	100	47
	ORS 8511	H	3476	6460	—	1	4968	-	—	199	51
	MEAN		2670	4931			3800				
Organic Soil - Irrigated											
	BORAH	H	3212	3132	—	6	3172	-	—	94	52
	FIELDWIN	S	2885	2740	—	8	2813	-	—	84	57
	WALLADAY	S	3547	2837	—	5	3192	-	—	95	57
	TWIN	S	4076	3657	—	1	3867	-	—	115	58
	SAWTELL	H	3507	3813	—	2	3660	-	—	109	46
	906 R	H	3594	2725	—	7	3160	-	—	94	55
	YECORA ROJO	H	3604	3109	—	4	3357	-	—	100	55
	ORS 8511	H	4256	2965	—	3	3611	-	—	108	56
	MEAN		3585	3122			3354				

1/ S = Soft White, H = Hard Red.
2/ Based on 3-year average yield on mineral soil site and 2-year average yield on organic soil sites.

Table 8. 1987 Intermountain Spring Wheat Variety Trial; yield, test weight, and plant height observations of spring wheat varieties planted in mineral soil at the Klamath Experiment Station, Klamath Falls, Oregon.

	SELECTION	CLASS[1]	YIELD RANK	YIELD LBS/A	TEST WT LBS/BU	HEIGHT cm
1)	MODOC	D	24	3847	66	61
2)	YOLO	H	11	6295	65	65
3)	FIELDWIN	S	4	7034	60	81
4)	TL 75-409	D	17	5525	63	71
5)	BLANCA	S	5	6960	60	80
6)	PROBRAND 751	H	20	5209	65	63
7)	COPPER	H	10	6304	69	76
8)	TREASURE	S	1	7784	61	76
9)	WESTBRED TURBO	D	18	5320	55	64
10)	WESTBRED LAKER	D	22	4963	63	74
11)	STERLING	S	6	6464	62	84
12)	BLISS	S	3	7094	60	85
13)	STOA	H	15	5974	63	100
14)	WADU		8	6441	62	83
15)	WAKANZ		7	6447	61	76
16)	SPILLMAN	H	9	6371	62	80
17)	IMPERIAL	D	21	5139	57	73
18)	WESTBRED 926		16	5568	63	66
19)	85S 412	H	13	6167	65	53
20)	85S 8607	H	12	6209	63	55
21)	85S 8608	H	14	6082	65	55
22)	WESTBRED DISCOVERY		2	7767	57	89
23)	WESTBRED 906R	H	19	5247	63	68
24)	W-444	H	23	3980	64	59
	MEAN			6008	62	72
	CV			15		
	LSD(0.05)			1258		

1/ Class: H = hard red, S = soft white, D = Durum

Table 9. 1987 Hard Red Spring Wheat ELITE; Grain yield, test weight and height measurements of hard red spring wheats grown on mineral soil at the Klamath Experiment Station, Klamath Falls, Oregon.

	ENTRY	AVG. YIELD LBS/A	Test Wt. (lb/bu)	Height (cm)
1)	McKAY	5355	60.0	71
2)	BORAH	5179	60.5	66
3)	WESTBRED 906R	4703	62.0	66
4)	YECORO ROJO	4644	64.0	48
5)	CM30697-2	5220	64.5	65
6)	CM33027-F	5368	61.0	65
7)	UT 1382	5634	61.0	68
8)	CM33028-F	5611	61.0	70
9)	CM33023-F	5802	63.0	63
10)	16IBWSN83	6597	61.0	68
11)	MPC790501	5368	63.0	68
12)	MPC770302	5912	63.0	66
13)	CM30136-3	5088	60.5	59
14)	MPC791432	7074	62.0	74
15)	MPC770062	6554	60.0	78
16)	ALP850015	5091	61.0	78
17)	ALP850016	5169	61.0	65
18)	ALP850017	5238	62.5	65
19)	ALP850020	5007	64.5	75
20)	SAWTELL	6400	55.0	74
	Mean	5498	62.0	68
	CV	12.4		
	LSD(0.05)	963		

Table 10. 1987 Western Regional Spring Wheat Trial. 1987 grain yield, plant height, and test weight observations of spring wheat varieties grown on mineral soil at the Klamath Experiment Station, Klamath Falls, Oregon.

Entry	Class[1]	YIELD LBS/A	HEIGHT CM	TEST WT. LBS/BU
McKAY	H	4963	66	61.0
EDWALL	S	4410	69	60.0
FEDERATION	S	4595	85	62.0
OWENS	S	5613	72	61.0
PENAWAWA	S	5399	62	61.0
SPILLMAN	H	5522	71	61.0
WA 7183	S	5120	65	61.0
ORS 8418	H	5069	60	64.0
OR 8508	H	4569	64	63.0
WA 7328	H	4878	74	61.0
WA 7326	H	5154	66	63.0
WA 7176	S	5120	72	61.0
WA 7492	S	5554	69	59.0
UT 402265	H	4966	79	61.0
ID 303	H	5618	72	63.0
ID 312	S	6046	67	61.0
ID 315	S	5826	70	61.5
ID 319	S	5930	69	61.5
UT 461941	H	5708	77	61.0
UT 1111	H	5397	76	60.0
UT 1821	H	5327	79	63.5
UT 2171	H	4798	75	0.0
UT 2506	H	5394	79	58.0
UT 8509	H	5164	65	61.0
ORS 8510	H	5241	69	63.5
ORS 8511	H	5710	69	62.5
ORS 8422	H	5294	61	62.5
ORS 8512	H	5610	60	64.0
WA 7496	S	5983	67	57.0
ID 307	H	5055	62	59.0
ID 341	H	4960	64	62.5
ID 365	H	5921	71	60.0
ID 366	H	5592	75	63.0
ID 348	S	6276	71	61.5
ID 372	S	5817	69	62.0
ID 373	S	6134	70	62.0
Mean		5382	70	61.4
CV		17		
LSD(0.05)		1286		

1/ H = Hard Red, S = Soft White

Table 11. Spring Oats Variety Trial; a three-year yield summary and 1987 observations of percent lodging and plant height of spring oats grown on mineral soil at the Klamath Experiment Station, Klamath Falls, Oregon.

VARIETY	1987 % Lodging	1987 Height(cm)	1987 RANK	1987 LBS/A	1984 RANK	1984 LBS/A	1983 RANK	1983 LBS/A	2 YR. AVG.[1] RANK	2 YR. AVG.[1] LBS/A	3 YR.AVG. RANK	3 YR.AVG. LBS/A
MARKTON	60	121	18	2873	11	3736	15	2178	12	3305	16	2929
PARK	30	118	14	2988	8	3830	18	2046	11	3409	14	2955
CAYUSE	15	108	8	3524	4	4125	6	2813	5	3825	5	3487
OTANA	32	118	13	3049	17	3235	8	2657	19	3142	13	2980
RANDOM	19	124	12	3251	16	3293	17	2143	14	3272	18	2896
APPALOOSA	63	111	5	3794	3	4404	12	2330	3	4099	4	3509
CORBIT	45	109	9	3440	12	3655	14	2272	8	3548	8	3122
CASCADE	28	119	22	2681	9	3799	20	1976	16	3240	19	2819
CAVELL	28	113	16	2909	14	3607	7	2730	15	3258	11	3082
ASTRO	0	113	3	3873	20	3013	21	1945	10	3443	15	2944
KELSEY	15	116	6	3586	21	2885	13	2277	17	3236	17	2916
HARMON	53	128	17	2892	22	2862	23	1412	21	2877	23	2389
LODI	25	124	23	2469	19	3096	19	1995	22	2783	22	2520
TERRA	15	116	20	2809	18	3111	22	1651	20	2960	21	2524
BURNETT	1	108	21	2704	23	2794	16	2164	23	2749	20	2554
MENOMINEE	38	113	11	3266	10	3752	11	2342	9	3509	9	3120
76AB6843	18	108	1	4246	2	4455	4	2966	1	4351	2	3889
PORTER	15	104	19	2810	15	3518	5	2924	18	3164	10	3084
74AB2300	43	99	10	3330	7	3949	2	3166	7	3640	6	3482
WA 6166	30	108	7	3555	5	4087	3	3068	6	3821	3	3570
78AB4119	43	105	15	2940	13	3652	9	2398	13	3296	12	2997
WA 6391	39	120	4	3825	6	4027	10	2361	4	3926	7	3404
WA 6160	3	104	2	4014	1	4495	1	3249	2	4255	1	3919
Mean				3253		3625		2394		3439		3091
CV				12		11		16				
LSD(0.05)				566		558		217				

1/ Average of 1987 and 1984 yields.

Table 12. 1987 Uniform Northwestern States Oat Nursery; yield, test weight, percent lodging and plant height observations for spring-planted oats on mineral soil at the Klamath Experiment Station Klamath Falls, Oregon.

	ENTRY	YIELD RANK	YIELD LBS/A	TEST WT LBS/BU	PERCENT LODGING	HEIGHT cm
1)	PARK	26	3225	32	10	114
2)	CAYUSE	18	3757	38	0	109
3)	OTANA	21	3717	34	5	123
4)	RANDOM	28	2809	29	10	109
5)	APPALOOSA	3	4630	39	15	105
6)	BORDER	7	4258	28	23	110
7)	74Ab2608	16	3971	35	15	109
8)	CASCADE	25	3296	30	8	130
9)	MONIDA	22	3513	33	5	128
10)	76Ab6843	20	3731	34	0	113
11)	OGLE	6	4433	30	0	101
12)	75Ab861	17	3870	35	13	108
13)	CALIBRE	14	4016	34	15	111
14)	PORTER	19	3732	31	15	118
15)	DUMONT	11	4113	30	5	104
16)	78Ab3965	24	3331	32	5	113
17)	IL 75-3402	23	3459	34	0	111
18)	80Ab4725	29	2632	34	10	113
19)	81Ab5792	13	4019	33	5	103
20)	STEELE	1	4902	35	0	85
21)	RIEL	2	4674	35	0	86
22)	80Ab988	9	4178	39	15	113
23)	80Ab5807	12	4058	33	0	108
24)	ND 820603	10	4170	38	0	104
25)	WI X4872-10	27	3030	26	5	101
26)	80Ab5322	5	4456	38	0	96
27)	82Ab248	4	4605	39	10	99
28)	82Ab1178	8	4212	38	0	86
29)	A83-5-35-3	15	4014	31	0	84
30)	TIBOR	30	2176	43	0	123
	MEAN		3833	34	6	107
	CV		11			
	LSD(0.05)		566			

Winter Small Grain Variety Trials in the Klamath Basin, 1987

R.L. Dovel, G.E. Carter, and G. Chilcote [1]

Introduction

Winter cereals are of minor importance in the small grain industry in the Klamath Basin. Late spring frosts when winter small grains are flowering and susceptible to cold injury have limited their use in the area. Cold dry winters common to the Klamath Basin often result in stand failure of fall-planted small grains. This in conjunction with frost heaving, which is a common occurrence in the area, makes fall-planting of small grains a risky venture. Winter small grains may be planted in March and still be vernalized, avoiding the hazards of Klamath Basin winter. Winter barley and wheat trials were planted with seed furnished from Oregon State University to assess the feasibility of growing winter cereals in the Klamath Basin and to screen promising released varieties and experimental lines for adaptation to this area.

Procedures

Winter barley and winter wheat trials were seeded on March 2. Both trials were planted at the Klamath Experiment Station on mineral soil. The agronomic practices and procedures described for the spring small grain variety trials were also employed in the winter variety trials. The trials were arranged in a randomized complete block design with three replications.

Results

Corvallis Source Winter Barley Trial (Table 1)

Scio and Boyer were the two highest-yielding released varieties in the study, yielding 4828 and 4012 lbs/A, respectively. The four top-yielding varieties in order of yield were ORWF 8414, ORWF 8422, ORWF 8410, and ORWF 8416. The highest yield was 5266 lbs/A and the average yield was 3876 lbs/A. This compares poorly to the Commercial Source Spring Barley Trial where the highest yield was 8697 lbs/A and the average yield was 6831 lbs/A.

1/ Assistant Professor, Associate Professor Emeritus, Research Aide, respectively, Klamath Experiment Station.

Corvallis Source Winter Wheat Variety Trial (Table 2)

The two highest-yielding varieties in this trial were commercially available white wheats, Dusty and Ute, which yielded 6311 and 6008 lbs/A, respectively. The highest-yielding red wheat was ORCR 8511, which yielded 5051 lbs/A. These values compare poorly to the Commercial Source Spring Wheat Variety Trial where the average yields of white and red wheats were 6243 and 5861 lbs/A, respectively.

Discussion and Conclusions

Winter planted cereals yielded well in 1987; however, conditions were unusually favorable for their development. Spring temperatures were unusually high and there were no late spring frosts. Such frosts may be expected in the Klamath Basin one out of every four years resulting in severe yield losses of winter grains, especially wheat. Even with the favorable weather, yields of both winter wheat and barley were less than their spring-planted counterparts. Lower yields coupled with increased risk of winter-planted wheat are considerations which weigh heavily against the use of winter wheat in the Klamath Basin. Winter barley appears to yield less than spring varieties in the Klamath Basin. However, barley is not as susceptible to frost damage as wheat. The use of late winter-planted winter barley as well as spring-planted varieties would spread out the period for timely planting and harvesting of small grains.

Table 1. Corvallis Source **Winter Barley Trial**; 1987 observations of plant height, grain yield, test weight, and percent thins for winter barley planted on March 2, 1987, at the Klamath Experiment Station, Klamath Falls, Oregon.

	ENTRY	YIELD RANK	YIELD LBS/A	TEST WT. LBS/BU	PERCENT THINS	HEIGHT cm
1)	SCIO	5	4828	54.0	10.0	60
2)	HESK	13	4405	49.0	18.2	55
3)	OR 1730001	16	4312	56.0	18.8	56
4)	KAMIAK	27	3953	50.0	6.9	61
5)	OR WF 8406	19	4196	53.0	15.8	58
6)	OR WF 8411	47	2662	53.0	12.0	58
7)	OR WF 8422	2	5086	53.0	14.7	58
8)	OR WM 8411	14	4404	53.0	4.6	68
9)	OR WF 8328	35	3625	51.5	20.6	56
10)	FB 75075-01	28	3937	48.0	7.4	55
11)	OR WF 8410	3	4942	50.0	17.3	53
12)	OR WF 8413	8	4692	53.0	9.8	56
13)	OR WF 8414	1	5266	52.0	9.3	65
14)	OR WF 8416	4	4841	50.0	15.3	58
15)	OR WF 8419	38	3438	51.0	10.7	50
16)	OR WF 8421	17	4275	53.0	3.7	63
17)	OR WF 8425	15	4336	52.0	11.1	56
18)	OR WM 8409	31	3806	51.0	2.2	58
19)	OR WF 8524	18	4259	48.0	8.3	55
20)	OR WF 8528	43	3134	50.0	14.9	48
21)	OR WF 8535	40	3216	48.0	15.1	53
22)	OR WM 8519	10	4505	55.0	3.6	60
23)	OR 1861021	45	2962	50.0	8.9	50
24)	BH 1906	6	4748	50.0	6.1	63
25)	OR 1861023	21	4052	54.0	6.8	60
26)	OR 1861024	22	4041	53.0	11.2	53
27)	OR 1861025	44	3131	46.5	12.6	56
28)	OR 1861026	36	3585	51.0	12.0	61
29)	OR 1861027	42	3156	51.5	9.4	55
30)	OR 1861028	26	3994	51.0	9.6	56
31)	OR 1861029	12	4423	49.0	5.5	58
32)	OR 1861030	37	3578	51.0	5.7	56
33)	OR 1861031	32	3786	57.0	20.5	65
34)	OR 1861032	25	4002	52.0	7.8	50
35)	OR 1861033	9	4524	53.0	8.1	61

(continued)

Table 1. Corvallis Source Winter Barley Trial (cont'd)

	ENTRY	YIELD RANK	YIELD LBS/A	TEST WT. LBS/BU	PERCENT THINS	HEIGHT cm
36)	OR 1861034	41	3173	50.5	11.7	60
37)	OR 1861035	30	3817	54.0	21.0	68
38)	OR 1861036	20	4185	51.0	16.4	63
39)	OR 1861037	33	3759	50.0	13.3	61
40)	OR 1861038	24	4010	51.0	16.1	61
41)	OR 1861039	34	3734	50.0	20.3	56
42)	OR 1861040	11	4470	55.0	22.4	61
43)	OR 1861041	29	3904	55.0	17.6	66
44)	OR 1861042	39	3411	51.5	6.5	55
45)	SHOWIN	46	2721	47.0	15.1	53
46)	SCHUYLER	23	4012	50.5	12.6	58
47)	BOYER	7	4697	54.0	11.9	63
48)	STEPTOE	48	1586	50.5	2.9	45
	Mean		3876	51.5	11.7	58
	CV		15			
	LSD(0.05)		984			

Table 2. 1987 Corvallis Source **Winter Wheat**; grain yield, test weight, and plant height observations of winter wheat grown on mineral soil at the Klamath Experiment Station, Klamath Falls, Oregon.

	ENTRY	TYPE[1]	YIELD LBS/A	RANK	TEST WEIGHT LBS/BU	PLANT HEIGHT cm
1)	OR7996	SW	5733	3	59	75
2)	ORCW 8723	SW	3532	23	59	70
3)	PRCW 8724	SW	3626	21	58	70
4)	ORCW 8725	SW	4834	10	—	65
5)	ORCW 8726	SW	4290	17	58	75
6)	OR 830166	SW	4832	11	58	70
7)	OR 830211	SW	4648	13	61	60
8)	OR 832665	SW	3551	22	57	55
9)	OR 832665	SW	4229	18	59	70
10)	OR 832784	SW	3241	28	59	60
11)	OR 833032	SW	4589	14	57	75
12)	OR 833053	SW	3426	26	56	70
13)	OR 833103	SW	4674	12	61	65
14)	OR 833313	SW	4311	16	58	75
15)	OR 833646	SW	3994	19	58	65
16)	OR 833649	SW	4909	8	60	65
17)	OR 833725	SW	5031	7	59	65
18)	OR 833765	SW	3441	25	56	70
19)	OR 834686	SW	5709	4	60	65
20)	EXP. 2222		4341	15	60	65
21)	ORCR 8313	HR	3278	27	61	65
22)	ORCR 8414	HR	3762	20	61	65
23)	ORCR 8601	HR	3521	24	61	70
24)	ORCR 8511	HR	5051	6	62	70
25)	NUGAINS	SW	5196	5	63	65
26)	HILL 81	SW	4836	9	59	70
27)	DUSTY	SW	6311	1	59	65
28)	UTE	SW	6008	2	61	55
29)	YAMHILL	SW	2161	29	37	75
30)	BORAH	HR	2149	30	59	55
	Mean		4307		58	67
	CV (S/Mean)		17			
	LSD(0.05)		1222			

1/ SW = Soft White, HR = Hard Red

Small Grains Management In The Klamath Basin

R.L. Dovel, G.E. Carter, and G. Chilcote [1]

Introduction

Management of small grains is dependent on environmental conditions, economic considerations, and variety requirements. The soil conditions in the Klamath Basin are in a state of flux due to the rapidly declining organic content in some recently drained marsh and lake bottom soils and due to the adoption of sprinkler irrigation which has lowered soil pH and altered mineral availability. New semi-dwarf small-grain varieties, which are better adapted to more intensive management practices, may need to be managed quite differently than conventional varieties. Studies were established to develop basic management information for the Klamath Basin on N fertilization and seeding rate under the present soil conditions in the Klamath Basin. The development of management strategies for newer varieties, which may have quite different management requirements to optimize profit, was a major objective.

Barley Management Study

Procedures

This study was conducted over a three-year period at the Klamath Experiment Station on a fairly deep and somewhat poorly drained sandy mineral soil which was classified as a Sandy, mixed, mesic Torripsammentic Haploxeroll. The study always followed a rotation of potatoes, which is a common rotation on this soil type. The study was arranged in a split-plot design with four replications. Nitrogen fertilization was the main plot, while seeding rate and variety were sub-plots. Varieties grown were Steptoe, Klages, Morex, Gus, Gustoe, and Advance.

Seed was drilled using a modified Kincaid planter at a rate of 60, 100, 140, or 180 lbs/A. Nitrogen as ammonium nitrate was applied following planting at a rate of 50, 100, or 150 lbs N/A. The plots were sprinkler irrigated immediately after N application and throughout the growing season. Weeds were controlled with an application of Bromoxynil at the labeled rate.

Barley was harvested with a plot harvester, and plot yield, test weight, and percent thins were determined. Grain N protein content was assayed.

1/ Assistant Professor, Associate Professor Emeritus, Research Aide, respectively, Klamath Experiment Station.

Acknowledgements: Sam Henzel provided off-station sites and crop care.

Results and Discussion

All three management parameters significantly affected grain yield. A significant interaction of N fertilization and seeding rate occurred. Grain yield increased with seeding rate in plots fertilized with 150 lbs N/A (Table 1). In plots with lower fertilization rates, seeding rate had a quadratic effect on grain yield. Grain yield did not increase at seeding rates above 100 and 140 lbs/A in plots fertilized with 50 and 100 lbs N/A, respectively.

Steptoe, the most widely accepted variety in the Klamath Basin, yielded significantly more than any other variety (Table 2). Klages, Morex, and Gustoe produced similar yields over the three years of the study. Yields of Gus and Advance were significantly lower than all other varieties.

Excluding Steptoe, which had the lowest amount of thins, the malting varieties Klages and Morex had less thins than the feed varieties (Table 2). The malting varieties also had higher bushel weights. The two lowest yielding varieties in the study, Gus and Advance, also had lower quality as assessed by bushel weight and percent thins.

Grain protein content tended to increase with increasing N fertilization and decrease with increasing seeding rate. However, seeding rate most dramatically affected grain protein content at the 50 lb N/A fertilization rate, with a less significant effect at the two higher N fertilization rates. It is important to note that protein content of the two malting varieties was in an acceptable range for malting only at the 50 lb N/A fertilization rate. Even at the 50 lb N/A rate, grain protein content was below 13.5 percent (the upper limit for malting quality) only when the two highest seeding rates were applied. This indicates that the addition of even 50 lbs N/A after potatoes may be excessive for growing malting barley. Results of this study also indicate that increasing barley seeding rates may be an effective means to lower grain protein content when soil nitrogen levels are believed to be too high.

Barley Seeding Rate on Two Organic Soil Sites

Procedures

Seeding rate studies were conducted over a three-year period on two organic soil sites in southern Klamath County. The soils were deep, poorly drained, lacustrine soils which were classified as Medial, mesic, Mollic Aquepts. One site was sprinkler irrigated, the other was flood irrigated once in the spring prior to planting. The studies were arranged in a randomized complete block design with four replications. Plots measured 5 by 20 feet with 5-foot alleyways and borders. Steptoe barley was planted using a modified Kincaid planter at rates of 60, 100, 140, and 180 lbs/A. Prior to planting, 50 lbs N/A as ammonium sulfate was broadcast over the plot area and incorporated. An additional 50 lbs N/A as 16-20-0 fertilizer was banded at planting. Weeds were controlled with an application of 2,4-D at the labeled rate.

Results and Discussion

Grain yield was more affected by seeding rate on the non-irrigated than the irrigated site. Though yield at both sites did not increase significantly with increasing seeding rates above 100 lbs/A, the effect of increasing seeding rates from 60 to 100 lbs/A was more pronounced at the non-irrigated than at the irrigated site (Table 3). This study was initiated in part to evaluate the effectiveness of increasing seeding rate to reduce the impact of high populations of wheat stem maggot on grain yield. Since the study was initiated in 1985, incidence of wheat stem maggot in the Klamath Basin has been lower than was experienced in 1984, when the insect caused substantial yield reductions. Low insect populations in both 1985 and 1986 produced some yield loss. There was very little damage observed in 1987 due to wheat stem maggot. Under the light wheat stem maggot pressure experienced during this study increasing seeding rates above 100 lbs/A did not improve yield.

Wheat Management Study

Procedures

The wheat was always planted adjacent to the barley study described above and was subjected to the same management, with the exception of seeding rate. The four seeding rates employed in this study were 40, 80, 120, and 160 lbs/A. The varieties included were Fieldwin, Yecoro Rojo, Borah, and Westbreed 906R.

Results

There was a quadratic relationship between seeding rate and grain yield with the greatest increase in yield occurring when seeding rate was increased from 40 to 80 lbs/A (Table 4).

Yield increased with increasing N fertilization throughout the range included in this study. Increasing N fertilization from 50 to 100 lbs/A increased grain yield 174 lbs/A compared to only 109 lbs/A when N fertilization was increased from 100 to 150 lbs N/A (Table 4). Crop yield only increased 7.6 percent from the lowest to the highest fertility level.

Grain quality, as assessed by N content, was not affected by N fertilization; however, increasing seeding rate significantly decreased wheat protein content. Yecoro Rojo and Westbred 906R had higher protein contents (17.8 and 17.6 percent, respectively) than Borah and Fieldwin (13.6 and 13.2 percent, respectively).

Conclusions

Although there was an interaction of N fertilization and seeding rate, there was a much less pronounced increase in barley grain yield at seeding rates above 100 lbs/A at all N levels. This was seen on organic as well as mineral soils. Thus the use of 100 to possibly 140 lbs of seed per acre appears to be an optimal seeding rate for all varieties included in this study. The higher seeding rate may provide some protection against high populations of wheat stem maggot.

Although barley grain yield increased with N fertilization, the protein content of malting barley varieties was unacceptably high at all but the lowest N fertilization rate. While feed barley varieties may benefit from N fertilization rates above 50 lbs N/A, the application of 50 lbs N/A or less appears to be appropriate for malting varieties under the conditions of this study.

Nitrogen had a small impact on wheat grain yield and an even less significant effect on wheat protein content in this study. If appears that the addition of N in excess of 50 lbs N/A, following potatoes on mineral soil in the Klamath Basin is not justified.

Table 1. Effect of N fertilization and seeding rate on grain yield as protein content based on three-year average at the Klamath Experiment Station.

N FERTILIZATION LBS/A	SEEDING RATE LBS/A	Yield LBS/A	PERCENT PROTEIN
50	60	3242	13.4
	100	3836	13.0
	140	3881	12.6
	180	3886	12.2
100	60	4219	13.7
	100	4378	13.7
	140	4897	13.4
	180	4621	13.2
150	60	4614	13.6
	100	5103	14.0
	140	5351	13.3
	180	5553	13.3
LSD(0.05)		239	0.3

Table 2. Three-year average yield and grain quality of six barley varieties grown at the Klamath Experiment Station.

Variety	YIELD* LBS/A	THINS %	BUSHEL WT. LBS/BU
Steptoe	5270 C	1.9 A	50.8 B
Klages	4684 B	3.3 C	54.7 D
Morex	4478 B	2.4 B	52.5 C
Gustoe	4471 B	4.8 D	49.6 A
Gus	3714 A	5.5 E	51.0 B
Advance	3484 A	6.2 F	49.9 A
LSD(0.05)	293	2.4	0.5

*/ Numbers in the same column followed by the same letter are not different at the 0.05 level of significance.

Table 3. Effect of seeding rate on barley grain yield on an irrigated and non-irrigated site in lower Klamath County (based on a three-year average).

SEEDING RATE	YIELD (LBS/A) IRRIGATED*	NON-IRRIGATED
60	3140 A	2278 A
100	3542 B	3264 B
140	3581 B	3557 B
180	3582 B	3563 B
LSD(0.05)	276	573

*/ Numbers in the same column followed by the same letter are not different at the 0.05 level of significance.

Table 4. The effect of seeding rate and nitrogen fertilization on spring wheat grain yield on mineral soil at the Klamath Experiment Station (based on a three-year average).

SEEDING RATE	GRAIN YIELD, LBS/A NITROGEN (LBS N/A) 50	100	150	AVERAGE
40	3165	3374	3451	3330
80	3670	3789	3972	3844
120	3749	4051	4117	3973
160	4200	4166	4375	4247
Average	3696	3870	3979	

Potato Variety and Seedling Screening Trials at Klamath Experiment Station, 1987

K.A. Rykbost, G. Carter, and J. Maxwell [1]

ABSTRACT

The 1987 program included a Preliminary Yield Trial of nine seedlings selected at KES in 1986, the Oregon Preliminary Variety Yield Trial with 160 entries, early and late harvested Oregon Statewide Variety Trials with 40 entries, and an Oregon Statewide Chipping Trial with 12 entries.

In the Klamath preliminary trial two seedlings, A084130-1 and A084339-6 produced outstanding yields with good type and appearance. Twenty-six seedlings were saved out of the PYT-2 trial, with five being considered outstanding and worthy of advancement regardless of performance elsewhere. These included C0083008-1, A083037-10, A083044-9, A083196-15, and A083222-6. Most of the twenty-six exceeded No. 1 yield of Russet Burbank by 100 cwt/acre or more.

In the Oregon Statewide Trial, Russet Burbank ranked 32 and 35 out of 40 in early and late harvest yield of No. 1's, an indication of some very promising material in the variety development program. Russet Norkotah ranked first in early harvest and second in late harvest and continues to look very promising as an early tablestock selection. A74212-1 ranked first in the late harvest in spite of stand problems. Other high yielders included A082260-8, A082281-1, A082611-7, and A082616-18.

In the Statewide Chipping Trial none of the entries exceeded Russet Burbank in yield, and most exhibited significantly lower specific gravity. Two clones of Russet Burbank failed to outperform the standard seed lot.

1/ Superintendent/Associate Professor, Associate Professor Emeritus, Experimental Biology Technician, respectively, Klamath Experiment Station.

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Introduction

As an integral part of the Oregon Potato Variety Development Program the KES participates in several aspects of the total program. In 1987 five individual trials were conducted to evaluate seedlings at various levels in the screening program, with more than 200 selections included in these trials. The short season and different soils of the Klamath Basin provide a significant contrast to conditions at other locations in the total program and therefore add an environmental stability component to the selection process.

A second major contribution to the total program involves the KES role in storing, eye indexing and packaging for shipment all seed lots maintained in the program. During the 1986-87 storage season more than 20 tons of seed, representing more than 600 individual lines, were stored at KES. During January in excess of 8,800 individual tubers were eye-indexed and delivered to Corvallis for disease testing. Prior to the planting season lines were individually packaged for redistribution to 10 locations in seven states.

A third component involves the evaluation of cultural management practices for optimizing production of promising material in the various regional programs, as well as new releases from any North American breeding program that may be of interest in the Northwest or in the Klamath Basin. In 1987 one experiment was conducted to evaluate seed spacing response of the standard varieties Russet Burbank and Norgold and new or near releases Krantz, Russet Norkotah, and A74212-1. A second trial assessed the fertilizer response in Russet Burbank, Norgold, Russet Norkotah, and Shepody. As the Oregon program approaches maturity and numbers of advanced materials increase, a major expansion of this activity will be required.

This report will consider only the variety screening aspects. Although the seed storage, eye indexing, and seed lot packaging role involves a very significant portion of the KES workload in mid-winter, it is not a research function. For 1988 and beyond the COAES will assume this role in the statewide program.

Procedures

All variety screening trials used a randomized complete block design. In all but one trial 15 plants with four replications were grown. The PYT-2 trial included 12 plants per plot and three replications. Seed spacing was 12 inches in 32-inch rows. Fertilizer for all trials included 850 lbs/acre of 16-20-0 banded at planting and 100 lbs/N acre as solution 32 sprayed on in combination with 3.5 lbs ai/acre of Eptam on June 3. Additionally, Metribuzin was applied aerially at 0.5 lb ai/acre on July 1.

All trial areas were treated with Telone II at 20 gpa shanked in on April 20. Temik at 3 lbs ai/acre was banded at planting and Monitor was applied aerially at 0.75 lb ai/acre on July 24. Fungicide treatments included Captan seedpiece treatment at 1 lb/100 lbs of cut seed and Ridomil MZ applied aerially at 2.0 lbs/acre on July 24.

Irrigation was applied with 40 foot x 40 foot solid set sprinklers twice weekly from early June through the first week of September at a schedule to replace 90 percent of pan evaporation. Total water applied for the season included 15.75 inches of irrigation and 2.54 inches of precipitation.

Planting dates, vine desiccation and harvest dates will be discussed individually by experiment. In all but the PYT-2, potatoes were harvested with a one-row digger-bagger and all tubers from each plot were saved, stored, and graded in early November. Specific gravity was determined on 10-pound samples of 6- to 10-ounce size from the No. 1 grade where possible, by the weight-in-air weight-in-water method.

Results and Discussion

Klamath PYT-2

Selections that looked outstanding in 1986 four-hill plots at KES, but were not saved at other locations in the state, were included in this experiment with Russet Burbank as the standard. The trial was planted on May 20, desiccated with Diquat at 2 pts/acre on September 22 and harvested on October 2. Two seedlings produced significantly higher No. 1 yields than Russet Burbank (Table 1). A084130-1 had a good size distribution, very attractive appearance, and solids nearly the same as Russet Burbank. A084339-6 produced the highest yield but size was excessive, greening was a problem, and solids were low. This entry would probably perform much better at a closer seed spacing. Of the nine entries included, only these two should be advanced for further evaluations.

Oregon Statewide PYT-2

Potatoes were planted on May 20. Vines were rolled on September 18, sprayed with Diquat at 2 pts/acre on September 22 and rotobeat on October 8. Harvesting occurred on October 13 and 14. All plots were dug with a one-row digger and left in place for selection. Only the attractive looking lots were selected. Russet Burbank was used as a filler to replace two seedlings not available at planting. A total of five Russet Burbank plots were selected. Lemhi was selected in two replications, and Norgold in one. Entries CO082177-3, CO083008-1, A083148-1, and A083218-10 were saved from each replication. A total of 15 entries were saved from two replications, and an additional 36 entries were picked up in only one replication.

A summary of the performance of Russet Burbank and the 26 best entries is presented in Table 2. Statistical analyses were not performed. An overall rating is indicated based on yield, solids, tuber type and other considerations. CO083008-1, A083037-10, A083196-15, and A083222-6 are considered worthy of further evaluation at KES whether or not there is interest at any other statewide locations. An additional eight entries showed outstanding performance in at least one aspect, while the remaining 13 had at least one major weakness that may be sufficient to drop them from further consideration.

Table 1. Tuber yield by grades and size for potato seedlings entered in the Klamath PYT- Trial. Klamath Experiment Station, 1987.

	U.S NO. 1'S											
	4-6 oz		6-10 oz		>10 oz		Total #1's		No 2's		Total Yield	Specific
VARIETY	cwt/A	%	cwt/A	%	cwt/A	%	cwt/A	%	cwt/A	%	cwt/A	Gravity
Russet Burbank	90	17	143	27	153	28	386	72	94	17	539	1.079
A084114-17	86	18	126	27	112	24	324	68	75	16	474	1.075
A084028-2	59	19	102	34	61	20	221	73	44	15	303	1.071
A084114-1	117	29	116	29	25	6	257	63	57	14	407	1.079
A084118-3	89	35	56	22	10	4	154	61	0	0	251	1.075
A084130-1	83	13	208	32	254	39	545	83	55	8	655	1.077
A084131-1	60	27	60	27	17	8	138	62	16	7	222	1.084
A084180-4	51	15	101	30	92	28	243	73	44	13	333	1.070
A084339-6	29	3	136	16	487	58	653	78	77	9	836	1.069
A083003-102	56	15	121	33	90	24	267	72	61	17	369	1.063
AVERAGE	72	19	117	28	130	24	319	71	52	12	439	1.074
CV (%)	45	—	37	—	51	—	32	—	50	—	26	0.300
LSD (.05)	47	—	63	—	96	—	147	—	38	—	168	0.005

Oregon Statewide Advanced Trials

Two identical experiments were planted on May 19 with standard varieties Russet Burbank, Lemhi and Norgold, a local clone of Russet Burbank, the named variety HiLite and 35 advanced seedlings from the Oregon program. The early season trial had vines rolled and sprayed with Diquat at 2 pts/acre on August 31 and vines shredded with a rotobeater on September 9. The full season trial had vines rolled on September 18 and shredded with a rotobeater on September 21. The trials were harvested with the one-row digger-bagger on September 30 and October 7, respectively.

The two outstanding selections in terms of No. 1 yields were Russet Norkotah, which ranked first in the early harvest and second in the late harvest, and A74212-1, which ranked ninth and first, respectively (Tables 3, 4, and 5). Both lines exhibited low solids but were good in all other respects. Russet Norkotah had excellent appearance and type except for a slight tendency for tapering on the stem end. The A74212-1 was a little rougher in appearance. Other seedlings with superior performance included A082260-8, A082281-1, A082611-7, and A082616-18. The local clone of Russet Burbank obtained from Carl Rajnus produced a significantly higher No. 1 yield at late harvest than did the standard clone and ranked third in yield of No. 1's. This suggests the need to look at clones or seed lots of Russet Burbank in more detail.

Oregon Statewide Chipping Trial

Potatoes were planted on May 22, topkilled with Diquat on September 22 and harvested on October 2. While low yields were observed for Yellow Fin, #12567, and DB-1 entries, no outstanding performance was noted (Table 6). Norchip produced a good yield at a spacing that is too wide for this variety. All entries exhibited solids that would be barely acceptable for chipping stock. A better selection of material is needed for this trial and the seed spacing should be changed to obtain optimum performance of Norchip and Kennebec, the industry standards. Atlantic, a leading chipping variety, should also be included as a standard variety in future trials. Processing quality data will be obtained at a later date from samples submitted to Corvallis.

Summary

A relatively large number of promising seedlings are in the Oregon Potato Variety Development Program. A comparison of the performance at KES with that at other stations shows that while some of the outstanding selections at KES also do well at other sites, cases also exist where excellent performance at KES is unique. This emphasizes the need to maintain an active role in the program at KES.

In future trials several procedural changes will be made to improve data quality. At advanced levels larger plot size will be implemented to improve precision. The need for early and late harvest of the Oregon Statewide Trial is questionable. Larger plots at this stage will be more beneficial. KES should be included as a site for the Western Regional Trial of advanced material that is close to official release. Additional varieties recently released from other breeding programs also need to be evaluated at some stage to provide local growers with advance information on performance of these varieties under local conditions. Current examples of this need are Krantz, Shepody, and Yukon Gold, all of which are of increasing interest in Oregon.

Table 2. Potato yield and quality of PYT-2 selections (KES), 1987.

Selection	Entry No.	Reps	Yield US No 1's cwt/A	Yield US No 1's Rank	Specific Gravity	Tuber Size	Percent 2's & Culls	Overall Rating
Russett Burbank	1	5	397	46	1.077	S	18	Standard
COC83008-1	5	3	583	6	1.081	L	8	A
CO083085-5	23	1	577	8	1.074	L	9	B
CO082177-3	35	3	343	51	1.066	S	7	B (Red)
A083005-1	42	1	505	18	1.084	M	2	B
A083010-7	44	1	613	5	1.074	L	10	B
A083019-10	48	1	649	4	1.061	VL	0	B
A083037-10	56	2	676	3	1.072	L	18	A
A083038-1	58	2	479	27	1.069	L	12	C
A083041-10	61	1	528	14	1.066	M	13	C
A083044-4	63	1	542	11	1.084	M	5	B
A083071-9	72	1	461	30	1.087	M	16	C
A083097-7	83	1	487	25	1.074	M	8	C
A083103-5	87	1	509	17	1.071	L	11	C
A083103-28	89	1	559	10	1.067	L	15	C
A083119-3	95	2	489	24	1.074	M	7	C
A083148-1	100	3	492	22	1.074	M	4	B
A083177-5	104	1	501	20	1.072	L	4	C
A083196-12	111	2	580	7	1.072	L	9	C
A083196-15	112	1	738	1	1.076	VL	4	A
A083218-10	122	3	463	29	1.079	M	8	C
A083221-4	127	2	510	16	1.078	M	7	C
A083222-6	129	1	682	2	1.077	M	4	A
A083222-7	130	1	535	12	1.070	S	2	B
A083224-1	132	1	493	21	1.065	M	4	C
A081323-20	149	2	480	26	1.084	M	8	B
CO083066-3	159	1	490	23	1.090	L	11	C

A – First Choice, advance at KES regardless of other interest.
B – 2nd Choice, advance at KES if performance good elsewhere.
C – 3rd Choice, advance at KES only if outstanding elsewhere.

Table 3. Tuber yield by grades for potato varieties entered in the **Oregon Statewide Trial**, early topkill. Klamath Experiment Station, 1987.

VARIETY	U.S. No. 1's 4-6 OZ cwt/A	%	6-10 OZ cwt/A	%	> 10 OZ cwt/A	%	Total # 1's cwt/A	%	Rank	No.2's cwt/A	%	Total Yield cwt/A
RUSSET BURBANK	47	14	118	35	26	8	191	57	32	44	13	334
LEMHI	40	10	118	31	123	32	281	73	8	42	11	382
NORGOLD	52	12	155	36	142	33	348	80	2	16	37	436
A74212-1	80	22	136	37	65	18	280	76	9	42	11	369
A081178-11	32	9	89	24	114	31	235	64	21	41	11	368
A081178-12	44	13	122	35	134	38	300	86	6	20	6	349
A081216-1	68	32	62	29	0	0	130	62	37	7	3	211
A081394-7	42	21	63	31	6	3	111	55	39	19	9	203
C0080152-1	60	18	132	39	51	15	243	72	18	38	11	338
C008177-2	79	29	95	35	9	3	182	67	33	7	3	271
RUSSET NORKOTAH	66	14	173	36	151	32	390	82	1	30	6	477
A81362-3	60	25	68	29	8	3	137	58	36	11	5	237
A81727-9	36	10	134	39	105	30	274	79	12	30	9	346
A081084-2	50	20	75	30	54	22	178	72	34	11	4	249
A081509-1	79	24	104	31	47	14	230	69	22	34	10	332
A081512-1	51	18	107	37	63	22	222	76	26	14	5	291
A081522-1	50	16	103	34	71	23	224	73	25	20	7	304
A081783-7	66	23	102	36	43	15	211	75	27	12	4	281
A081794-9	49	29	50	29	28	16	126	74	38	12	7	170
A082023-1	52	19	89	33	65	24	205	76	28	15	6	269
A082254-24	37	12	112	36	81	26	229	74	23	23	7	308
A082260-4	32	10	93	29	140	43	265	83	13	17	5	322
A082260-7	38	28	44	33	8	6	91	68	40	0	0	134
A082260-8	65	18	119	32	120	33	303	82	5	12	3	369
A082281-1	44	13	114	34	123	37	280	84	10	8	2	335
A082283-1	61	18	127	38	59	18	248	75	16	28	8	331
A082283-5	67	26	102	40	27	11	196	76	30	13	5	257
A082283-9	24	10	67	29	105	45	195	84	31	6	3	231
A082606-13	91	37	46	19	5	2	142	58	35	10	4	244
A082611-7	87	26	111	33	38	11	236	69	20	24	7	341
A082616-12	93	24	169	44	51	13	313	81	4	10	3	385
A082616-18	68	17	138	35	108	27	315	80	3	20	5	396
C0082136-2	62	22	94	34	82	29	238	85	19	10	4	280
C0082063-3	69	19	134	36	50	14	252	68	15	23	6	369
ND01062-1	54	21	105	40	38	15	197	76	29	20	8	260
ND01496-1	60	16	118	31	106	28	283	74	7	18	5	381
ND01567-2	82	23	91	25	56	16	229	64	24	49	14	359
ND02061-2	75	20	126	33	43	11	244	64	17	77	20	283
HI LITE	68	19	121	34	88	25	277	78	11	38	11	355
R.B. LOCAL CLONE	111	27	146	36	2	0	258	63	14	25	6	409
AVERAGE	60	19	107	34	66	21	232	73		22	7	317
CV (%)	39	--	33	--	55	--	25	--		72	-	19
LSD (.05)	33	--	49	--	51	--	82	--		23	-	84

Table 4. Tuber yield by grades for potato varieties entered in the **Oregon Statewide Trial**, late topkill. Klamath Experiment Station, 1987.

VARIETY	U.S. No. 1's 4-6 OZ cwt/A	%	6-10 OZ cwt/A	%	> 10 OZ cwt/A	%	Total # 1's cwt/A	%	Rank	No.2's cwt/A	%	TOTAL YIELD cwt/A
RUSSET BURBANK	58	16	85	23	66	18	209	57	35	71	19	370
LEMHI	18	5	84	21	144	35	246	60	29	39	10	408
NORGOLD	58	14	136	33	165	40	359	86	7	13	3	417
A74212-1	40	8	126	25	240	49	405	82	1	41	8	495
A081178-11	37	9	63	16	163	42	263	68	25	71	18	389
A081178-12	22	5	73	17	235	56	330	79	11	45	11	420
A081216-1	78	24	102	31	64	20	244	75	30	19	6	325
A081394-7	56	16	108	31	108	31	271	77	24	25	7	353
C0080152-1	49	15	82	25	119	36	250	76	78	34	10	328
C008177-2	56	20	117	42	25	9	198	70	36	13	5	283
RUSSET NORKOTAH	44	9	132	27	223	45	399	81	2	46	9	495
A81362-3	74	20	133	35	109	29	316	84	13	5	1	376
A81727-9	47	12	97	25	184	48	329	85	12	25	6	388
A081084-2	32	11	81	27	124	41	238	79	31	17	6	302
A081509-1	55	13	133	33	146	36	333	82	9	10	3	407
A081512-1	16	4	64	16	200	51	280	72	20	45	12	390
A081522-1	28	7	99	26	179	47	306	79	14	21	5	386
A081783-7	37	12	81	26	114	36	231	73	34	18	6	317
A081794-9	51	22	81	35	35	15	167	71	38	30	13	236
A082023-1	84	24	113	33	82	24	274	80	21	24	7	347
A082254-24	51	14	83	22	138	37	272	73	23	21	6	373
A082260-4	28	10	68	24	141	50	236	83	32	9	3	283
A082260-7	NO DATA OBTAINED											
A082260-8	37	8	102	23	235	52	373	83	4	33	7	450
A082281-1	37	9	127	37	203	49	367	89	5	10	3	413
A082283-1	46	12	112	28	148	37	305	77	15	35	9	397
A082283-5	23	8	90	30	122	40	236	78	33	29	10	303
A082283-9	31	10	91	30	130	42	252	82	27	28	9	307
A082606-13	64	26	92	37	27	11	184	74	37	7	3	248
A082611-7	76	17	147	33	141	31	363	81	6	30	7	449
A082616-12	46	12	148	39	86	23	281	73	19	28	7	385
A082616-18	42	8	103	20	194	39	339	67	8	71	14	503
C0082136-2	33	10	128	39	111	34	272	83	22	21	7	329
C0082063-3	28	9	78	26	152	51	258	86	26	28	9	301
ND01062-1	29	17	60	35	52	30	141	82	39	0	0	172
ND01496-1	34	9	106	26	149	37	289	72	18	21	5	403
ND01567-2	62	15	149	35	93	22	304	72	16	59	14	422
ND02061-2	57	14	158	40	78	20	292	73	17	58	14	399
HI LITE	63	15	133	31	134	31	331	76	10	54	12	435
R.B. LOCAL CLONE	113	21	167	32	98	19	379	72	3	48	9	528
AVERAGE	47	13	106	28	132	35	285	76		31	8	373
CV (%)	40	—	35	—	45	—	28	—		72	-	23
LSD (.05)	26	—	52	—	84	—	114	—		31	-	120

Table 5. Performance of Oregon Statewide Varieties. Klamath Experiment Station, 1987.

VARIETY	% EMERGENCE		METRIBUZIN INJURY		SPECIFIC GRAVITY		U.S. NO.1's YIELD RANK		MISCELLANEOUS COMMENTS
	EARLY	LATE	EARLY	LATE	EARLY	LATE	EARLY	LATE	
RUSSET BURBANK	97	98	1.0	2.3	1.070	1.080	32	35	Rough, H.H.
LEMHI	87	80	1.5	2.3	1.074	1.075	8	29	G.C. Knobs
NORGOLD	95	88	1.8	1.0	1.065	1.066	2	7	B.C.
A74212-1	78	87	1.3	1.5	1.062	1.066	9	1	Rhizoc.
A081178-11	85	85	1.5	1.5	1.059	1.068	21	25	G.C.
A081178-12	90	92	1.8	1.0	1.066	1.074	6	11	Rhizoc.
A081216-1	95	92	5.5	6.3	1.071	1.077	37	30	Long, N.N.
A081394-7	87	80	1.0	1.0	1.080	1.089	39	24	S.E.B.
CO080152-1	92	82	1.5	2.0	1.069	1.074	18	28	Rhizoc., Long
CO08177-2	95	80	1.3	1.5	1.078	1.085	33	36	Pale Yellow
RUSSET NORKOTAH	95	98	1.0	1.5	1.063	1.067	1	2	Nice, T.
A81362-3	85	87	1.0	1.0	1.069	1.078	36	13	Rhizoc.
A81727-9	93	88	2.5	2.5	1.072	1.075	12	12	Scab
A081084-2	87	88	1.5	1.0	1.066	1.076	34	31	Rhizoc, Smooth
A081509-1	82	85	1.3	1.3	1.065	1.075	22	9	Rough
A081512-1	97	90	1.3	2.0	1.071	1.083	26	20	G.C., Scab
A081522-1	95	88	1.0	1.3	1.057	1.066	25	14	G.C., Rot
A081783-7	90	82	1.5	1.5	1.069	1.073	27	34	
A081794-9	80	95	2.5	2.5	1.065	1.082	38	38	Rough
A082023-1	75	83	1.0	1.0	1.068	1.078	28	21	T, Long
A082254-24	77	88	1.5	1.0	1.065	1.070	23	23	Ugly, Knobs
A082260-4	82	70	1.5	3.0	1.071	1.078	13	32	Smooth
A082260-7	80	78	4.8	6.8	1.066	1.077	40	---	No Yield
A082260-8	97	85	2.5	3.5	1.075	1.085	5	4	Rough
A082281-1	92	85	1.8	2.5	1.062	1.073	10	5	Some Rot
A082283-1	80	85	2.0	4.3	1.067	1.073	16	15	G.C., Yellow F.
A082283-5	87	85	1.0	1.0	1.074	1.082	30	33	Rhiz., T.
A082283-9	87	92	1.0	1.8	1.070	1.078	31	27	Yellow F,. Scab
A082606-13	85	80	1.0	1.3	1.069	1.076	35	37	Rhizoc.
A082611-7	82	98	1.0	2.3	1.068	1.081	20	6	T., Long
A082616-12	97	92	1.0	3.0	1.077	1.083	4	19	Knobs
A082616-18	92	83	1.5	1.5	1.073	1.080	3	8	G.C., Gr, Knobs
CO082136-2	98	95	1.0	1.5	1.075	1.087	19	22	Long, Scab
CO082063-3	97	77	1.5	1.8	1.068	1.079	15	26	Rough
ND01062-1	85	70	4.3	5.5	1.076	1.085	29	39	Smooth
ND01496-1	88	85	1.0	1.0	1.077	1.086	7	18	G.C., W, Round
ND01567-2	93	90	1.0	1.8	1.060	1.069	24	16	Long, T.
ND02061-2	93	98	1.5	2.5	1.061	1.065	17	17	Long, T., Poor
HI LITE	97	97	1.0	1.0	1.067	1.074	11	10	Rhizoc., T.
R.B. LOCAL CLONE	98	100	1.0	1.8	1.067	1.080	14	3	H.H., S.E.B., T
AVERAGE	---	---	---	---	1.069	1.077	---	---	

Abbreviations: H.H.-hollow heart, G.C.-growth cracks, B.C.-brown center, N.N.-net necrosis, S.E.B.- stem end discoloration, T.- tapered ends, W - white skin, R - round.

Metribuzin Injury Rating: 1 - no injury, 10 - plant death.

Table 6. Tuber yield by grades and size for varieties and seedlings entered in the Oregon Statewide Chipping Trial, Klamath Experiment Station, 1987.

VARIETY	U.S NO. 1'S 4-6 oz cwt/A	%	6-10 oz cwt/A	%	>10 oz cwt/A	%	Total #1's cwt/A	%	No 2's cwt/A	%	Total Yield cwt/A	Specific Gravity
Russet Burbank	94	19	189	39	81	16	363	74	72	15	489	1.078
Kennebec	17	3	71	11	267	42	355	56	178	28	637	1.068
Norchip	90	18	178	35	104	20	372	73	40	8	513	1.070
A-B-1	64	15	165	40	113	27	342	83	23	6	414	1.071
RB Clone 14	132	23	151	27	68	12	351	62	77	14	567	1.075
RB Clone 6	112	25	128	28	62	14	301	66	47	10	454	1.075
A74212-1	71	15	153	32	153	32	376	78	39	8	481	1.070
N.Y. 72	79	18	174	39	109	24	363	82	20	4	445	1.070
12567	102	26	121	31	28	7	251	65	34	9	385	1.070
Yellow Fin	85	16	123	24	34	7	242	46	153	29	523	1.068
7586	51	15	116	33	125	36	292	84	8	2	347	1.053
DB-1	57	16	97	27	30	8	184	51	26	7	358	1.074
AVERAGE	80	17	139	31	98	20	316	68	60	12	468	1.070
CV (%)	40	—	35	—	52	—	25	—	61	—	25	0.300
LSD (.05)	46	—	69	—	73	—	115	—	52	—	168	0.005

Potato Variety Management Trials at the Klamath Experiment Station, 1987

K.A. Rykbost, G.E. Carter, J. Maxwell[1], D. Beck[2]

ABSTRACT

Four experiments were conducted at KES in 1987 to evaluate the response to various management practices of several prominent new varieties which may find an important niche in the local or regional industry. Entries included the standard varieties Russet Burbank, Norgold, and Kennebec, the new varieties Russet Norkotah, Krantz, and Shepody, and the promising A74212-1 seedling in one or more of the trials. Management factors assessed included seed spacing, rates of N, P, and K banded at planting, N rates and timing, irrigation rate, and delay between topkill and harvest dates.

Norgold, A74212-1, Krantz, and Shepody produced optimum yields at six-inch spacing while Russet Norkotah and Russet Burbank required nine-inch spacing for optimum yield in 32-inch rows. A 12 inch spacing markedly reduced yield of No. 1's in A74212-1 and Krantz.

Banded fertilizer at rates of 64, 96, and 128 lbs/acre of N, P_2O_5, and K_2O were compared for Russet Burbank, Norgold, Russet Norkotah, and Shepody. The optimum rates were 64 lbs/acre for Russet Norkotah and Norgold, 96 lbs/acre for Shepody, and 128 lbs/acre for Russet Burbank, when an additional 50 lbs N/acre was applied at cultivation.

Russet Burbank, Kennebec, A74212-1, and Krantz were harvested at 10, 21, and 29 days after topkill. Serious skinning damage in Kennebec was not reduced to acceptable levels at 21 days after topkill. A74212-1 was more susceptible to skinning than Russet Burbank and Krantz but achieved satisfactory skin set 21 days after topkill. Delaying harvest did not affect yields.

Nitrogen rates from 100 to 300 lbs/acre and irrigation at 50 and 90 percent of pan evaporation were compared for Russet Burbank and A74212-1. Very poor stands in A74212-1 and nearly two inches of rainfall in mid-July were at least partially responsible for inconclusive results. Petiole N content was lower at high irrigation rates and was higher when N was applied weekly rather than all at planting. Yields were unaffected by N rates or irrigation rates.

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Introduction

The successful commercialization of new potato varieties is greatly enhanced by the development of variety specific management information at an early stage. Varieties often have substantially different requirements for population, fertilization rates, storage, and other cultural factors. Producers have a greater chance of success with new varieties when management practices have been developed before introduction. Few, if any, varieties will perform optimally under management suitable for Russet Burbank.

Any successful variety development program must include a component of management research to routinely establish optimum practices for each introduction. As the Oregon Potato Variety Development Program matures and approaches the stage of releasing new varieties, this need becomes more urgent. Recently released varieties from other breeding programs, such as Russet Norkotah, Krantz, Yukon Gold, and Shepody are rapidly gaining importance in the local industry. Management information is needed under local conditions to allow growers to achieve the potential of these varieties.

At KES a number of management trials have been conducted for some time. In 1987 four separate experiments evaluated several aspects of cultural management. Seed piece spacing, fertilizer requirements, time from topkill to harvest, irrigation rates, and N management were assessed for several promising new varieties as well as standard varieties.

A. Seed Spacing

Procedures

Potatoes were planted on May 26. Furrows were opened and Temik at 3 lbs ai/acre, and 16-20-0 analysis fertilizer at 850 lbs/acre were applied with a two-row assisted feed planter. The varieties Russet Burbank, Norgold, A74212-1, Russet Norkotah, and Krantz were hand planted at seed spacings of 6-, 9-, and 12-inches in a randomized complete block design with four replications. Individual plots were one row, 15 feet long. Standard cultural practices were followed. Vines were sprayed with Diquat at 2 pts/acre on September 22 and rotobeat on October 1. Plots were harvested on October 5. Treatment main effects were statistically compared using the Student's T test.

Results and Discussion

Varietal differences were significant for each yield component (Table 1). In yield of No. 1's Norgold was alone at the top, Russet Norkotah and A74212-1 were better than Russet Burbank and Krantz had a very low yield. Averaged over all varieties 6- and 9-inch spacings significantly improved yields over the 12-inch spacing. Yield by variety interactions were not significant for any of the yield components.

Yield response to spacing appeared to be variety-dependent but large experimental error, indicated by high CV values and attributable to small plot size, did not allow segregation of individual responses. The trends suggest an optimum spacing of six inches for Norgold, A74212-1, and Krantz and nine inches for Russet Burbank and Russet Norkotah. The large yield reduction for Russet Burbank at 12 inches does not agree with previous experience and is probably an anomaly. Russet Burbank typically performs best at 12-inch spacing in 32-inch rows.

Russet Norkotah produced a very smooth crop with excellent size and appearance. Greening of exposed tubers was the major cause of downgrading. A74212-1 was somewhat rough with knobs being more prevalent at the 12-inch spacing. Growth cracks were the major reason for downgrading Krantz. These are consistent with observations in other trials in the current and previous years. Seed spacing will be very important in obtaining optimum performance from A74212-1 and Krantz.

B. NPK Fertilizer Rates

Procedures

Potatoes were planted on May 27. Furrows were opened and Temik at 3 lbs ai/acre and fertilizer at 400, 600, or 800 lbs/acre of 16-16-16 were applied with a two-row assisted feed planter. A split-plot design was used with fertilizer rate as the main plot. Sub plots included Russet Burbank at 12-inch spacing, Norgold and Russet Norkotah at 9-inch spacing,and Shepody at 6-, 9-, or 12-inch spacing. Individual plots were two adjacent rows 22 feet long. Nitrogen as solution 32 was applied at 50 lbs/N acre on June 4. Standard cultural practices were followed in other regards. The vines were topkilled with Diquat at 2 pts/acre applied on September 22 after vine rolling on September 11. Plots were harvested on October 1 with entire plots used for harvest areas. All tubers were graded and weighed. Specific gravity was determined on two samples from each plot and averaged.

Results and Discussion

The yield response to fertilizer application rates was not statistically significant (Table 2). A size response trend was apparent, however. The 800 lb/acre rate tended to reduce size in all varieties. The increase in 4- to 6-ounce size corresponded with a reduction in yield of tubers over 10-ounce at higher fertilizer rates. Averaged over all varieties, the intermediate fertilizer rate resulted in the highest yield of No. 1's and total yield. For Russet Burbank the low rate resulted in a high percentage of culls due to knobbiness. Quality was largely unaffected by fertilizer rate for the other varieties.

Varietal differences were significant for all parameters (Table 2). Norgold produced the highest yield, largest size, and best percentage of No. 1's. Russet Burbank was at the bottom in yield, size, and percentage of No. 1's. Shepody at a six-inch seed spacing had a higher No. 1 yield than Russet Norkotah, but at wider spacings slightly less.

As in other 1987 experiments, Russet Norkotah produced a good yield with excellent size distribution, type, and appearance. It showed no response to fertilizer rates and produced the economic optimum yield at the lowest rate. This finding is not surprising for an early maturing variety and agrees with the results observed for Norgold. The nine-inch seed spacing used for Russet Norkotah in this trial was found to be optimum in the previously discussed experiment. A tentative management recommendation based on one year's findings would be to use a seed spacing of nine inches and a lower fertilizer application rate for Norkotah than typically used for Russet Burbank.

This was the first time that Shepody has been evaluated in the Klamath Basin. It is rapidly gaining acceptance as an early processing variety for french fries across North America and is being marketed in tablestock trade in the Northeast. In this trial Shepody produced a good yield of No. 1's with optimum performance being at the intermediate fertilizer rate at each seed spacing. Averaged over three fertilizer rates, the optimum seed spacing appeared to be six inches. The major cause of down grading to No. 2's or culls was greening. With a shallow tuber set Shepody requires a better hill than was obtained in this trial. Eliminating this problem would result in a higher yield of No. 1's for Shepody.

Russet Burbank was the only variety to show a yield increase for number ones to the highest fertilizer rate. With late maturity compared with the other varieties this response is not unexpected. In general fertility trials elsewhere have shown a trend for at least N requirements to range from low to high for a maturity range from early to late.

In combination with the seed spacing experiment discussed above this trial emphasizes the need to assess varietal response to these aspects of cultural management for new varieties. In the future, more emphasis in the variety development program is needed in this area.

C. Delaying Harvest for Tuber Maturity

Procedures

The varieties Russet Burbank, Kennebec, A74212-1, and Krantz were planted at 12-inch seed spacing on May 26. An application of 16-20-0 fertilizer banded at planting at 850 lbs/acre was followed by a topdressing with 100 lbs N/acre on June 2. Individual plots were arranged in a split-plot design with harvest date as the main plot and variety as the split plot. Four replications included one-row, 38-foot plots for harvest. The vines were topkilled with Diquat at 2 pts/acre on August 31. Harvest dates were September 10, September 21, and September 29. Standard cultural practices were followed in all other respects.

Results and Discussion

Poor stands were experienced in all varieties (Table 3). The best stand was obtained with Kennebec (90 percent), but only 65 to 75 percent stand was obtained for the other varieties. In each variety stands were uniform across harvest dates. Both yields and size distribution were affected for all varieties by the high percentage of missing plants. Dry and cloddy conditions at planting were probably the main factors contributing to dehydration and rotting of some seed. While poor stands were seen in A74212-1 in other trials, the problems with Russet Burbank and Krantz were unique to this experiment, which was conducted on a poor soil site.

This problem did not detract from the main objective of the trial, which was to assess skinning damage response to delay between topkill and harvest. A skinning damage index on a scale of 0 (no damage) to 10 (100 percent of tubers showing skinning over 10 percent of the surface) was used to assess damage. Differences were statistically significant between varieties and days to harvest (Table 3). The interaction between these factors was also significant. Russet Burbank and Krantz were least damaged. A74212-1 had 60 percent damage after 10 days but little damage after 21 days. Kennebec exhibited the most severe damage and was somewhat susceptible to skinning at 21 days after topkill. These results suggest the necessity to delay harvest or kill crops down earlier for varieties such as Kennebec that are light skinned.

Varietal differences were observed in all parameters of yield, size and quality. The combination of poor stands and early topkill resulted in relatively low yields for all varieties compared with performance in other experiments. A wide seed spacing was detrimental to all varieties except Russet Burbank. Both A74212-1 and Krantz produced significantly higher yields of No. 1's than Russet Burbank, even at the wide spacing.

D. Irrigation and Nitrogen Rates

Procedures

Russet Burbank and A74212-1 were assessed at irrigation rates of 50 and 90 percent of pan evaporation under four N fertilization regimes including: (1) 100 lbs N/A at planting; (2) 100 lbs N/A at planting and 12.5 lbs N/A/week broadcast and irrigated in over eight weeks (200 lbs N/A total); (3) 100 lbs N/A at planting and 100 lbs N/A on June 2; (4) 100 lbs N/A at planting and 200 lbs N/A on June 3.

The experiment was a split-split-plot design with irrigation regime as the main plot, variety as the split-plot, and nitrogen as the split-split-plot, with four replications. Potatoes were planted on May 21. Petiole samples were taken on July 29, August 12, and September 3 and analyzed at KES for nitrate-nitrogen levels. Vines were rotobeat on September 21 and plots were harvested on September 30. Standard cultural practices were followed in other respects. Harvest areas for individual plots were two rows, 15 feet long.

Results and Discussion

A stand of only 50 to 65 percent in A74212-1 plots clearly affected its performance in terms of yield, size, and quality. This problem was also noted in small commercial plantings of the same seed source and was attributed to Erwinia bacterial decay of seed pieces.

Size distribution and specific gravity differences between varieties and specific gravity differences between irrigation treatments were statistically significant (Table 4). Other performance comparisons were inconclusive, showing little effect of relatively large differences in irrigation and N management on yields, size, or quality.

Petiole nitrate-nitrogen levels suggest that the high irrigation rate leached out N quite early in the season except in treatments receiving weekly N applications. However, this was not reflected in crop performance. Nearly two inches of rainfall in mid-July replenished soil moisture in low irrigation rate treatments and may have resulted in excessive soil moisture in high rate plots. The rainfall at a critical time in crop development may account for the lack of response to irrigation management.

Very poor stands in the A74212-1 seedling make varietal comparisons meaningless. However, the fact that yields were equivalent to Russet Burbank yields, with poor stands and at a seed spacing of 12 inches, is evidence of an excellent yield potential for this seedling. Management requirements in terms of irrigation and N cannot be deduced from this experiment.

Summary and Conclusions

These experiments have demonstrated the need for management information on new potato varieties of interest in the Klamath Basin and other regions of the Pacific Northwest. Few, if any, new varieties will perform up to their potential if managed under optimum conditions for Russet Burbank. An ongoing effort is needed to assess releases from all North American potato breeding programs to determine optimum management practices for those varieties of interest in the region. The scale of effort should be expanded to (1) include more entries and at an earlier stage in their development and (2) substantially increase plot size to improve the precision and validity of the results obtained.

Table 1. Effect of seed spacing on yield and grade of five varieties at the Klamath Experiment Station, 1987.

Variety	Spacing	U.S. #1's (cwt/A) 4-6 oz	6-10 oz	>10 oz	Total	% #1's	Yield (cwt/A) B's	#2's	Culls	Total
R. Burbank	6	150	136	42	331	58	108	68	59	566
"	9	104	166	88	358	63	69	62	84	572
"	12	114	96	35	245	56	66	61	63	435
Norgold	6	101	179	322	602	85	46	34	28	710
"	9	68	190	225	483	82	47	30	26	586
"	12	35	163	322	520	88	31	15	28	593
A74212-1	6	92	161	216	469	77	55	43	47	613
"	9	80	143	191	414	73	49	57	47	568
"	12	53	107	154	314	67	39	72	45	470
R. Norkotah	6	82	165	167	413	78	55	41	18	527
"	9	106	187	207	500	84	52	29	12	592
"	12	82	124	156	361	82	25	21	34	441
Krantz	6	71	121	71	264	67	52	41	38	395
"	9	49	93	97	239	61	34	89	30	391
"	12	31	54	66	151	68	15	42	14	221
Treatment Main Effects:										
<u>Variety</u>										
R. Burbank		124^{a}	133^{b}	55^{c}	311^{c}	59	81^{a}	64^{a}	69^{a}	524^{b}
Norgold		68^{c}	177^{a}	290^{a}	535^{a}	85	41^{b}	26^{b}	27^{bc}	631^{a}
A74212-1		75^{bc}	137^{b}	187^{b}	399^{b}	73	48^{b}	57^{a}	46^{b}	550^{ab}
R. Norkotah		90^{b}	159^{ab}	177^{b}	425^{b}	82	44^{b}	30^{b}	21^{c}	520^{b}
Krantz		50^{d}	89^{c}	78^{c}	218^{d}	65	34^{b}	57^{a}	27^{bc}	336^{c}
LSD (.05)		21	32	57	76	---	14	25	21	82
<u>Seed Spacing</u>										
6		100^{a}	152^{a}	164	416^{a}	74	63^{a}	45	38	562^{a}
9		81^{b}	156^{a}	162	399^{a}	74	50^{b}	53	40	542^{a}
12		62^{c}	109^{b}	147	318^{b}	74	35^{c}	42	37	432^{b}
LSD (.05)		17	25	NS	59	---	11	NS	NS	63
CV (%)		32	28	44	24	---	35	63	68	19

Table 2. Effects of N, P, K rates on yield, grade, and specific gravity of four varieties at the Klamath Experiment Station, 1987.

Variety	Fert. Rate (#/A)	Yield No 1's (cwt/A) 4-6 oz	6-10 oz	>10 oz	Total	% No 1's	Yield (cwt/A) B's	No 2's	Culls	Total	Specific Gravity
Russet Burbank	64	62	85	79	227	53	39	35	127	427	1.076
" "	96	138	139	47	324	69	85	43	17	467	1.080
" "	128	141	142	53	336	76	67	21	19	442	1.078
Norgold	64	74	184	193	452	82	29	23	44	548	1.068
"	96	79	189	187	455	85	42	12	27	535	1.066
"	128	85	191	136	412	87	34	21	10	476	1.069
Russet Norkotah	64	76	166	103	344	82	36	23	13	417	1.071
" "	96	67	135	125	326	77	36	32	31	425	1.068
" "	128	85	156	95	336	82	42	27	5	411	1.067
Shepody (6")	64	61	138	156	354	71	37	67	44	502	1.075
"	96	76	142	171	389	74	43	61	36	528	1.072
"	128	84	147	139	370	80	39	33	21	464	1.070
Shepody (9")	64	56	144	119	319	72	29	63	34	445	1.072
"	96	61	168	175	403	79	33	38	34	507	1.071
"	128	51	109	100	260	66	30	60	46	396	1.073
Shepody (12")	64	58	120	113	290	69	24	52	55	421	1.074
"	96	37	120	203	360	76	24	44	44	472	1.075
"	128	69	102	139	309	66	26	65	71	470	1.073
Treatment Main Effects:											
Fertilizer Rate											
	64	64 b	139	127	331	72	32	44	53	460	1.072
	96	76ab	149	151	376	77	44	38	31	489	1.072
	128	86a	141	110	337	76	40	38	29	443	1.072
CV (%)		29	21	53	24	—	60	41	117	15	10
LSD (.05)		15	NS	NS	NS	—	NS	NS	NS	NS	NS
Variety											
Russet Burbank		114a	122 c	60 c	295 c	66	64a	33ab	54a	445 c	1.077a
Norgold		79 b	188a	172a	440a	85	35 bc	19 b	27ab	520a	1.068 c
Russet Norkotah		76 b	152 b	107 b	335 bc	80	38 b	28 b	17 b	418 c	1.068 c
Shepody (6")		74 b	142 bc	155a	371 b	74	39 b	53a	34ab	498ab	1.072 b
Shepody (9")		56 c	140 bc	131ab	327 bc	73	31 bc	54a	38ab	449 c	1.072 b
Shepody (12")		55 c	114 c	151a	320 bc	70	24 c	53a	57a	454 bc	1.074 b
CV (%)		27	25	40	19	--	42	67	112	12	5
LSD(.05)		16	30	43	56	--	13	22	35	47	.003

Table 3. Effects of variety and days from topkill to harvest on yield, grade, and skinning damage, Klamath Experiment Station, 1987.

Variety	Days to Harvest	Yield No. 1's (cwt/A) 4-6 oz	6-10 oz	>10 oz	Total	Yield (cwt/A) B's	No. 2's	Culls	Total	Specific Gravity	Skinning Index	% Stand
R. Burbank	10	89	69	7	165	107	19	19	310	1.079	4.0	76
"	21	86	69	11	166	66	20	22	274	1.077	1.3	77
"	29	99	73	8	180	96	15	22	312	1.076	1.0	77
Kennebec	10	32	90	188	310	19	73	48	449	1.067	8.8	90
"	21	35	86	165	286	19	61	52	418	1.064	3.3	90
"	29	32	77	177	286	12	52	89	439	1.065	1.8	88
A74212-1	10	63	106	141	309	31	42	20	402	1.068	5.9	68
"	21	66	92	111	268	46	60	30	404	1.070	1.5	70
"	29	52	111	124	287	36	60	47	430	1.068	1.4	69
Krantz	10	50	100	95	244	26	35	13	318	1.076	2.9	66
"	21	38	98	94	230	23	38	22	312	1.076	1.8	65
"	29	56	115	97	268	26	44	18	355	1.073	2.0	64
Treatment Main Effects:												
Days to Harvest												
10		58	91	108	257	46	42	25 b	370	1.073a	5.4a	75
21		56	86	95	237	39	45	31ab	352	1.072ab	2.0 b	76
29		60	94	101	255	42	43	44a	384	1.071 b	1.6 b	75
CV (%)		19	27	19	16	35	25	53	12	2	2.5	--
LSD (.05)		NS	NS	NS	NS	NS	NS	15	NS	.002	0.6	--
Variety												
R. Burbank		91a	70 c	9 d	170 c	90a	18 c	21 c	299 b	1.077a	2.1 c	77
Kennebec		33 c	85 b	175a	294a	17 c	62a	63a	435a	1.065 c	4.6a	89
A74212-1		60 b	103a	125 b	288a	38 b	54a	32 b	412a	1.069 b	2.9 b	69
Krantz		48 b	104a	95 c	247 b	25 c	39 b	18 c	328 b	1.075a	2.2 c	65
CV (%)		28	15	23	12	31	30	48	12	4	2.5	--
LSD (.05)		14	11	20	25	11	11	13	37	.003	0.6	--

Table 4. Effects of two irrigation and four nitrogen regimes on yield, specific gravity, and petiole nitrate nitrogen levels of Russet Burbank and A74212-1 at Klamath Experiment Station, 1987.

Treatment Main Effects			Yield No. 1's (cwt/A)			Total Yield	Specific	Petiole NO_3-N (ppm)		
Irrigation[1]	Nitrogen[2]	Variety[3]	4-10 oz	>10 oz	Total	(cwt/acre)	Gravity	July 29	Aug. 12	Sept. 3
1	AVG	AVG	167	125	292	414	1.080	20,000	21,700	10,200
2	AVG	AVG	159	118	277	390	1.087	14,600	8,100	3,100
AVG	1	AVG	175	119	294	417	1.084	16,200	12,200	3,800
AVG	2	AVG	159	137	297	409	1.082	16,300	17,700	10,100
AVG	3	AVG	160	111	271	395	1.083	17,800	14,900	5,800
AVG	4	AVG	159	117	276	386	1.086	18,800	14,900	6,900
AVG	AVG	1	206	73	280	402	1.088	17,200	13,500	6,600
AVG	AVG	2	119	169	289	402	1.079	17,400	16,400	6,700

1/ **Irrigation Rates:**
1 - 50% of Pan Evaporation (8.75 inches total)
2 - 90% of Pan Evaporation (15.75 inches total)

2/ **Nitrogen Rates:**
1 - 100 lbs N/A at planting
2 - 100 lbs N/A at planting and 12.5 lbs N/A/week for 8 weeks.
3 - 100 lbs N/A at planting and 100 lbs N/A on June 2.
4 - 100 lbs N/A at planting and 200 lbs N/A on June 2.

3/ **Varieties:**
1 - Russet Burbank
2 - A74212-1

Evaluation of Alternative Production Aids for Potatoes in the Klamath Basin, 1987

K.A. Rykbost, G.E. Carter, J. Maxwell[1], D. Beck[2]

ABSTRACT

Experiments were conducted to evaluate alternatives to dinoseb products for vine desiccation and captan for seed piece treatment. The registration for dinoseb has been suspended and captan is currently under review. Diquat was satisfactory in efficacy at the rate of 2 pints/acre. At 1 pint/acre Diquat required several days longer to achieve vine kill and skin set but yield improvements were observed. This product is cost competitive and is presently the best alternative to dinoseb. Des-i-cate was slower acting, resulted in the lowest yield and is considerably more expensive than either dinoseb or Diquat. Vine rolling increased efficacy of desiccants with no adverse effects on yield.

Thiabendazole produced some phytotoxic response and a yield reduction. This product is not recommended for treatment of cut seed. As a group, several products with a thiophanate methyl base achieved slightly higher yields than two bark products. Seed piece decay was not a problem in the seed lot used. As a result, the merits of alternative products cannot be accurately judged. Under the conditions of the trial gypsum was the economically optimum treatment.

1/ Superintendent/Associate Professor, Associate Professor Emeritus, Experimental Biology Technician, respectively, Klamath Experiment Station.

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Introduction

Chemicals used as production aids in agriculture are constantly changing. New products as supplements to or replacements for standard materials must be continually evaluated at on-site locations. In recent years a number of chemicals used in potato production have had registrations suspended and several others under review are also likely to be lost in the near future.

The registration for dinoseb as a vine desiccant and harvest aid was suspended in 1987. Captan, used widely for control of fungal diseases on cut seed pieces, is currently under review. It is highly likely that this use will be suspended in the near future. An array of alternatives to both products are available. Trials were established at KES in 1987 to evaluate optional production aids for Russet Burbank crops in the Klamath Basin.

A. Vine Desiccation

Procedures

Russet Burbank was planted on May 27 and grown under standard cultural practices. A split-plot design with four replications was imposed. Main plots were mechanical rolling and no rolling on September 14. Six desiccant treatments included: 1) Control; 2) Dinitro at 2 qts/acre plus 5 gal/acre diesel fuel; 3) Diquat at 1 pt/acre; 4) Diquat at 1 pt/acre plus 1 pt/acre one week later; 5) Diquat at 2 pts/acre; and 6) Des-i-cate at 2 gal/acre. Treatments 3 to 6 included X-77 sticker spreader at 6 oz/acre. Initial treatments were applied on September 15 with flat fan nozzles at 50 psi in 32 gal/acre of water.

Desiccation efficacy was rated on a scale of 1 (completely dead) to 5 (vigorous growth) on September 23 and September 28. Harvest areas were two rows 27 feet long. Potatoes were harvested on October 8 and samples were graded in November.

Results and Discussion

Plants were beginning to senesce naturally in mid-September. A light frost on September 16 hastened the process to the extent that control plots senesced nearly as quickly as the 1 pt/acre Diquat treatment (Table 1). Vine rolling appeared to speed up vine kill by about two days. At the full rate Diquat was as effective as Dinitro while Des-i-cate was about two days slower acting. Thirteen days after treatment all three chemicals had identical ratings. Half rate and split applications of Diquat required four to five days longer to produce complete vine kill.

Vine rolling slightly improved vine kill ratings eight days after treatment but had no effects on yields or size distribution of tubers (Table 1). This practice is widely used to open up the canopy for better penetration of desiccants and to close soil cracks and reduce susceptibility of crops to sunburn damage. There is some concern about its use with Diquat which can be deactivated by soil. There was no evidence that this occurred in the trial.

The desiccation treatments did not significantly affect yields or size distribution. Bulking had apparently slowed considerably by the time of treatment, as evidenced by the failure of the control treatment to outyield other treatments. A trend was observed for lower yield of No. 1's for Des-i-cate and the full rate of Diquat than for control or Dinitro treatments. The highest yield was observed for the 1 pt/acre Diquat treatment.

Rapid vine destruction by chemical or physical means has sometimes been associated with tuber stem end discoloration. Approximately 200 tubers per treatment were inspected for stem end discoloration, hollow heart and other internal disorders. The percentage of stem end discoloration observed ranged from 1 percent for control and Des-i-cate treatments to 4 percent for Dinitro and the split application of Diquat. Rolling of vines did not effect its occurrence. The levels observed are not sufficient to affect the crop quality or value.

The cost of treatment is an important criterion for selecting an alternative product. Dinoseb treatment costs are in the range of $6 to $10/acre, depending on rate used. Diquat is about $5 to $10/acre while Des-i-cate is about $25/acre at the labeled rate. The high cost for Des-i-cate and its slower action will preclude its widespread use as an alternative to dinoseb. Diquat appears to be a satisfactory alternative, both in cost and effectiveness.

B. Seed Piece Treatment

Procedures

The experiment was a randomized complete block design with four replications and 15-foot, one-row plots. Russet Burbank seed was cut, treated, and planted on May 21. Ten seed treatments were evaluated (Table 2). Standard cultural practices were followed. Vines were shredded with a rotobeater on September 21 and sprayed with 2 pt/acre Diquat on September 22. Plots were harvested on October 6 and grading was done in November.

Results and Discussion

As a group the products containing Thiophanate Methyl (TOPS) produced higher yields than the bark products which are relatively new on the market (Table 2). Thiabendazole gave the poorest performance. When applied to cut seed Thiabendazole has produced phytotoxicity and yield reductions in numerous tests in the northeastern U.S. and in northern Europe and England. This product provides excellent control of Fusarium dry rot when applied to crops going into storage or prior to shipment. It is not a safe fungicide to use on cut seed. Captan and gypsum produced good results. Gypsum is commonly used commercially and serves as an excellent drying aid but has no fungicidal activity.

Crops were evaluated for rhizoctonia presence on tubers at the time of grading. The percentage of tubers with sclerotia ranged from 8 percent for the captan treatment to 28 percent for Tops 2.5 D and Tops - Rizolex, with about 20 percent on the other treatments. These differences were not statistically significant.

The likelihood of getting a response to treatment of cut seed is in proportion to the level of infection of seed with seed piece decay organisms, including Fusarium species. Adverse soil conditions at planting would also be important in determining the extent of damage experienced. Seed used in this trial was relatively free of infection and soil conditions were not conducive to disease problems. Under these conditions large responses to treatments would not be expected. The most significant finding was the adverse effect of Thiabendazole on cut seed, which is consistent with observations in other regions. This product should not be considered as an alternative for captan on cut seed.

Further definition of efficacy of seed treatment products will require additional testing, preferably with seed that is infected with seed piece decay organisms. Larger plot size would be required to improve experimental precision and increase the chance of detecting differences.

Table 1. Effect of rolling and desiccants on vine killing efficacy and yields of Russet Burbank, 1987.

Treatment Main Effects	Efficacy (1-5) 8 days	13 days	Yield No. 1's (cwt/A) 4-6 oz	6-10 oz	>10 oz	Total	Total Yield (cwt/A)
Rolling:							
Not Rolled	2.8	1.8	92	89	25	207	321
Rolled	2.4	1.7	92	90	24	206	324
CV (%)	---	---	21	16	52	13	10
LSD (.05)	---	---	NS	NS	NS	NS	NS
Desiccant:							
Control	3.3	2.1	100	87	24	211	325
Dinitro- 2 qts.	2.0	1.6	101	86	25	213	319
Diquat - 1 pt.	2.8	1.9	95	100	28	222	345
Diquat - 1 pt + 1 pt.	2.8	1.7	87	92	23	204	310
Diquat - 2 pts.	2.0	1.6	89	88	21	198	334
Des-i-cate - 2 gal.	2.8	1.6	78	85	25	188	301
CV (%)	---	---	23	21	58	18	11
LSD (.05)	---	---	NS	NS	NS	NS	NS

Table 2. Effects of 10 seed piece treatments on yields and grade of Russet Burbank, 1987.

Treatment	Yield No. 1's (cwt/A) 4-6 oz	6-10 oz	>10 oz	Total	Yield (cwt/A) B's	No 2's	Culls	Total
TOPS 2.5D	119	149	42	311	84	52	12	459
TOPS - ANCHOR	95	160	45	300	83	79	10	472
TOPS - ROVRAL	120	182	41	342	122	48	16	529
TOPS - RIZOLEX	112	153	35	300	105	49	9	464
TOPS - VITAVAX	99	137	44	280	86	65	20	451
CAPTAN 7.5	95	165	68	329	72	62	18	481
FIR BARK	83	128	54	265	75	49	21	410
SPUD BARK W/ZINEB	98	153	29	280	96	47	15	438
THIABENDAZOLE 1/2%	111	105	16	232	108	35	3	378
GYPSUM	120	181	46	347	98	49	7	500
CV (%)	26	21	70	19	33	47	86	11
LSD (.05)	NS	46	43	77	NS	36	16	76

Fumigation and Nematicides for Control of Root-Knot Nematode and Other Nematode Related Diseases in the Klamath Basin, 1987

K.A. Rykbost, G.E. Carter, J. Maxwell [1], and D. Beck [2]

ABSTRACT

Russet Burbank response to various combinations of fumigants and nematicides in terms of yields, grades, tuber infestation with root-knot nematodes and corky ring spot, and the economics of disease control were investigated at the Klamath Experiment Station and at two off-station sites. Root-knot nematode damage occurred at each site even though extensive soil sampling failed to detect this pest at either off-station site. High populations at KES required a minimum treatment of TELONE II at 12 gpa plus Temik at 3 lbs ai/acre for satisfactory control. Mocap alone at 9 lbs ai/acre gave satisfactory control at both off-station sites. Corky ring spot, associated with stubby root nematodes at populations up to 34/250 cc soil, required spring-applied TELONE II for satisfactory control on a sandy soil. On a sandy loam soil with very low stubby root nematode numbers, Mocap alone at 9 lbs ai/acre controlled corky ring spot. Total yield increases from untreated controls to optimum treatment of TELONE C-17 applied in spring were 34 and 26 percent on off-station sites. These responses were largely attributed to suppression of early dying in soils initially high in root lesion nematode numbers. Over a range in crop values, economically optimum disease control was achieved with spring-applied TELONE in most cases.

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Introduction

Soil fumigants and granular nematicides have been evaluated for control of root-knot nematode at several sites over numerous years in the Klamath Basin and elsewhere. Although results are often inconsistent between years and locations in any given year, their use in the Klamath Basin is routine. Over 50 percent of the region's potato crop is treated annually, with TELONE* fumigants being most widely used.

Cooperative research projects, with assistance from Dow Chemical Company, Basin Fertilizer and Chemical Company, and the OSU Department of Botany and Plant Pathology, have been conducted in each year since 1984. The most recent studies can be summarized as follows:

1986 - At the Klamath Experiment Station (KES) the granular nematicides, Temik and Mocap at rates of 3 and 6 lbs ai/A, alone or in combination, were evaluated with TELONE II, spring-applied rates of 0, 12, and 20 gpa. Nematode infestation was less than 5 percent and no treatment effects were observed on nematode damage, yields of No. 1's or total yields. No untreated checks were included in this study.

1985 - Mocap at 6 and 9 lbs ai/A, Temik at 3 and 6 lbs ai/A and a combination of Mocap and Temik were evaluated alone or in combination with spring-applied TELONE II at 20 gpa. In an untreated check 81 percent tuber infestation by nematodes was observed. Temik and Mocap reduced infestation levels to 40 to 60 percent when applied without fumigation. TELONE II completely eliminated nematode infestation whether applied alone or in combination with nematicides. Total yields were largely unaffected by treatments but yields of No. 1's exhibited very large response due to the wide variation in nematode damage.

1984 - Three fields with previous histories of nematode infestations were chosen to represent sandy loam, loamy sand, and sand soil types. TELONE II (20 gpa), TELONE C-17 (27.5 gpa), and Soil Prep (50 gpa) were compared with an untreated check at each site. In the sandy soil 19 percent infestation of tubers was observed at harvest in the check, 3 percent in Soil Prep, and 0 percent in TELONE treatments. Some nematodes survived treatment with TELONE which was attributed to a poor sealing of the surface under dry conditions. In the loamy sand soil both TELONE treatments provided complete control of tuber infection while Soil Prep exhibited 4 percent and the untreated check 15 percent infestation at harvest. Initial sampling at this site indicated pretreatment populations of less than 10 nematodes/250 cc of soil, only 5 percent of pretreatment levels in the sandy site, but sufficient to result in economic losses when uncontrolled. In the loam soil, initial populations were between 187 and 385 nematodes/250 cc of soil. At harvest, populations ranged from 39 to 694 nematodes/250 cc of soil. Infestation levels were 7 to 9 percent for treated plots and 19 percent in the untreated check. Poor control was attributed to inadequate penetration of fumigants in the heavier soil with higher moisture content.

These trials have left several questions on root-knot nematode control unanswered. Two other economically important disease problems, verticillium wilt and corky ring spot, are also related to nematode populations and therefore may be controlled to some extent by fumigation or nematicides. As a follow-up to the research conducted in 1984 to 1986 two experiments were established for 1987. Objectives were to assess: 1) fall versus spring fumigation; 2) application rates for TELONE II; 3) TELONE II versus TELONE C-17; and 4) granular nematicides as a supplement to or substitute for fumigants.

Procedures

Off-station Experiments

A sand soil type on Adam's Point Rd. between Merrill and Malin was chosen as Site 1. A loamy sand soil about 7 miles SE of Klamath Falls was selected as Site 2. Pre-treatment soil samples from the 0 to 12 inch layer were collected from each plot at both sites on September 18, 1986. Post-treatment samples were obtained from check and fall treated plots on October 9. All samples were analyzed for several species of nematodes at the OSU Department of Botany and Plant Pathology.

A randomized complete block design with four replications was used. The treatments included are identified in Table 1. Individual plots were 15 feet wide and 40 feet long. Fall fumigation treatments were applied on September 18, spring fumigation treatments on April 16, and Mocap treatments on June 17. Russet Burbank potatoes were planted at Site 1 in early May and at Site 2 in late May. Standard cultural practices were followed. Vines senesced naturally in September and plots were harvested on October 2 on Site 1 and October 6 on Site 2.

Harvest areas were one row 30 feet long. All tubers were saved, graded for size and quality parameters, and weighed. Sub-samples of 25 tubers per treatment were obtained from each replication for nematode analysis. A 10-pound sample of No. 1 grade tubers from each plot was cut and inspected for corky ring spot and other internal disorders.

KES Experiment

Pre-treatment composite soil samples from 0 to 6-inch and 6- to 12-inch layers were collected in mid-April and analyzed for root-knot and root lesion nematodes. A split plot design with four replications included fumigation treatments as main plots and nematicide treatments as split plots. Main plots were 30 feet wide and 180 feet long. Split plots were applied to the four center rows 30 feet long. Fumigation treatments were applied on April 22, Russet Burbank potatoes were planted on May 26 and nematicide treatments were applied on June 5. Standard cultural practices were followed. Vines senesced naturally and plots were harvested on October 12. Harvest areas included 15-foot sections of the two center rows. Grading procedures were as described above.

Results

Off-station Experiments

Root-knot nematodes were not identified in any of the 96 samples from the two sites. Root lesion nematodes were abundant at both sites with populations about three times as high at Site 1 (Table 1). Pin, stubby root, and stunt species were widely observed at Site 1 but were detected at low numbers in only a few of the samples at Site 2.

Post-treatment samples showed similar populations on check plots and large reductions in nematode numbers on treated plots. Better root lesion nematode control was observed for the high rate of TELONE II, while TELONE C-17 gave the best control.

Most treatments significantly increased yield of No. 1's over the untreated check at both sites (Table 2). Mocap applied alone produced a substantial yield effect, but in combination with fumigation added little benefit. TELONE C-17 produced the highest yield at both sites. Trends were evident for higher yields from spring-applied fumigants.

Although root-knot nematodes were not detected in soil samples, unacceptable levels of tuber infestation were found in check treatments at both sites (Table 2). All combinations of Mocap and fumigation treatments provided root-knot nematode damage control at both sites. Corky ring spot was observed in 6 percent of No. 1 tubers in the check treatment on Site 2 and 24 percent on Site 1. The effects of treatments on corky ring spot was site-specific. At Site 2 all treatments provided excellent control. At Site 1 Mocap alone had little effect. Fall-applied TELONE II, or TELONE C-17 applied in spring or fall provided acceptable control but did not eliminate corky ring spot.

Yields of No. 1's (Table 2) were not adjusted to reflect corky ring spot infection. Inclusion of this parameter in grade determinations would reduce No. 1 yields in check treatments at both sites and in several treatments at Site 1. This damage must be considered in the calculation of economic responses.

KES Experiment

Nematode counts indicated pre-treatment populations of root-knot species at 13 and 650/250 cc of soil and root lesion species at 50 and 90/250 cc of soil at 0 to 6-inch and 6 to 12-inch depths, respectively. Effects of treatments on yields and nematode damage as a percent of total yield are shown in Table 3. Total yield was unaffected by treatments. The yield of No. 1's responded in proportion to nematode control achieved.

Nematicides without fumigation did not provide acceptable control of nematode damage. Temik was more effective than Mocap at both rates but the effects of Temik and Mocap were not additive. TELONE II at 12 gpa was also unacceptable but provided adequate nematode damage control when Temik was applied with it. At 20 gpa, TELONE II was effective without the addition of granular nematicides. Corky ring spot was not observed in this experiment.

Discussion

In two of the three sites serious nematode damage occurred even though root-knot nematodes were not detected in extensive soil sampling before and after treatment. In both cases Mocap effectively controlled nematode infestation of tubers. In the third site, where high numbers of root-knot nematodes were detected in soil samples, either TELONE II at 12 gpa, plus Temik, or TELONE II at 20 gpa was required for control.

Corky ring spot, the tuber manifestation of Tobacco Rattle Virus, is known to be transmitted by stubby root nematode species. Significant numbers of this species were detected in pre-treatment samples on Site 1 with very few observed at Site 2. Samples from the KES site were not assayed. At Site 1 the fall fumigation treatments appeared to eradicate this species. Fall fumigation did not provide satisfactory control of corky ring spot, and Mocap alone provided no control. This problem is potentially more serious for tablestock potatoes than root-knot nematode damage because it cannot be sorted out in packaging operations. Clearly, any indication of stubby root nematode in soil samples is an indication of potential problems in subsequent crops. Yet the failure to detect this species is not a guarantee of freedom from problems, as demonstrated at Site 2, and as is the case for root-knot nematodes.

Early dying was observed to some extent at all three sites but was most pronounced at Site 1. Plant vigor ratings made on September 1 showed wide differences in the degree of early dying, with check treatments being nearly dead while vines were most vigorous on treatments that received TELONE C-17. At Site 2 on the same date little evidence of early dying was noted except on check treatments. At both off-station sites clear trends are evident for increasing total yield from lows for check treatments, to highs for the TELONE C-17 treatments. Mocap alone provided some improvement. Fall fumigation added further improvement but produced lower yields than spring treatments. Although tuber size data is not presented it indicated that higher yields were a function of better sizing, which is consistent with control of early dying. At the KES site there were no effects of treatments on early dying, which was present but spotty throughout the trial. Total yields were essentially the same for all treatments. The largest increase in total yields occurred on Site 1 where lesion nematode populations were greatest, providing evidence that early dying was associated with this species, as has been observed elsewhere.

The economic implications of fumigation and nematicide treatments were assessed (Tables 4 and 5). Costs of treatments were obtained from local suppliers. Crop values are based on two price structures which are fairly representative of prices experienced for the 1986 and 1987 crops in the Klamath Basin. The yield of No. 1's on off-station sites were adjusted for corky ring spot infection.

Economically optimum treatments were not the same at each site nor were they the same for the two market situations in two cases out of three. At Site 1 with low prices the optimum was TELONE II at 15 gpa, spring-applied, with Mocap. Under the high price regime, TELONE C-17 was optimum even though its cost was double that of most other treatments. On Site 2, where corky ring spot was controlled by all treatments and early dying was less severe, the 15 gpa rate of TELONE II, spring-applied, was optimum at both price structures. At the KES the low rate of Temik with no fumigant was optimum at low prices, while at high prices the optimum was TELONE II at 20 gpa and Temik at the low rate.

This data clearly shows the dilemma facing growers who must make treatment decisions with little or no knowledge of prices to be expected from the crop. However, it also points out the potential value of knowing the field history for disease problems and knowing the population levels of the important nematode species.

Summary and Conclusions

Under a range of soil conditions, nematode populations, and treatment schedules the 1987 experiments provided some interesting information, summarized as follows:

1. Soil sampling is useful in determining both the kinds and populations of nematodes present as an indication of potential problems.

2. An absence of nematodes in soil tests is not a guarantee of freedom from the pest or its associated effects on yield or quality.

3. The presence of stubby root nematodes at populations of less than 40/250 cc of soil was associated with CRS injury that was not corrected by fall fumigation with TELONE II at 20 gpa.

4. Lesion nematode populations of 200 to 600/250 cc of soil were associated with yield reductions from early dying of 34 percent in total yield at Site 1. At populations from 30 to 215/250 cc of soil, total yield was reduced by 26 percent at Site 2.

5. At high root-knot nematode populations, tuber damage control required a minimum of 12 gpa TELON II plus Temik at 3 lb ai/A. Mocap at 9 lbs ai/A was effective where nematodes were not detected in soil samples.

6. At both off-station sites, spring fumigation was superior to fall fumigation. However, soil conditions were unusually good in the spring of 1987.

7. The economics of control of problems associated with nematodes are affected by site-specific pest pressure as well as market conditions. The latter cannot be predicted at the time treatment decisions must be made.

Additional information will be available at a later date when soil and tuber samples obtained in late summer and at harvest have been analyzed. This will undoubtedly help in determining the effects of treatments on population dynamics and in explaining some of the responses observed. While some of the findings are not new, the information on corky ring spot and early dying responses adds a new dimension to understanding nematode-related problems in mineral soils of the Klamath Basin.

Table 1. Nematodes per 250 cc soil pre-treatment and post-treatment at off-station sites, 1987.

Treatment				Site 1				Site 2			
Fumigation	**Rate**	**Time**	**Mocap**	**Lesion**	**Pin**	**Stubby**	**Stunt**	**Lesion**	**Pin**	**Stubby**	**Stunt**
	gpa		lbs ai/A	---------	---------	nematodes/250cc	---------	---------			
						Pre-treatment					
None	--	--	0	52	57	21	27	32	0	0	0
None	--	--	9	141	93	32	2	77	0	5	2
Telone II	15	F	0	234	59	32	16	138	0	0	4
Telone II	20	F	0	407	182	18	2	122	0	0	0
Telone II	15	F	9	206	428	18	15	96	0	0	2
Telone II	20	F	9	598	505	11	0	215	0	0	3
Telone II	15	S	0	89	76	34	21	119	0	0	4
Telone II	20	S	0	510	269	9	16	21	0	0	0
Telone II	15	S	9	96	858	27	5	58	0	0	0
Telone II	20	S	9	230	362	25	5	72	0	2	2
Telone C-17	27.5	F	0	450	68	20	18	63	0	0	7
Telone C-17	27.5	S	0	41	626	32	25	9	0	0	0
						Post-treatment					
None	--	--	0	112	61	17	0	39	0	1	2
Telone II	15	F	0	98	10	0	1	12	0	0	1
Telone II	20	F	0	11	3	0	0	6	0	0	0
Telone II	15	F	9	45	1	0	0	12	0	0	0
Telone II	20	F	9	32	1	0	0	7	0	0	0
Telone C-17	27.5	F	0	15	0	0	0	4	0	0	0

Table 2. Effect of treatments on No. 1 and Total Yields and damage from root-knot nematodes and corky ring spot on Russet Burbank in the Klamath Basin, 1987.

Treatment				Yield No 1's(cwt/A)[1]			Total Yield (cwt/A)			Nema (%)[2]		CRS (%)[3]	
Fumigation	Rate	Time	Mocap	Site 1	Site 2	Avg	Site 1	Site 2	Avg	Site 1	Site 2	Site 1	Site 2
None	--	--	0	142	190	166	319	405	362	18	7	24	6
None	--	--	9	213	263	238	360	423	392	2	1	21	0
Telone II	15	F	0	239	302	271	378	491	435	0	0	7	0
Telone II	20	F	0	270	309	290	397	475	436	0	0	6	0
Telone II	15	F	9	290	263	277	423	474	449	0	0	1	0
Telone II	20	F	9	282	254	268	426	405	416	0	0	3	0
Telone II	15	S	0	237	327	282	384	527	456	0	0	1	0
Telone II	20	S	0	279	315	297	427	518	473	0	0	0	0
Telone II	15	S	9	308	323	316	446	515	481	0	0	1	0
Telone II	20	S	9	313	327	320	453	501	477	0	0	1	0
Telone C-17	27.5	F	0	312	317	315	475	488	482	0	0	1	0
Telone C-17	27.5	S	0	365	336	351	483	549	516	0	0	0	0
CV (%)				20	19	—	17	14	—	584	375	88	381
LSD(.05)				77	79	—	99	95	—	NS	3	8	3

1/ Yield of No. 1's is adjusted to reflect nematode but not CRS damage.
2/ Nematode injury is expressed as percent of total yield.
3/ Corky Ring Spot infection is expressed as percent of No. 1 yield.

Table 3. Effects of fumigation and nematicide treatments on yields and root-knot nematode damage on Russet Burbank at KES, 1987.

Treatment Rates			Yield (cwt/A)			% of Total Yield
Fumigation	Mocap	Temik	No. 1's	Total	Nema. Damage	Nema. Damage
gpa	—lbs ai/A—					
0	0	0	158	372	121	33
0	3	0	181	374	121	32
0	6	0	216	366	32	9
0	0	3	238	395	62	16
0	0	6	257	401	23	6
0	3	3	232	407	81	20
12	0	0	202	365	46	13
12	3	0	257	397	21	5
12	6	0	225	395	31	8
12	0	3	276	390	7	2
12	0	6	248	388	0	0
12	3	3	259	396	5	1
20	0	0	269	415	0	0
20	3	0	245	364	0	0
20	6	0	268	397	4	1
20	0	3	289	426	0	0
20	0	6	242	352	0	0
20	3	3	268	411	0	0
Treatment Main Effect:						
TELONE II Rate:						
0			214 b	386	73a	19
12			245ab	389	18 b	5
20			264a	394	1 b	0
CV (%)			15	11	201	--
LSD(.05)			26	NS	44	--
Nematicide:						
	0	0	210 b	384	55a	15
	3	0	228ab	378	48ab	12
	6	0	236ab	386	22ab	6
	0	3	268a	394	23ab	6
	0	6	249ab	380	8 b	2
	3	3	253ab	405	29ab	7
CV (%)			28	14	169	—
LSD (.05)			56	NS	43	—

Table 4. Economic analysis of off-station fumigation - nematicide experiment, 1987.

Treatment				Cost[1]	Crop Value[2] ($/acre)				Return over costs[3] ($/acre)			
					Site 1		Site 2		Site 1		Site 2	
Fumigation	Rate	Time	Mocap	($/acre)	CASE I	CASE II	CASE I	CASE II	CASE I	CASE II	CASE I	CASE II
None		--	0	0	430	850	763	1526	430	860	763	1526
None	--	--	9	90	600	1200	869	1738	510	1110	779	1648
Telone II	15	F	0	135	744	1488	1001	2002	609	1353	866	1867
Telone II	20	F	0	173	834	1668	1010	2020	661	1495	837	1847
Telone II	15	F	9	225	929	1858	895	1790	704	1633	670	1565
Telone II	20	F	9	263	898	1796	840	1680	635	1533	577	1417
Telone II	15	S	0	135	780	1560	1081	2162	645	1425	946*	2027*
Telone II	20	S	0	173	911	1822	1039	2078	738	1649	866	1905
Telone II	15	S	9	225	986	1972	1065	2130	761*	1747	840	1905
Telone II	20	S	9	263	1002	2004	1068	2136	739	1741	805	1873
Telone C-17	27.5	F	0	446	1010	2020	1037	2074	564	1574	591	1628
Telone C-17	27.5	S	0	446	1154	2308	1114	2228	708	1862*	668	1782

1/ **Cost of Treatments:** Mocap - $1.00/lb - 10G; Temik - $2.80/lb - 15G; Telone II - $7.65/gal; Telone C-17 - $15.50/gal; Telone Application - $20/acre.

2/ **Crop Value:** Case I - $3.00/cwt No. 1's; $.50/cwt - remainder of crop.
Case II - $6.00/cwt No. 1's; $1.00/cwt - remainder of crop.
CRS infected tubers are not included in No. 1's.

3/ **Return Over Costs:** Crop value - Cost of treatment.

Table 5. Economic analysis of the KES fumigation - nematicide experiment, 1987.

Treatment			Treatment	Crop Value		Return over costs	
Fumig.	Mocap	Temik	Cost	CASE I	CASE II	CASE I	CASE II
			$/Acre				
0	0	0	0	581	1162	581	1162
0	3	0	30	640	1280	610	1250
0	6	0	60	723	1446	663	1386
0	0	3	56	793	1586	737*	1530
0	0	6	112	843	1686	731	1574
0	3	3	86	784	1568	698	1482
12	0	0	112	688	1376	576	1264
12	3	0	142	841	1682	699	1540
12	6	0	172	760	1520	588	1348
12	0	3	168	885	1770	717	1602
12	0	6	224	814	1628	590	1404
12	3	3	198	846	1692	648	1494
20	0	0	173	880	1760	707	1587
20	3	0	203	795	1590	592	1387
20	6	0	233	869	1738	636	1505
20	0	3	229	936	1872	707	1643*
20	0	6	285	781	1562	496	1277
20	3	3	259	876	1752	617	1493