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Malheur Experiment Station Annual Report, 1996

Agricultural Experiment Station
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Idaho-Eastern Oregon Onion Committee
Malheur County Potato Growers
Nevada Seed Council
Nyssa-Nampa Beet Growers Association
Oregon Alfalfa Seed Commission
Oregon Alfalfa Seed Growers Association
Oregon Potato Commission
Oregon Processed Vegetable Commission
Washington Alfalfa Seed Growers

OREGON PUBLIC AGENCIES SUPPORTING RESEARCH:

Department of Agriculture
Department of Environmental Quality
Department of Economic Development

1996 WEATHER REPORT

Erik Feibert, J. Mike Barnum, and Clint Shock
Malheur Experiment Station
Oregon State University
Ontario, Oregon

Introduction

Daily observations of air temperature and precipitation have been recorded at the Malheur Experiment Station since July 20, 1942. Installation of additional equipment in 1948 allowed for evaporation and wind measurements. Evaporation is measured as inches of water evaporated from a standard 10-inch deep by 47.5-inch diameter pan over 24 hours. Wind run is measured as total wind movement in miles over a 24 hour period measured at 24 inches above ground level. A soil thermometer was added in 1967. A biophenometer, to monitor degree days, and pyranometers, to monitor solar and photosynthetically active radiation, were added in 1985.

Since 1962, daily readings from the station have been reported to the U.S. Department of Commerce, Environmental Science Service Administration, and the National Weather Service. Each day the 8:00 a.m. air temperature, preceding 24-hour air and soil temperature extremes, and 24-hour accumulated precipitation are recorded and transmitted to radio station KSRV in Ontario. KSRV then conveys this information, along with their own daily readings, to the U.S. Weather Station in Boise, Idaho. During the irrigation season (April -October), evaporation, wind, and water temperature are also monitored and reported.

On June 1, 1992, in cooperation with the U.S. Bureau of Reclamation, a fully automated weather station, connected by satellite to the Northwest Cooperative Agricultural Weather Network (AgriMet) computer in Boise, Idaho, began transmitting data from the Malheur Experiment Station. The automated station monitors air temperature, relative humidity, dew point temperature, precipitation, wind run, wind speed, wind direction, solar radiation, and soil temperature at 8-inch and 20-inch depths. Stored data is transmitted via satellite to the Boise computer every 4 hours. The database may be accessed via computer modem. Daily Malheur County crop water-use estimates, which are based on data from this automated weather station, are also available by modem.

1996 Weather

Total precipitation was 12.69 inches for the year, exceeding the 10-year and 54-year station averages by 30 percent and 20.3 percent, respectively (Table 1). The months of March, April, and May had precipitation totals above both the 10-year and 54-year means (Table 1, Figure 1).

Total snowfall for 1996 was 14.5 inches, 27.5 and 26.1 percent below the 10-year and 54-year means, respectively (Table 2). Mean monthly maximum air temperatures for July and August were 94 and 91 °F, above the long term station means (Table 3, Figure 2). The total accumulated growing degree days (50-86 °F) was slightly lower than the 10-year mean (Table 4, Figure 3). The total number of degree days in the 86-104 °F range for July was 42 percent above the 70-year mean (Table 5).

The mean monthly maximum and minimum 4-inch soil temperatures were close to the 10-year and 54-year means (Table 6).

Total pan-evaporation for April through October was 56.77 inches, below the 10-year mean and above the 48-year mean (Table 7).

April, May, June, August, September, and October were windier than the 10-year and 54-year means (Table 8).

The last spring frost ($\leq$32 °F) occurred on May 6, 10 days later than the 20-year mean date of April 26; the first fall frost occurred on September 23, 11 days earlier than normal (Table 9).

The weather in 1996 did not exceed any record weather events recorded over the 54-year history for the Malheur Experiment Station (Table 10).

Table 1. Annual precipitation totals at the Malheur Experiment Station, Oregon State University, Ontario, Oregon.

1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	10 yr mean	54 yr mean
inches												
8.64	9.81	7.58	9.15	7.21	9.25	8.64	13.30	10.05	14.01	12.69	9.76	10.24

Table 2. Annual snowfall totals at the Malheur Experiment Station, Oregon State University, Ontario, Oregon.

1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	10 yr mean	54 yr mean
inches												
13	15.5	34.8	25.1	5.7	7.5	15.5	36	32	15	14.5	20.01	19.62

Table 3. Daily air temperature for 1996 at the Malheur Experiment Station, Oregon State University, Ontario, Oregon.

Day	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
	°F																							
1	47	23	21	2	46	22	71	35	72	45	75	42	92	55	94	56	85	49	83	40	58	30	40	27
2	41	27	20	6	52	22	61	42	70	42	81	47	97	59	97	52	83	47	83	39	58	26	46	27
3	40	28	20	5	58	29	60	36	61	33	88	52	101	60	84	52	83	53	81	41	55	25	43	28
4	42	25	16	6	53	35	59	33	59	29	89	56	99	59	77	46	82	54	83	43	52	25	39	13
5	42	25	26	14	56	36	63	33	59	36	88	53	92	52	80	46	81	46	80	41	53	29	35	13
6	39	27	38	23	51	31	67	34	68	32	82	47	83	50	78	46	67	37	80	47	51	21	34	18
7	39	26	41	29	52	32	71	35	67	39	88	49	86	52	81	47	75	38	82	45	47	24	34	14
8	37	26	43	34	56	34	78	43	70	38	96	56	95	54	90	49	81	40	84	45	49	27	37	19
9	43	31	45	32	62	34	82	40	66	39	95	54	95	56	97	54	86	46	86	44	58	23	39	30
10	37	27	50	29	64	36	77	44	69	41	89	53	99	57	101	53	89	47	84	43	57	22	44	30
11	40	27	43	28	62	38	61	39	72	40	84	55	93	57	102	50	93	55	84	42	56	22	59	30
12	44	24	49	26	64	46	64	36	82	44	81	47	95	61	102	57	95	55	75	38	53	23	45	29
13	43	24	51	27	46	38	57	34	85	54	85	48	97	57	96	64	90	55	79	40	53	25	48	29
14	30	24	51	27	60	37	59	28	76	55	92	54	100	58	98	62	82	53	62	31	57	32	46	24
15	32	25	54	28	63	29	66	25	71	55	91	57	99	65	90	57	79	51	59	33	52	27	42	19
16	47	30	54	29	65	32	73	42	68	52	94	62	91	60	96	58	62	40	60	33	49	27	32	21
17	42	28	54	32	62	32	61	37	63	51	89	52	86	52	97	59	64	39	54	21	47	28	42	15
18	39	23	50	34	60	31	62	35	71	45	77	37	93	50	89	52	66	39	57	21	48	35	33	12
19	33	24	61	35	62	30	56	28	64	41	66	34	81	43	79	41	67	40	57	31	62	39	28	12
20	45	25	54	36	67	38	57	30	62	37	74	42	84	48	83	48	69	40	51	23	64	35	30	14
21	42	31	56	38	65	35	55	28	66	43	76	49	88	55	88	54	73	42	50	18	46	33	28	22
22	43	24	53	30	65	37	59	32	62	48	72	46	91	59	84	45	69	41	53	20	48	35	32	22
23	39	27	46	28	50	25	59	38	62	38	79	47	92	59	88	44	64	32	49	30	49	29	30	12
24	38	27	54	28	54	32	64	38	60	43	80	49	100	60	92	45	67	34	52	33	47	30	32	16
25	44	18	37	20	48	26	61	33	71	46	68	49	100	63	94	48	67	36	57	34	43	29	38	24
26	38	15	37	21	50	23	65	35	77	49	73	50	101	65	99	53	72	37	52	33	49	25	39	29
27	34	17	34	14	57	26	66	36	79	53	79	47	103	59	98	55	70	36	55	27	47	25	43	28
28	37	21	36	15	48	36	58	28	76	64	74	51	103	66	81	47	75	37	54	25	42	27	51	30
29	40	24	43	19	42	25	63	37	71	45	78	47	99	63	85	48	81	37	48	26	47	29	49	29
30	35	13			51	26	67	42	68	42	85	50	85	59	93	52	84	40	51	39	45	26	58	39
31	24	4			56	28			71	39			93	55	95	52			51	36			51	40
1996 mean	39	24	43	24	56	32	64	35	69	44	82	49	94	57	91	51	77	43	66	34	51	28	40	23
10 yr mean	34	18	43	23	56	32	66	38	75	46	83	53	89	57	89	55	81	46	68	36	47	27	37	19
53 yr mean	35	19	43	25	54	31	64	37	74	45	82	52	91	57	89	55	80	46	65	36	47	28	37	22

Figure 1. Monthly total precipitation for 1996 (solid bar) and 54 year average (crossed bar), Ontario, OR, 1996.

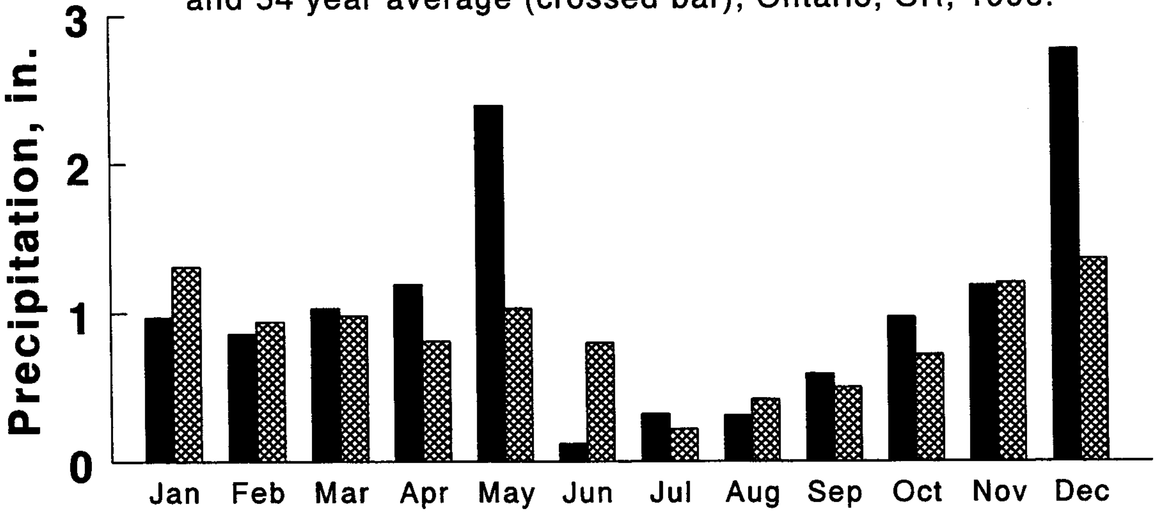

Figure 2. Monthly mean maximum (solid bar) and minimum (crossed bar) air temperature for 1996, Ontario, OR, 1996.

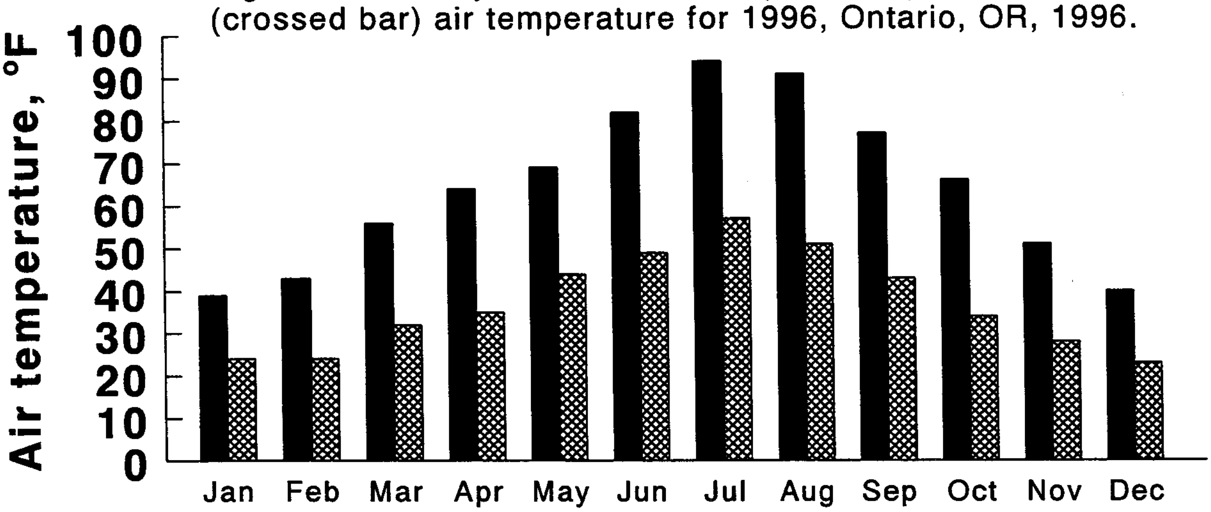

Figure 3. Cumulative growing degree days (50-86 °F) for 1996 (solid line) and 10 yr. av. (dashed line), Ontario, OR, 1996.

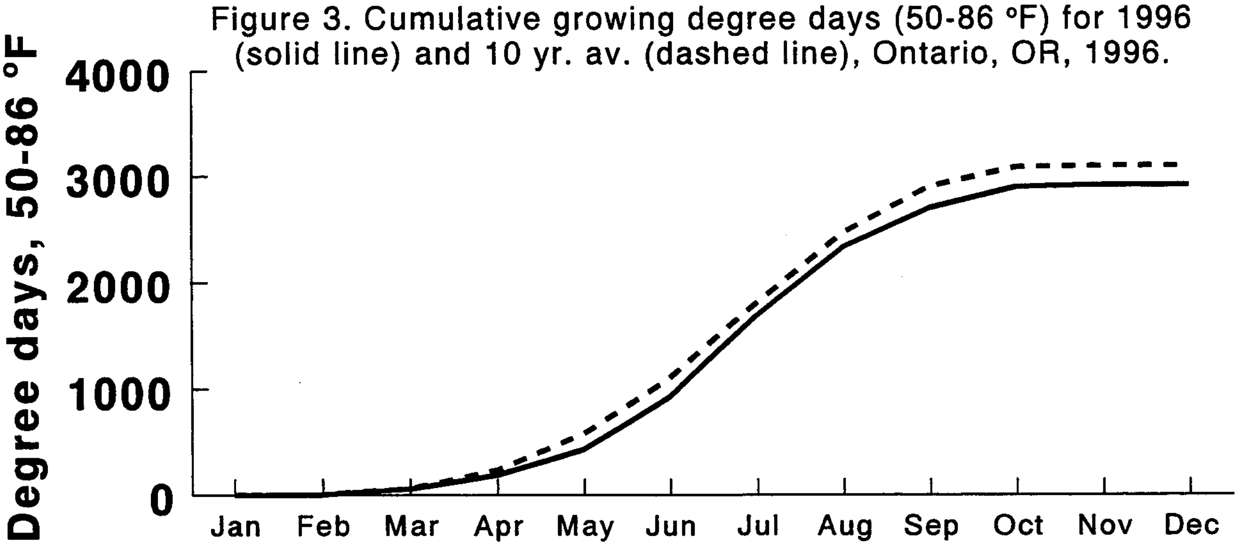

Table 4. Monthly growing degree days (50-86 °F) at the Malheur Experiment Station, Oregon State University, Ontario, Oregon.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1986	0	16	101	220	558	1197	1847	2643	2939	3097	3111	3111
1987	0	0	43	318	741	1288	1929	2578	3064	3287	3316	3318
1988	0	5	56	236	554	1139	2050	2741	3117	3426	3446	3446
1989	0	0	13	197	469	1018	1751	2332	2721	2838	2852	2852
1990	2	9	88	327	588	1085	1819	2454	3039	3077	3077	3077
1991	0	13	29	153	365	754	1530	2248	2684	2878	2879	2879
1992	0	13	119	321	803	1377	2016	2720	3105	3279	3283	3283
1993	0	0	23	104	527	885	1349	1873	2281	2533	2539	2539
1994	0	2	94	283	652	1175	1969	2743	3252	3396	3398	3398
1995	0	29	61	167	460	893	1573	2161	2633	2734	2737	2747
1996	0	5	58	193	436	929	1687	2345	2709	2903	2921	2923
Mean	0	8	62	229	559	1067	1775	2440	2868	3041	3051	3052

Table 5. Monthly degree days (86-104 °F) at the Malheur Experiment Station, Oregon State University, Ontario, Oregon.

Year	Apr	May	Jun	Jul	Aug	Sep	Oct
1990	0	0	13	56	41	14	0
1991	0	0	2	41	36	4	0
1992	0	5	20	23	54	2	0
1993	0	4	4	2	11	5	0
1994	0	2	16	68	54	7	0
1995	0	0	4	23	22	7	0
1996	0	0	5	54	32	4	0
7 yr	0	2	9	38	36	6	0

Table 6. Daily 4-inch soil temperature for 1996 at the Malheur Experiment Station, Oregon State University, Ontario, Oregon.

Day	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
	°F																							
1	32	32	30	25	41	35	57	41	70	52	81	60	90	69	93	71	86	71	75	60	53	42	38	37
2	33	32	29	25	44	35	53	47	73	57	84	62	92	72	96	73	85	69	77	60	55	41	40	36
3	33	33	29	23	47	35	56	45	65	52	86	65	94	75	87	74	85	69	75	60	54	40	37	36
4	33	33	28	23	47	40	56	43	65	49	85	67	94	76	86	70	80	70	76	61	50	40	38	34
5	33	33	29	26	48	41	60	42	67	49	88	70	94	75	86	70	79	68	72	60	50	40	33	33
6	33	33	30	25	46	38	65	44	69	52	88	68	88	72	84	69	75	62	75	62	49	38	33	33
7	34	34	31	31	48	38	66	48	70	51	88	67	90	71	86	68	77	61	76	62	44	37	33	33
8	34	34	32	31	50	40	70	51	72	56	90	68	92	73	88	69	80	62	76	62	47	38	34	33
9	39	34	32	32	57	43	73	50	71	55	92	73	90	75	91	71	83	64	77	62	53	39	34	34
10	37	36	33	32	53	43	70	48	72	55	91	72	94	75	94	74	84	66	76	62	51	39	34	34
11	39	35	34	33	54	45	62	53	74	56	89	72	93	76	93	75	85	68	75	62	50	38	43	34
12	41	35	38	33	57	46	76	52	77	58	86	71	94	76	92	77	87	70	70	59	48	39	39	36
13	27	35	42	33	48	44	61	49	81	63	88	69	94	77	90	78	87	72	72	58	48	38	43	36
14	35	35	44	35	53	43	62	47	72	64	91	69	95	77	91	76	82	71	63	53	49	41	40	36
15	35	35	47	35	58	43	65	47	69	62	90	74	94	78	87	74	81	70	52	60	49	41	39	35
16	37	34	47	36	56	42	62	52	66	61	93	74	88	77	93	74	71	57	62	52	48	40	35	35
17	38	36	48	36	58	44	60	49	65	59	92	74	86	74	94	75	67	54	60	47	44	39	35	34
18	35	35	45	39	59	45	63	49	65	55	82	64	91	74	90	75	73	53	56	46	44	43	34	32
19	35	35	49	41	59	45	54	45	64	53	80	60	88	72	87	70	71	56	54	48	49	43	32	31
20	35	34	47	42	59	44	56	44	66	51	83	62	87	71	84	69	72	57	55	44	50	45	32	31
21	34	34	46	41	60	46	57	43	67	51	78	67	89	71	85	70	75	56	55	42	48	43	32	32
22	36	35	43	37	60	47	59	43	61	55	74	64	91	74	86	70	74	58	54	42	49	43	32	32
23	35	35	44	37	52	44	53	48	67	51	84	63	93	75	87	70	72	54	50	45	47	40	32	32
24	34	34	41	36	51	43	55	51	63	50	82	65	94	77	97	69	71	53	53	45	47	40	32	31
25	34	34	38	35	48	39	57	46	72	54	75	64	95	78	96	70	68	55	58	46	44	40	33	33
26	33	33	42	35	57	39	64	46	79	57	75	65	96	79	97	73	71	56	52	43	48	39	33	32
27	34	34	35	34	54	41	69	51	77	61	80	64	98	80	88	73	70	55	51	41	45	38	33	33
28	34	33	33	33	47	44	63	48	81	62	78	63	97	79	80	70	73	57	55	41	41	37	33	33
29	33	33	39	33	42	38	69	47	80	61	82	64	94	80	85	69	74	57	49	40	45	38	38	33
30	33	33			48	38	64	52	79	60	87	66	89	75	88	71	77	59	50	46	41	37	40	38
31	33	26			52	38			80	60			92	74	88	72			49	44			43	40
1996 mean	35	34	38	33	52	41	62	47	71	56	85	67	92	75	89	72	77	62	63	52	48	40	36	34
10 yr mean	32	31	38	34	51	41	63	50	73	59	82	67	89	75	87	74	77	65	63	52	44	39	34	32
54 yr mean	33	32	38	34	51	41	62	48	74	58	82	67	90	75	88	74	77	64	61	51	44	39	34	33

Table 7. Pan-evaporation totals at the Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1996.

Day	April	May	Jun	Jul	Aug	Sep	Oct	Total
	------ inches ------							
1	0.26	0.28	0.27	0.32	0.38	0.45	0.19	
2	0.09	0.29	0.26	0.32	0.38	0.33	0.30	
3	0.17	0.23	0.30	0.38	0.39	0.24	0.16	
4	0.14	0.22	0.31	0.41	0.36	0.28	0.17	
5	0.18	0.20	0.45	0.51	0.30	0.28	0.15	
6	0.16	0.26	0.33	0.23	0.53	0.16	0.19	
7	0.15	0.22	0.34	0.27	0.28	0.19	0.18	
8	0.19	0.40	0.36	0.40	0.31	0.18	0.19	
9	0.23	0.18	0.46	0.31	0.32	0.25	0.16	
10	0.27	0.39	0.39	0.55	0.37	0.26	0.17	
11	0.14	0.26	0.37	0.43	0.33	0.25	0.16	
12	0.24	0.33	0.47	0.39	0.50	0.32	0.14	
13	0.22	0.27	0.31	0.45	0.27	0.31	0.18	
14	0.18	0.16	0.47	0.43	0.43	0.31	0.07	
15	0.15	0.20	0.50	0.65	0.22	0.23	0.10	
16	0.27	0.13	0.53	0.24	0.31	0.11	0.15	
17	0.22	0.07	0.36	0.25	0.48	0.15	0.15	
18	0.24	0.28	0.30	0.45	0.50	0.18	0.34	
19	0.12	0.23	0.27	0.33	0.28	0.12	0.00	
20	0.18	0.18	0.29	0.39	0.32	0.12	0.00	
21	0.17	0.18	0.23	0.36	0.42	0.26	0.00	
22	0.13	0.09	0.13	0.37	0.28	0.24	0.31	
23	0.08	0.28	0.27	0.41	0.27	0.21	0.03	
24	0.11	0.30	0.30	0.43	0.33	0.17	0.08	
25	0.17	0.44	0.14	0.41	0.26	0.18	0.02	
26	0.17	0.33	0.16	0.44	0.29	0.31	0.23	
27	0.28	0.46	0.17	0.41	0.39	0.28	0.15	
28	0.34	0.42	0.28	0.44	0.28	0.26	0.07	
29	0.18	0.36	0.29	0.10	0.23	0.20	0.03	
30	0.16	0.23	0.30	0.24	0.25	0.20	0.03	
31		0.32		0.28	0.41		0.02	
1996 total	5.59	8.19	9.61	11.60	10.67	7.03	4.08	56.77
10 yr mean	6.21	9.02	9.82	11.88	10.55	7.45	4.28	59.21
48 yr mean	5.54	7.6	8.8	11.1	9.5	6.19	3.09	51.82

Table 8. Daily wind-run totals at the Malheur Experiment Station, Oregon State University, Ontario, Oregon.

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	miles											
1	114	55	37	124	69	40	27	40	130	41	120	39
2	26	76	34	83	81	35	28	39	65	54	27	134
3	29	60	28	94	116	32	36	90	45	26	35	147
4	34	68	36	81	109	56	42	92	56	19	28	55
5	26	60	90	57	48	106	121	54	126	40	64	64
6	17	44	140	33	87	48	105	161	31	44	63	31
7	26	56	39	42	52	45	35	42	28	30	38	47
8	43	28	37	37	135	47	34	31	26	32	23	149
9	23	32	29	47	91	69	26	33	27	25	25	60
10	34	81	60	94	79	111	84	24	29	19	22	55
11	32	38	75	104	48	81	66	30	31	40	25	90
12	26	36	88	90	81	110	46	76	49	32	23	169
13	38	24	97	97	50	36	52	32	55	47	25	80
14	39	27	184	61	60	91	44	54	84	51	69	77
15	23	21	46	37	85	86	32	27	56	42	60	37
16	65	31	186	114	59	124	35	41	75	104	30	48
17	99	23	135	84	57	74	37	86	109	89	192	96
18	46	40	84	108	115	97	89	125	71	222	202	25
19	261	90	69	99	66	64	50	63	32	124	131	23
20	102	130	88	74	72	42	61	49	34	115	138	34
21	153	145	68	79	27	67	52	108	73	62	40	30
22	66	171	50	42	80	42	49	38	101	31	34	30
23	76	138	161	118	118	42	42	25	74	51	51	20
24	171	158	176	190	189	70	37	27	41	87	28	24
25	63	72	204	92	135	40	37	43	61	65	47	107
26	25	87	55	68	127	47	34	29	104	181	51	51
27	120	154	82	98	182	53	32	87	106	144	21	26
28	171	57	102	138	158	84	44	98	23	28	52	97
29	87	46	192	36	109	52	65	30	32	37	80	98
30	82		72	52	45	37	46	22	25	34	60	153
31	77		41		59		50	99		72		152
1996 mean	2,194	2,048	2,785	2,473	2,789	1,928	1,538	1,795	1,799	1,988	1,804	2,248
10 yr mean				2,168	2,367	1,926	1,861	1,617	1,504	1,480		
48 yr mean				2,092	1,889	1,515	1,440	1,283	1,216	1,223		

Table 9. Last and first frost dates and number of frost free days at the Malheur Experiment Station, Oregon State University, Ontario, Oregon.

Year	Date of last frost	Date of first frost	Total number of frost free days
	Spring	Fall	
1976	Apr 23	Oct 5	165
1977	Apr 20	Sep 22	155
1978	Apr 23	Oct 14	174
1979	Mar 20	Oct 27	221
1980	Apr 13	Oct 17	187
1981	Apr 14	Oct 1	170
1982	May 5	Oct 5	153
1983	Apr 27	Sep 20	146
1984	May 7	Sep 25	141
1985	May 13	Sep 30	140
1986	May 23	Oct 12	142
1987	Apr 21	Oct 11	173
1988	May 2	Oct 30	181
1989	May 19	Sep 13	117
1990	May 8	Oct 7	152
1991	Apr 30	Oct 4	157
1992	Apr 24	Sep 14	143
1993	Apr 20	Oct 11	174
1994	Apr 15	Oct 6	174
1995	Apr 16	Sep 22	159
1996	May 6	Sep 23	139
Mean	April 26	October 4	161

Table 10. Record weather events at the Malheur Experiment Station, Oregon State University, Ontario, Oregon.

Event	Measurement	Date
Greatest annual precipitation	16.87 inches	1983
Greatest 24-hour precipitation	1.52 inches	Sep 14, 1959
Greatest annual snowfall	40 inches	1955
Greatest 24-hour snowfall	10 inches	Nov 30, 1975
Earliest snowfall	1 inch	Oct 25, 1970
Highest air temperature	108 °F	Aug 4, 1961
Total days with max. air temp. >= 100 °F	17 days	1971
Lowest air temperature	-26 °F	Jan 21 and 22, 1962
Total days with min. air Temp. <= 0°F	35 days	1985
Lowest 4-inch soil temp.	12 °F	Dec 24-26, 1990

1996 RESULTS OF THE 1992 TO 1997 ALFALFA VARIETY TRIAL

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Purpose

The purpose of this irrigated hay production trial is to compare the forage productivity of 35 alfalfa varieties through five years based on four harvests per year.

Procedure

The alfalfa varieties plots were seeded September 16, 1992, and sprinkler irrigated for seed germination and stand establishment. Details of the fertilizer and pesticide applications in establishment and in production years 1993, 94, and 95 are published in the MES Annual Report for each of those years. Irrigation was applied by sprinkler.

Yield samples were taken at each cutting by harvesting a 3 foot wide by 22 foot long swath from the center of each plot with a flail forage harvester. At each cutting date, moisture content was determined by drying samples from eight randomly selected plots. Fresh weight of forage was converted to 88 percent dry matter (DM) for all varieties. Hay cutting dates were May 27, July 1, July 31, and September 10, 1996.

Forage quality of each variety was analyzed by Near Infrared Reflectance Spectroscopy (NIRS) to estimate percentage crude protein (CP) and acid detergent fiber (ADF). Samples of 20 mature stems were taken from each variety at the second and third cuttings in 1995, oven dried, ground to powder and submitted for NIRS analysis.

Variety performance was compared using ANOVA and protected least significant differences at the 5 percent level, LSD (0.05).

Results and Discussion

The average hay production at 88 percent dry matter in the trial was 9.1 ton/acre (Table 1). Averages for the first through fourth cuttings were 2.4, 2.9, 1.9, and 1.9 ton/acre, respectively. The varieties are ranked by total production, from highest to lowest, with the 13 highest yielding varieties producing 9.2 ton/acre or more.

The average hay production at 88 percent DM of all varieties in the trial over four years was 40.3 ton/acre (Table 2). Average values of acid detergent fiber (ADF) from second and third cuttings ranged from 30.8 percent for Wrangler to 34.7 percent for Lahontan.

Average crude protein (CP) ranged from 19.0 percent for CUF-101 to 21.8 percent for WL 320 and Wrangler.

The information on variety resistance to diseases and pests in Table 3 was provided by participating seed companies and/or the Certified Alfalfa Seed Council. Most of the varieties have some degree of resistance to diseases and pests that could limit hay production in our area. Growers should choose varieties that have stronger resistance ratings to known disease or pest problems as well as demonstrated yield potential.

Table 1. Fourth year forage yield of 35 alfalfa varieties at Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1996.

	Yield* by cutting and date				
Variety or blend	1st 5/27	2nd 7/1	3rd 7/31	4th 9/10	Total 1996
	ton/acre				
Achieva	2.7	3.2	1.9	2.2	9.9
AP 8950	2.5	3.0	2.0	2.3	9.7
Excalibur II	2.6	3.0	1.9	2.1	9.6
Archer	2.4	3.0	2.0	2.3	9.6
Garst 630	2.6	2.7	2.0	2.1	9.5
Lobo	2.5	2.9	1.9	2.2	9.5
ABI 9151	2.4	2.7	2.0	2.2	9.4
DK133	2.5	3.0	1.9	1.9	9.4
Sutter	2.4	2.7	2.1	2.1	9.3
WL 323	2.5	3.1	1.8	1.8	9.3
PGI 2152	2.5	2.8	1.9	2.0	9.2
Crystal	2.5	3.0	1.8	1.8	9.2
Vernema	2.4	2.9	2.0	1.9	9.2
WL 317	2.7	2.8	1.8	1.8	9.1
Blazer-XL	2.6	3.0	1.8	1.7	9.1
Asset	2.5	2.7	1.9	2.0	9.1
Washoe	2.4	2.8	1.9	1.9	9.1
5683	2.4	3.0	1.9	1.8	9.1
5472	2.5	3.0	1.7	1.8	9.1
Hyland	2.4	2.9	1.9	1.9	9.0
1-T-11	2.5	2.6	1.9	2.0	9.0
3 J 15	2.2	2.9	1.9	2.0	9.0
1-A	2.4	2.8	1.8	1.9	9.0
ABI 9160	2.3	2.8	1.8	2.2	9.0
WL 320	2.4	2.7	1.9	1.9	8.9
PSS 393	2.2	3.0	1.8	1.8	8.8
Perry	2.5	3.0	1.8	1.6	8.8
WL 322 HQ	2.4	2.8	1.7	1.9	8.8
Ovation	2.4	2.9	1.7	1.8	8.8
Wrangler	2.4	3.0	1.6	1.8	8.8
Lahontan	2.2	2.7	1.9	2.0	8.8
Future	2.3	2.8	1.8	1.7	8.7
5364	2.5	2.8	1.7	1.7	8.7
Maxi-Leaf	2.4	3.0	1.7	1.4	8.5
CUF-101	1.3	2.1	2.0	1.7	7.0
Mean	2.4	2.9	1.9	1.9	9.1
LSD (0.05)	0.4	0.4	0.4	0.4	0.8

*Yield at 88 percent dry matter.

Table 2. Yield by year and average acid detergent fiber (ADF) and percent crude protein (CP) in 35 alfalfa varieties at Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1996.

Variety or blend	1993	1994	1995	1996	Total yield four years	ADF	CP
	---------------- ton/acre				---------------	----- %	-----
Lobo	13.5	10.9	9.0	9.5	42.9	32.9	20.1
Achieva	12.7	11.1	8.9	9.9	42.5	33.1	20.6
Archer	12.9	10.9	8.9	9.6	42.4	33.5	20.2
AP 8950	12.7	10.8	9.0	9.7	42.2	32.3	20.7
DK133	13.2	10.8	8.4	9.4	41.8	32.0	21.4
PGI 2152	13.1	10.6	8.8	9.2	41.6	32.6	20.2
Excalibur II	12.6	10.6	8.7	9.6	41.5	32.2	21.0
Garst 630	12.7	10.5	8.7	9.5	41.4	32.5	20.7
ABI 9151	12.4	10.4	9.0	9.4	41.2	32.8	19.8
cv5683	12.7	10.8	8.6	9.1	41.1	32.5	20.2
Blazer-XL	12.9	10.6	8.3	9.1	41.0	34.4	19.3
Sutter	12.4	10.6	8.6	9.3	40.9	33.4	19.3
WL 323	12.2	10.7	8.7	9.3	40.9	32.2	20.9
1-A	12.7	10.6	8.5	9.0	40.8	33.5	19.8
Asset	12.5	10.2	8.8	9.1	40.7	32.9	20.3
cv5472	12.2	10.7	8.5	9.1	40.6	33.3	19.9
ABI 9160	12.3	10.7	8.4	9.0	40.4	32.5	20.5
WL 320	12.2	10.4	8.9	8.9	40.4	31.2	21.8
Hyland	12.3	10.5	8.6	9.0	40.3	34.3	19.4
Crystal	12.5	10.3	8.3	9.2	40.3	32.6	20.4
3 J 15	12.1	10.3	8.7	9.0	40.1	31.6	21.2
Lahontan	12.5	10.1	8.4	8.8	39.9	34.7	19.4
WL 317	12.3	10.3	8.1	9.1	39.8	31.6	21.0
Wrangler	12.4	10.1	8.5	8.8	39.8	30.8	21.8
1-T-11	12.2	10.2	8.2	9.0	39.5	32.2	20.8
Ovation	11.9	10.4	8.5	8.8	39.5	32.1	21.0
Washoe	11.8	10.0	8.4	9.1	39.4	34.0	19.5
Vernema	11.7	9.9	8.6	9.2	39.4	32.7	20.1
WL 322 HQ	11.9	10.4	8.3	8.8	39.3	30.9	21.9
Future	11.8	10.3	8.2	8.7	39.1	32.3	20.8
Perry	11.7	9.6	8.5	8.8	38.6	31.0	21.3
Maxi-Leaf	12.2	9.8	7.9	8.5	38.4	31.7	20.9
cv5364	11.8	9.8	8.0	8.7	38.2	32.8	20.2
PSS 393	11.6	8.5	8.4	8.8	37.3	33.5	19.6
CUF-101	12.0	9.4	8.1	7.0	36.6	33.9	19.0
Mean	12.4	10.3	8.5	9.1	40.3	32.6	20.4
LSD (0.05)	1.2	0.7	0.7	0.8			

Table 3. Disease and insect resistance levels for the 35 alfalfa varieties included in the 1992-1997 alfalfa forage evaluation trial at Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1996. The information on varieties in this table was provided by participating seed companies and/or the Certified Alfalfa Seed Council.

Variety or blend	Source	Release year	FD	BW	VW	FW	AN	PRR	SAA	PA	SN	AP	RKN
1-A	Candy Co.	92	3	-	-	-	-	-	-	-	-	-	-
1-T-11	Candy Co.	92	5	-	-	-	-	-	-	-	-	-	-
3 J 15	Union Seed	NR	3	HR	R	HR	HR	HR	HR	R	R	-	-
cv5364	Pioneer Hi-Bred	89	4	R	MR	R	MR	MR	HR	HR	R	-	-
cv5472	Pioneer Hi-Bred	89	4	HR	MR	HR	MR	MR	R	HR	R	-	-
cv5683	Pioneer Hi-Bred	88	7	MR	S	R	S	R	HR	R	R	-	-
ABI 9160	ABI	NR	5	MR	MR	MR	-	R	R	R	R	-	R
ABI 9151	ABI	NR	5	MR	MR	HR	MR	R	-	-	MR	-	-
Achieva	Allied Seed	-	3	R	R	HR	HR	HR	R	R	MR	R	-
AP 8950	ABI	NR	4	MR	MR	HR	MR	R	HR	HR	R	-	R
Archer	America's Alfalfa	88	5	MR	LR	HR	MR	R	-	-	MR	-	-
Asset	Allied Seed	90	4	HR	R	R	R	HR	R	R	-	MR	-
Blazer-XL	Union Seed	91	3	R	R	HR	HR	HR	HR	R	R	R	-
Crystal	PGI/MBS	90	4	HR	R	HR	R	HR	LR	R	MR	MR	-
CUF-101	USDA/UC	76	9	-	-	HR	-	MR	HR	HR	LR	-	MR
DK133	DeKalb	91	4	HR	R	HR	HR	HR	R	R	MR	R	-
Excalibur II	Allied Seed	93	4	HR	R	HR	HR	HR	HR	R	R	R	-
Future	Ray Brothers	87	3	HR	MR	MR	LR	R	MR	-	MR	-	-
Garst 630	ICI Americas	85	4	HR	MR	R	MR	R	MR	R	R	-	-
Hyland	Oasis Seed	93	3	HR	R	HR	R	HR	R	HR	R	MR	-
Lahontan	USDA/U NV	54	6	MR	S	LR	-	LR	MR	LR	R	-	S
Lobo	SeedTec	91	6	MR	MR	HR	HR	R	HR	R	R	-	R
Maxi-Leaf	Ray Brothers	93	4	R	LR	MR	R	R	-	-	-	-	-
Ovation	W-L Research	NR	4	HR	HR	HR	HR	HR	MR	R	MR	R	-
Perry	USDA/U NB	79	3	R	S	R	LR	MR	MR	R	-	-	-
PGI 2152	PGI/MBS	92	5	HR	R	HR	R	R	HR	R	MR	-	-
PSS 393	Price & Sons	NR	6	-	-	-	-	-	-	-	-	-	-
Sutter	PGI/MBS	87	7	R	LR	HR	LR	HR	HR	R	R	-	-
Vernema	USDA/WSU	81	4	MR	MR	-	LR	LR	MR	-	HR	-	-
Washoe	USDA/U NV	65	5	R	-	-	LR	R	R	R	R	-	-
WL 322 HQ	W-L Research	91	4	HR	R	HR	MR	R	HR	HR	LR	-	LR
WL 320	W-L Research	85	4	R	MR	HR	MR	R	R	R	MR	-	-
WL 323	W-L Research	93	4	HR	R	HR	HR	HR	MR	R	R	R	-
WL 317	W-L Research	88	3	HR	R	HR	R	HR	HR	HR	R	-	MR
Wrangler	USDA/U NB	83	2	R	LR	R	LR	HR	HR	HR	-	-	-

FD=Fall Dormancy, BW=Bacterial Wilt, FW=Fusarium wilt, VW=Verticillium wilt, PRR=Phytophthora Root Rot, AN=Anthracnose, SAA=Spotted Alfalfa Aphid, PA=Pea Aphid, SN=Stem Nematode, AP=Aphanomyces, RKN=Root Knot Nematode (Northern).

Fall Dormancy: 1=Norseman, 2=Vernal, 3=Ranger, 4=Saranac, 5=DuPuits, 6=Lahontan, 7=Mesilla, 8=Moapa 69, 9=CUF 101.

Pest Resistance Rating: >50%=HR (high resistance), 31-50%=R (resistant), 15-30%=MR (moderate resistance), 6-14%=LR (low resistance), 0-6%=S (susceptable).

ALFALFA FORAGE VARIETY TRIAL, 1996-2000

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Purpose

The purpose of this alfalfa variety trial is to compare the yield potential of 32 alfalfa varieties in a five year life of stand harvested four times per year.

Procedures

The variety trial was established in August of 1995, following a wheat crop. Pre-plant fertilizer was 550 lb/acre of 0-46-0 plus 200 lb/acre of sulfur broadcast and disked in. Plots were seven rows of alfalfa planted 6 inches apart on beds 60 inches wide by 20 feet long. Thirty-two varieties of alfalfa were entered into the trial, each replicated four times in a randomized complete block experimental design. Alfalfa was seeded August 23, and 1 inch of sprinkler irrigation water was applied after planting.

On September 10, Poast at 2 pints/acre and 2,4-DB at 2 quarts/acre were applied. On November 11, a tank-mix of Kerb at 2 lb ai/acre plus Sencor at 2 lb ai/acre plus Diuron at 2 lb ai/acre was applied to the border area around the plots. On March 22, Kerb 50W at 1.5 lb ai/acre was applied, and incorporated by rainfall that day.

One 8-hour sprinkler irrigation of 2.4 inches of water was applied May 7, and the first cutting was taken May 28. Plots were sampled by cutting a 30-inch swath from the center of each plot using a flail mower. The fresh hay was weighed, and the moisture content was determined by drying samples from eight randomly selected plots in a forage dryer. The next irrigation was 2.5 inches of water applied June 3 and 4. Another 2.5 inch irrigation application was applied June 18 and 19, and the second cutting was taken July 2. The third cutting was taken July 31, and the fourth cutting was taken September 11, with irrigation applied as needed during the summer.

Variety differences in yield and protein were compared using ANOVA and protected lease significant differences at the 5 and 10 percent levels.

Results and Discussion

The average total yield of all the alfalfa varieties in the trial for the first year for four cuttings was 8.81 ton/acre, based on 12 percent moisture content (Table 1). Significant differences in yield were found in the third cutting at the 10 percent probability level, and in the fourth cutting at the 5 percent probability level. The low overall first year yield and lack of detectable differences in total yield among the alfalfa varieties at the beginning of the season may be attributable to non-uniform application of the sprinkler irrigation water. In future years the irrigation system will include an additional sprinkler line in the plots to improve irrigation water application uniformity.

The information on varieties' resistance to pests in Table 2 was provided by participating seed companies and/or the Certified Alfalfa Seed Council. Most of the varieties have some degree of resistance to diseases and pests that could limit hay production in our area. Growers should choose varieties that have stronger resistance ratings for known disease or pest problems in their fields as well as demonstrated potential for high yield.

Table 1. Alfalfa variety trial first year forage yields and first cutting forage protein and ADF reported at 88 percent dry matter. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1996.

Variety or blend	1st 5/28	2nd 7/2	3rd 7/31	4th 9/11	1996 Total	Protein	ADF
	ton/ac					%	%
Sterling	3.44	2.72	1.64	1.84	9.64	20	26
W-L 252HQ	3.22	2.77	1.49	1.99	9.48	20.4	25.9
Wrangler	3.30	2.58	1.54	1.91	9.33	19.5	28.4
Tahoe	2.83	2.76	1.73	1.98	9.30	19.3	27.1
330	3.51	2.26	1.63	1.91	9.30	19.9	26.5
UN 13	2.92	2.55	1.65	2.09	9.21	19.9	25.2
CUF-101	2.92	2.52	1.73	1.95	9.11	19.9	25.8
Magnum III	3.24	2.35	1.53	1.90	9.02	19.2	27.9
Sevelra	3.02	2.51	1.56	1.93	9.02	18.2	28.9
Excalibur II	3.01	2.33	1.61	1.97	8.91	19.8	27.4
MP 2000	2.80	2.51	1.54	2.05	8.90	19.8	25.1
Innovator +Z	3.16	2.42	1.42	1.87	8.87	19	29
ABI 9252	2.70	2.54	1.62	2.00	8.86	19.8	26.1
Nitro	2.82	2.49	1.56	1.92	8.79	19.2	28.2
Idaho Gold	2.99	2.32	1.58	1.90	8.78	19.9	27
Rushmore	2.91	2.37	1.49	2.02	8.78	19.7	26.8
Gangbusters	2.78	2.42	1.55	2.01	8.76	19.2	26.5
Columbia 2000	2.97	2.29	1.59	1.91	8.75	18.7	28.6
ZX9352	2.70	2.53	1.55	1.95	8.73	19.1	27.4
Robust	3.08	2.14	1.60	1.85	8.67	19.3	26.1
Alfagraze	2.72	2.55	1.51	1.88	8.66	19.4	26
92-31F	2.80	2.39	1.59	1.89	8.66	18.8	28.1
Wild Card	2.61	2.46	1.67	1.90	8.64	18.8	27.2
Vernal	2.75	2.49	1.49	1.88	8.62	18.6	28.9
Goliath	2.89	2.11	1.59	1.97	8.57	20.1	26.2
Laser 152	2.83	2.20	1.64	1.89	8.55	19.3	27.5
Ladak	2.94	2.16	1.50	1.88	8.47	19.6	27.1
ZX9351	2.76	2.30	1.49	1.87	8.42	20.3	24.6
Lahontan	2.69	2.21	1.66	1.84	8.40	19.3	26.5
Orestan	2.67	2.21	1.60	1.79	8.26	19.4	27
Magnum IV	2.62	2.22	1.45	1.92	8.21	18.7	26.1
Stamina	2.72	2.04	1.49	1.95	8.20	20.4	25.3
Mean	2.91	2.4	1.57	1.93	8.81	19.5	26.9
LSD (0.10)	-	-	0.15	-	-	-	2.3
LSD (0.05)	ns	ns	ns	0.12	ns	1.1	ns

Yield at 88% dry matter.

Table 2. Disease and insect resistance levels for the 32 alfalfa varieties included in the 1996-2000 alfalfa forage evaluation trial at Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1996. The information on varieties in this table was provided by participating seed companies and/or the Certified Alfalfa Seed Council.

Variety or Blend	Source	Release Year	FD	BW	FW	VW	PRR	AN	SAA	PA	SN	AP	RKN
ABI 9252	ABI America's Alfalfa	-	6	R	R	R	R	R	HR	R	R	-	R
ZX9351	ABI America's Alfalfa	-		-	-	-	-	-	-	-	-	-	-
ZX9352	ABI America's Alfalfa	-		-	-	-	-	-	-	-	-	-	-
Alfagraze	ABI America's Alfalfa	-		-	-	-	-	-	-	-	-	-	-
Innovator +Z	ABI America's Alfalfa	93	3	HR	HR	R	HR	HR	-	R	R	-	-
Excalibur II	Allied Seed	94	4	HR	HR	R	HR	HR	R	R	-	R	-
Columbia 2000	Allied Seed	96	2	R	R	-	MR	R	-	MR	-	-	-
Stamina	Allied Seed	96		HR	HR	HR	HR	HR	HR	R	HR	MR	HR
Goliath	Black Canyon Seed	93	3	HR	R	R	R	R	MR	R	-	-	-
Idaho Gold	Black Canyon Seed	93	4	R	R	MR	R	-	MR	-	-	-	-
Sterling	Cargill Hybrids	93	2	HR	HR	R	HR	HR	-	R	-	R	-
MP 2000	Cenex/Land O'Lakes	94	3	HR	HR	R	HR	HR	R	HR		R	-
Robust	Gooding Seed	93	5	R	HR	R	HR	R	R	R	R	-	MR
Laser 152	J-V Seeds	94	4	HR	HR	R	HR	R	MR	-	MR	MR	MR
Rushmore	Northrup King	93	4	HR	HR	R	HR	HR	HR	R	-	HR	-
Magnum III	Dairyland Seed	88	4	R	R	MR	R	MR	MR	R	MR	LR	-
Magnum IV	Dairyland Seed	92	4	HR	HR	R	HR	R	MR	-	R	MR	MR
CUF-101	Public	-	9	-	-	-	-	-	HR	HR	-	-	-
Lahontan	Public	54	6	MR	LR	-	LR	-	MR	LR	R	-	-
Nitro	Public		8	-	-	-	R	-	MR	-	-	-	-
Wrangler	Public	83	2	R	R	LR	HR	LR	HR	HR	-	-	-
Orestan	Public	-		-	-	-	-	-	-	-	-	-	-
Vernal	Public	-	2	R	MR	-	-	-	-	-	-	-	MR
Ladak	Public	-		-	-	-	-	-	-	-	-	-	-
Sevelra	Public	-		-	-	-	-	-	-	-	-	-	-
Gangbusters	Ray Brothers	94	4	HR	R	R	R	MR		R	R	-	-
330	Union Seed	93	4	HR	HR	R	HR	HR	R	R	-	R	-
UN 13	Union Seed	94	7	MR	HR	MR	HR	HR	HR	R	-	-	-
Wild Card	University of Idaho	-		-	-	-	-	-	-	-	-	-	-
92-31F	W-L Research	-	3	HR	HR	HR	HR	HR	R	R	MR	HR	
W-L 252HQ	W-L Research	94	3	HR	HR	R	HR	HR	MR	-	R	-	-

FD=Fall Dormancy, BW=Bacterial Wilt, FW=Fusarium wilt, VW=Verticillium wilt, PRR=Phytophthora Root Rot, AN=Anthracnose, SAA=Spotted Alfalfa Aphid, PA=Pea Aphid, SN=Stem Nematode, AP=Aphanomyces, RKN=Root Knot Nematode (Northern).

Fall Dormancy: 1=Norseman, 2=Vernal, 3=Ranger, 4=Saranac, 5=DuPuits, 6=Lahontan, 7=Mesilla, 8=Moapa 69, 9=CUF 101.

Pest Resistance Rating: >50%=HR (high resistance), 31-50%=R (resistant), 15-30%=MR (moderate resistance), 6-14%=LR (low resistance).

USING DEGREE DAY ACCUMULATIONS TO PREDICT LYGUS HATCHES IN ALFALFA SEED

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Introduction

Numerous publications have described degree day or physiological time requirements for lygus bug development. However, little work has been done to test degree day models for lygus development in the context of the Northwest alfalfa seed IPM system. The objective of this study was to validate a published degree day model for lygus development in Malheur County seed production fields, and to explore whether this tool has utility as a pest management decision aid for fieldmen and growers. This project was initiated in 1995 and observation carried out for two consecutive seasons. This report provides data from the 1996 study and summarizes results for both seasons.

Methods

Four fields were monitored for lygus population trends, and in particular for peak onset of egg hatch. The fields were located in major seed production districts of the county including Adrian, Sunset Valley, Cairo, and Oregon Slope. Standard 180 degree sweep samples were taken from fields on a weekly or semi-weekly basis. Sweep samples were preserved in glass jars containing ~70 percent ethanol solution and returned to the lab. The samples were analyzed and detailed counts of all adult and nymphal instars of lygus recorded. Sampling began in mid-April and continued through mid-August. At all four sites baseline population levels were observed prior to clean-up (pre-bloom) insecticide treatments. Population trends and especially surges of first and second nymphal emergence were observed during the course of the season. Cooperating growers reported all insecticide applications including active ingredients, rates, treatment dates, and application methods. Physiological time or degree day accumulations were measured using Datalogger Omnidata Biophenometers. Each biophenometer was placed in a small instrument shelter located at the edge of the study field. For each biophenometer the lower threshold of development was set at 52° F. Published lygus developmental requirements for egg hatch and peak emergence of first instar has been reported at 252 degree days. This value was correlated with observed hatches in the field. For the first spring pre-bloom hatch the biofix was set at January 1. For subsequent hatches during the bloom period the biofix was set at the date of the first insecticide (clean-up) treatment. Observations were then carried out to determine if using degree day accumulations accurately predicted observed hatches of lygus bugs.

Results/Conclusions

Based on the data from three fields monitored in 1995 and four fields monitored in 1996 the following observations can be drawn.

1. Using a January 1 biofix, the accumulation of 252 degree days (egg development requirement) consistently predicted the first hatch of lygus bugs. This event occurred about mid-May in both seasons (Figure 1 and 2).

2. A 252 degree day accumulation did not consistently predict the second (bloom period) hatch of lygus when setting the biofix at the first insecticide treatment date.

3. The observed first hatch in 1996 was ~10 days earlier than the first hatch of the 1995 season. This season to season difference was predicted by the recorded degree day accumulations (Figure 3).

4. Subtle differences in observed hatches at the four fields seemed to be related to subtle differences in degree day accumulation at the four sites (Figure 4).

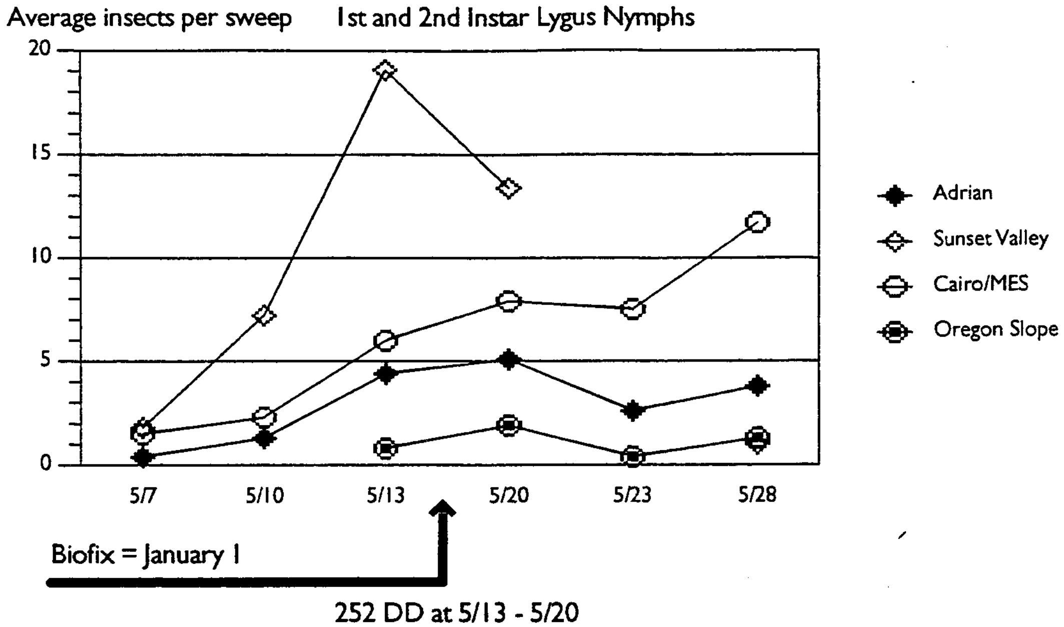
5. The use of biophenometers appeared to be a simple and user friendly method of tracking physiological time for lygus populations.

Based on these preliminary observations, the use of degree day accumulations may have some potential as an IPM management tool for control of lygus populations in alfalfa seed. Monitoring the egg development time (252 degree days) may be helpful to predict the first nymphal hatch and optimize sampling and treatment schedules during the pre-bloom period. It is unclear if alternate management techniques for the first hatch will mitigate subsequent hatches of lygus or reduce insecticide costs during the bloom period. Further research is required to fully explore this IPM technology.

Grower Impacts

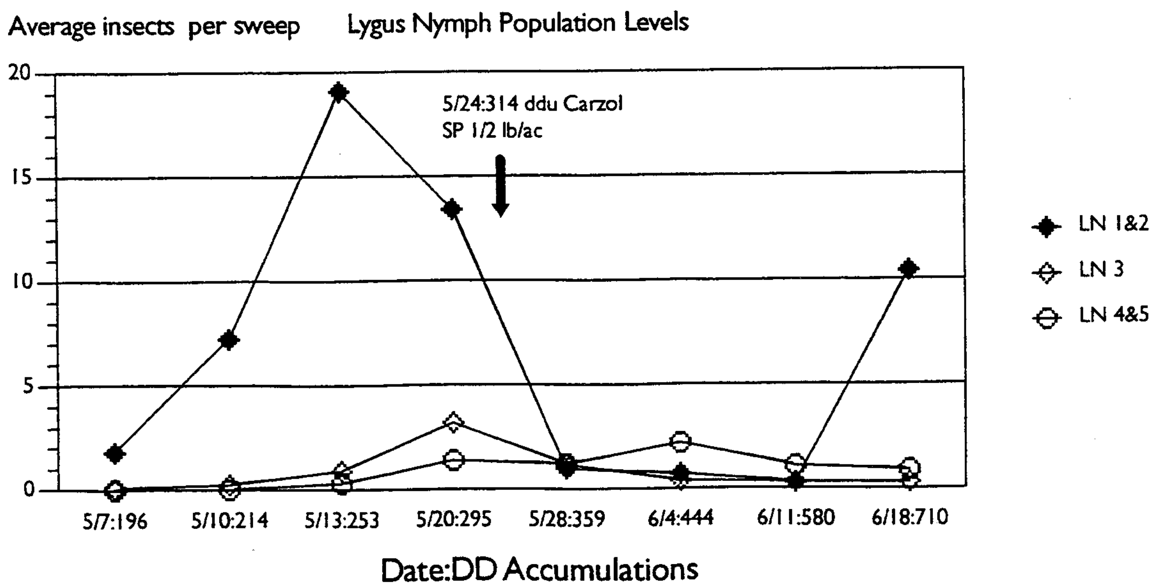
This method needs further study under controlled conditions. Researchers and selected growers/seed company agronomists are encouraged to test this technique at other sites and production regions. At this time the cost effectiveness of using biophenometers is not firmly established and widespread grower adoption is not recommended by the principle investigator.

Figure 1. Comparison of Lygus hatches with accumulated degree days (DD) required for egg development (252 DD) at four locations in Malheur County, Oregon - 1996.*



* Lower Threshold = 52° F: DD accumulations using a biophenometer

Figure 2. Comparison of a prebloom lygus hatch with accumulated degree days (DD) required for egg development (252 DD) in a commercial alfalfa seed field, Sunset Valley, Oregon - 1996.*



* Lower Threshold = 52° F: Biofix = January 1: DD accumulations using a biophenometer

Figure 3. Comparison of Lygus degree day (DD) accumulations in a commercial alfalfa seed field for 1995 and 1996 Cairo, Ontario, Oregon.

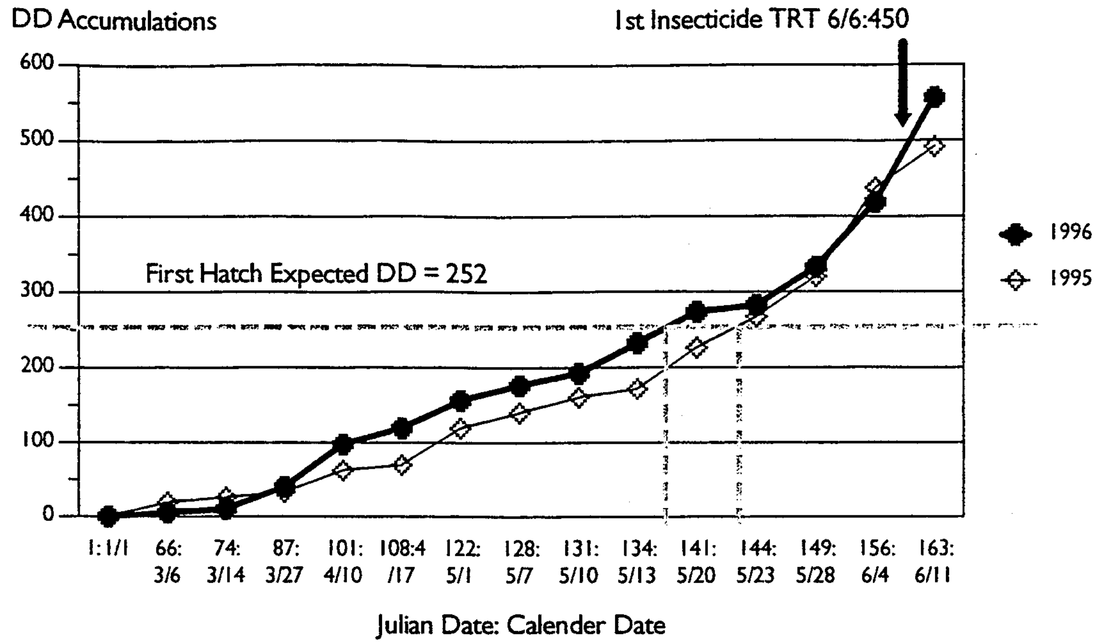
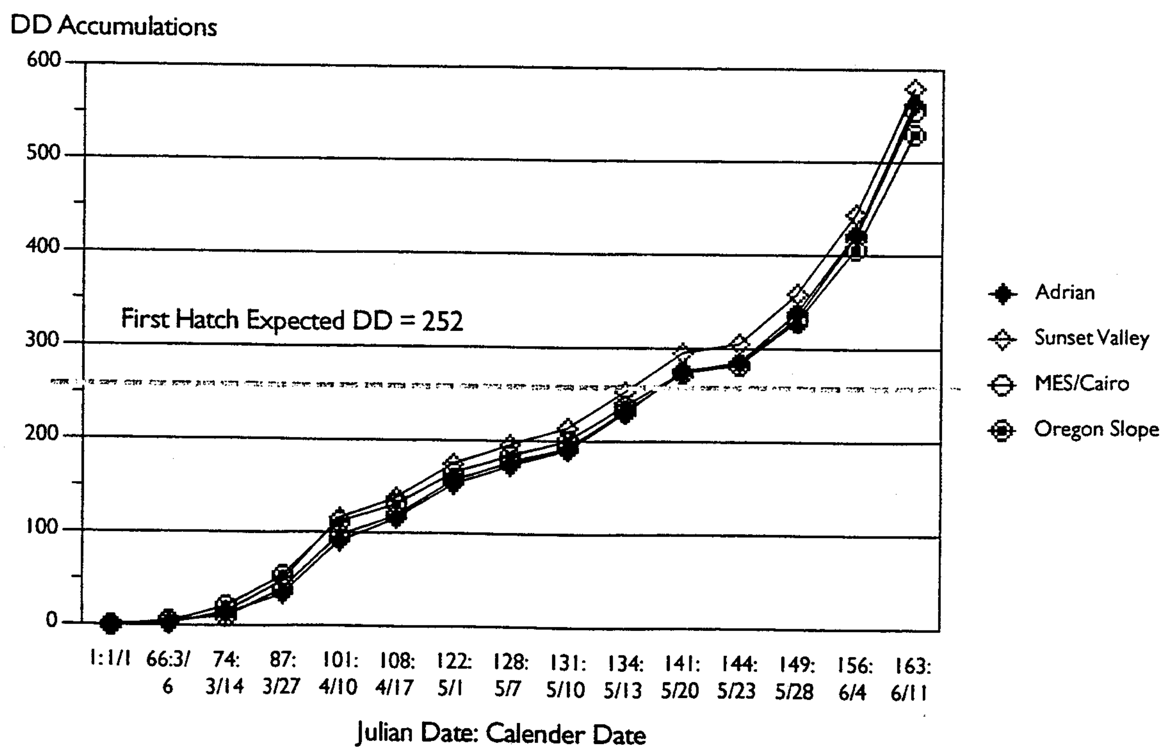


Figure 4. Comparison of lygus degree day (DD) accumulations at four sites in Malheur County, Oregon 1996.



PROWL HERBICIDE IN ALFALFA AND RED CLOVER SEED PRODUCTION

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Purpose

Prowl herbicide is not currently registered for use in alfalfa and red clover seed production. Two rates of Prowl herbicide, as early incorporated, late broadcast, or banded treatments, were evaluated for weed control, crop tolerance, and seed yield in red clover and alfalfa seed production.

Methods

The study was conducted on established red clover at two locations (Allen Bennett Farm, Adrian, OR, NW1/4 sec. 24 T21S R46E, and Wong Brothers Farm, Roswell, ID, SW1/4 sec. 22 T5N R5W), and on alfalfa at one location (Brent Ishida Farm, Adrian, OR, SW1/4 sec. 23 T21S R46E). At all three locations the treatments and incorporation methods were the same. Treatments were Prowl at 2 or 4 lb ai/acre applied early and incorporated, Prowl at 2 or 4 lb ai/acre applied late as a broadcast spray, and Prowl at 2 or 4 lb ai/acre applied late and banded between the rows of crop plants. The early treatments were applied to the red clover April 4 and 5, 1996, when the crop was 4 to 5 inches tall, and to the alfalfa April 6, when the crop was 5 to 6 inches tall. Early herbicide treatments were incorporated 2 inches deep with one pass with a Triple K immediately after application. Late broadcast and late banded treatments were applied May 8 and 14 on red clover when the clover was 10 to 12 inches tall, and May 8 on alfalfa when the alfalfa was 8 to 12 inches tall.

Treatments were evaluated for crop height, phytotoxicity, flowering, and weed control on May 24, June 12, and July 1 for alfalfa, and May 24 and 29, June 12, and July 2 for red clover. The handweeded check plots in each study had not been weeded when the weed counts were done. The alfalfa seed was harvested September 5, and one of the red clover locations (Bennett) was harvested for seed yield September 31.

Results

Prowl herbicide is not currently registered for use in alfalfa and red clover seed production. Results of the Prowl applications on red clover grown for seed are given in Table 1. Data from both locations are combined in Table 1, but each column gives the result observed for that variable at a single location. The only plant characteristics influenced by any Prowl treatment was clover height on June 12 at one location. The evaluation for that date indicated slightly shorter clover in the early incorporated Prowl at 2 lb and the late broadcast Prowl at 4 lb. The late broadcast treatments also caused clover leaf yellowing in May. There were no significant differences in crop height after June first.

The results of the Prowl applications on alfalfa for seed are presented in Table 2. Small differences in alfalfa height on the 5/24 evaluation date with the late broadcast and banded Prowl application had disappeared by the next evaluation date, 6/12. Differences in alfalfa height on 7/1 do not appear to be related to Prowl application because there is also a difference between the untreated and handweeded check treatments. Annual sowthistle control was better with the late broadcast and banded Prowl treatments. Marsh elder and prickly lettuce populations were too sporadic to detect control differences in this trial. Seed yield was not significantly different with any treatment, indicating good crop tolerance of the herbicide Prowl.

Table 1. Prowl herbicide effects in clover grown for seed near Roswell, ID, and Adrian OR, 1996. Oregon State University Malheur Experiment Station, Ontario, OR 1996.

			Roswell				Adrian							
Treatment	Rate	Application timing and method	Clover height 5/24	Flowers 5/24	Prickly lettuce 5/24	Clover height 6/12	Clover height 5/29	Flower s 5/29	Prickly lettuce 5/29	Clover height 6/12	Clover height 7/2	Prickly lettuce 7/2	Mustard 7/2	Clover seed yield 9/31
	lb ai/acre		inch	per 20 ft		inch	inch	per 20 ft		inch		per 20 ft		lb/acre
Handweeded	-		12.8	9.3	4.5	26.8	14.3	29.5	2.3	23.3	24.8	7.5	7.5	699
Prowl	2	Early incorporated	12.5	6.3	5.3	24.8	13.9	23.8	0.3	21.8	26	2.3	2.3	770
Prowl	4	Early incorporated	12.7	6.3	5	27	13.2	195.5	0.5	21	26.2	1.5	1.5	740
Prowl	2	Late broadcast	13.3	6.5	6.3	25.8	13.5	30.8	2.3	21.5	25.8	3.3	3.3	719
Prowl	4	Late broadcast	12.2	5.8	5	25	12.9	29	0.3	21	24.5	0.8	0.8	718
Prowl	4	Late banded	12.6	8.3	5.3	26.3	14.1	24.5	1.3	23.5	23.9	2.5	2.5	719
Untreated	-		12.7	11.5	14	27.3	14.7	26.8	2.5	23.3	23.8	4.5	4.5	690

Table 2. Prowl herbicide effects in alfalfa grown for seed near Adrian, Oregon, 1996. Oregon State University Malheur Experiment Station, Ontario, OR, 1996.

Treatment	Rate	Application timing and method	Alfalfa height 5/24	Alfalfa height 6/12	Alfalfa height 7/1	Annual sowthistle 5/24	Annual sowthistle 7/1	Marsh elder 7/1	Prickly lettuce 7/1	Alfalfa seed yield
	lb ai/acre		------inch------			------plants per 20 ft of row------				lb/acre
Handweeded	-		13.2	25.6	26	52	43	8.8	1	480
Prowl	2	Early incorporated	14.4	28.5	25.8	35	21	2.5	3.5	575
Prowl	4	Early incorporated	13.8	26.3	26.7	17	23	6.8	2.3	609
Prowl	2	Late broadcast	12.9	25.8	23.5	10	1	7.3	0.3	510
Prowl	4	Late broadcast	11.8	24.8	22.7	12	7	6.3	0.5	546
Prowl	4	Late banded	14.5	26	24.5	16	8	5.3	0.3	689
Untreated Check	-		13.2	27	23.1	27	43	5.8	0.8	555
LSD (0.05)			1.3	ns	3.1	27	17	ns	ns	ns

ASPARAGUS VARIETY PERFORMANCE

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Introduction

Acreage of asparagus for canning has been expanding in the western Treasure Valley since 1994. This trial compared the performance of varieties in the Treasure Valley of eastern Oregon.

Procedures

Asparagus crowns of five varieties (Table 1) were planted at the Malheur Experiment Station on an Owyhee silt loam soil on April 7, 1994. The crowns were dipped in a liquid mixture of Benlate at 1 percent (v/v) and Captan at 1/2 percent (v/v) and planted 8 inches apart in trenches 12 inches deep and 5 feet apart. Plots were four rows wide and 40 feet long and arranged in a randomized complete block design with six replicates. The field was sprinkler irrigated until the spears emerged (April 18, 1994), thereafter furrow irrigation was used. Furrow irrigations were run as necessary on every furrow (every 5 feet). The field was fertilized with 50 lb N/ac as broadcast urea in May 1994 and with water-run urea at 15 lb N/ac in 1995, and 56 lb N/ac in 1996. The field was hand weeded twice in 1996 to control volunteer asparagus. The first harvest season was in 1996. Spears were picked eight times from April 8 to April 30. The harvest was terminated on April 30 due to declining spear diameter. The minimum spear length for harvest was 6 inches measured from ground level to spear tip. Spears from the central 20 feet of each of the middle 2 rows in each plot were cut using asparagus knives and graded immediately. The spears were graded and weighed by class (US Number One and US Number Two), and by diameter 5 inches from the tip (small: <6/16 inch, medium: 6/16 to 8/16, large: 8/16 to 10/16, mammoth: 10/16-13/16, and colossal: 13/16 to 16/16) according to USDA canning asparagus standards. Spears were graded by class based on straightness and head compactness. Asparagus beetle feeding damage was not taken into account when grading. Data were analyzed by analysis of variance. Means separation was determined by the protected least significant difference test.

Results and Discussion

Spears were harvested for 3 weeks before diminishing spear diameters prompted the termination of harvest. Adults of the asparagus beetle (*Crioceris asparagii*) were observed feeding on the spears during harvest and feeding on the ferns later in the season. Feeding damage observed on the stems and heads would have rendered a substantial proportion of the spears as either US Number Two grade or culls. Overwintering adults start feeding as soon as the spears emerge, so control measures must start early during the harvest with insecticides of short pre-harvest interval. One backpack application of rotenone at 0.4 lb ai/ac immediately after harvest and two aerial applications of Lannate at 0.6 lb ai/ac during the season were used for asparagus beetle control.

Asparagus growth is minimal when air temperature is below 50 °F and increases with increasing temperature above 50 °F. The total yield for a season can be influenced by temperature. The total degree days (50 - 86 °F) for April 1996 of 128 was slightly lower than the average for April from 1990 to 1996 of 133.

Jersey Giant had the highest total yield for grades US Number One and large US Number One, followed by Mary Washington (Table 1). Jersey Giant was among the highest for yield of US Number One mammoth grade yield and for total yield followed by Mary Washington. Asparagus contracted with American Fine Foods is paid as all US Number One if less than 10 percent of the total is US Number Two. The proportion of US Number Two yield was low for all varieties (10 percent or less) and the differences between varieties in US Number Two yield were not statistically significant.

Table 1. Yield and grade of five asparagus varieties harvested from April 8 to April 30, 1996. Asparagus was planted on April 7, 1994. Malheur Experiment Station, Oregon State University, Ontario, Oregon.

Variety	——— US Number One ———						——— US Number Two ———								
	Small	Medium	Large	Mammoth	Colossal	Total	Small	Medium	Large	Mammoth	Colossal	Total	Proportion of total yield	Culls	Total yield
	——— lb/ac ———												%	— lb/ac —	
Jersey Giant	167.7	521.7	307.9	102.9	3.1	1,103.3	10.1	32.7	34.2	5.4	0.0	82.4	6	144.4	1,330.1
Jersey Knight	82.2	227.0	145.4	48.4	2.5	505.5	10.4	22.8	20.0	11.5	2.7	67.4	10.1	51.1	624.0
M. Washington	181.6	345.2	172.3	52.6	2.7	754.4	14.3	33.9	18.6	18.3	0.0	85.1	7.8	220.0	1,059.5
UC 157	115.9	203.1	49.0	7.9	0.0	375.9	10.1	18.0	5.1	0.0	0.0	33.2	6.2	153.7	562.8
Del Monte 361	162.8	351.2	138.8	41.4	2.3	696.5	27.3	43.2	24.9	7.5	0.0	102.9	9.9	224.3	1,023.6
LSD0.05	55.6	121.0	110.3	58.3	ns	275.3	ns	ns	ns	ns	ns	ns	ns	64.3	350.8

SOYBEAN RESEARCH AT ONTARIO IN 1996

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Introduction

Soybean is a potentially valuable new crop for Oregon. Soybean could provide a high quality protein for animal nutrition and oil for human consumption, both of which are in short supply in the Pacific Northwest. In addition, edible or vegetable soybean production could be exported to the Orient and provide a raw material for specialized food products. Soybean would also be a valuable rotation crop because of the soil improving qualities of its residues and N_2-fixing capability.

Because of the high value irrigated crops typically grown in the Snake River valley, soybeans may be economically feasible only at high yields. Hoffman and Fitch in 1972 demonstrated that Evans soybeans adapted to Minnesota could yield 50 to 65 bushels/acre at Ontario. The most productive lines averaged 60-65 bushels/acre for several years. Furthermore, yields were increased by approximately 20 percent for certain cultivars by decreasing row widths to 22 inches. Yields could also be increased by increasing the seeding rate from 200,000 seeds/ac to 300,000 seeds/ac if semidwarf lines were found adapted to local conditions.

Soybean varieties developed for the midwestern and southern states are not necessarily well adapted to Oregon due to lower night temperatures, lower relative humidity, and other climatic differences. Previous research at Ontario has shown that, compared to the commercial cultivars bred for the midwest, plants for Oregon need to have high tolerance to seed shatter and lodging, reduced plant height, increased seed set, and higher harvest index (ratio of seed to the whole plant). There is also a need to identify cultivars that will grow and yield well under high seeding rates and narrow row spacing.

In 1992, 241 single plants were selected from five F_5 lines that were originally bred and selected for adaptation to eastern Oregon. Seed from these selections was planted and evaluated in 1993. A total of 18 selections were found promising and selected for further testing in larger plots in 1994 and 1995. This report summarizes work done in 1996 as part of the continuing breeding and selection program to adapt soybeans to eastern Oregon.

Procedures

The 1996 trials were conducted on a Owyhee silt loam previously planted to wheat. The herbicide Dual at 1 lb ai/ac was broadcast preplant and incorporated with a bed harrow on May 9. Seed was planted on May 24 at 300,000 seeds/acre in rows 22 inches apart. Rhizobium japonicum soil implant inoculant was applied in the seed furrow at planting. Emergence started on May 31. The crop was furrow irrigated as necessary.

Thirteen of the single plant selections from 1992, and eight older cultivars were planted in replicated plots four rows wide by 25 feet long in 1996. The experimental design was a complete randomized block with five replicates. Thirty-four single plant selections made from F_2 lines in 1995 were planted at the same time in single rows 15 feet long. Eight F_2 lines were also planted in single rows on May 31.

Plant height and reproductive stage were measured weekly for each cultivar. Prior to harvest the cultivars were evaluated for lodging and seed shatter. The middle two rows in each four- row plot, and single rows from the single plant selection plots, were harvested on October 28 using a Wintersteiger Nurserymaster small plot combine. The beans were cleaned, weighed, and oven dried for moisture content determination. Dry bean yields were corrected to 13 percent moisture. Single plant selections were selected, cut at ground level, threshed in the small plot combine, and labeled individually. Single plants were selected from the F_2 lines and the seed will be planted and evaluated in 1997. Data were analyzed by analysis of variance. Means separation was determined by the protected least significant difference test.

Results and Discussion

The field had to be irrigated May 29 due to inadequate moisture for emergence. Emergence started on May 31 and was poor for most varieties, resulting in low plant stands (Table 1).

Yields ranged from 14 to 58 bu/ac (Table 1). The older cultivars lodged heavily and took too long to mature or did not reach adequate harvest maturity for efficient combining. Most of the 1992 single plant selections reached physiological maturity in 115 days or less, had no lodging, and had seed sizes large enough for the manufacturing of tofu (< 2,270 seeds/lb).

Higher yields would be achievable with plant stands closer to the planned 300,000 plants/ac and planting date closer to the ideal of May 7. Frost on September 23 complicated the late planting date and reduced yield of late maturing cultivars.

All F_2 lines measured less than 55 cm in height, except HC 35 which was 85 cm tall. No shatter nor lodging was observed for any of the F_2 lines.

Table 1. Performance characteristics of soybean cultivars. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1996.

Cultivar	Days to maturity[z]	Days to harvest maturity[y]	Lodging	Shatter	Height	Stand[w]	Yield	Seed count
	days from emergence		0-10[x]	%	cm	plants/ac	bu/ac	seeds/lb
M92-314	90	98	0	0	74	155,587	57.8	1,962.0
M92-330	90	105	0	0	74	115,786	55.0	2,195.2
M92-213	105	115	0	0	80	155,587	52.3	2,084.1
M92-225	90	98	1	0	76	57,893	51.7	2,195.1
M92-217	105	115	0	0	86	72,366	48.8	1,999.9
M92-220	115	126	2	0	80	130,259	46.3	1,974.0
M92-239	105	115	0	0	85	123,022	44.4	2,226.7
M92-350	90	105	9	0	79	173,678	43.0	2,168.1
M92-237	90	105	0	0	88	47,038	42.1	2,049.4
M92-085	105	115	6	0	70	184,533	41.2	2,030.4
Agassiz	98	126	6	0	76	155,587	38.6	1,984.2
M92-223	115	126	0	0	70	47,038	34.5	1,929.9
Lambert	126	n	7	0	81	249,663	29.4	1,934.4
OR-6	98	105	9	0	97	188,152	25.3	1,984.9
Gnome 85	105	126	8	0	90	126,641	25.3	2,040.4
OR-8	126	n	7	0	78	159,205	22.1	2,055.1
Sibley	126	n	7	0	75	115,786	18.4	1,827.9
Evans	126	n	8	0	70	94,076	14.2	1,971.5
LSD (0.05)							7.5	115.6

[z] Pods yellowing, 50% of leaves yellow. [y] 95% of pods brown, stems dry enough to be combined.

ONION VARIETY TRIAL

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Malheur Experiment Station
Oregon State University
Ontario, Oregon, 1996

Purpose

This trial compared commercial varieties and experimental lines of yellow, white, and red onions for yield and grade. Field observations were made for relative maturity, incidence of plate rot, and bolting.

Procedures

The 1996 trials were conducted on a Owyhee silt loam soil with 1.2 percent organic matter and a pH of 7.3. The field had previously been planted to wheat. Before plowing, 100 lbs/ac of P_2O_5, and 60 lbs N/ac were broadcast. The wheat stubble was shredded and the field deep-chiseled, disked, irrigated, moldboard-plowed, roller-harrowed, and bedded in the fall. After bedding, the field was left until spring without further tillage.

Onion seed for entry in the trial was received from 15 companies: American Takii, Aristogene, Asgrow, Bejo, Champion, Crookham, Ferry Morse, Harris Moran, Petoseed, Rio Colorado, Rispens Seed, Scott Seeds, Shamrock, Sunseeds, and Waldow Seed. Seventy-one onion varieties were planted April 9 in plots four rows wide and 27 feet long. The onions were planted on 22-inch single-row beds. Each variety was planted with five replications. Seed for each row was prepackaged using enough seed for a planting rate of 12 viable seeds per foot of row. Seed was planted using four cone-seeders mounted on John Deere Model 71 Flexi-planter units equipped with disc openers.

The onions were furrow-irrigated during the growing season. The first irrigation was applied on April 13 to supply the soil with moisture for seed germination. On May 8, alleys 3 ft wide were cut between plots, leaving plots 24 ft long. On May 28 through June 1 the seedling onion plants were thinned by hand to a plant population of four plants per foot of row (3-inch spacing between individual onion plants). On June 3, 100 lb N/ac as Urea was sidedressed on each side of every row. On June 15, a second sidedressed application of 100 lb N/ac as Urea was applied.

The trial was managed to avoid yield reductions from pests. Dacthal was applied on May 4, and Lorsban 15G was applied for onion maggot control on May 11. Weeds were controlled with cultivations and low-rate herbicide applications as needed until layby.

On July 5, layby herbicides Buctril, Goal, Poast, and Prowl were applied, along with Warrior insecticide for thrips control. On August 7, Lannate was applied by airplane.

Bulb maturity ratings for each plot were recorded on August 22, 30, and September 9, as visual estimates of percent dry leaf material in each plot, and percent of bulbs with necks collapsed and leaves on the ground. Those percentages for each date were averaged for the reported maturity ratings. Plate rot was counted on bulbs in the two center rows of each plot on September 4-6, and the number of bolters in the two center rows of each plot was recorded on September 9.

The onion bulbs were lifted on September 11 to field-dry. On September 15, 0.10 inch of rain fell, followed by 0.44 inch of rain on September 16. On September 25-26 the onions were hand-topped and placed into slatted wooden crates. The crates were placed into wooden bins (4 x 4 x 6 feet) on September 27, and the bins were moved into storage on September 30 and October 1.

The onion bulbs were removed from storage and graded from January 2-8, 1997. Bulbs were graded according to their diameter and quality. Size categories were 2¼ to 3-inch (medium), 3 to 4-inch (jumbo), and 4-inch and larger (colossal). Split bulbs and bulbs smaller than 2¼ inches were graded as No. 2s. Bulbs rotted by *Botrytis* neckrot, plate rot, and bacterial decay during storage were weighed and the percent of storage rot was calculated.

Varietal differences were compared using ANOVA and least significant differences at the 5 percent probability level, LSD (0.05).

Results

Varieties are listed by company in alphabetical order and ranked by marketable bulb yield for each company's varieties (Table 1). Average marketable yield was 806 cwt/ac with 27 percent colossal-sized bulbs, 72 percent jumbo, and 1 percent medium. Average cullage for No. 2's (3 percent) and storage rot (4 percent) are expressed in percentage above the total marketable yield. Bulbs smaller than 2¼ inches were included in the No. 2s category, which represents mostly split double bulbs. Small onions were less than 1 percent of yield for all varieties, and many varieties produced no small bulbs.

The LSD (0.05) values at the bottom of Table 1 should be considered when comparisons are made between varieties for yield and grade. Differences equal to or greater than the LSD (0.05) value for a column should exist before any variety is considered different from any other variety in the category compared in that column.

Table 1. Yield and grade of experimental and commercial onion varieties evaluated in 1996. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1996.

Seed company	Onion variety	Bulb color	Marketable yield by grade							Non-marketable			Maturity rating			Plate rot	Bolters
			Total	> 4 inch		3 - 4 inch		2 1/4 - 3 inch		Storage rot	No. 2's		8/22	8/30	9/6	9/4	9/9
			cwt/ac	cwt/ac	%	cwt/ac	%	cwtac	%	%	cwt/ac	%	--------- % ---------				
American Takii	9003-C	yellow	1131	630	55.1	499	44.8	1.5	0.1	4.8	73	6.4	0	3	19	2.9	1.1
	9003	yellow	988	377	38.6	606	60.9	5.7	0.6	9.4	43	4.4	0	1	5	3.1	0.3
	ATX 596	yellow	893	309	34.6	582	65.1	2.8	0.3	2.1	22	2.5	2	6	16	3.5	0.2
	ATX 589	yellow	869	351	40.8	514	58.8	3.5	0.4	3.2	28	3.3	2	3	13	4.9	0.8
	Condor	yellow	818	225	27.8	591	72.0	1.2	0.1	4.4	13	1.6	14	22	44	10.3	0.4
	T-406	yellow	800	177	22.0	622	77.8	1.0	0.1	2.1	20	2.5	3	6	24	5.3	1.3
	T-432	yellow	699	295	42.8	399	56.6	4.1	0.6	5.7	21	3.2	2	11	20	5.1	0.0
	Frontier	yellow	503	18	3.2	467	93.2	12.7	2.5	3.5	8	1.7	64	75	89	5.6	0.0
Aristogene	Seville	yellow	1093	493	45.1	597	54.6	2.4	0.2	3.7	13	1.2	6	12	30	2.3	1.9
	El Charro	yellow	1071	467	43.6	601	56.1	2.9	0.3	5.5	11	1.0	4	9	21	4.5	1.5
	El Padre	yellow	1040	479	46.3	559	53.4	1.8	0.2	2.3	10	1.0	1	3	16	3.4	1.5
	Bravo	yellow	1015	460	45.2	552	54.5	1.3	0.1	3.8	29	3.0	6	10	21	4.8	1.9
	Maritime	yellow	910	199	21.7	707	77.8	2.3	0.2	2.9	11	1.2	25	40	53	6.9	0.8
	Envoy	yellow	881	249	28.3	628	71.3	3.7	0.4	2.8	25	2.9	33	43	52	5.3	0.9
Asgrow	Viper	yellow	885	242	27.3	640	72.4	2.8	0.3	5.8	28	3.2	29	40	50	4.5	2.2
	Viceroy	yellow	807	155	19.2	645	80.1	5.8	0.7	1.9	19	2.3	22	38	52	3.4	0.0
	Regiment	yellow	775	241	30.7	534	69.3	0.4	0.1	4.1	16	2.1	37	48	51	9.9	1.1
	Fury	yellow	638	96	15.5	536	83.6	4.7	0.7	2.4	39	6.3	27	35	50	7.8	0.0
Bejo Seeds	Gladstone	white	766	102	13.3	654	85.4	9.6	1.2	2.0	19	2.5	1	3	13	4.0	0.3
	BGS 77F1	yellow	706	90	12.6	608	86.2	5.7	0.8	1.1	19	2.7	2	9	20	3.4	0.1
	Daytona	yellow	704	93	13.1	603	85.7	6.7	1.0	1.1	21	3.0	2	5	11	4.9	0.3
	Redwing	red	656	75	11.6	580	88.2	1.6	0.2	1.9	4	0.7	3	11	22	10.0	0.0
	Tamara F1	yellow	609	17	2.6	585	96.1	5.5	1.0	4.1	2	0.4	23	47	60	8.8	0.0
	Santana	yellow	534	34	6.4	493	92.4	6.3	1.1	4.0	8	1.5	23	40	55	14.6	0.0
Champion	PX 81892	red	498	121	24.6	368	73.6	5.4	1.1	6.3	16	3.1	11	13	19	8.3	0.0
Crookham	Sweet Amber	yellow	990	342	35.1	644	64.5	3.4	0.3	4.5	39	4.0	13	27	42	3.6	0.8
	Celebrity	yellow	985	426	43.4	553	56.0	4.5	0.5	4.4	39	4.0	1	6	18	3.5	1.6
	Sweet Perfection	yellow	970	439	45.3	528	54.4	1.8	0.2	3.0	42	4.3	12	18	30	3.8	0.8
	XPH 93386	yellow	708	118	16.9	581	81.9	7.1	1.0	3.2	21	3.0	10	22	43	5.2	1.5
Ferry Morse	FMX 2074	yellow	886	322	35.9	561	63.7	3.0	0.3	3.0	11	1.3	7	22	35	5.8	1.0
	Caesar	yellow	885	231	26.2	651	73.4	3.5	0.4	2.5	7	1.1	3	11	32	4.4	0.8
	Oro Grande	yellow	857	270	31.2	582	68.4	2.4	0.3	3.2	8	1.0	5	11	30	4.5	1.0
	Augustus	yellow	838	249	30.3	588	69.6	1.0	0.1	4.8	14	1.8	2	6	14	3.4	1.2
	Fabius	yellow	830	175	21.0	652	78.5	2.7	0.3	2.7	16	1.9	22	36	52	7.0	2.1
Harris Moran	Impact	yellow	598	26	4.7	566	94.3	5.5	1.0	1.8	22	3.7	47	54	67	3.8	0.6
	White Ivory	white	492	7	1.4	469	95.2	14.6	2.9	1.4	66	13.4	12	17	35	6.3	0.1
	Squire	yellow	478	36	7.8	431	89.9	10.2	2.1	5.4	16	3.3	35	49	57	11.1	0.0

Table 1 continued on next page

Seed company	Onion variety	Bulb color	Marketable yield by grade							Non-marketable			Maturity rating			Plate rot	Bolters
			Total	> 4 inch		3 - 4 inch		2 1/4 - 3 inch		Storage rot	No. 2's		8/22	8/30	9/6	9/4	9/9
			cwt/ac	cwt/ac	%	cwt/ac	%	cwtac	%	%	cwt/ac	%	---------- % ----------				
Petoseed	Quest	yellow	939	579	62.1	359	37.8	0.8	0.1	4.6	14	1.5	2	5	20	9.1	0.6
	Atlas	yellow	925	627	68.0	296	31.8	1.3	0.2	5.0	37	4.2	6	17	31	9.3	0.8
	Vision	yellow	917	430	47.2	485	52.6	1.0	0.1	4.3	22	2.5	2	5	21	7.2	0.6
	Pinnacle	yellow	855	191	22.4	661	77.1	2.4	0.3	1.4	3	0.4	6	15	40	5.1	0.0
	Apex	yellow	828	157	18.8	667	80.9	2.6	0.3	1.4	16	2.0	3	6	24	3.3	0.0
	Teton	yellow	778	188	24.3	589	75.6	0.6	0.1	3.9	15	2.0	15	27	48	8.9	1.9
Rio Colorado	6077	yellow	851	277	32.8	571	66.9	2.3	0.3	2.2	65	7.7	13	23	36	5.3	0.6
	Challenge	yellow	846	262	31.0	581	68.8	2.1	0.3	3.5	42	4.9	14	22	40	5.8	1.0
	Rio Seco	yellow	801	112	13.9	683	85.5	3.4	0.4	4.5	19	2.4	50	53	55	7.6	0.2
	Discovery	yellow	733	156	21.4	567	77.2	9.8	1.3	4.0	28	3.8	27	38	45	5.6	0.3
	RNX 10090	yellow	670	71	10.6	598	89.2	1.2	0.2	4.2	8	1.2	36	45	53	8.3	0.6
	RCS 6171	yellow	655	113	17.4	536	81.7	3.7	0.6	6.3	37	5.8	44	47	52	10.2	0.6
	RNX-10001	white	550	28	5.1	509	92.3	11.9	2.2	2.8	12	2.3	20	26	43	3.7	0.1
Rispen Seeds	Golden Security	yellow	1022	467	45.5	553	54.3	2.3	0.2	3.7	48	4.7	2	3	17	1.5	1.1
	Victory	yellow	982	438	44.7	540	55.0	2.0	0.2	3.4	43	4.3	8	19	33	3.6	0.2
	Wrangler	yellow	786	161	20.9	586	74.6	36.0	4.1	2.2	24	3.0	3	12	29	3.8	0.2
Scottseed	Great Scott	yellow	900	404	45.2	495	54.6	0.3	0.03	3.9	62	7.0	3	8	25	2.8	0.2
Shamrock	55C 1992	yellow	788	165	20.7	614	78.2	7.3	0.9	3.0	40	5.1	8	18	28	5.2	0.3
	Impala	yellow	751	109	14.0	636	85.1	4.4	0.7	4.5	73	10.0	47	52	57	4.2	0.0
	SSC 3359	yellow	697	149	21.3	544	78.0	4.5	0.7	3.6	46	6.6	14	26	38	2.9	0.0
	SSC 9983	yellow	629	101	16.1	525	83.5	2.8	0.5	3.4	17	2.8	20	37	51	9.3	1.2
Sunseeds	Sunre 1430	yellow	1061	449	42.2	611	57.7	1.1	0.1	0.9	8	0.7	16	36	46	1.8	0.2
	Vaquero	yellow	996	336	33.9	657	65.7	3.2	0.3	2.9	2	0.2	3	6	27	2.4	0.3
	Snow White	white	853	364	42.5	485	56.9	3.0	0.4	7.2	41	4.8	0	3	5	3.1	0.8
	Bullring	yellow	834	171	19.9	661	79.7	2.4	0.3	5.9	5	0.6	33	49	54	8.4	3.5
	Winner	yellow	779	386	49.5	389	50.0	3.3	0.4	9.4	10	1.3	19	33	42	17.1	2.8
	Tesoro	yellow	764	155	20.1	606	79.4	3.5	0.5	1.6	15	2.0	15	27	45	2.9	1.0
	Sunex 1440	yellow	744	99	13.4	639	85.8	4.5	0.6	2.2	15	2.1	6	22	46	6.9	0.0
	Valiant	yellow	721	122	16.8	593	82.3	5.1	0.7	4.1	11	1.5	11	22	49	10.0	1.5
	Blanco Duro PVP	white	691	116	17.3	572	82.2	2.6	0.4	6.2	13	2.1	1	3	12	3.9	0.4
	Mambo	red	604	69	11.2	525	87.1	8.1	1.3	3.0	29	4.8	2	8	16	7.6	0.0
	Tango	red	493	18	3.5	465	94.5	7.1	1.4	3.7	9	1.8	13	24	40	11.1	0.0
Waldow Seeds	X202	yellow	1004	385	38.3	615	61.4	3.5	0.3	9.6	24	2.4	1	2	12	3.7	1.6
	X201	yellow	949	402	42.7	546	57.1	1.1	0.1	12.3	33	3.7	2	9	19	4.6	1.6
Mean			805.6	237.9	27.13	562.5	72.12	4.40	0.63	3.87	24.1	3.1	13.5	21.7	34.7	5.9	0.7
LSD (0.05)			73.5	81.0	9.46	101.47	9.34	10.27	1.21	3.85	19.38	2.4	8.12	8.73	9.17	3.3	0.8

5 non-marketable percents and cwt/ac are over and above total marketable yield

ONION THRIPS CONTROL TRIALS

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Ontario, Oregon, 1996

Objectives

The purpose of this project was to compare the efficacy of new insecticides on onion thrips control and to determine if rotating different classes of insecticides would result in better thrips control. There is a continuing need to screen new insecticides or new formulations of registered insecticides to determine if they are effective in controlling thrips. Because of the number of generations per year, thrips rapidly build up resistance to insecticides. Rotating between different classes of insecticides is one method of reducing resistance.

Materials and Methods

The trial was conducted on the Hasebe Farms on the southern edge of Ontario. The two-acre field was split between the variety Tango and a yellow variety. The trial was in the Tango onions. The plots were four double rows, 25 feet in length, and each treatment was replicated four times. The first part of the trial consisted of two applications of 16 treatments, the second treatments being made 14 days after the first. The exception was the ES 9601 compounds, which were sprayed every 7 days for three applications. Thrips counts were made just prior to spraying and at 3, 7, and 14 days after the first application, and at 7 days after the second application.

The treatments were made with a CO_2 pressurized plot sprayer set to deliver 27.4 gal/ac of water. The center two rows of each plot were used for evaluation. The number of thrips on 15 onion plants in each plot were counted to determine control.

The different products and their application rates for the efficacy trial are listed in Table 1. A new formulation of Warrior was tested alone and with a non-ionic surfactant, a silicone surfactant and a crop oil concentrate. ES 9601 is a fungal biopesticide of Mycotech's *Beauveria bassiana.*

The second part of the trial consisted of applications of Warrior, Guthion, Fipronil, Mustang, Diazinon, and Lannate in various sequences to determine which would give the best season-long control. Insecticide applications were made at two week intervals and thrips counts were made just prior to each application. Three applications were made during the growing season. The sequence trial was initiated on June 12 with subsequent applications on June 27 and July 16. The following products were used.

Lannate, Diazinon and Guthion were buffered with 3.5 oz/ac Leffingwell ZKP as a buffering agent.

The sequential applications were made according to the schedule in Table 3.

Thrips samples were collected from the red and yellow varieties in the field along with a sample from one other field near Nyssa to identify species makeup of the population and for comparison.

Results and Discussion

The results of the efficacy trial are shown in Table 4 and the sequence trial in Table 5.

Except for the 3 days after treatment counts in the efficacy trial, none of the data were significantly different. Even though there were differences in the three day trial, it is hard to draw conclusions based solely on one count date.

The bigger question is why were there no differences among treatments in either of the efficacy on sequence trials when significant differences have been shown in other years. A major pesticide company also had a thrips trial in the same field with similar results. Samples of thrips were taken from the field in the Tango portion and from the yellow variety portion. A field in Nyssa was also sampled to give an idea of which species of thrips were present. The thrips were identified by Nancy Matteson, an entomologist with the University of Idaho in Twin falls. She found the following.

Ontario Tango field: Mostly Western Flower Thrips (*Frankliniella occidentalis*) and a few Onion Thrips (*Thrips tabaci*).

Ontario Yellow: a 50:50 mix of Western Flower Thrips and Onion Thrips.

Nyssa Field (yellow onions): Mostly Western Flower Thrips and a few Onion Thrips.

No positive conclusions can be drawn from this year's study but there are indications that a species shift towards a higher population of Western Flower Thrips may have occurred in the trial area. If this is the case, thrips populations need to be examined throughout the region since Western Flower Thrips are resistant to most of the registered insecticides. If a species shift is taking place, alternative strategies such as variety selection and biological control may be necessary.

Table 1. Insecticides and rates used in the efficacy trial for onion thrips. Ontario, OR. 1996.

Treatment		Application Rates	
Product	Formulation	Active Ingredient/ac	Product volume/ac
Warrior 11	1.0 CSO	0.03 lb	3.84 oz
Fipronil	1.67 SC	0.022 lb	1.7 oz
Fipronil	1.67 SC	0.044 lb	3.4 oz
Fipronil	1.67 SC	0.06 lb	4.6 oz
Mustang	1.5 EC	0.03 lb	2.6 oz
Mustang	1.5 EC	0.0375 lb	3.2 oz
ES 9601	ES	-	1.0 pint
ES 9601	ES	-	2.0 pint
ES 9601	WP	-	0.5 lb
ES 9601	WP	-	1.0 lb
Orthene	75 WP	-	21.25 oz
Warrior	1.0 EC	0.03 lb	3.84 oz

Table 2. Insecticides and rates used in the sequential application evaluation for onion thrips control. Ontario, OR. 1996.

Treatment		Application Rates	
Product	Formulation	Active Ingredient/ac	Product volume/ac
Warrior	1.0 EC	0.03 lb	3.8 oz
Mustang	1.5 EC	0.03 lb	2.6 oz
Guthion	2.0 EC	0.5 lb	1.0 pt
Diazinon	4.0 EC	0.5 lb	1.0 pt
Fipronil	1.67 SC	0.06 lb	4.6 oz
Lannate	2.4 WSL	0.9 lb	3.0 pt

Table 3. Date of application and materials used in the sequential application trial for onion thrips control. Ontario, OR. 1996

1st Treatment 6/12/96	2nd Treatment 6/27/96	3rd Treatment 7/16/96
Warrior	Fipronil	Lannate
Warrior	Warrior	Warrior
Warrior	Lannate	Lannate
Warrior	Fipronil	Warrior
Warrior	Warrior	Lannate
Warrior	Diazinon	Lannate
Warrior	Warrior	Fipronil
Fipronil	Warrior	Lannate
Warrior	Guthion	Lannate
Guthion	Diazinon	Lannate
Guthion	Diazinon	Warrior
Fipronil	Guthion	Diazinon
Mustang	Mustang	Mustang
Mustang	Fipronil	Lannate
Mustang	Mustang	Lannate
Mustang	Guthion	Lannate

Table 4. Onion thrips control results from the insecticide efficacy trial. Ontario, OR. 1996.

Treatment		Thrips Counts			
	ai/ac	1st application			2nd appl.
		3 DAT	7 DAT	14 DAT	7 DAT
Warrior 11	0.03	2.5	8.3	19.6	11.8
Warrior 11 + NIS*	0.03	2.5	10.5	17.3	13.3
Warrior 11 + COC**	0.03	3.6	11	19.5	13
Warrior 11 + SIS***	0.03	5.1	11.1	20.1	18.2
Fipronil	0.02	3.9	10.3	20.1	14
Fipronil	0.04	12.1	11.2	21.3	14.2
Fipronil	0.06	4.7	9.5	18.1	15.6
Mustang	0.03	3.4	10.2	19.5	12.4
Mustang	0.04	3.6	10	19	11
Check	-	10.1	9.6	22.9	16.8
ES 97-1	1.0 pt	7.6	10.1	21.8	14.7
ES 9601	2.0 pt	8.3	10.7	21.8	14.3
ES 9601	0.5 lb	4.6	9.9	21.1	11.9
ES 9601	0.5 lb	6.8	11.2	19.2	14.2
Orthene	1.3 lb	3.1	10.3	21	15
Warrior	0.03	3.7	9.3	21.3	12.5
LSD		4	N.S.	N.S.	N.S.
* non-ionic surfactant; ** crop oil concentrate; *** silicone surfactant					

Table 5. Average onion thrips counts after sequential insecticide applications. Ontario, OR. 1996

Treatment 1	Ave Thrips Count	Treatment 2	Ave Thrips Count	Treatment 3	Ave Thrips Count	Average
Warrior	13.2	Fipronil	22.9	Lannate	69	35
Warrior	10.9	Warrior	20.8	Warrior	70.5	34.1
Warrior	12.1	Lannate	21.2	Lannate	57	30.1
Warrior	8.2	Fipronil	23.1	Warrior	75	35.4
Warrior	11.4	Warrior	20.7	Lannate	79.5	37.2
Warrior	12.4	Diazinon	20.8	Lannate	67.5	33.6
Warrior	10.7	Warrior	20.2	Fipronil	84	38.3
Fipronil	11.7	Warrior	19.4	Lannate	79.5	36.9
Warrior	11.7	Guthion	25.2	Lannate	66	34.3
Guthion	16	Diazinon	22	Lannate	76.5	38.2
Guthion	13.7	Diazinon	25	Warrior	72	36.9
Fipronil	13.1	Guthion	24.6	Diazinon	72	36.6
Mustang	12.2	Mustang	21.7	Mustang	82.5	38.8
Mustang	10.8	Fipronil	21.3	Lannate	75	35.7
Mustang	14	Mustang	21.2	Lannate	76.5	37.2
Mustang	12.5	Guthion	22.3	Lannate	75	36.6

AUTOMATION OF SUBSURFACE DRIP IRRIGATION FOR ONION PRODUCTION

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Summary

Information on soil water potential was used to automatically control a subsurface-drip irrigation system for onion production. Granular matrix sensors provided the soil water potential data. A datalogger was programmed to maintain soil water potential at constant levels by high frequency irrigations (up to 8 times/day) using controllers connected to solenoid valves. Soil water potential was maintained constant at -10, -20, -30 or -40 kPa minimizing oscillations. Irrigation at -10 kPa resulted in water applications in excess of crop evapotranspiration and continuously wet soil at the 20 inch depth. Irrigation at -20 kPa or drier resulted in water applications close to or less than crop evapotranspiration, and slow soil drying at the 20 inch depth below the onions and drip tape.

Introduction

Subsurface drip irrigation allows for the application of small amounts of water at a high frequency close to the crop root zone. Soil water potential measurements can provide the feedback necessary to automatically schedule high frequency drip irrigations. The feedback allows the maintenance of nearly constant soil water potential in the crop root zone. Maintenance of constant soil water potential in the crop root zone could result in optimum crop growth with a low leaching potential. Onions have a shallow root system and need to be grown in wet soil for optimum yield (Dragland, 1974). In general, onions receive substantial inputs of N fertilizer (Voss, 1979). Onion crop requirements for wet soil, combined with high N fertilizer inputs, result in a substantial nitrate leaching risk under this crop.

Where rainfall is minimal, irrigating onions for optimum yield with little leaching of nutrients could be possible with an automated, high frequency, subsurface drip irrigation system.

Materials and methods

Sweet Spanish onions (CV. "Vision," Petoseed) were grown on 64-inch beds (88-inch centers) with nine single onion rows per bed on an Owyhee silt loam (coarse-silty, mixed, mesic, Xerollic Camborthid) at the Malheur Experiment Station, Oregon State University, Ontario, Oregon. Three drip tapes (Turbulent Twin-Wall, Chapin Watermatics, Watertown, NY) with 0.3 gal/min/100 ft flow rate and 12-inch emitter spacing, were laid 4 inches deep and spaced 8 inches apart prior to planting in each bed. Plots were three beds wide and 40 feet long, and arranged in a randomized complete block design with five replicates.

The treatments consisted of four target soil water potentials (-10, -20, -30, and -40 kPa) as irrigation criteria. Soil water potential was monitored in each plot by five granular matrix sensors (GMS, Watermark Soil Moisture Sensors Model 200 SS, Irrometer Co., Riverside, CA). Four of the five GMS in each plot were installed at 8-inch depths, and one GMS was installed at a 20-inch depth. All GMS were installed below one of the onion rows that was 0.2 m to the side of a drip tape. All GMS were connected via multiplexers (AM 410 multiplexer, Campbell Scientific, Logan, UT) to the datalogger (CR 10 datalogger, Campbell Scientific, Logan, UT). All GMS were calibrated to soil water potential (Barnum and Shock, 1992).

The datalogger was programmed to make irrigation decisions at a frequency of eight times per day for each plot individually using the average soil water potential at the 8-inch depth in that plot as the criterion. If the soil water potential for a plot was drier than the irrigation criterion, the datalogger would irrigate the plot for 30 minutes (0.06 inch of water) using a solenoid valve (DV Series electric remote control valve, Rainbird Mfg. Corp.) wired to a controller (SDM CD16AC controller, Campbell Scientific, Logan, UT). With the capacity for eight irrigations, each at 0.06 inch, a total of 0.48 inches could theoretically be applied in a 24 hour period. Consequently, the system had the capacity to replace the highest historical daily evapotranspiration (Et_c) for onions of 0.35 inches.

Crop evapotranspiration was measured at the Malheur Experiment Station using an AgriMet weather station and a modified Penman equation (Wright, 1982). The amount of water applied in each plot was recorded daily by reading the water meter installed at the inlet of each plot. The pressure in the drip lines in each plot was maintained at 10 PSI by pressure regulators installed before each solenoid valve.

Nitrogen fertilizer as URAN (Urea ammonium nitrate solution) was injected in the drip lines using venturi injectors (Mazzei injector Model 1087, Mazzei Injector Corp., Bakersfield, CA). A total of 150 lb N/ac was applied as six split applications of 25 lb N/ac from May 11 through July 19.

Onions from a 30-foot section in the middle bed of each plot were topped and put in storage in late September. The onions were graded out of storage in mid-December. Gross economic returns were calculated by crediting medium onions with US $2.50/cwt, jumbo onions with US $5.00/cwt, and colossal onions with US $10.00/cwt.

Differences between treatments were compared using ANOVA and protected least significant differences at the 5 percent level, LSD (0.05).

Results and Discussion

The amount of water applied (including rainfall) to maintain the soil water potential at the 8-inch depth at -10 kPa was substantially higher than Et_c (Figure 1). The amount of water applied to the -20 kPa treatment was slightly higher (29 inches) than Et_c (27 inches) and the amount of water applied to the -30 kPa treatment was slightly lower (26 inches) than Et_c.

The automated, subsurface drip irrigation system maintained soil water potential at the 8-inch depth fairly constant for the different criteria (Figure 2). The irrigation system used in this study avoided the large oscillations in soil water potential common with furrow irrigation (Figure 3; Shock et al., 1994). Large oscillations in soil water potential can result in plant stress and conditions favorable to insect and disease development. Large oscillations in soil water potential where the soil is alternately saturated, then dried, will result in nitrate leaching below the crop root zone.

Soil water potential at the 20-inch depth remained wetter than at the 8-inch depth for the -10 kPa treatment suggesting a high leaching potential (Figure 4). For the -20 and -30 kPa treatments, soil water potential at the 20-inch depth remained drier than at the 8-inch depth suggesting a low leaching potential.

Onion total yield and yield by size class were not significantly responsive to the treatments in this trial at harvest (Table 1). When the gross return at harvest is calculated from the different treatments the optimal irrigation criterion is -20 kPa (Table 1). This is in accordance with previous research at the Malheur Experiment Station that demonstrated that the optimum target soil water potential for onions on silt loam soils is -12.5 to -37.5 kPa depending on the site and year (Shock et al., 1994).

There was a trend for a significant increase in storage rot with the increasing wetness (higher soil water potential) of the irrigation criteria. As a result there was a trend for a decrease in marketable onion yield out of storage with the increasing wetness of the irrigation criteria.

Conclusions

It is feasible to use soil water potential measurements at 8-inch depth to automatically control drip irrigations for optimum onion production with a low leaching potential.

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Table 1. Effect of irrigation criteria on onion yield, quality, and gross economic return. Malheur Experiment Station, Oregon State University, Ontario, OR.

Soil water potential criteria	Yield by market grade						Gross return	Onion quality out of storage	
	#2	Small	Medium	Jumbo	Colossal	Total yield		Rot	Marketable (med-col)
kPa	cwt/ac						US $/ac	cwt/ac	
-10	22.3	25.0	137.4	750.5	42.8	978.1	8,254.5	412.3	538.1
-20	17.9	23.2	113.3	773.7	41.1	969.1	8,361.5	394.4	550.6
-30	17.0	29.4	126.7	717.5	26.8	916.5	7,882.0	209.7	671.1
-40	4.5	33.0	169.6	722.0	25.9	954.0	8,150.5	158.0	764.8
LSD (0.05)	ns	ns	ns	ns	ns	ns		194.5	149

Fig. 1. Water applied (includes precip.) for drip irrigated onions, Ontario, OR, 1995.

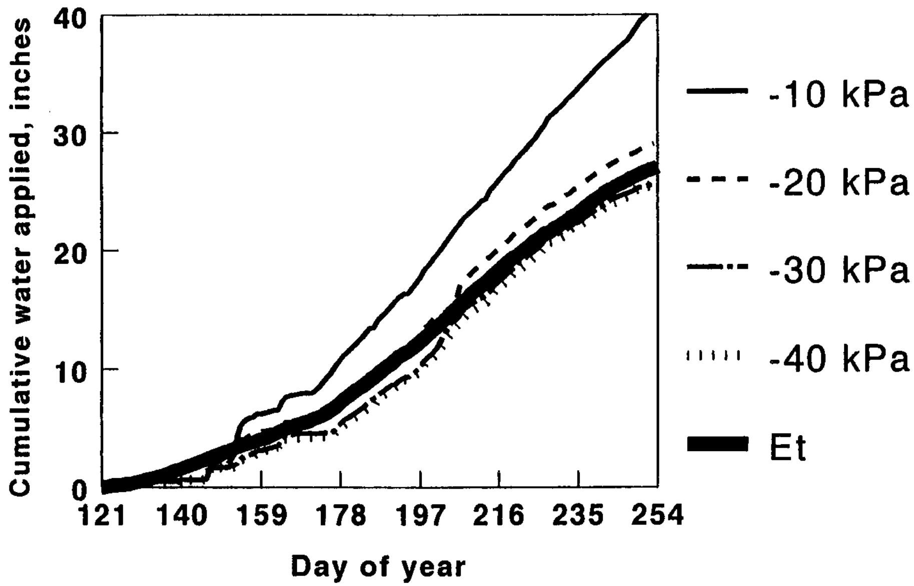


Fig. 2. Soil water potential at 8-inch depth for drip irrigated onions, Ontario, OR, 1995.

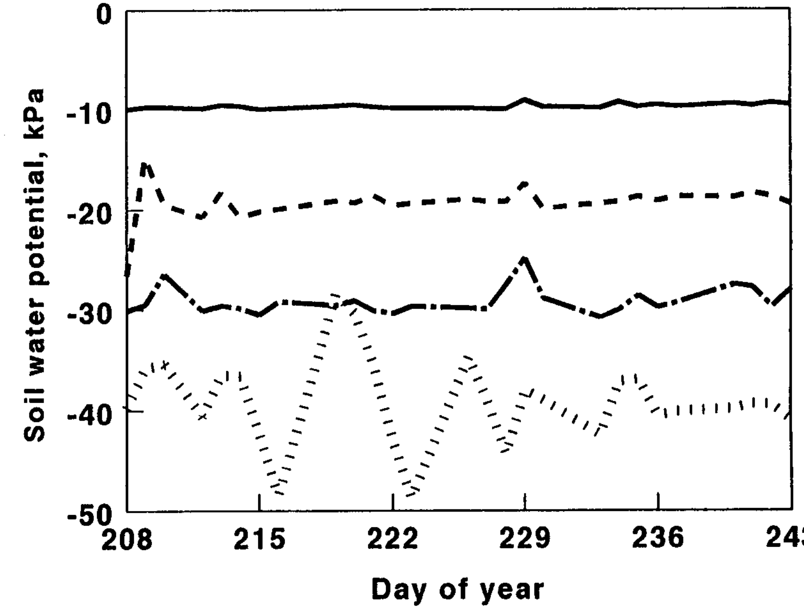


Fig. 3. Soil water potential at 8-inch depth for onions furrow irrigated at -25 kPa, Ontario, OR, 1994.

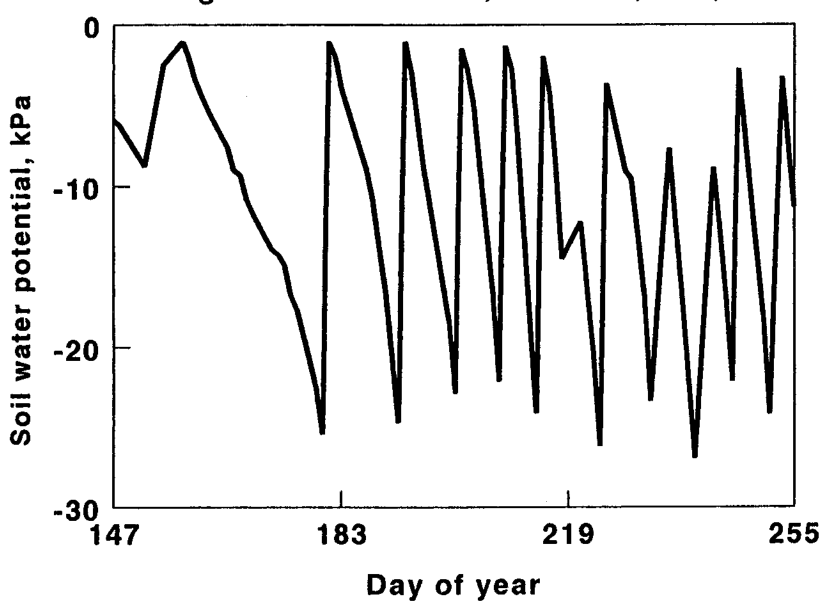
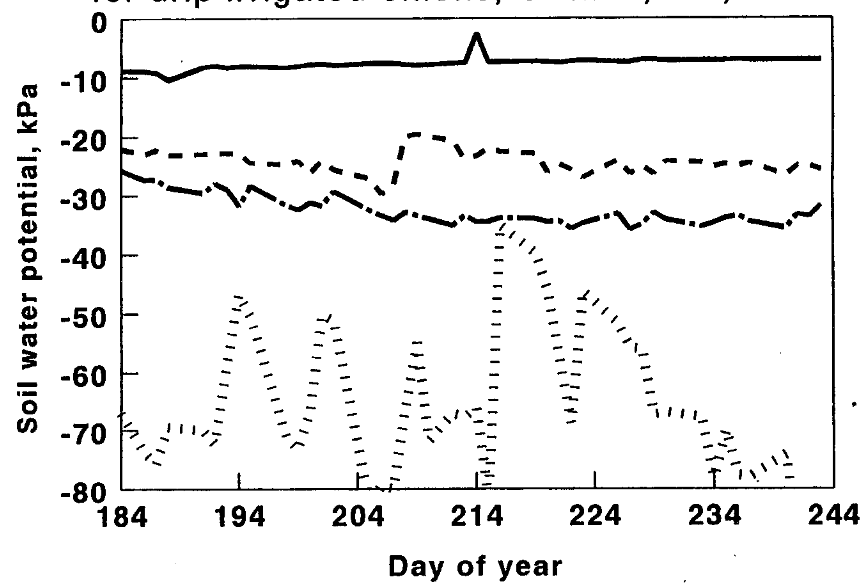


Fig. 4. Soil water potential at 20-inch depth for drip irrigated onions, Ontario, OR, 1995.



ONION TOPPING AND HEAT TREATMENT FOR STORAGE, 1996-1997

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Purpose

Onion growers would like to reduce harvesting cost and still achieve high quality onions out of storage. This trial compared hand topped, flail topped, and untopped Valdez sweet Spanish onions for decay and weight loss from all sources during storage. Onions with each type of topping were either heat treated to a pulp temperature of 90 ^{o}F or not heat treated after harvest and before storage.

Procedures

The 1996-1997 onion storage trial was grown on the Malheur Experiment Station on an Owyhee silt loam following wheat. The soil had 1.2 percent organic matter and a pH of 7.3. The wheat stubble was shredded and the field deep-chiseled, disked, irrigated, moldboard-plowed, roller harrowed, and bedded in the fall. Before the plowing operation in the fall, 100 lbs/ac of P_2O_5, and 60 lb N/ac were broadcast. After bedding, the field was left until spring without further tillage.

Valdez onion seed was planted April 9 in 22-inch single-row beds. Seed was planted using four cone-seeders mounted on John Deere Model 71 Flexi-planter units equipped with disc openers.

The onions were furrow-irrigated as needed during the growing season. The first irrigation was applied on April 13 to supply the soil with moisture for seed germination. Between May 28 and June 1 the seedling onion plants were thinned by hand to a plant population of four plants per foot of row (3-inch spacing between individual onion plants). On June 3, 100 lb N/ac as Urea was sidedressed along both sides of every row. On June 15, a second sidedressing 100 lb N/ac as Urea was applied.

The trial was managed to avoid yield reductions from pests. Dacthal was applied pre-plant and Lorsban 15G was applied for onion maggot control on May 11. Weeds were controlled with cultivations and low rate herbicide applications as needed until layby. On July 5, layby herbicides Buctril, Goal, Poast, and Prowl were applied, with Warrior insecticide for thrips control. On August 7, Lannate was aerially applied.

Onion topping treatments consisted of flailed, hand topped, and untopped bulbs in a randomized complete block design with seven replicates. Ten 70 to 80 lb boxes of onions were harvested from each plot. The gross weight of each box plus onions was determined out of the field. After weighing, half of the boxes (5) from every plot received heat treatment with forced air at 105 °F. Heat treatment continued for up to 2 hours until the onion pulp temperature 1 cm deep in the bulb tissue reached 90 °F. The other 5 boxes from each plot did not receive the heat treatment.

Onions were flailed when the plants were near maturity on September 10. The onion bulbs were lifted on September 11 so they could finish drying in the field. On September 15, 0.10 inches of rain fell, followed by 0.44 inches of rain on September 16. The onions were hand-topped on October 2 and the onions from all treatments were placed into slatted wooden crates. The crates were transported to storage October 7 to 9, where they either were or were not heat treated. Afterwards the crates were placed into wooden bins (4 x 4 x 6 feet) for storage.

The onions were removed from storage, and graded on January 2, 1997. Bulbs were graded according to their diameter and quality. Size categories were 2¼ to 3-inch (medium), 3 to 4-inch (jumbo), and 4-inch and larger (colossal). Bulbs rotted by *Botrytis* neck rot, plate rot, and black mold during storage were separated and weighed. The percent of rotten bulbs from each disease was calculated. Empty crates were weighed to allow the calculation of additional weight loss from tops, skins, water, respiration, and dirt during storage and grading.

Treatments were compared using ANOVA and least significant differences at the 5 percent level, LSD (0.05).

Results and Discussion

The environmental conditions following the rainfall in mid-September were favorable for onion curing. Averaged over all treatments, 94.19 percent of the onion weight into storage was recovered as marketable onions on January 2, 1997 (Table 1). Total losses averaged only 5.81 percent and were as follows: black mold (0.05 percent), plate rot (2.55 percent), neck rot (0.51 percent), and losses of tops, skins, water, and dirt (2.70 percent). Due to the very low incidence of neck rot in these onions, no response to heat treatment would be expected, and none was found.

As expected, untopped bulbs lost slightly more weight to the loss of tops, skins, water and dirt than hand-topped and untopped onions.

Untopped-unheated onions had one of the highest recoveries of marketable bulbs (95.74 percent) in this trial. Untopped-heated bulbs had one of the lowest recoveries of marketable bulbs, yet the recovery was still relatively high in industry terms at 92.61 percent. Untopped-heated bulbs suffered more plate rot and other weight loss during storage in this trial.

This trial should be repeated over several years, so that these treatments can be evaluated when the incidence of neck rot is high. The experiment could be enhanced by the addition of onions topped by a "topper-loader".

Table 1. Storage loss of Valdez onions subjected to variable topping and heat treatments. Onions were stored from late September 1996 to January 2, 1997.

		Loss by type					
		Black mold	Plate rot	Neck rot	Other loss	Total loss	Sound onions
		----------------	---------------- %	----------------	----------------	%	%
Topping Method							
Flail topped		0.04	2.58	0.6	2.35	5.57	94.43
Untopped		0.11	2.23	0.32	3.16	5.82	94.18
Hand topped		0	2.85	0.61	2.57	6.03	93.97
LSD (0.05) topping		ns	ns	ns	0.55	ns	ns
Heat treatment							
Unheated		0.02	2.28	0.55	2.59	5.44	94.56
Heated to 90°F		0.07	2.83	0.47	2.8	6.17	93.83
LSD (0.05) heating		ns	ns	ns	ns	ns§	ns
Treatments							
Topping method	Heat treatment						
Flail topped	Unheated	0	2.87	0.71	2.28	5.86	94.14
	Heated	0.09	2.29	0.5	2.4	5.28	94.72
Untopped	Unheated	0.07	1.39	0.22	2.58	4.26	95.74
	Heated	0.15	3.07	0.42	3.75	7.39	92.61
Hand topped	Unheated	0	2.57	0.73	2.91	6.21	93.79
	Heated	0	3.12	0.49	2.24	5.85	94.15
Overall averages		0.05	2.55	0.51	2.7	5.81	94.19
LSD (0.05) topping x heating		ns	1.16	ns	0.77	1.5	1.5

§significantly different at P=0.10

APPLICATION OF ONION SLUDGE AS A FERTILIZER SUPPLEMENT

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Summary

Onion sludge resulting from onion oil extraction was applied to fields of Virtue silt loam in Skyline Farms, Ontario, Oregon. The application of 58 tons of sludge per acre added substantial nutrients to the land; 135.7 lb N/ac, 30.7 lb P/ac, and 152.0 lb K/ac. The nitrogen was mostly in the forms of ammonium-N (17.5 percent) and organic N (82.5 percent). Based on average nitrate-N and ammonium-N in the fall in farm fields, approximately 32 percent of the organic N mineralized during the first summer after application. Replicated and controlled field plots would be necessary for more accurate N mineralization estimates. Onion sludge should be valuable for use as a crop fertilizer.

Procedures

Onion sludge resulting from onion oil extraction was applied to four fields of Virtue silt loam at the rate of 58 tons per acre between November 16, 1995 and March 1996 and was disked into the soil. Part of each field was left untreated.

The sludge contained an average 2.34 lb of N per ton, of which 0.41 lb was available as ammonium at the time of application (Table 1). The average application of 58 t/ac resulted in 135.7 lb N/ac being added to the land.

In the spring (March 29 through April 2) and again in the fall (November 16 through 20) of 1996 soil samples were taken on both the treated and untreated fields. The soil was analyzed for nitrate-N, ammonium-N, phosphorous, potassium, pH, electrical conductivity, percent N, cation exchange capacity, and percent organic matter. The pounds of nitrate-N and ammonium-N were calculated by assuming a soil bulk density of 1.2 in the top foot of soil and 1.3 in the second and third foot of soil.

All operations and samplings were conducted by Northwest Essential Oil of Ontario, Oregon.

Results and Discussion

Soil analyses revealed no change in soil organic matter or percent nitrogen due to the addition of 58 tons per acre of sludge. In the spring of 1996, available nitrogen remained low in all fields averaging 8.4 lbs per acre more in the treated areas than in the untreated areas (Table 2).

In November, 1996 available-N as nitrate and ammonium averaged 44.0 lb N/ac higher in the treated than in the untreated fields. The increase in available-N is consistent with mineralization of 35.6 lb N/ac of the organic matter (111.9 lb N/ac as organic N in the onion sludge) or 32 percent mineralization. The high variability of the mineralization calculations was consistent with field scale operations. Further N mineralization studies are warranted with carefully controlled rates of application and replicated sampling.

Table 1. Onion sludge content by wet weight. Ontario, Oregon, 1995-1996.

	Nutrient application		
Nutrient	g/Mg	lb/ton	lb/58 tons
Ammonium-N	205	0.41	23.8
Nitrate-N	<6.2	ns	ns
Nitrate	ns	ns	ns
Total Kjeldahl N	1,170	2.34	135.7
K	1,310	2.62	152.0
P	265	0.53	30.7
Na	220	0.44	25.5
Heavy metals	ns	ns	ns

Table 2. Comparison of available nitrogen forms in fields receiving and not receiving onion sludge by the spring of 1996, Ontario, Oregon.

Field ID	Nitrate -N	Ammonium -N	Nitrate plus ammonium-N		
					Difference when treated
	ppm	ppm	ppm	lb N/ac	lb N/ac
02-check					
1'	8.46	3.7	12.16	39.7	
2'	9.06	3.42	12.48	44.1	
3'	11.1	4.18	15.28	54	
	Total			137.8	
02-treated					
1'	8.46	3.38	11.84	38.6	
2'	8.76	3.22	11.98	42.4	
3'	8.88	3.28	12.16	43	
	Total			124.0	-13.8
05-check					
1'	5.7	3.28	8.98	29.3	
2'	7.68	3	10.68	37.8	
3'	9.48	2.84	12.42	43.9	
	Total			111.0	
05- treated					
1'	9.18	2.94	12.12	39.6	
2'	12.06	3.52	15.58	55.1	
3'	10.8	3.2	14	48.5	
	Total			144.2	33.2
06-check					
1'	8.22	3.54	11.76	38.4	
2'	8.40	3.28	11.68	41.3	
3'	10.62	3.30	13.92	49.2	
	Total			128.9	
06 treated					
1'	8.28	4.18	12.46	40.7	
2'	8.34	3.68	12.02	42.5	
3'	8.82	3.38	12.20	43.1	
	Total			126.3	-2.6
07-check					
1'	7.02	3.06	10.08	32.9	
2'	5.82	3.22	9.04	32.0	
3'	5.40	2.68	8.08	28.6	
	Total			93.5	
07-treated					
1'	6.60	2.80	9.40	30.7	
2'	6.18	3.06	9.24	32.7	
3'	9.72	3.54	13.26	46.9	+ 16.8
	Total			110.3	
Average difference					+ 8.4

Table 3. Comparison of available nitrogen forms in fields receiving and not receiving onion sludge by the fall of 1996, Ontario, Oregon .

Field ID	Nitrate -N	Ammonium -N	Nitrate plus ammonium-N		
					Difference when treated
	ppm	ppm	ppm	lb N/ac	lb N/ac
02-check					
1'	8.05	4.18	12.23	39.9	
2'	3.43	3.98	7.41	26.2	
3'	7.91	4.56	12.47	44.1	
	Total			110.2	
02-treated					
1'	6.51	5.06	11.57	37.8	
2'	6.58	4.58	11.16	39.5	
3'	6.58	4.30	10.88	38.5	
	Total			115.8	+ 5.6
05-check					
1'	7.56	5.22	12.78	41.7	
2'	4.55	4.92	9.47	33.5	
3'	2.87	4.54	7.41	26.2	
	Total			101.4	
05- treated					
1'	19.67	4.50	24.17	78.9	
2'	6.37	4.78	11.15	39.4	
3'	10.71	4.42	15.13	53.5	
	Total			171.8	+ 70.4
06-check					
1'	3.64	4.16	7.80	25.5	
2'	5.32	4.44	9.76	34.5	
3'	4.69	3.96	8.65	30.6	
	Total			90.6	
06 treated					
1'	5.67	4.76	10.43	34.0	
2'	2.10	5.58	7.68	27.2	
3'	4.76	5.14	9.87	34.9	
	Total			96.1	+ 5.5
07-check					
1'	7.35	5.62	12.97	42.3	
2'	5.39	5.12	10.51	37.2	
3'	5.11	4.56	9.67	34.2	
	Total			113.7	
07-treated					
1'	25.22	4.66	30.21	98.6	
2'	8.54	4.54	13.08	46.3	
3'	13.37	4.54	17.91	63.3	
	Total			208.2	+ 94.5
Average difference					+ 44.0

NITROGEN REQUIREMENTS FOR NEW POTATO VARIETIES UNDER FURROW IRRIGATION

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Summary

Nitrogen requirements for potato varieties were tested under furrow irrigation on an Owyhee silt loam soil (bottom soil) in 1994 and 1995, and on a Nyssa silt loam (bench soil) in 1996. Potatoes followed soy beans in 1994, and wheat in 1995 and 1996. Potatoes were treated to four total N supply rates; soil residual N only, 120, 180, and 240 lb N/ac. The N rates included the spring soil residual available N. In 1996 an additional 30 lb N/ac as water run urea was applied to all plots except the check plots, due to low petiole nitrate values. The unfertilized potatoes had the highest yield in 1994. In 1995 tuber yield was maximized by 84 lb N/ac. Potato yields (US Number One yield and marketable tuber yield) in 1996 were highest with 234 lb N/ac. Varieties did not differ significantly in their response to N fertilizer. The new varieties Umatilla Russet and Legend Russet performed as well or better than Shepody in terms of marketable tuber yield, over the three years. Nitrogen fertilization in 1994 resulted in darker frying tubers and in reduced tuber specific gravity. Neither tuber stem-end fry color nor specific gravity were affected by N fertilization in 1995 and 1996.

Introduction

The development of new potato varieties has made it possible to achieve good tuber yield and quality under furrow irrigation on silt loam soils. These new varieties might differ from each other in their nitrogen requirements. Previous studies under sprinkler irrigation showed that the optimum N rate was less than the rate recommended by either the Oregon or Idaho fertilizer guides (Feibert et al., 1995). The present study compared Russet Burbank, Shepody, Frontier Russet, Ranger Russet, Agria (a yellow fleshed, processing variety), two new processing varieties; Umatilla Russet (formerly AO82611-7) and Legend Russet (formerly COO83008-1), and the experimental line NDTX 8-731-1R (a fresh market, red variety) as to their nitrogen requirements under furrow irrigation.

Procedures

The 1996 trial was conducted on a Nyssa silt loam with approximately 1.5 percent slope, following wheat at the Malheur Experiment Station. The field had been leveled in the past. Topsoil from the top half of the field had been removed over 30 years ago, in order to fill a gully running through the center, resulting in large areas of low fertility. In addition, the field was deep plowed in 1985, inverting the soil profile. Nitrogen at 22 lb/ac and phosphorus at 103 lb/ac were broadcast and then the field was bedded into 36-inch hills in the fall of 1995. A soil sample taken from the top foot on April 23, 1996 showed a pH of 7.8, 1.1 percent organic matter, 18 meq per 100 g of soil cation exchange capacity, 9 ppm nitrate-N and 4 ppm ammonium-N, 11 ppm phosphorus, 793 ppm potassium, 4,500 ppm calcium, 299 ppm magnesium, 474 ppm sodium, 1.9 ppm zinc, 8.2 ppm iron, 9.1 ppm manganese, 1.1 ppm copper, 23 ppm sulfate-S, and 0.8 ppm boron.

Two-ounce seed pieces were planted April 20 at 9-inch spacing. On May 6, Thimet 20G insecticide at 3 lbs ai/ac was shanked-in at the same time that urea for the nitrogen treatments was applied. The shanks were adjusted to place the urea in bands on both sides of the hill, located at the same depth as the seed piece and offset 9 inches from the hill center. The hills were remade with a Lilliston cultivator. The herbicides Prowl at 1 lb ai/ac and Dual at 2 lbs ai/ac were broadcast on the entire soil surface on May 8 and incorporated with the Lilliston cultivator.

The experimental design had four N treatments as main plots and the eight potato varieties as split-plots within the main plots (Table 3). The main plots were six rows wide and 50 feet long. The four nitrogen treatments were replicated six times.

Nitrogen fertilizer rates were 0, 114, 174, and 234 lb N/ac (Table 1). Pre-emergence N fertilizer was applied as urea on May 6. The post-emergence nitrogen applications consisted of urea applied to the furrow bottom immediately before an irrigation to simulate water-run nitrogen. The N supplies for the fertilized plots in 1996 exceeded the planned levels by 30 lb N/ac. Probably due to the low soil fertility of the 1996 site, low petiole nitrate levels for all treatments indicated the need for the N supplement on July 16.

Table 1. Nitrogen rates applied to eight potato varieties. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1996.

Treatment	Spring nitrate plus ammonium N 0-1 feet	Pre-emergence N (May 6)	Post-emergence "water-run" N		Total available nitrogen supply*
			June 29	July 16	
	---------- lbs N/ac ----------				
1	36	0	0	0	36
2	36	60	24	30	150
3	36	100	44	30	210
4	36	140	64	30	270

* Does not include nitrogen mineralized during the season.

Wheat straw at 800 lb/ac was applied on May 31 to the furrow bottoms by hand to reduce irrigation induced erosion and to improve irrigation efficiency.

A total of 36 granular matrix sensors (GMS, Watermark Soil Moisture Sensors Model 200, Irrometer Co., Riverside, CA) were installed in the top foot of soil and six GMS were placed in the second foot of soil to monitor soil water potential. The GMS in the top foot of soil were offset 6 inches from the hill top and centered 8 inches below the hill surface. The GMS in the second foot of soil were placed in the hill center and centered 20 inches below the hill surface. Half of the sensors in the first foot of soil were located on the wheel traffic side of the potato hill and the other half were located on the non-wheel traffic side of the hill. Sensors were read five times per week at 8 AM from July 10 to September 1. The daily sensor readings were used to schedule irrigations. Irrigations were started when the average soil water potential in the first foot of soil dried to -50 to -60 kPa. At each irrigation, every other furrow was irrigated, with the irrigated furrows alternating from irrigation to irrigation. Sixteen irrigations of 24-hour duration were applied from June 7 to August 28.

Petiole samples were collected every two weeks from June 27 to August 15 from Russet Burbank, Shepody, Frontier Russet, Ranger Russet, and Legend Russet plants in each plot, and analyzed for nitrate. A complete petiole analysis of composite samples from Russet Burbank and Shepody plants on July 12 showed deficiencies of nitrogen, potassium, sulfur, magnesium, manganese, and copper.

The fungicides Bravo at 0.56 lb ai/ac and Manex at 1.2 lb ai/ac were ground sprayed on June 19 and July 19, respectively, for preventive control of late blight. Zinc chelate at 0.02 lb Zn/ac and Copper sulfate at 0.12 lb Cu/ac were added to the Manex application on July 19 for correction of the nutrient deficiencies. Manex, at 1.2 lb ai/ac, contains 0.26 lb Mn/ac.

Plant available-N contributed from organic matter mineralization was determined by the buried bag method (Westermann and Crothers, 1980). A composite soil sample from each of the top two feet of soil from the whole field was taken at the end of April and placed in plastic bags. The bags were sealed and placed back in the field at the appropriate depth. Every month a subset of the bags was removed for NO_3-N and NH_4-N analysis to determine a profile of N release over time. The available N content in the soil in the bags is a result of organic matter decomposition due to microbial activity, without the effects of leaching and plant uptake. When crop residues having a high carbon to nitrogen ratio are decomposed, microorganisms will use the available soil N, causing N immobilization and a negative N mineralization value.

Tubers from the central 40 feet of row in each plot were harvested on September 26 and evaluated for yield and grade. A subsample was stored and analyzed for tuber specific gravity and stem-end fry color in early November.

Data were analyzed by analysis of variance. Means separation was determined by the protected least significant difference test.

Results and Discussion

The soil remained generally wetter than -60 kPa at the 8-inch depth during the season, except for a brief period in late July (Figure 1).

Petiole nitrate levels for all varieties on all sampling dates were below the sufficiency range (Jones and Painter, 1974), except for fertilized Ranger Russet plants on July 30.

Total tuber yield and large US Number One tuber yield (>10 oz), over all varieties, increased with increases in N rate up to 234 lb N/ac (Table 2). In 1995, tuber yield was maximized by 84 lb N/ac of applied fertilizer, while in 1994, potato yield was relatively unresponsive to N fertilization (Table 3).

Varieties Russet Burbank and Agria had among the highest total and marketable tuber yield. Following the red variety NDTX 8-731-1R, Agria, Ranger Russet, and Umatilla Russet had among the highest US Number One tuber yield. Following the red variety NDTX 8-731-1R, Frontier Russet, Umatilla Russet, and Agria had among the highest large US Number One tuber yield.

Nitrogen fertilization did not have any effect on either tuber stem-end fry color or specific gravity (Table 4). Varieties Agria and Legend Russet had among the lightest frying tubers. Varieties Ranger Russet and Frontier Russet were among the highest in specific gravity.

Nitrogen mineralization in the top two feet of soil released 105 lbs N/ac between May 1 and September 24 (Table 5). However, from May 1 to July 31 (main period of potato N uptake) N mineralization released only 34 lb N/ac.

The higher amount of N fertilizer needed to maximize tuber yields in the 1996 trial compared to the 1994 and 1995 trials (Table 6), could be due to the lower amount of N mineralization occurring during the main period of potato N uptake in 1996 compared to 1994 and 1995 (Table 5). In the 1994 and 1995 trials, tuber yield was maximized by substantially less N fertilizer than recommended by either the Oregon or the Idaho fertilizer guides (Anonymous, 1985; McDole et al., 1987). The N rate maximizing total tuber yield in 1996 was in accordance with the fertilizer guides. Low N mineralization was expected at this site in 1996 due to the removal of topsoil decades ago.

In addition, the lower fertility of the 1996 site could also be a factor in the lower total tuber yields in 1996 at all N rates. The low soil test results for magnesium, moderate level of phosphorus, the very high test result for sodium, and the low petiole analyses for potassium, sulfur, and some micronutrients could have had a negative influence on tuber yield.

Conclusions

The N rate necessary for maximum total tuber yield in 1996 was in accordance with the university fertilizer guides. In 1994 and 1995, total yield, marketable yield and US Number One yield were maximized by lower N rates than recommended by the fertilizer guides.

Averaged over all N rates, the new processing varieties Legend Russet and Umatilla Russet, performed as well as, or better than the commercial varieties in total US Number One yield and large US Number One yield. The yellow-fleshed, processing variety Agria had more marketable yield and US Number One yield than several other commercial varieties in this one test in 1996.

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Table 2. Yield response of eight potato cultivars to four nitrogen fertilizer treatments. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1996.

Variety	Nitrogen fertilizer rate	Potato yield by market grade									Undersize	Rot	Total
		US Number One				US Number Two				Marketable			
		4-6 oz	6-10 oz	>10 oz	total	4-6 oz	6-10 oz	>10 oz	total				
	lb N/ac	cwt/ac											
Russet Burbank	0	29.5	58.0	67.8	155.0	25.2	67.2	91.4	183.9	338.9	43.1	20.6	402.7
	114	28.8	83.6	49.5	161.9	23.7	71.2	105.3	200.3	362.2	30.4	21.6	414.2
	174	35.4	94.1	98.9	228.4	21.4	58.0	120.8	200.2	428.6	31.2	8.1	467.8
	234	32.2	114.9	170.8	317.9	18.6	37.7	119.8	176.1	494.0	23.7	5.3	523.0
	Average	31.5	87.6	96.8	215.8	22.2	58.5	109.3	190.1	405.9	32.1	13.9	451.9
Shepody	0	29.0	73.6	123.1	225.7	10.1	15.0	44.9	70.0	295.7	19.5	6.0	321.3
	114	35.1	71.0	123.4	229.5	4.5	11.1	22.7	38.3	267.8	15.5	34.2	317.5
	174	25.2	84.9	165.8	275.8	12.1	22.8	68.3	103.1	379.0	18.2	10.5	407.6
	234	31.6	75.5	180.7	287.8	4.5	6.3	38.6	49.4	337.2	14.5	36.8	388.6
	Average	30.2	76.2	148.2	254.7	7.8	13.8	43.6	65.2	319.9	16.9	21.9	358.7
Frontier Russet	0	25.2	82.5	134.0	241.7	3.3	11.9	50.4	65.7	307.4	16.7	9.1	333.3
	114	20.9	66.1	170.1	257.0	11.5	13.2	65.3	90.1	347.1	20.9	8.2	378.2
	174	16.8	66.9	204.7	288.3	6.0	12.4	79.6	98.0	386.3	22.0	2.1	410.4
	234	16.4	54.7	202.0	273.0	4.3	8.9	72.7	85.9	358.9	18.2	7.1	384.2
	Average	19.8	67.5	177.7	265.0	6.3	11.6	67.0	84.9	349.9	19.5	6.6	376.0
Ranger Russet	0	30.1	99.7	144.3	274.1	14.0	29.0	48.7	91.7	365.8	28.5	4.1	398.3
	114	24.6	94.5	134.7	253.8	14.3	37.3	43.9	95.5	349.2	24.0	5.8	379.1
	174	23.7	88.5	150.5	262.7	14.6	32.9	30.8	78.3	341.0	19.5	2.1	362.6
	234	19.5	85.8	193.8	299.0	8.8	24.7	35.4	68.9	367.9	20.9	5.1	393.9
	Average	24.5	92.1	155.8	272.4	12.9	31.0	39.7	83.6	356.0	23.2	4.3	383.5
Umatilla Russet	0	35.9	96.0	116.1	248.0	21.4	40.6	51.0	113.1	361.1	38.5	3.9	403.6
	114	29.4	77.0	131.1	237.5	12.3	23.4	71.4	107.1	344.6	21.3	11.5	377.3
	174	24.7	73.2	175.1	273.0	12.8	15.3	79.5	107.6	380.6	24.1	21.4	426.1
	234	22.8	80.5	217.5	320.8	8.1	26.4	66.3	100.8	421.6	24.8	7.1	453.6
	Average	28.0	81.3	160.7	270.0	13.6	25.9	67.6	107.2	377.1	27.1	11.5	415.7
Legend Russet	0	19.0	58.2	109.0	186.2	5.2	13.9	34.3	53.4	239.6	13.2	6.2	259.0
	114	29.6	79.0	126.6	235.2	6.3	12.3	46.1	64.7	299.9	17.4	8.7	325.9
	174	23.2	76.2	132.1	231.5	6.5	15.4	34.5	56.4	287.9	13.8	0.4	302.2
	234	14.9	61.9	155.3	232.0	7.5	15.9	37.0	60.4	292.4	14.0	14.1	320.5
	Average	21.6	68.6	130.7	220.9	6.4	14.3	38.1	58.8	279.7	14.6	7.6	301.9
NDTX 8-731-1R	0	34.6	115.7	167.9	318.2	0.0	0.9	1.3	2.1	320.4	23.1	7.2	350.8
	114	39.9	121.4	250.2	411.5	0.0	0.0	0.0	0.0	411.5	24.5	4.3	440.3
	174	35.8	124.4	239.2	399.4	0.0	0.0	0.0	0.0	399.4	25.3	6.3	431.0
	234	43.1	108.3	272.5	423.9	0.0	0.0	0.0	0.0	423.9	26.5	8.9	459.3
	Average	38.4	117.5	232.4	388.3	0.0	0.2	0.3	0.5	388.8	24.9	6.7	420.3
Agria	0	43.1	90.2	112.2	245.4	8.8	34.9	71.5	115.2	360.6	29.1	1.7	391.4
	114	41.6	103.3	114.9	259.8	10.5	34.6	81.2	126.2	386.0	32.5	11.9	430.4
	174	28.0	85.4	180.9	294.3	14.5	29.1	86.8	130.4	424.8	21.4	0.8	446.9
	234	25.1	100.3	212.3	337.8	10.3	29.1	122.2	158.3	496.0	25.0	6.9	527.9
	Average	34.4	94.8	155.1	284.3	11.0	31.1	90.4	132.5	416.9	27.0	5.3	449.2
All varieties	0	30.4	83.4	121.6	235.5	10.7	26.1	48.8	85.6	321.2	25.9	7.0	354.5
	114	31.2	87.0	137.4	255.7	10.3	25.2	54.0	89.4	345.1	23.2	13.0	381.6
	174	26.6	86.7	168.4	281.7	11.0	23.2	62.5	96.8	378.5	21.9	7.0	406.8
	234	25.5	84.8	199.3	309.7	7.8	18.0	60.9	86.6	396.3	20.7	12.0	428.6
LSD (0.05) Trt		5.9	ns	58.3	32.8	3.5	5.6	ns	ns	38.8	5.3	ns	70.7
LSD (0.05) Variety		6.0	13.8	29.2	61.0	3.9	7.5	18.1	21.8	78.9	4.5	ns	34.5
LSD (0.05) Trt X Var		ns	ns	ns	ns	ns	ns	ns	ns	ns	9.0	ns	ns

Table 3. Tuber yield response to N supply in 1994, 1995, and 1996. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1996.

Variety	Nitrogen supply*	1994			1995			1996		
		US #1	Marketable	Total	US #1	Marketable	Total	US #1	Marketable	Total
	lb N/ac	---------- cwt/ac ----------								
Russet Burbank	residual	164.0	316.2	423.8	422.3	454.4	548.6	155.0	338.9	402.7
	120	159.4	292.5	379.4	432.3	480.9	567.6	161.9	362.2	414.2
	180	204.9	363.1	468.4	428.8	480.9	561.5	228.4	428.6	467.8
	240	231.2	375.4	478.8	391.5	438.0	522.0	317.9	494.0	523.0
	Average	189.8	336.8	437.6	418.7	463.5	549.9	215.8	405.9	451.9
Shepody	residual	221.5	315.8	373.4	415.6	423.2	440.4	225.7	295.7	321.3
	120	235.4	349.8	399.9	449.8	470.7	492.8	229.5	267.8	317.5
	180	267.1	363.5	414.0	437.4	470.7	489.9	275.8	379.0	407.6
	240	303.9	410.6	463.3	453.4	496.4	512.5	287.8	337.2	388.6
	Average	257.0	359.9	412.6	439.0	465.3	483.9	254.7	319.9	358.7
Frontier Russet	residual	285.9	324.9	392.1	435.2	456.5	513.0	241.7	307.4	333.3
	120	282.7	337.7	403.5	437.7	460.5	523.6	257.0	347.1	378.2
	180	306.3	358.0	416.0	401.3	432.8	485.3	288.3	386.3	410.4
	240	332.6	395.6	461.2	385.6	418.7	478.2	273.0	358.9	384.2
	Average	301.9	354.0	418.2	414.9	442.1	500.0	265.0	349.9	376.0
Ranger Russet	residual	286.5	373.5	422.9	373.5	403.1	433.2	274.1	365.8	398.3
	120	289.6	353.1	424.4	449.3	481.7	508.1	253.8	349.2	379.1
	180	305.5	396.1	451.0	424.3	458.1	485.3	262.7	341.0	362.6
	240	363.2	445.4	488.9	392.7	440.3	472.3	299.0	367.9	393.9
	Average	311.2	392.0	446.8	409.9	445.8	474.7	272.4	356.0	383.5
Umatilla Russet	residual	249.1	377.3	442.1	438.8	456.1	505.1	248.0	361.1	403.6
	120	277.6	347.4	409.4	460.2	488.2	526.7	237.5	344.6	377.3
	180	302.1	426.3	471.2	477.1	508.6	552.2	273.0	380.6	426.1
	240	303.2	419.2	476.9	504.0	531.4	574.8	320.8	421.6	453.6
	Average	284.2	394.1	451.5	470.0	496.1	539.7	270.0	377.1	415.7
Legend Russet	residual	283.8	390.6	434.2	389.0	421.0	440.2	186.2	239.6	259.0
	120	289.6	353.5	387.8	449.2	498.9	512.7	235.2	299.9	325.9
	180	302.9	376.5	415.1	445.0	477.2	497.8	231.5	287.9	302.2
	240	296.4	367.0	399.3	450.5	489.5	510.7	232.0	292.4	320.5
	Average	292.4	371.1	408.3	433.4	471.6	490.4	220.9	279.7	301.9
NDTX 8-731-1R	residual	330.4	366.6	429.1	401.9	401.9	444.3	318.2	320.4	350.8
	120	427.2	474.2	518.8	454.8	454.8	500.2	411.5	411.5	440.3
	180	379.6	409.8	469.4	419.6	419.6	460.1	399.4	399.4	431.0
	240	417.7	473.7	545.3	398.8	398.8	441.1	423.9	423.9	459.3
	Average	388.8	431.1	490.7	418.8	418.8	461.4	388.3	388.8	420.3
All varieties	residual	261.1	352.5	416.6	410.9	430.9	475.0	235.5	321.2	354.5
	120	280.8	358.4	416.2	447.6	476.5	518.8	255.7	345.1	381.6
	180	295.3	383.5	442.8	433.4	464.0	504.6	281.7	378.5	406.8
	240	321.2	412.4	473.4	425.2	459.0	501.7	309.7	396.3	428.6
LSD (0.05) Treatment		37.2	32.3	34.8	21.5	21.5	20.8	32.8	38.8	70.7
LSD (0.05) Variety		36.6	38.4	39.9	28.3	29.2	29.2	61.0	78.9	34.5
LSD(0.05)Trt X Var		ns	ns	ns	ns	ns	ns	ns	ns	ns

*Spring soil NO_3-N + NH_4-N in 0-1' depth plus fertilizer N

Table 4. Tuber stem-end fry color and specific gravity response of seven potato cultivars to four nitrogen treatments. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1996.

Variety	Nitrogen fertilizer rate	Stem-end fry color	Specific gravity	Variety	Nitrogen fertilizer rate	Stem-end fry color	Specific gravity
	lb N/ac	% reflectance			lb N/ac	% reflectance	
Russet Burbank	0	20.1	1.087	Ranger Russet	0	34.9	1.097
	114	24.8	1.087		114	34.8	1.094
	174	24.2	1.087		174	37.4	1.096
	234	23.4	1.084		234	38.6	1.096
	Average	23.0	1.086		Average	36.4	1.096
Shepody	0	39.9	1.093	Umatilla Russet	0	38.9	1.088
	114	42.2	1.094		114	41.5	1.091
	174	40.8	1.091		174	34.0	1.092
	234	32.2	1.090		234	39.3	1.091
	Average	38.6	1.092		Average	38.2	1.091
Frontier Russet	0	34.0	1.096	Legend Russet	0	39.7	1.093
	114	32.6	1.097		114	39.8	1.090
	174	32.7	1.095		174	41.7	1.093
	234	32.4	1.095		234	40.2	1.093
	Average	32.9	1.095		Average	40.3	1.092
All varieties	0	33.3	1.092	Agria	0	42.8	1.087
	114	33.6	1.091		114	41.9	1.085
	174	34.4	1.092		174	43.3	1.088
	234	33.8	1.091		234	44.5	1.088
					Average	43.1	1.087
LSD(0.05) Trt		ns	ns				
LSD(0.05) Variety		3.1	0.002				
LSD (o.05)Trt X Var		ns	ns				

Table 5. Nitrogen mineralization over time for furrow irrigated potatoes estimated by the buried bag method. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1996.

Month	Mineralized N (NO_3-N + NH_4-N)					
	1994		1995		1996	
	0-1 feet	1-2 feet	0-1 feet	1-2 feet	0-1 feet	1-2 feet
	---------- lb/ac ----------					
May	-4.4	12.0	10.0		8.0	8.0
June	13.8	19.4	46.0	41.4	-1.0	-10.0
July	27.1	25.6	-24.0	-21.5	22.0	7.0
August	12.7	20.7	35.7	37.1	17.0	15.0
September	52.8	30.2	2.9	-4.0	31.0	8.0
Total	102.0	107.9	70.6	53.0	77.0	28.0
From May 1 to July 31	36.5	57.0	32.0	19.9	29.0	5.0

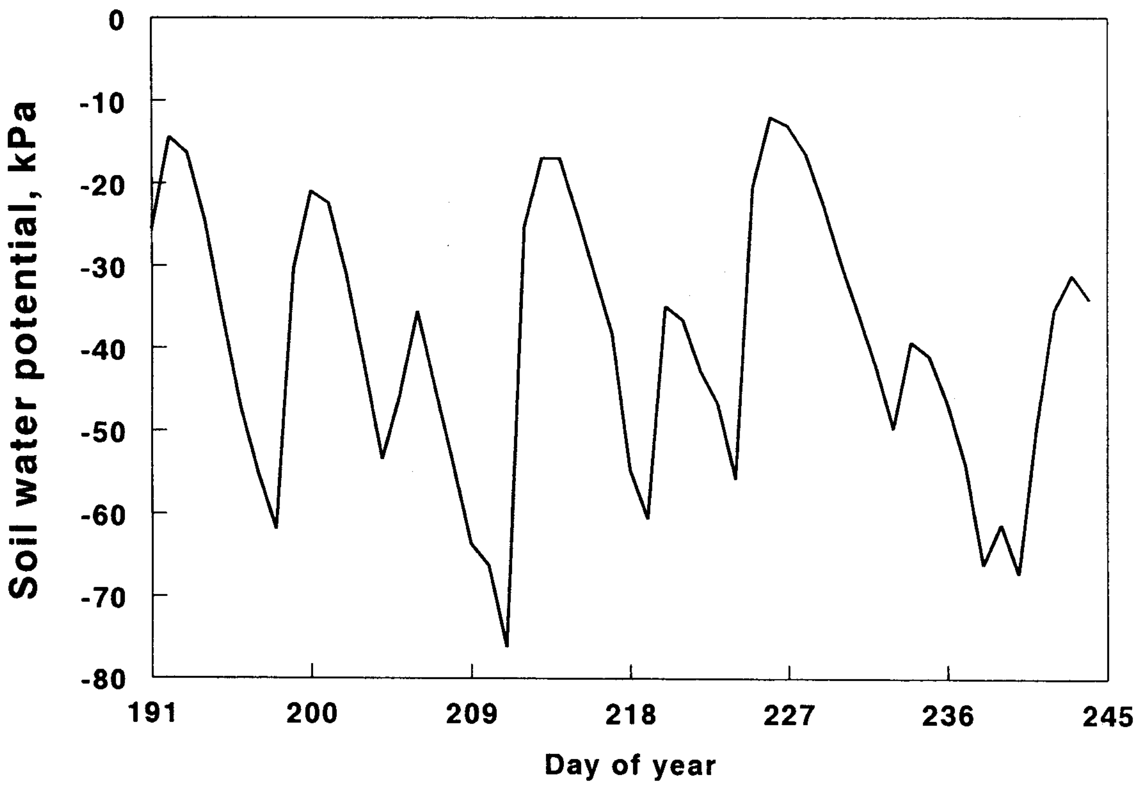
Table 6. University N fertilizer recommendations compared to actual sidedressed N fertilizer needed to maximize furrow irrigated potato yield. Malheur Experiment Station, Ontario, Oregon, 1996.

Year	Soil nitrate & ammonium, 0-24 inches at planting	University recommendation		Lowest N rate tested achieving top yield
		Oregon	Idaho	
	---------- lb/ac ----------			
1994	108	80	110	0
1995	75	236*	220**	84
1996	74	236*	220**	234

* 176+ 60 (20 lb N/ac per ton of wheat straw residue)

** 175+45 (15 lb N/ac per ton of wheat straw residue)

Figure 1. Soil water potential over time for furrow-irrigated potatoes. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1996.



VALIDATION AND ADAPTATION OF THE "BLITECAST" MODEL FOR PREDICTION OF POTATO LATE BLIGHT DEVELOPMENT IN OREGON

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Introduction

Prior to the 1995 growing season, potato late blight (Phytophthora infestans) was not a management concern in the Treasure Valley. During the 1995 season, late blight spread rapidly throughout the valley from initial outbreaks in low lying humid areas. Growers needed to make three to six fungicide applications in 1995. Lack of adequate late blight control in 1995 resulted in a loss of yield and a loss of some of the crop during storage. The ability to predict when the disease is most likely to commence and when conditions are conducive to rapid spread would aid in decisions of necessity and timing of fungicide applications. Late blight development predictions could thus save growers money and could improve the efficiency of control measures. Accurate late blight predictions are now needed for areas where the disease has not been a problem in the past.

We are applying Blitecast to regions with hotter and/or drier summer weather patterns than Wisconsin and Pennsylvania. Some additional factors may be needed to adapt the model to PNW conditions.

Dr. Dennis Johnson of Washington State University and Dr. Phil Hamm of OSU are building a different potato late blight prediction model specific for the Columbia Basin.

Objectives

1. Validate the accuracy of the computer model "Blitecast" in predicting the development of potato late blight in the Pacific Northwest.

2. Automate the "Blitecast" calculations from additional weather stations in growers' fields and additional AgriMet stations.

3. Adapt the "Blitecast" model to the relatively arid areas not originally envisioned in the development of the model where potatoes are now suffering economic losses from late blight.

Procedures

"Blitecast" is a program module that is part of the "Wisdom" software for potato crop and pest management from the University of Wisconsin, Madison. Weather data from eight weather stations (four AgriMet stations, and four remote stations in growers' fields) were collected at the Malheur Experiment Station and entered into the "Blitecast" computer model to make daily predictions of late blight development. The model uses the duration of high relative humidity along with the corresponding range of temperatures to calculate the extent to which the daily environment has been favorable for disease development and sporulation. The Blitecast program calls these accumulated favorable environmental conditions for late blight "severity values". When "severity values" reach 18, late blight is predicted and fungicide control measures are indicated. The Blitecast model also accumulates the risk of early blight as "P-Days". These predictions were compared to the actual onset and development of the disease in fields located in close proximity to each of the weather stations.

The predictions and control recommendations from the model were updated daily and made available as a recorded message on a telephone line. Access to the predictions included calls to a 1-(800) number, information distribution by regular FAX service, and access to the Malheur Experiment Station home page, http://ww.primenet.com/~mesosu/ where late blight risks and treatment information were posted regularly.

Results

In 1996 we successfully collected data from four weather stations in growers' fields and four AgriMet weather stations. Examples of the accumulated late blight "severity values" are presented in the graphs that follow (Figures 1 and 2). The weather data was collected from the AgriMet weather stations at Glenn's Ferry (Idaho), Dry Lake at Nampa (Idaho), the Malheur Experiment Station at Ontario (Oregon), and the Parma Experiment Station (Idaho) in 1996. None of the weather data from the AgriMet stations predicted the occurrence of late blight, even though the critical level of relative humidity for calculating severity values was reduced from 90 to 80 percent (Figure 1).

The weather stations in the potato canopies developed a range of risk estimates (Figure 2). The late blight "severity value" threshold of 18 was reached on July 2 at Morton Island, Ontario, Oregon and later in the season at the other locations. Clearly late blight could have developed fairly early at Morton Island, Ontario if the disease organism had been present there and protective fungicide measures had not been exercised. Once late blight sporulates at any susceptible location, the risk would be spread throughout the region.

Late blight was first detected locally at Parma, Idaho near the Idaho-Oregon border on August 21, 1996. By the time late blight was detected, many fields had been harvested. Many more fields were nearing harvest.

The 1996 data provided growers with regular predictions of the risk of late blight using "Blitecast". In 1996, growers accessed predictions via approximately 3,980 phone calls to the 1-(800) 790-7264 number, information distribution by regular FAX service, and 2,140 hits on the Malheur Experiment Station home page, http://ww.primenet.com/~mesosu/ where late blight risks and treatment information was posted.

Access to late blight predictions and low cost recommendations in 1996 allowed growers in the Treasure Valley of Oregon and Idaho to reduce fungicide costs and control late blight.

Future Plans

In 1997 we will expand the late blight prediction service to more of Oregon and adapt the "Blitecast" model for Oregon environments.

Adaptation of "Blitecast" to Oregon conditions will allow accurate prediction of potato late blight outbreaks. The late blight forecasts help assure high potato yields of excellent quality tubers with minimum fungicide applications. Yields are assured because the disease is anticipated and controlled. Fungicide applications are decreased because only sprays that have benefit controlling the disease are recommended.

Figure 1. Accumulated risk of late blight "severity values" at four AgriMet stations during 1996. Data graphed is accumulated severity units from potato emergence on May 6 through August 28 using 80 percent relative humidity at Glenn's Ferry, Idaho, Nampa, Idaho, the Malheur Experiment Station at Ontario, Oregon, and Parma, Idaho. The late blight threshold of 18 "severity values" was not reached.

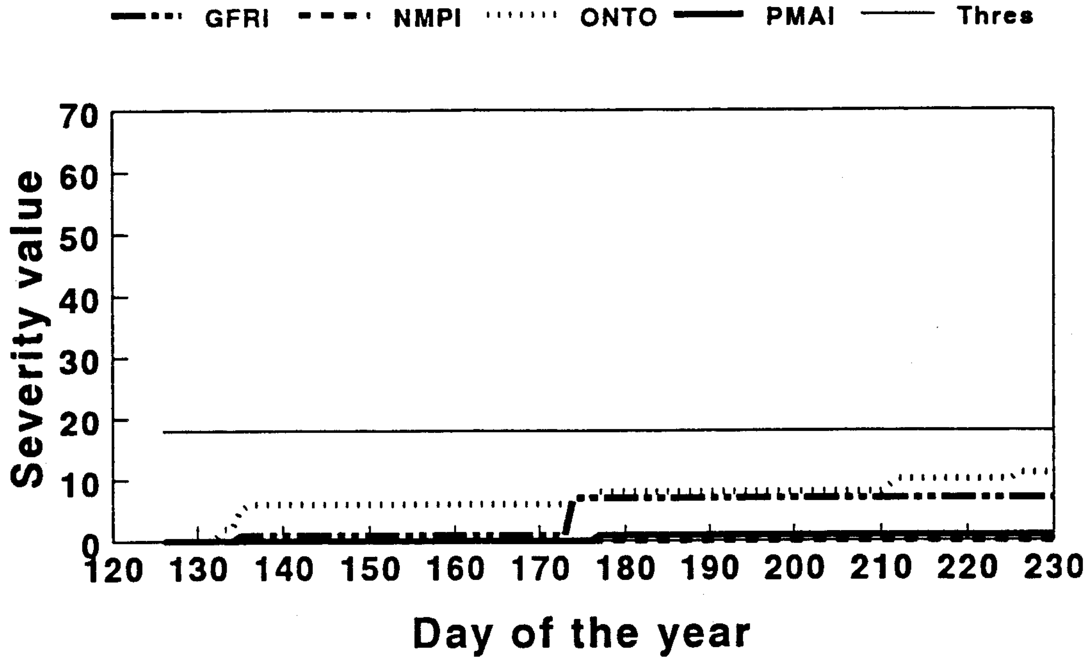
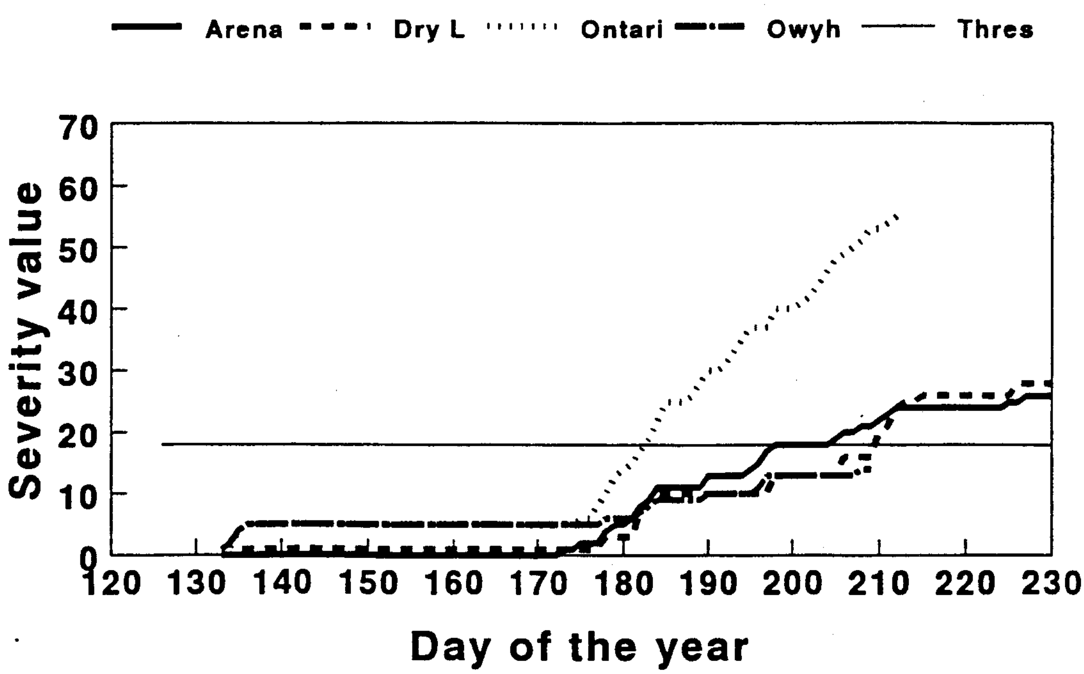


Figure 2. Accumulated risk of late blight "severity values" at four weather stations in the potato canopies during 1996. Data graphed is accumulated severity units from potato emergence on May 6 through August 28 using 90 percent relative humidity at Arena Valley, Idaho, Dry Lake at Nampa, Idaho, Morton Island near Ontario, Oregon, and Owyhee Junction near Adrian, Oregon. The late blight threshold of 18 "severity values" was exceeded starting July 2 at Morton Island.



NITROGEN MINERALIZATION FROM POTATO SLUDGE

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Introduction

Disposing of potato sludge from Malheur County's only potato processing plant has been an ongoing problem. While potato waste products are an excellent cattle feed, the nutritional value of potato sludge is low, making it a poor feed. Land application by shanking directly into the soil has been tried, but the cost has made it economically unfeasible. Land applying sludge to the soil surface can be done economically with manure application equipment over a wider time frame than was available for shanking methods. The feasibility of this approach to the problem along with a limited approval from the Oregon Department of Environmental Quality has made this application method worth pursuing. Two questions that have arisen are: 1) How much sludge can be applied without endangering ground water? 2) What is the nitrogen release curve, and how does it match up with crop nitrogen use requirements? This is the second year of this study.

Materials and Methods

An analysis of the potato sludge indicated a total Kjeldahl nitrogen content of 10,100 ppm. Based on the nitrogen release rates of other organic materials, it was postulated that about 30 percent of the total nitrogen would convert to available nitrogen during the initial growing season. A typical commercial fertilizer application for crops grown in Malheur County would range from 150 - 200 pounds of nitrogen per acre. In order to achieve this amount of nitrogen from sludge, it was estimated that 25 tons of sludge would need to be applied.

25 tons sludge = 550 lb total N

[*.3 (estimated release %) = 151 lb of available N]

On May 15th, two application rates of sludge (25 and 50 tons/ac) were used in the trial. Eighty-nine pounds of soil from a Malheur Experiment Station field was collected and thoroughly blended in a portable cement mixer. Twenty check samples were taken, then potato sludge was added at a rate to equal 25 tons/ac and 20 samples were then taken. Additional sludge was added at a rate to equal 50 tons of sludge per acre and 20 samples were taken.

Each sample was poured into a small plastic bag that held about 1 pound of soil. One end of the bag was heat sealed prior to filling the bags. After filling, the bags were tied with nylon fishing line. The 20 filled bags of each treatment were divided into groups of four to make four replications. Four bags of each treatment were buried eight inches deep in the field. This allowed for four replications of each treatment to be dug up and analyzed in May, June, July, August, and September.

The buried plastic bags created a closed micro climate that approximates a field without allowing leaching or anaerobic denitrification to occur.

Results

The nitrogen mineralization going on in the soil itself was compared with the nitrogen mineralization occurring when 25 and 50 tons/ac of potato sludge were added (Figure 1). Over the five-month period, the soil released 230 lbs N/ac. This number is consistent with mineralization studies conducted at the Malheur Experiment Station.

A comparison was made of the nitrogen released from the potato sludge after subtracting the soil contribution (Figure 2). The 50 ton/ac sludge rate released about three times as much nitrogen as the 25 ton/ac rate. The total nitrogen release of 152 lb N/ac from the 50 ton/ac rate would be adequate for most crops grown in Malheur County. The 57.2 lb/ac nitrogen released from the 25 ton/ac rate would require supplemental nitrogen for most crops. The 1996 sludge released less nitrogen than in 1995 when 110 and 254 lb N/ac was released from the 25 ton/ac and 50 ton/ac rates, respectively.

Figure 1. Comparisons of mineralization in the soil compared with two rates of potato sludge and soil. Ontario, OR. 1996.

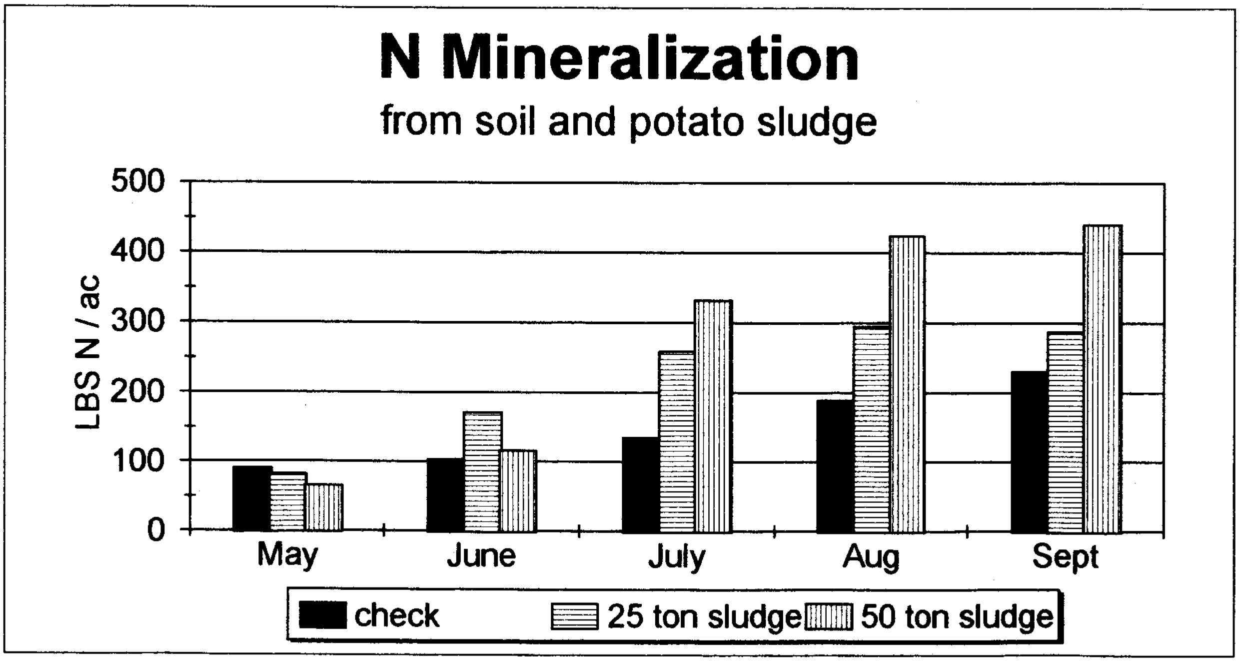
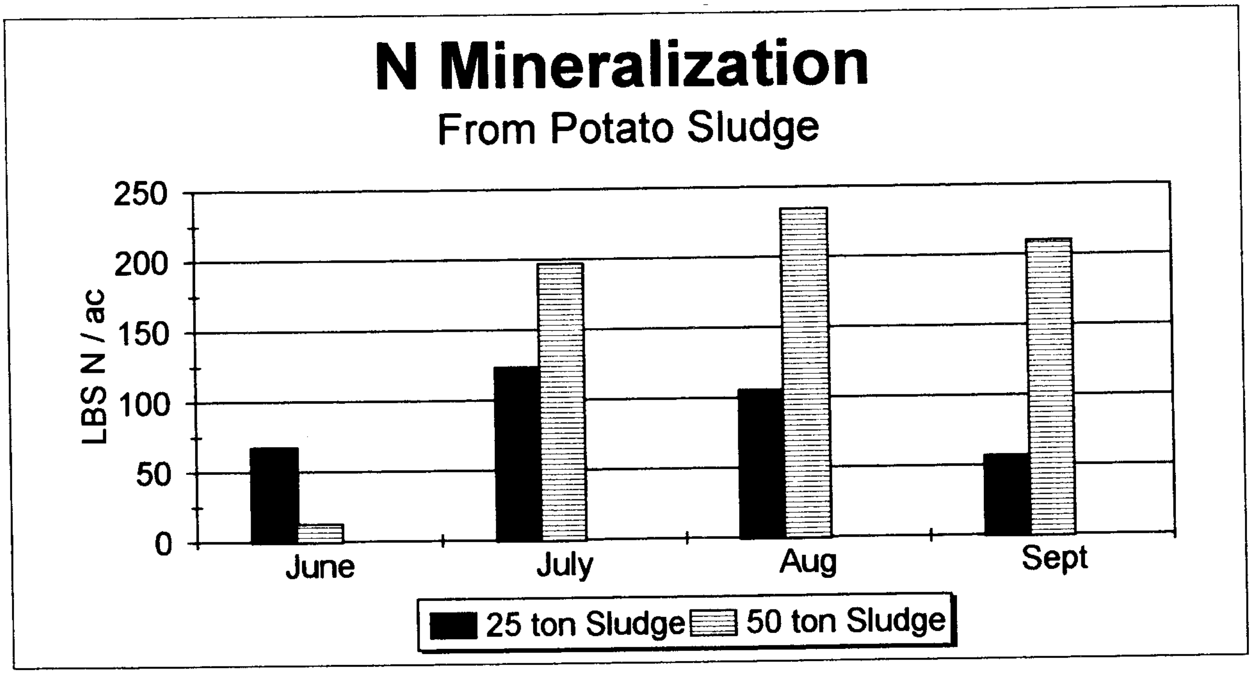


Figure 2. Comparisons of nitrogen released from the potato sludge after subtracting the soil contribution. Ontario, OR. 1996.



A COMPARISON OF STRAW MULCHING AND PAM FOR POTATO PRODUCTION

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Summary

Russet Burbank, Shepody, Frontier Russet, and Ranger Russet potatoes were tested for their response to furrow irrigation with either straw mulched furrows, PAM-treated irrigation water, or an untreated check on a Nyssa silt loam with approximately 1.5 percent slope. Neither straw mulching nor PAM resulted in a significant difference in potato yield or grade compared to the untreated check in 1996. Soil water potential at an 8-inch depth in the straw-mulched and PAM-treated plots remained wetter during the season with fewer irrigations compared to the untreated check. Irrigation-induced erosion was reduced by either straw mulching or PAM compared to the untreated check. The total sediment loss from five irrigations was reduced by 96 percent and 90 percent by straw mulching and PAM, respectively, compared to the check.

Introduction

Irrigation-induced erosion is a serious problem in areas of irrigated agriculture. Polyacrylamide (PAM) is a water soluble polymer and is a high potency flocculent. PAM has been shown to significantly reduce soil erosion (90-95 percent reduction) associated with surface irrigation when applied to irrigation water. Straw mulching of furrow bottoms has also been shown to significantly reduce soil erosion associated with surface irrigation. Straw mulching and PAM have the potential to increase potato yield by reducing nutrient loss in sediment and by maintaining irrigation efficiency during the season.

Procedures

The 1996 trial was conducted on a Nyssa silt loam with approximately 1.5 percent slope, following wheat at the Malheur Experiment Station. The field had been leveled in the past. Topsoil from the top half of the field had been removed over 30 years ago in order to fill a gully running through the center, resulting in large areas of low fertility. In addition, the field was deep plowed in 1985, inverting the soil profile. Nitrogen at 22 lb/ac and phosphorus at 103 lb/ac were broadcast and then the field was bedded into 36-inch hills in the fall of 1995. A soil sample taken from the top foot on April 23, 1996 showed a pH of 7.8, 1.1 percent organic matter, 18 meq per 100 g of soil cation exchange capacity, 9 ppm nitrate-N and 4 ppm ammonium-N, 11 ppm phosphorus, 793 ppm potassium, 4,500 ppm calcium, 299 ppm magnesium, 474 ppm sodium, 1.9 ppm zinc, 8.2 ppm iron, 9.1 ppm manganese, 1.1 ppm copper, 23 ppm sulfate-S, and 0.8 ppm boron.

Two-ounce seed pieces were planted April 20 at 9-inch spacing. On May 6, Thimet 20G insecticide at 3 lbs ai/ac was shanked-in with urea at 100 lb N/ac to both sides of the hill (Figure 1). The shanks were adjusted to place the urea in bands located at the same depth as the seed piece and offset 9 inches from the hill center. The hills were remade with a Lilliston cultivator. The herbicides Prowl at 1 lb ai/ac and Dual at 2 lbs ai/ac were broadcast on the entire soil surface on May 8 and incorporated with the Lilliston cultivator. Post-emergence nitrogen applications consisted of water-run urea at 44 lb N/ac on June 29 and at 30 lb N/ac on July 12.

The experimental design had the two erosion control treatments and the untreated check as main plots and the varieties (Russet Burbank, Shepody, Frontier Russet, and Ranger Russet) as split-plots within the main plots. The treatments were replicated six times.

Wheat straw at 800 lb/ac was applied to the furrow bottoms by hand on May 31. PAM was applied as an aqueous solution at 1 lb/ac during the first two irrigations and at 0.5 lb/ac during subsequent irrigations. The premixed PAM solution was applied directly into the irrigation water with a K-Box in the transmission line to enhance mixing with the irrigation water. The PAM application rate was adjusted so that 80 percent of the PAM was applied during the advance time and the remainder during the rest of the irrigation set. At each irrigation, every other furrow was irrigated, with the irrigated furrows alternating from irrigation to irrigation.

Six granular matrix sensors (GMS, Watermark Soil Moisture Sensors Model 200, Irrometer Co., Riverside, CA) were installed in the top foot of soil and one GMS was placed in the second foot of soil in each plot. Daily sensor readings were used to schedule irrigations. The GMS in the top foot of soil were offset 6 inches from the hill top and centered 8 inches below the hill surface. The GMS in the second foot of soil were placed in the hill center and centered 20 inches below the hill surface. Half of the first foot sensors were located on the wheel traffic side of the potato hill and the other half were located on the non-wheel traffic side of the hill. Sensors were read at 8 AM five times per week from July 10 to September 1. Irrigations were started when the average soil water potential in the first foot of soil dried to -50 to -60 kPa. Irrigations were run individually for each treatment as needed. Inflow and outflow measurements were taken hourly for each of the first five irrigations. Imhoff cones were used to measure the sediment loss at the same time outflow measurements were taken.

Petiole samples were collected every two weeks from July 15 to August 15 from Shepody plants in each plot, and analyzed for nitrate. A complete petiole analysis of composite samples from Russet Burbank and Shepody plants from all treatments on July 12 showed deficiencies of nitrogen, potassium, sulfur, magnesium, manganese, and copper.

The fungicides Bravo at 0.56 lb ai/ac and Manex at 1.2 lb ai/ac were ground sprayed on June 19 and July 19, respectively, for preventive control of late blight. Zinc chelate at 0.02 lb Zn/ac and Copper sulfate at 0.12 lb Cu/ac were added to the Manex application on July 19 for correction of the nutrient deficiencies. Manex, at 1.2 lb ai/ac, contains 0.26 lb Mn/ac.

Plant available-N contributed from organic matter mineralization was determined by the buried bag method (Westermann and Crothers, 1980). A composite soil sample from each of the top two feet of soil in each plot was taken at the end of April and placed in plastic bags. The bags were sealed and placed back in the field at the appropriate depth. Every month a subset of the bags was removed for NO_3-N and NH_4-N analysis to determine a profile of N release over time. The available N content in the soil in the bags is a result of organic matter decomposition due to microbial activity, without the effects of leaching and plant uptake.

Four furrows in each treatment, at the middle of the field, were measured using a drop rod measuring device on September 2. Tubers from 40 feet in each plot were harvested on September 26 and evaluated for yield and grade. A subsample was stored and analyzed for tuber specific gravity and stem-end fry color in early November.

Differences between treatments and varieties were compared using ANOVA and least significant differences at the 5 percent level, LSD (0.05).

Results and Discussion

A total of 329 hours of irrigation (16 irrigations) for the straw plots, 382 hours of irrigation (18 irrigations) for the PAM plots, and 430 hours of irrigation (20 irrigations) for the untreated plots, were necessary to maintain soil water potential at the 8-inch depth wetter than -60 kPa. Despite the higher number of irrigations, the soil water potential at the 8-inch depth in the untreated check plots became drier than -60 kPa more often than in the straw or PAM plots (Figure 1). The strawed plots were among the highest in average total infiltration per irrigation and total infiltration for the five irrigations measured (Table 1).

From May 1 to July 31 (main period of potato N uptake) N mineralization released 34 lb N/ac.

Petiole nitrate levels were below the sufficiency range (Jones and Painter, 1974) in all treatments on all sampling dates.

Neither straw mulching of the furrow bottoms nor PAM treatment of the irrigation water resulted in significant differences in tuber yield compared to the untreated check (Table 2). The soil at the trial site had low phosphorus and magnesium and very high sodium. The low fertility of the trial site might have limited tuber yield response to the improved soil moisture management in the straw mulched and PAM treated plots..

Neither straw mulching of the furrow bottoms nor PAM treatment of the irrigation water resulted in significant differences in tuber internal quality (Table 3).

At the end of the season, the untreated wheel and non-wheel furrows at the middle of the field showed evidence of more pronounced erosion than either the straw-mulched or PAM treated furrows (Figures 2 and 3). Average total sediment loss per irrigation and total sediment loss for the five irrigations measured was significantly lower for the straw- and PAM-treated plots than for the untreated plots. Straw mulching and PAM reduced total sediment loss from five irrigations by 96 percent and 90 percent, respectively, compared to the untreated check.

The higher number of irrigations applied to the untreated plots were not effective in maintaining the soil water potential at the 8-inch depth wetter than -60 kPa. Despite having the same infiltration as the untreated plots, the PAM plots required fewer irrigations to maintain the soil water potential at the 8-inch depth wetter than -60 kPa. Due to the more severe erosion in the untreated plots, the water flowed deeper in relation to the hill than in the PAM and straw plots, resulting in less effective wetting of the hill.

Nitrogen nutrition may have been limiting in this trial. Straw and PAM may have tended to reduce yields by increasing infiltration, hence inducing greater nitrate leaching below the potato root zone.

Literature cited

Jones, J.P. and C.G. Painter, 1974. Tissue analysis: A guide to nitrogen fertilization of Idaho Russet Burbank Potatoes. University of Idaho, College of Agriculture, Cooperative Extension Service, Agricultural Experiment Station, Current information series # 240, June 1974.

Table 1. Effect of erosion control method on irrigation water infiltration and sediment loss during five irrigations. Malheur Experiment Station, Oregon State University,

Treatment	Average		Total	
	Infiltration	Sediment loss	Infiltration	Sediment loss
	ac-inch/ac	lb/ac	ac-inch/ac	lb/ac
Straw	2.4	32.5	12.1	162.7
PAM	1.4	74.9	7.0	374.7
Check	1.8	778.3	8.8	3,891.4
LSD (0.05)	0.8	360.4	4.0	1,801.9

Table 2. Yield response of four potato cultivars to two erosion control methods. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1996.

Variety	Treatment	Potato yield by market grade									Undersize	Rot	Total yield
		US Number One				US Number Two				Marketable			
		4-6 oz	6-10 oz	>10 oz	total	4-6 oz	6-10 oz	>10 oz	Total				
		cwt/ac											
Russet Burbank	Straw	35.4	94.1	98.9	228.4	21.4	58.0	120.8	200.2	428.6	31.2	8.1	459.7
	PAM	22.6	82.3	102.9	207.8	16.0	34.7	133.0	183.7	391.5	28.0	20.2	419.5
	Check	39.7	108.6	145.9	294.2	10.9	37.3	110.8	159.1	453.3	27.7	0.0	481.0
	Average	32.6	95.0	115.9	243.5	16.1	43.3	121.5	181.0	424.5	9.4	29.0	453.4
Shepody	Straw	25.2	84.9	165.8	275.8	12.1	22.8	68.3	103.1	379.0	18.2	10.5	397.1
	PAM	20.5	62.5	153.8	236.8	12.3	19.9	71.0	103.3	340.1	14.3	0.0	354.4
	Check	29.2	107.4	167.3	303.9	11.4	15.6	48.5	75.5	379.4	19.9	0.0	399.3
	Average	25.0	84.9	162.3	272.2	11.9	19.4	62.6	94.0	366.1	3.5	17.5	383.6
Frontier Russet	Straw	16.8	66.9	204.7	288.3	6.0	12.4	79.6	98.0	386.3	22.0	2.1	408.3
	PAM	17.1	56.0	184.9	258.0	7.6	19.1	103.9	130.6	388.6	19.5	0.0	408.1
	Check	23.9	66.5	178.8	269.2	7.2	12.5	73.1	92.7	362.0	24.6	1.1	386.6
	Average	19.3	63.1	189.4	271.8	6.9	14.7	85.5	107.1	379.0	1.1	22.0	401.0
Ranger Russet	Straw	23.7	88.5	150.5	262.7	14.6	32.9	30.8	78.3	341.0	19.5	2.1	360.5
	PAM	20.9	98.9	170.7	290.4	11.6	20.4	35.8	67.9	358.3	18.4	0.0	376.7
	Check	21.9	91.0	189.6	302.5	8.9	27.2	56.7	92.8	395.3	20.7	2.6	416.1
	Average	22.2	92.8	170.2	285.2	11.7	26.8	41.1	79.7	364.9	1.6	19.5	384.4
All varieties	Straw	25.3	83.6	155.0	263.8	13.5	31.5	74.9	119.9	383.7	5.7	22.7	406.4
	PAM	20.3	74.9	153.1	248.2	11.9	23.5	85.9	121.4	369.6	5.0	20.1	389.7
	Check	28.7	93.4	170.4	292.5	9.6	23.2	72.3	105.0	397.5	0.9	23.2	420.7
LSD (0.05) Treatment		5.8	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
LSD (0.05) Variety		6.2	19.8	31.8	ns	4.8	11.1	21.6	28.8	ns	4.7	ns	51.0
LSD (0.05) Trt X var		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

Table 3. Effect of erosion control treatments on tuber internal quality. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1996.

Variety	Treatment	Stem-end fry color	Specific gravity
		% reflectance	$g \cdot cm^{-3}$
R. Burbank	Straw	24.2	1.087
	PAM	23.4	1.089
	No straw, no PAM	24.3	1.087
	Average	24.0	1.088
Shepody	Straw	40.8	1.091
	PAM	38.6	1.095
	No straw, no PAM	44.8	1.109
	Average	41.4	1.098
F. Russet	Straw	32.8	1.095
	PAM	33.1	1.109
	No straw, no PAM	36.1	1.098
	Average	34.0	1.101
R. Russet	Straw	37.4	1.097
	PAM	35.3	1.092
	No straw, no PAM	37.1	1.097
	Average	36.5	1.095
All varieties	Straw	33.6	1.092
	PAM	32.6	1.096
	No straw, no PAM	35.5	1.098
LSD (0.05) Trt		ns	ns
LSD (0.05) Variety		3.8	ns
LSD (0.05) Trt X Var		ns	ns

Fig 1. Soil water potential at 8-inch depth for furrow irrigated potatoes, Ontario, OR, 1996.

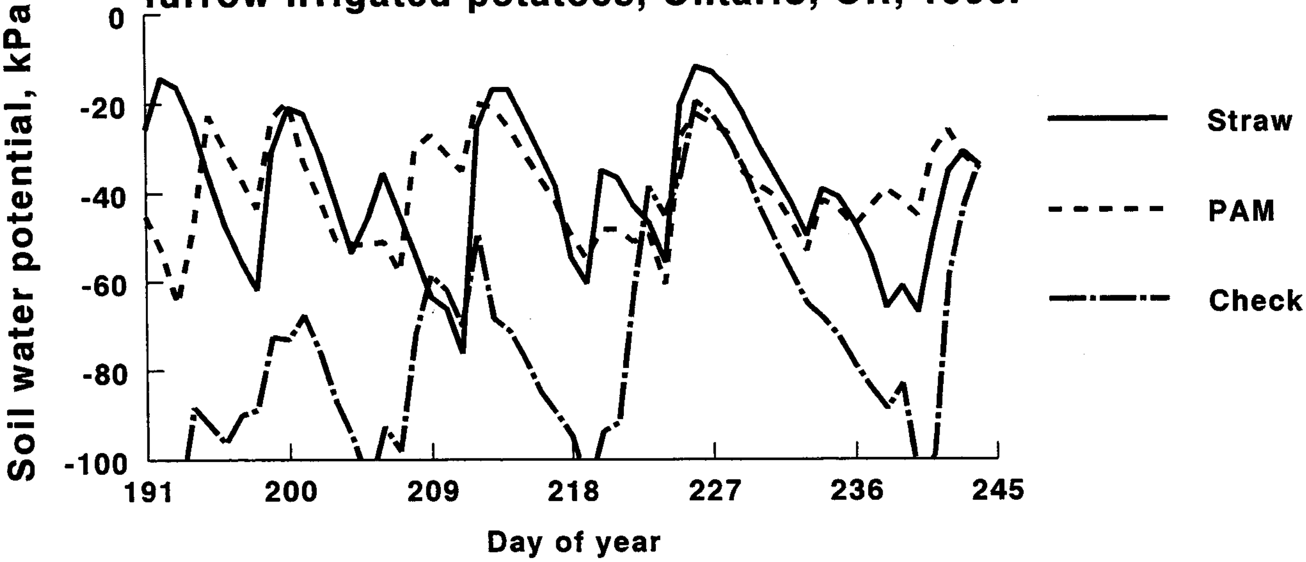


Fig 2. Furrow shape at field middle (200' from top) for wheel traffic furrows, Ontario, OR, 1996.

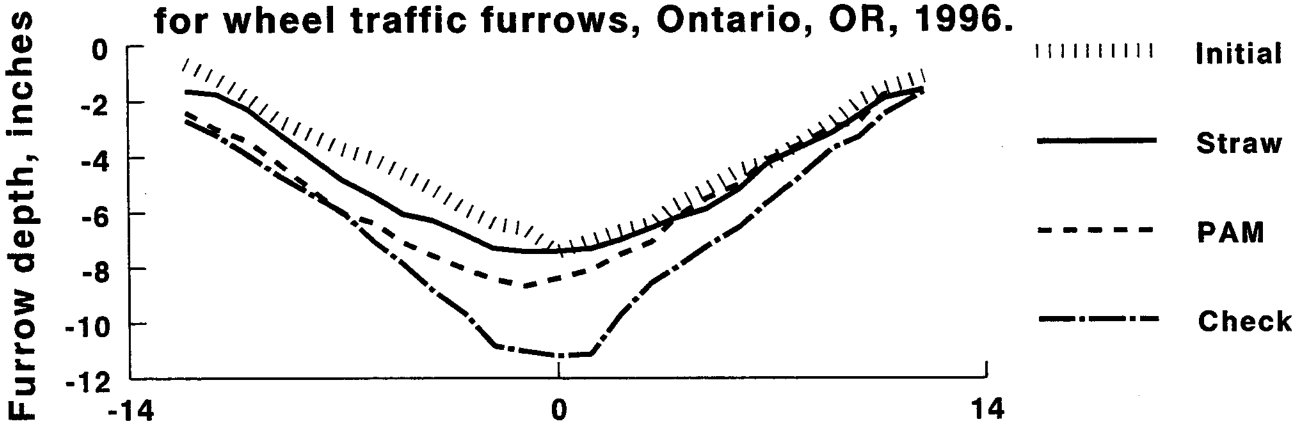
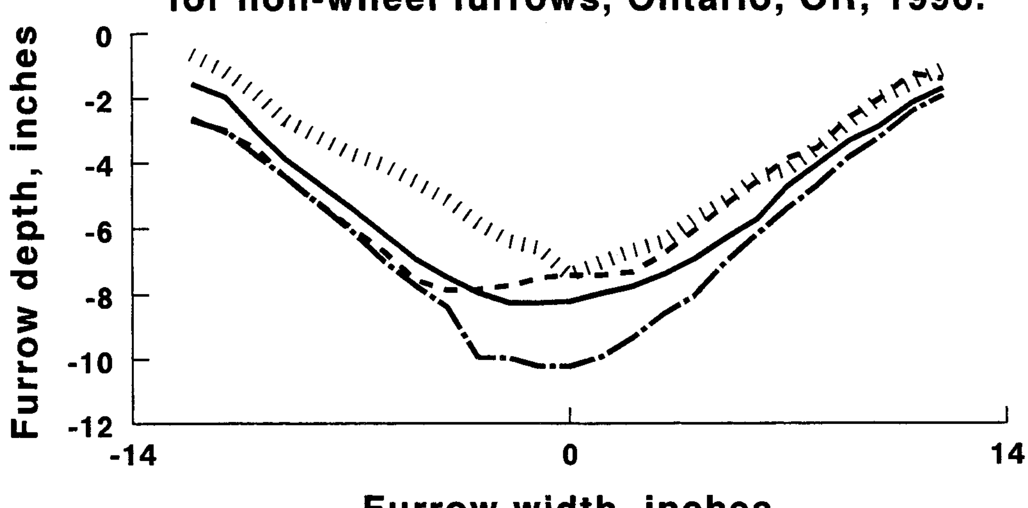


Fig. 3. Furrow shape at field middle (200' from top) for non-wheel furrows, Ontario, OR, 1996.



SUGAR BEET VARIETY TESTING RESULTS, 1996

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Purpose

Commercial varieties and experimental lines of sugar beets were evaluated to identify lines with high sugar yields and root quality. A joint seed advisory committee evaluates the accumulated performance data for the varieties over several years and locations, and restricts growers in Idaho and Malheur County of Oregon to planting only those varieties ranking above minimum industry requirements.

Procedures

Sixteen commercial varieties and 45 semi-commercial lines of sugar beets were evaluated in trials conducted at the Malheur Experiment Station, Ontario, Oregon. Seed of varieties included was received from American Crystal, Betaseed, Hilleshog Mono-Hy Inc., Holly, Seedex, and Spreckels beet seed companies. The sugar beets were planted in Owyhee silt loam soil where winter wheat was grown the previous year. Soil pH was 7.5 and soil organic matter was 1.7 percent. The field was plowed in the fall of 1995. March 3 soil test results in the first foot of extractable soil were NO_3-N 8 lb/ac, NH_4-N 7 lb/ac, and in the second foot were NO_3-N 7 lb/ac, NH_4 6 lb/ac. Phosphorus was 19 ppm and zinc was 0.9 ppm.

Nortron was broadcast for weed control and incorporated at 2 lb ai/ac using a spike-tooth bed harrow before planting. The commercial and semi-commercial varieties were planted in separate trials. Each entry was replicated eight times using a randomized complete block experimental design. Each plot was four rows wide and 24 feet long with 3-foot alleys separating plots. Approximately 12 viable seeds per foot of row were planted in each plot row. The seed was planted on April 10 with a cone-seeder mounted on a John Deere model 71 flexi-planter equipped with disc openers. After planting, the trials were corrugated and Counter 15G was applied in a band over the row at 7 oz/1000 ft of row. The sugar beets trials were furrow-irrigated to furnish moisture for uniform seedling emergence April 12, and seedlings began emerging on April 22. On May 1 herbicides Progress at 0.25 lb ai/ac, Stinger at 0.05 lb ai/ac, and Poast at 0.10 lb ai/ac were applied. The sugar beets were hand-thinned May 14 to 22. Spacing between plants was approximately 7 inches. On May 29 Progress at 0.25 lb/ac and Poast at 0.1 lb ai/ac were applied, followed by sidedress of the crop with 200 lb of nitrogen per acre as urea on May 30.

Treflan at 1 pint/ac plus Eptam at 3 pint/ac were applied for weed control June 7. Beets were mechanically cultivated June 30. Six pints/ac flowable sulfur was applied by aerial application July 30, and Bayleton at 1 lb/ac with 50 lbs powdered sulfur on August 7 to protect the sugar beet leaves from powdery mildew infection.

The sugar beets were harvested October 10-16. The foliage was removed by a flail beater and the crowns clipped with rotating scalping knives. The roots from the two center rows of each four-row plot were dug with a single-row wheel-type lifter harvester, and all roots in each 24 feet of row were weighed to calculate root yields. A sample of eight beets was taken from each of the harvested rows and analyzed for percent sucrose, pulp nitrate nitrogen, and conductivity by Amalgamated Sugar Company. The percent extraction was calculated using an empirical formula that used percent sucrose and conductivity readings as factors.

Variety differences were calculated using ANOVA and protected least significant differences at the 5 percent levels, LSD (0.05).

Results

Variety performance (Table 1 and 2) was analyzed statistically for LSD value at the 5 percent level of significance and ranked by recoverable sugar within each company.

Yields of recoverable sugar from commercial varieties ranged from a high of 11,875 lbs of sugar/ac to a low of 9,693 lbs of sugar/ac, with a variety mean of 10,797 lbs of sugar/ac. Among the top yielding cultivars were HM Canyon, 4006R, HM WSPM9, and HM WS91 (Table 1).

Yield of recoverable sugar from semi-commercial lines ranged from 13,184 lbs of sugar/ac to a low of 9,756 lbs of sugar/ac, with an entry mean of 11,633 lbs of sugar/ac. Among the top yielding cultivars were HM2919, HM2929, ACH9622 (Table 2).

Table 1. Root yields, sugar yields and root quality data from sugar beet lines entered as commercial lines at the Malheur Experiment Station, Oregon State University, Ontario, 1996.

Company	Variety	Root yield	Sugar content	Gross sugar	Conductivity	Root NO_3-N	Extraction	Estimated recoverable sugar	Estimated recoverable sugar
		ton/ac	%	lb/ac	mmhos	ppm	%	lb/ac	lb/ton
Hilleshog Mono-Hy	HM CANYON	39.27	17.44	13,697	0.71	133	86.69	11,875	302.3
	HM WSPM9	39.54	16.73	13,230	0.73	130	86.36	11,426	288.94
	HM WS91	37.01	17.53	12,973	0.71	116	86.76	11,258	304.2
	HM R2	36.84	17.17	12,653	0.69	103	86.98	11,006	298.76
	HM WS88	36.75	17.1	12,570	0.72	135	86.57	10,885	296.04
	HM 9155	36.16	17.29	12,497	0.79	129	85.68	10,709	296.38
	HM WS62	36.34	16.86	12,252	0.72	128	86.54	10,604	291.87
American Crystal	ACH 203	35.78	17.14	12,256	0.73	140	86.36	10,585	296.06
	ACH 211	34.13	17.66	12,046	0.67	108	87.33	10,520	308.41
Beta Seed	4006R	39.27	17.17	13,490	0.69	158	86.9	11,725	298
	8450	36.9	17.48	12,899	0.78	153	85.8	11,068	299.99
	8422	36.04	17.16	12,361	0.82	156	85.17	10,527	292.3
Holly	RIVAL	35.87	16.88	12,108	0.77	153	85.88	10,402	290.03
	RHIZOGUARD	35.37	16.47	11,652	0.74	148	86.23	10,049	284.12
Holly (Spreckels)	SS 781 R	34.75	16.45	11,420	0.84	136	84.87	9,693	279.17
Seedex	SX 1505	34.63	17.23	11,939	0.67	123	87.26	10,419	300.74
	LSD (0.05)	2.02	0.35	728	0.05	34	0.73	668	7.7 0
	Mean	36.54	17.11	12,503	0.74	134	86.33	10,797	295.48

Table 2. Root yields, sugar yields and root quality data from sugar beet lines entered as semicommercial lines at the Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1996.

Company	Variety	Root yield	Sugar content	Gross sugar	Conductivity	Root NO3-N	Extraction	Estimated recoverable sugar	Estimated recoverable sugar
		ton/ac	%	lb/ac	mmho	ppm	%	lb/ac	lb/ton
Hilleshog Mono-Hy	HM 2919	41.83	17.94	14,990	0.62	101	88.00	13,184	315.58
	HM 2929	42.95	17.46	15,002	0.63	107	87.84	13,178	306.77
	HM 2921	41.1 0	17.91	14,723	0.63	93	87.86	12,936	314.81
	HM2925	40.00	17.75	14,375	0.66	123	87.49	12,575	310.65
	HM 2916	39.54	17.74	14,028	0.67	122	87.34	12,252	309.95
	HM 2923	39.1 0	17.77	13,894	0.6 0	98	88.16	12,251	313.35
	HM 2922	38.39	18.02	13,836	0.58	97	88.54	12,251	319.13
	HM 2928	39.01	17.57	13,702	0.6 0	119	88.19	12,085	309.83
	HM2924	38.78	17.65	13,681	0.7 0	139	86.86	11,883	306.69
	WS PM9	39.89	17.1 0	13,635	0.69	122	86.94	11,853	297.41
	HM 2927	37.78	17.78	13,417	0.62	95	87.97	11,799	312.81
	HM 2926	37.63	17.75	13,359	0.61	82	88.06	11,764	312.66
	HM RZ72	36.72	17. 0	12,478	0.75	125	86.08	10,740	292.65
	HM Pillar	33.02	17.99	11,882	0.62	87	87.99	10,455	316.58
	HM RZ20	34.66	17.41	12,069	0.75	116	86.20	10,404	300.20
Beta Seed	5CG7004	43.01	16.78	14,411	0.75	175	86.15	12,415	289.13
	3BG6110	39.74	17.94	14,255	0.73	126	86.57	12,339	310.64
	3BG6111	40.92	17.52	14,322	0.79	140	85.73	12,277	300.46
	2BG6303	39.66	17.87	14,165	0.73	122	86.53	12,252	309.22
	4KG5983	37.04	18.59	13,773	0.70	87	87.01	11,986	323.57
	4546	40.66	17.13	13,925	0.76	203	86.03	11,980	294.82
	4CG6070	40.04	17.28	13,834	0.72	100	86.51	11,968	299.04
	4CG6430	38.57	17.91	13,800	0.73	90	86.49	11,934	309.73
	4035R	40.74	16.68	13,576	0.81	206	85.34	11,585	284.67
	4CG6460	38.86	17.40	13,513	0.82	131	85.30	11,524	296.88
	4CG6088	38.16	17.25	13,164	0.69	95	86.92	11,443	299.93
	4CG6486	37.78	17.28	13,058	0.77	96	85.89	11,218	296.92
	8422	36.69	17.35	12,736	0.80	159	85.48	10,889	296.73
	4CG6429	35.13	16.99	11,934	0.73	112	86.40	10,307	293.68
	4CG6456	34.60	17. 0	11,760	0.73	94	86.35	10,155	293.56
	3BG6956	33.84	16.83	11,375	0.77	112	85.79	9,756	288.78
American Crystal	ACH 9622	41.71	17.59	14,670	0.70	93	86.83	12,738	305.43
	ACH 9612	39.45	17.30	13,634	0.70	151	86.81	11,835	300.36
	ACH 9624	38.33	17.50	13,418	0.70	132	86.90	11,660	304.23
	ACH 203	37.04	17.62	13,052	0.65	124	87.54	11,428	308.45
	ACH 9614	35.25	17.07	12,038	0.75	187	86.15	10,378	294.24
Seedex	SX1509	39.57	17.63	13,942	0.70	125	86.91	12,109	306.52
	SX1510	39.63	17.41	13,777	0.68	162	87.08	11,992	303.26
	SX1511	35.81	17.51	12,526	0.71	101	86.79	10,870	304.04
Holly (Spreckels)	SS 93805	39.45	16.92	13,335	0.79	128	85.57	11,410	289.55
	SS 694	37.57	16.67	12,516	0.74	121	86.17	10,783	287.34
	SS 93424	37.42	16.87	12,620	0.80	139	85.42	10,781	288.24
	SS 943203	36.81	17.04	12,489	0.78	134	85.73	10,705	292.31
Holly	96 HX 405	43.62	16.20	14,125	0.87	162	84.44	11,927	273.67
	96 HX 406	41.10	16.22	13,322	0.88	167	84.35	11,234	273.58
	LSD (O.O5)	2.06	0.36	720	0.05	46	0.67	627	7.77
	Mean	38.65	17.38	13,425	0.72	124	86.64	11,633	301.29

IMPROVED NITROGEN AND IRRIGATION EFFICIENCY FOR SUGAR BEET PRODUCTION

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Summary

Management alternatives for reducing N fertilizer and irrigation water application rates were tested for furrow irrigated sugar beets in replicated half acre plots. A moderate N fertilizer rate and a reduced N fertilizer rate were tested under conventional furrow irrigation (continuous) and surge irrigation. The moderately fertilized and continuously irrigated sugar beets had the highest beet yield. There was no significant difference in sugar yield between the beets that were moderately fertilized and either continuously or surge irrigated. The reduced fertilizer beets had significantly lower sugar yields, whether they were continuously or surge irrigated.

Introduction

Previous small plot research at the Malheur Experiment Station has demonstrated the effectiveness of using greatly reduced nitrogen fertilizer inputs for optimum sugar beet production.

Surge irrigation is a tool that can be used to improve the water application efficiency of furrow irrigation. In surge irrigation, water is applied to an irrigation furrow intermittently during an irrigation set, whereas in continuous-flow (or conventional) irrigation, water is applied to the furrow during the entire irrigation set. With surge irrigation, an automated switching valve, commonly referred to as a surge valve, is used to repeatedly cycle water from one half of the field to the other half. Total water application can be reduced substantially with the use of surge irrigation. Previous research at the Malheur Experiment Station with wheat, onions, and potatoes has demonstrated the effectiveness of surge irrigation in reducing water applications while maintaining crop yield and quality equivalent to conventional furrow irrigation.

The reduced water applications with surge irrigation could result in a reduction of nitrate leaching and adjustment in N fertilizer practices. This trial compared sugar beet production with moderate and reduced N inputs under either conventional furrow irrigation or surge irrigation in field scale plots. Plots were 0.5 acres each with 600-foot long irrigation runs. The intent was to investigate the interaction between reduced nitrogen fertilizer and reduced water inputs on crop yield and quality.

Procedures

The 1995 trial was conducted on a Greenleaf silt loam previously planted to potatoes at the Malheur Experiment Station. The field was leveled and bedded into 44-inch centers in the spring of 1996. A soil sample taken from the top foot on May 1, 1995 showed a pH of 7.6, 1.4 percent organic matter, 19 meq per 100 g of soil cation exchange capacity, 4 ppm nitrate-N, 7 ppm ammonium-N, 14 ppm phosphorus, 178 ppm potassium, 1748 ppm calcium, 256 ppm magnesium, 340 ppm sodium, 0.7 ppm zinc, 4.4 ppm iron, 4.1 ppm manganese, 0.7 ppm copper, 13 ppm sulfate-S, and 0.7 ppm boron.

Sugar beet seed (cv PM-9, Hilleshog) was planted on April 11 in two rows 22 inches apart on each bed. Counter insecticide at 6 oz/1,000 ft of row (1.2 oz/1,000 ft of row) was applied in a band over the seed row. Spring ground work had dried the field and two soaking irrigations were used for seed germination and emergence.

The experimental design had the irrigation and nitrogen fertilizer treatments arranged in a randomized complete block factorial design replicated three times. The plots were 20 rows wide and 600 feet long. The treatments consisted of two fertility levels and two irrigation methods (Table 1). Fertility levels consisted of either fertilizing for a total N supply (soil NO_3-N + NH_4-N in the 0 to 3 foot depth plus fertilizer N) of 200 lb N/ac, or fertilizing for a total N supply of 128 lb N/ac (reduced level). The amount of fertilizer to be applied to each plot was based on late March soil samples. Each plot was sampled in one foot increments to six feet in three locations corresponding to the top, middle and bottom of the plot. The fertilizer was applied as water-run urea on June 7.

Gated pipe was arranged to permit all 12 plots to be irrigated simultaneously. A Waterman Model LVC-5 surge valve automatically oscillated water from three of the surge irrigation plots to the other three surge irrigation plots. The valves on the gated pipe were adjusted to deliver the same flow rate to all furrows in the surge and conventional irrigation systems.

Four granular matrix sensors (GMS, Watermark Soil Moisture Sensors Model 200, Irrometer Co., Riverside, CA) were installed at the 10-inch depth and four GMS were installed at the 20-inch depth in the top, middle, and bottom of one conventionally irrigated plot and in the top, middle, and bottom of one surge irrigated plot in the field center. The GMS were installed in line with the plants. The GMS were read at 8 AM five times per week from July 5 to September 17. Irrigations were started when the average soil water potential at the 10-inch depth dried to -75 kPa. The surge plots and the conventional furrow irrigation plots were irrigated separately as needed to maintain the soil water potential wetter than -75 kPa.

Petiole samples were collected from plants in the top, middle, and bottom of each plot on July 17, July 31, and August 28 and analyzed for nitrate. Eight beets in the top, middle, and bottom of each plot were harvested for nitrogen analysis on October 15. The beets were separated into beets, crowns, and tops. Tops and crowns were oven dried, and weighed. Beets were shredded, weighed, oven dried and weighed. All dried samples were ground and analyzed for nitrogen content. Beets from 40 feet of the middle two rows in the top, middle, and bottom of each plot were harvested and weighed on October 17. A 10 beet subsample was sent to the Amalgamated Sugar Company lab in Nyssa for quality analyses. After harvest, the soil from each plot was sampled in one foot increments to six feet in the top, middle, and bottom of the plot.

The available N balances were calculated by subtracting the post harvest accounted nitrogen (crop N uptake plus available soil N after harvest) from the nitrogen supply (available soil N in spring plus fertilizer N plus N from irrigation water plus N from organic matter mineralization).

Treatment differences in beet yield, beet quality, or petiole nitrate were compared using analysis of variance and the protected least significant difference test at the five percent level, LSD(0.05).

Results and Discussion

Conventional furrow irrigated plots required 11 irrigations totaling 259 hours, and surge irrigated plots required 13 irrigations totaling 331 hours in order to maintain the soil water potential at the 10-inch depth wetter than -75 kPa. The actual duration of water applications with surge irrigation would be half of that for conventional irrigation. Actual water applications were 259 hours for conventional irrigation and 166 hours for surge irrigation (a 36 percent reduction in applied water).

Despite the higher number of irrigations, soil water potential at the 10-inch depth averaged drier in the surge irrigated plots during the season than in the conventionally irrigated plots. The season long average soil water potential at the 10-inch depth for the surge plots was -62 kPa, and for the conventionally irrigated plots was -48 kPa. Soil water potential at the 20-inch depth remained drier during the season in the surge plots than in the conventional plots. The season long average soil water potential at the 20-inch depth for the surge plots was -85 kPa, and for the conventionally irrigated plots was -48 kPa.

Petiole nitrate was significantly lower for the reduced nitrogen beets than for the beets receiving 200 lb N/ac on July 17 and August 28 (Table 1). Irrigation method did not have an effect on petiole nitrate.

The moderately fertilized and continuously irrigated beets had the highest beet yield. (Table 2). There was no significant difference in sugar yield between the moderately fertilized, continuously irrigated beets and the moderately fertilized, surge irrigated beets. The conventionally irrigated, reduced fertilizer beets had among the lowest beet yield and sugar yield. The differences between treatments in beet sugar content, pulp nitrate, conductivity, and extractable sugar were significant but small. Beet sugar content was high, and pulp nitrate and beet conductivity were low for all treatments.

The soil N balance was not influenced by the treatments (Table 3). The N balances were all positive suggesting a substantial N contribution from organic matter mineralization. Total available nitrogen supply in growers' fields would normally be about 320 lbs nitrogen per acre based on soil nitrate, soil ammonium, and nitrogen fertilizer. The sugar beets in a typical grower's field would yield 30 tons per acre with 16 1/2 percent sugar, resulting in 4.5 tons per acre of recoverable sugar.

Table 1. Effect of nitrogen fertilizer rate and irrigation method on sugar beet petiole nitrate. Malheur Experiment Station, Oregon State University, Ontario, OR, 1996.

Irrigation type	N supply*	Petiole nitrate		
	lb N/ac	July 17	July 31	August 28
		------ ppm ------		
Continuous	200	1,683	707	273
Continuous	128	317	193	88
Surge	200	1,600	763	223
Surge	128	333	237	78
$LSD_{0.05}$		688	ns	89

*Soil NO_3 -N + NH_4-N in 0-3' depth plus fertilizer N

Table 2. Influence of reduced N application and surge irrigation on sugar beet yield and sugar yield. Malheur Experiment Station, Oregon State University, Ontario, OR, 1996.

Irrigation type	N supply*	Beet yield	Beet sugar content	pulp nitrate	Conductivity	Extractable sugar	Recoverable sugar yield
	lb N/ac	t/ac	%	ppm	µmhos	%	t/ac
Continuous	200	32.0	18.1	163.4	0.73	95.68	5.26
Continuous	128	27.7	18.5	171.1	0.67	95.73	4.65
Surge	200	29.2	18.3	161.7	0.71	95.71	4.86
Surge	128	28.6	18.4	167.1	0.67	95.72	4.78
LSD (0.05)		2.6	0.4	7.5	0.06	0.05	0.41

*Soil NO_3-N + NH_4-N in 0-3' depth plus fertilizer N

Table 3. Influence of reduced N application and surge irrigation on the available nitrogen accounting. Malheur Experiment Station, Oregon State University, Ontario, OR, 1996.

Irrigation type	N rate*	N supply		Fall nitrogen accounting			Balance**
		Pre-plant soil available N (0-3')	Fertilizer N	Fall soil available N (0-3')	Plant N recovery	Accounted N	
	lb N/ac	---------- lb/ac ----------					
Continuous	200	167.9	32	71.6	282.3	353.9	154.0
Continuous	128	133.3	0	63.6	234.5	298.1	164.7
Surge	200	173.0	27	59.2	284.8	344.1	144.0
Surge	128	144.0	0	60.9	230.8	291.8	147.8
$LSD_{0.05}$				ns	49.7	50.9	ns

*Soil NO_3-N + NH_4-N in 0-3' depth plus fertilizer N

** based on the difference between N supplies and fall N accounting.

SUPERSWEET CORN AND SWEET CORN VARIETY EVALUATIONS

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Objectives

Sweet corn and supersweet corn varieties were evaluated for agronomic and processing performance.

Procedures

Two trials were conducted on a Greenleaf silt loam following sugar beets. In the fall of 1995, 100 pounds of phosphate per acre and 20 lbs N per acre were plowed down. The field was then groundhogged twice and worked into 30-inch beds.

Alachlor (Partner) at 3 lbs ai/ac was broadcast and incorporated with a bed harrow on April 24, 1996. Eighteen supersweet corn (Sh_2) and 14 sweet corn (Su_1) varieties were planted in separate trials. Each trial had a randomized complete block design with five replicates. The seed had standard fungicide seed treatments applied by the suppliers. The supersweet varieties were planted on April 26 and the sweet varieties on June 4 to avoid cross pollination between the two corn types. Seed was planted at a 2-inch depth using an Almaco cone seeder on a John Deere 77 Flexi Planter.

A soil sample taken from the top foot of soil on May 31, 1996 showed a pH of 7.2, 2.1 percent organic matter, 24 meq per 100 g of soil cation exchange capacity, 27 ppm nitrate-N, 6 ppm ammonium-N, 34 ppm phosphorus, 565 ppm potassium, 2529 ppm calcium, 432 ppm magnesium, 354 ppm sodium, 1.9 ppm zinc, 29 ppm iron, 13.4 ppm manganese, 1.8 ppm copper, 26 ppm sulfate-S, and 0.7 ppm boron.

The field was cultivated on June 3 and again on June 12 immediately after sidedressing with Urea at 140 lb N/ac. The crop was furrow irrigated as needed on alternate furrows starting on June 12.

Emergence counts were made on May 8, May 10, and May 20 for the supersweet corn and on June 17 for the sweet corn. All plots were thinned to 24,000 plants/ac (1 plant every 8.71 inches). The supersweet corn plots were thinned on June 10 and the sweet corn plots were thinned on July 21. Starting on July 5, the silk stage was evaluated for 20 plants in one of the middle two rows of each plot in the first replicate. Varieties were considered to be at the mid-silk stage when 40 to 60 percent of the plants were silking. About 16 days after the mid-silk stage, ear samples from the border rows were taken and analyzed for moisture content to determine the stage of maturity. The target ear moisture content for harvest was 78 percent for the supersweet corn varieties and 71 percent for the sweet corn varieties.

At harvest all ears in the central 15 feet of the middle two rows in each plot were picked and weighed. A 10 ear subsample was weighed, shucked, weighed, and evaluated for length, maximum diameter, diameter 6 inches from the base, and kernel row number. Ear taper was calculated by the difference between the maximum diameter and the diameter at 6 inches from the base. Ear taper is a descriptive measure of ear shape; the higher the ear taper, the less cylindrical the shape of the ear. A composite subsample consisting of five ears from each replicate of each variety (20 ears total) was taken to the American Fine Foods processing lab and evaluated for moisture and processing recovery. The processing recovery was calculated as the percentage of the weight of the unhusked ears that was recovered as cut corn. Processing recovery data for each variety was based on a composite sample and was not replicated. Degree days were measured and calculated by a biophenometer at the Malheur Experiment station. Data were analyzed by analysis of variance. Means separation was determined by the protected least significant difference test.

Results and Discussion

Emergence for the supersweet corn started on May 6. Varieties Punchline, Sheba, and Bandit were among the highest rated for stand on the first stand count (May 8, Table 1). Final stand counts on May 20 ranged from 58 to 89 percent. Sheba, GSS 6274 F1, and Punchline were among the highest rated for stand count on May 20. Yields of unhusked ears ranged from 6 to 11 t/ac (Table 2). Marvel, Mecca, Uprise, and Sheba were among the highest rated for yield. Maverick, Contender, and Trigger had ears with the least taper (most cylindrical ears). Recovery of cut corn ranged from 35 to 54 percent among varieties. Marvel, Contender, and GSS 6274 had the highest cut corn yield.

Emergence for the sweet corn varieties started on June 10 and ranged from 61 to 90 percent (Table 3). Varieties Chase and GH 1861 lodged heavily (stalks bent at base,and lying flat on ground), and Tracer lodged moderately (stalks bent at base and lying at a 45° angle), based on visual observations. Yields of unhusked ears ranged from 7 to 9 t/ac. GH 1861, HMX 5371, HMX 5372, GH 1887 F1, and Sequel were among the highest rated for yields. Excalibur, HMX 5372, and Tracer had ears with the least taper (most cylindrical ears). Recovery of cut corn ranged from 41 to 58 percent. Sequel and XPH 3125 were among the highest rated for cut corn yields.

Corn yields in the 1996 variety trials averaged lower than in the 1995 variety trials. Total yields for the supersweet corn were 11.3 t/ac in 1995 vs. 8.8 t/ac in 1996, and for the sweet corn total yields were 10.1 t/ac in 1995 vs. 8.3 t/ac in 1996. Higher average corn yields in 1995 compared to 1996 could be associated with hotter weather in 1996. There were 54 degree days in the sub-optimal range (86 to 104 °F) from June through August in 1996 and only 27 in 1995. Lower yields at the Malheur Experiment Station in 1996 were consistent with lower yields of corn grown in the Treasure Valley for canning by American Fine Foods.

Table 1. Supersweet corn stand counts. Corn was planted on April 26, 1996 and emergence started on May 6. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1996.

Variety	Seed source[1]	Stand count		
		May 8	May 10	May 20
		---------------- % ----------------		
Sheba	4	56.2	75.3	89.0
GSS 6274 F1	1	48.7	72.8	88.3
Punchline	4	79.3	53.0	88.2
Uprise	5	46.5	68.7	87.8
GSS 9298 F1	1	39.8	72.7	87.7
Mecca	4	38.2	70.8	86.7
Endeavor	4	46.2	67.8	86.7
Bandit	5	51.7	75.5	85.0
Shaker	4	24.5	58.7	83.2
Victor	2	17.8	52.2	82.5
710 Crisp N' Sweet	3	20.0	54.8	81.7
Trigger	3	37.8	59.2	79.7
Marvel	3	24.2	50.2	78.2
Contender	3	25.2	52.0	77.8
HMX 5375S	5	12.8	39.5	75.5
FMX 412	2	16.8	53.0	68.8
Missouri	3	2.7	11.8	60.0
Maverick	4	34.0	58.3	64.2
LSD (0.05)		11.9	15.2	14.6

[1]Sources: 1= Rogers/Sandoz, 2= Ferry-Morse, 3= Crookham, 4= Asgrow, 5= Harris-Moran

Table 2. Plant development, yield, and ear characteristics of supersweet corn varieties in 1996. Malheur Experiment Station, Oregon State University, Ontario, Oregon.

Variety	Seed source[1]	Days to mid-silk[2]	Days to harvest[2]	Degree days to harvest[3]	Yield[4]	Harvest date	Ear weight	Ear length	Max. ear diameter	Taper[5]	Rows	Moisture	Recovery[6]	Cut corn yield
					t/ac		lb	----- inches -----			#	------ % ------		t/ac
Marvel	3	63	95	1,550	11.0	August 9	0.61	8.1	2.2	0.63	17.2	78.1	54	5.9
Mecca	4	70	98	1,633	10.9	August 12	0.59	8.0	2.0	0.50	17.6	76.2	37	4.0
Uprise	5	61	93	1,508	10.5	August 7	0.65	7.5	2.1	0.50	17.3	77.2	42	4.4
Sheba	4	59	92	1,492	10.4	August 6	0.69	8.5	2.0	0.37	14.4	77.8	42	4.4
Shaker	4	68	95	1,550	10.0	August 9	0.64	8.3	1.9	0.34	17.5	76.1	35	3.5
GSS 6274 F1	1	70	98	1,633	10.0	August 12	0.59	7.8	2.1	0.38	18.8	77.6	45	4.5
Contender	3	61	92	1,492	9.9	August 6	0.74	7.8	2.1	0.23	16.0	78.2	49	4.9
HMX 5375S	5	70	99	1,660	9.8	August 13	0.69	7.9	2.0	0.38	18.1	77.6	39	3.8
FMX 412	2	67	98	1,633	9.7	August 12	0.71	7.7	2.1	0.38	19.7	77.7	42	4.1
GSS 9298 F1	1	61	92	1,492	9.4	August 6	0.68	7.1	2.0	0.32	18.4	78.5	41	3.9
Victor	2	71	99	1,660	8.3	August 13	0.50	8.0	2.1	0.60	18.0	na	na	na
710 Crisp N' Sweet	3	67	95	1,550	8.3	August 9	0.49	7.7	2.0	0.68	16.6	78.2	44	3.7
Missouri	3	67	95	1,550	8.2	August 9	0.49	8.7	2.1	0.41	16.6	78.8	42	3.4
Trigger	3	72	99	1,660	6.7	August 13	0.61	7.5	2.0	0.30	18.1	78.5	40	2.7
Punchline	4	68	95	1,550	6.6	August 9	0.62	7.0	2.0	0.35	16.8	77.2	40	2.6
Bandit	5	70	98	1,633	6.6	August 12	0.65	6.6	2.0	0.37	17.5	77.5	42	2.8
Endeavor	4	66	95	1,550	6.4	August 9	0.54	7.0	2.0	1.01	16.7	77.9	41	2.6
Maverick	4	70	99	1,660	5.9	August 13	0.62	7.2	1.9	0.28	17.8	76.6	39	2.3
Average		67	96	1,581	8.8		0.62	7.7	2.0	0.45	17.4	77.6	42	3.7
LSD (0.05)					1.1		0.05	0.4	0.1	0.12	0.7			

[1]Seed sources: 1= Rogers/Sandoz, 2= Ferry-Morse, 3= Crookham, 4= Asgrow, 5= Harris-Moran

[2]from emergence. [3]degree days (50 - 86 ^{o}F) from emergence. [4]yield of unhusked ears.

[5] max. diameter minus diameter 6" from the base. [6] % of unhusked ear weight recovered as cut corn.

Table 3. Plant development, yield, and ear characteristics of sweet corn varieties in 1996. Malheur Experiment Station, Oregon State University, Ontario, Oregon.

Variety	Seed source[1]	Days to mid-silk[2]	Days to harvest[2]	Degree days to harvest[3]	Stand June 17	Yield[4]	Harvest date	Ear weight	Ear length	Max. ear diameter	Taper[5]	Rows	Moisture	Recovery[6]	Cut corn yield
					%	t/ac		lb	----- inches -----			#	----- % -----		t/ac
GH 1861	1	50	77	1,530	72.9	9.3	August 26	0.68	8.8	2.0	0.31	17.8	72.0	41	3.8
HMX 5371	4	56	85	1,658	81.2	9.2	September 3	0.66	7.9	2.1	0.26	18.9	71.1	47	4.3
HMX 5372	4	56	81	1,615	78.0	9.2	August 30	0.71	8.6	2.1	0.19	17.8	72.6	50	4.6
GH 1887 F1	1	50	80	1,593	79.2	9.1	August 29	0.74	8.3	2.0	0.32	19.2	70.6	50	4.6
Sequel	3	56	86	1,669	86.0	9.0	September 4	0.81	8.1	2.1	0.27	16.9	70.1	53	4.8
Excalibur	5	56	86	1,658	88.7	8.8	September 3	0.68	8.1	2.0	0.14	22.4	72.0	47	4.1
Chase	3	50	77	1,530	81.9	8.6	August 26	0.7	9.0	2.0	0.25	18.3	71.2	47	4.0
XPH 3125	3	56	81	1,615	79.7	8.2	August 30	0.75	8.5	2.1	0.31	16.7	71.8	58	4.8
Splendor	2	56	86	1,669	69.7	8.1	September 4	0.81	8.6	2.2	0.26	22.6	68.7	50	4.1
Regal	2	56	86	1,669	62.0	7.7	September 4	0.74	8.4	2.1	0.38	21.5	67.5	48	3.7
StylePak	5	56	86	1,669	90.9	7.5	September 4	0.7	8.1	1.9	0.32	20.5	69.3	43	3.2
GH 9056 F1	1	56	85	1,658	60.7	7.3	September 3	0.65	8.1	2.0	0.45	21.0	71.3	46	3.4
Tracer	3	58	86	1,669	88.4	7.1	September 4	0.64	9.0	2.1	0.22	17.7	72.4	49	3.5
HMX 5373	4	56	81	1,615	75.5	7.0	August 30	0.66	8.3	2.1	0.34	17.4	75.1	43	3.0
Average		55	83	1,630	78.2	8.3		0.7	8.4	2.1	0.3	19.2	71.1	48	4.0
LSD (0.05)					9.9	1.6		0.06	0.3	0.1	0.07	0.9			

[1]Sources: 1= Rogers/Sandoz, 2= Ferry-Morse, 3= Crookham, 4= Asgrow, 5= Harris-Moran

[2]from emergence. [3]Degree days (50 - 86 °F) from emergence [4]yield of unhusked ears.

[5] max. diameter minus diameter 6" from the base. [6] % of unhusked ear weight recovered as cut corn.

WEED CONTROL IN SWEET CORN

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Ontario, OR 1996

Purpose

Preplant incorporated herbicides alone and in tank-mixes were tested for annual grass and broadleaf weed control in sweet corn.

Procedures

The herbicides evaluated in this study were Axiom 68 WG alone and in mixtures with either Atrex 4L or Bladex 4L, and, for comparison, treatments of Frontier 7.5 SL and Dual 8E. The plot area was in a field that had been in winter wheat the previous year. Following the 1995 harvest the field was plowed and cultivated, and fertilizer was broadcast at 100 lb P and 20 lb N per acre. The soil was Greenleaf silt loam with an organic matter content of 1.5 percent and a pH of 7.6. The field was planted again to winter wheat and corrugated. In May the emerged winter wheat was killed with Roundup and the existing beds were used.

On May 25, a mixture of weed seeds from mill screenings was broadcast uniformly with a hand-cranked spreader over the 32 plots (8 treatments x 4 replications) each of which was 10 by 30 ft. A mixture of weed seeds from mill screenings was broadcast uniformly with a hand-cranked spreader. Herbicide treatments were applied with a hand sprayer with a four nozzle boom with 8003 flat fan tips spaced 30 inch and operated at 40 psi. Treatments were applied in a water carrier at 20 gallons per acre. Herbicide treatments and weed seed were immediately incorporated into the surface 2 in of the beds by harrowing in two directions with a spike-toothed bed harrow.

On May 26, Golden Jubilee sweet corn was planted approximately 2 in deep into moist soil. Seeding rate was 30,000 seeds per acre, or 1.7 seeds per foot of row, in rows spaced 30 in apart. Rainfall from May 12 to 18 totaled 2.33 in at the site, with another 0.02 in of rain on May 29. The average daily high temperature for the period May 26 to June 3 was 76 ^{0}F. Corn had emerged uniformly by June 3, and corn plants were visually evaluated for herbicide tolerance on June 12. The field was furrow irrigated from gated pipe to maintain adequate moisture for the corn. Herbicide effectiveness was evaluated visually on June 27 . The hand-weeded check plots were weeded to provide 100 percent weed control, and the untreated check plots for each replicate represented zero weed control for that replicate. On July 12, Urea fertilizer at 100 lb N per acre was applied dissolved in the irrigation water.

The comparative effectiveness of the treatments to control weeds was evaluated using ANOVA and the protected least significant difference test at the 5 percent level LSD (0.05).

Results

One plot treated with Axiom + Atrex showed slight chlorosis on the corn when the plots were evaluated on June 12, but other than that, there were no treatments showing any symptom of phytotoxicity. Percent control was visually estimated and recorded for each weed species found in each plot (Table 1).

Herbicide treatments providing the highest percent control of redroot pigweed were Axiom + Atrex, Axiom + Bladex, and Frontier. Herbicide treatments resulting in the highest percentage control of barnyardgrass were Axiom + Atrex, Axiom + Bladex, and Dual. Yellow foxtail control was adequate with all treatments. Populations of common mallow and lambsquarters were too sporadic to detect differences in control between any of the herbicide treatments. The results suggest that Axiom, when used in combination with another herbicide, can control annual grasses and redroot pigweed, lambsquarters, and common mallow in sweet corn.

Table 1. Weed control results from preplant incorporated herbicide treatments on Golden Jubilee sweet corn. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1996.

Treatment	Herbicide rate	Redroot pigweed	Barnyard-grass	Yellow foxtail	Lambs-quarters	Common mallow
	lb ai/acre	percent control				
Hand-weeded Check	-	100	100	100	100	100
Axiom 68WG + Atrex 4L	0.85 + 1.5	98	99	98	100	99
Axiom 68WG + Bladex 4L	0.85 + 3.0	95	100	100	100	97
Axiom 68WG	0.85	87	98	99	87	100
Axiom 68WG	0.94	88	98	98	88	70
Frontier 7.5SL	1.5	97	98	99	87	72
Dual 8E	3.0	88	99	99	90	68
Untreated check	-	0	0	0	0	0
LSD (0.05)		7.3	1.6	2	19	33

1996 SMALL GRAIN VARIETY TRIALS

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Purpose

The purpose of these trials was to evaluate the performance of newly released and commercially available small-grain cultivars under local cultural practices and environmental conditions. Data obtained from these trials provide local producers with area-specific information for cultivar selection. The data also provides public and private plant breeders with site-specific performance information for advanced lines and newly released varieties.

Six small grain variety trials were conducted at the Malheur Experiment Station during the 1995-96 crop year. The OSU statewide winter cereal, winter barley, spring cereal, and spring barley trials were conducted as part of a statewide small-grain variety testing program. For the fifth year, fall-planted fall-emergence and fall-planted winter-emergence wheat trials were conducted at the Malheur Experiment Station. The purpose of these trials is to develop a database to help local growers decide when to stop planting winter types and start planting spring types.

Procedures

All winter and spring trials were planted in a randomized complete-block design with three replications. Each plot was planted on one or two 60-inch beds (depending on the trial) with seven rows spaced 7 inches apart on each bed. The dimensions of each plot were 5 or 10 feet wide by 15 feet long. All trials were furrow irrigated. At maturity, harvest samples were collected from a 50-inch swath through the center of each plot, an area of 62.5 square feet. All "harvester-run" samples were cleaned with an aspirator cleaner and processed at the Malheur Experiment Station.

Winter Trials

The 1996 winter cereal trials followed the 1995 harvest of sweet corn. No preplant fertilizer was applied. The OSU statewide winter cereal, OSU statewide winter barley, and the fall-planted fall-emergence wheat trials were planted October 10, 1995. All entries were drilled approximately 1 inch deep. The seeding rate for the OSU statewide winter cereal trial and the OSU statewide winter barley trial was 30 seeds per square foot. The seeding rate for the fall-planted fall-emergence wheat was 120 pounds per acre.

The fall-planted winter-emergence wheat trial was planted at 120 pounds per acre on December 4, 1995. The planting procedure was the same as for the previously described fall-planted trials.

On April 10, 1996, all six nurseries were top-dressed with 100 lb/ac N as ammonium sulfate.

To control broadleaf weeds, a tank-mix containing 2.4 pints of Curtail and 0.25 pints (0.125 lb ai/ac) of dicamba (Banvel) in 30 gallons of water per acre was applied by ground-rig over the winter trials on April 14, 1996.

The three wheat trials were furrow irrigated on May 3, June 6, and June 19. The winter barley trial was furrow irrigated on May 3 and June 6.

The trials were harvested on August 1, 1996. Grain yield per acre was calculated based on a plot length of 18 feet for all four trials, due to the growth of the grain plants using space above ground to the east and west beyond the planted edges of the plots.

Spring Trials

The 1996 spring cereal trials were grown in the same field as the winter trials with no preplant fertilizer. All entries in the OSU statewide spring cereal trials and the OSU statewide spring barley trials were drilled approximately 1 inch deep into moist soil on March 15,1996. The seeding rate for both plantings was 30 seeds per square foot.

On April 10 both trials were top-dressed with 63 lb/ac N as ammonium sulfate.

On April 15 a tank-mix containing 1.5 pints per acre (0.75 lb ai/ac) of MCPA (Bronate 4EC), and 0.25 pints per acre (0.125 lb ai/ac) of dicamba (Banvel) in 30 gallons of water per acre was applied by ground-rig over both trials.

Irrigations were applied on May 3, June 4, and June 19.

Both spring trials were harvested July 30, 1996. Grain yield per acre was calculated based on a plot length of 18 feet for both trials, due to the growth of the grain plants using space above ground to the east and west beyond the planted edges of the plots.

Variety performance was compared in each trial using ANOVA and protected least significant differences at the 5 percent level, LSD (0.05).

Results and Discussion

1995-96 Winter Cereal Grain Trials

Good seedling emergence was achieved. Weather during November was unusually warm, and fall planted grain developed more than usual, resulting in many tillers late in winter and early spring. The well-developed plants helped provide the basis for high yields in 1996.

The OSU statewide winter cereal trial included 14 soft white winter wheats, one hard red winter wheats, one winter club wheat, and four winter triticales (Table 1). Yields for the soft white cultivars ranged from 157 bu/ac for Stephens to 113 bu/ac for Hiller. Test weights for the soft whites ranged from 61.2 lb/bu for ID8614502B to 55.8 lb/bu for Hiller. Protein for the soft white cultivars has not been determined. The average heading date (50 percent headed) for the trial was May 24. Heading dates for soft white wheat cultivars ranged from May 19 for ID8614502B to May 27 for Basin and Daws. At maturity, plant heights within the soft whites ranged from 31 inches for Basin to 39 inches for Hill 81. Lodging was observed mostly in the plots adjoining the onion field on the north side of the grain trial irrespective of variety.

The OSU statewide winter barley trial included 10 six-row feed barley entries (Table 2). Yields ranged from 9,445 lb/ac for SDM 204B to 7,016 lb/ac for Hundred. Test weights ranged from 44.4 lb/bu for Hundred to 48.4 lb/bu for the variety Gwen. Protein levels are yet to be determined. The average heading date (50 percent headed) for the nursery was May 13. Heading dates ranged from May 8 for Gwen to May 18 for SDM 204B. At maturity, plant height ranged from 28 inches for Kold to 37 inches for Steptoe. Lodging was insignificant for all entries in 1996.

Both the fall-planted fall-emergence wheat trial and the fall-planted winter-emergence wheat trial included the same eight soft white and two hard red wheat cultivars (Tables 3 and 4).

Yields in the fall-emergence trial ranged from 157 bu/ac for Stephens to 128 bu/ac for Anza (Table 3). Test weights for the soft white types ranged from 63.7 lb/bu for Alpowa to 59.5 lb/bu for Stephens. The average heading date (50 percent headed) for the fall-emergence trial was May 16. Heading dates ranged from May 12 for Alpowa to May 22 for Malcolm and MacVicar. The difference in the mean heading dates for winter versus spring cultivars was significant. At maturity, plant heights ranged from 34 to 38 inches. At harvest no statistically significant differences in lodging were observed.

In the winter-emergence trial, yields ranged from 149 bu/ac for Penawawa to 115 bu/ac for ID0448 (Table 4). Test weights for the soft white types ranged from 62.3 lb/bu for Alpowa to 57.3 lb/bu for MacVicar. The average heading date (50 percent headed) for the winter-emergence trial was May 28. Heading dates ranged from May 23 for Alpowa to June 6 for MacVicar. At maturity, plant heights ranged from 34 to 38 inches. At harvest, lodging was observed in the plots adjoining the onion field to the north.

Yields of Penawawa were relatively high where the variety was planted on October 14 or December 4. The yields of Stephens, Malcolm, and MacVicar were among the highest when planted on October 14, but they were significantly less than Penawawa when planted on December 4.

1996 Spring Cereal Grain Trials

Considerable heat occurred toward the end of the grain fill period in 1996. The heat apparently was less favorable for the spring grains, reducing their productivity.

Yields for the soft white types in the OSU statewide spring cereal trial ranged from 115 bu/ac for Sunstar Promise to 95 bu/ac for Pomerelle (Table 5). Yields for the hard red types ranged from 106 bu/ac for Yecoora Rojo to 99 bu/ac for WPB 926R. The yield for the triticale TriCal 2700 was 89 bu/ac. Test weights for the spring white wheats ranged from 64.2 lb/bu for ID 377S (a hard white wheat) to 60.0 lb/bu for Pomerelle. Test weights for the hard red cultivars ranged from 63.5 lb/bu for Yecoora Rojo to 61.9 lb/bu for WPB 926R. Heading dates (50 percent headed) for the soft white wheats ranged from May 31 for Centennial to June 5 for ID 448. Heading dates for the hard red types ranged from May 31 for several varieties to June 5 for Pomerelle. At maturity, plant heights for the soft white cultivars ranged from 32 inches for Treasure to 38 inches for Wawawai. No lodging was observed among any of the entries in this trial.

The OSU statewide spring barley trial included nine feed, two malting, and three hulless cultivars (Table 6). Yields ranged from 6,906 lb/ac for Steptoe treated with Baytan to 4,038 lb/ac for Waxbar. Test weights ranged from 62.1 lb/bu for WPB BZ489-74 (a hulless barley) to 46.8 lb/bu for Gustoe. The average heading date (50 percent headed) for the trial was June 1. Heading dates ranged from May 26 for Russell to June 5 for Idagold. At maturity, plant heights ranged from 23 inches for Gustoe to 34 inches for Colter. Waxbar lodged severely with no other variety lodging.

Table 1. Statewide winter cereal trial planted October 14, 1995, and harvested August 1, 1996, at Ontario, Oregon. Malheur Experiment Station, Oregon State University, Ontario, Oregon.

Variety	Market class[1]	Yield[2]	Test weight	Protein	Plant height	Heading date	Lodging
		bu/ac	lb/bu	%	inches	May	%
Daws	SWW	127	59.7	9	36	27	0
Gene	SWW	130	56.8	10.6	34	20	0
Hill 81	SWW	135	59.3	9.6	39	27	0
Hiller	SWW	113	55.8	9.5	37	24	13
MacVicar	SWW	150	60.2	8.9	36	24	0
Madsen	SWW	143	59.1	9.7	36	26	0
Madsen + Stephens	SWW	149	59.4	8.9	36	21	0
Malcolm	SWW	148	58.8	9.6	38	22	13
Rhode	Club	128	60.3	9.5	37	24	30
Stephens	SWW	152	59.7	9.7	36	21	3
Stephens (Gaucho)[3]	SWW	157	59.5	10.1	36	21	0
Celia	Trit	96	53.1	10.2	36	23	0
Rod	SWW	137	58.7	9	37	28	11
ID8614502B	SWW	138	61.2	9.4	34	19	3
ID 467	HRW	134	61. 0	9.2	36	22	2
RS87-123	Trit	131	52.8	8.3	46	15	0
RS87-183	Trit	126	54.1	9	46	15	0
RS87-202	Trit	131	52.1	9.9	47	14	0
W-301	SWW	151	59.6	10.3	38	22	43
Basin	SWW	136	59.7	8.6	31	27	3
Mean		135	58.1	9.5	38	22	6
LSD (0.05)		11	1.6	1	2	2	22

[1] Market classes were soft whit winter wheat, club wheat, triticale, and hard red winter wheat.

[2] Yield reported on basis of 60 lb/bu at 12 percent moisture.

[3] Gaucho seed treatment., all entries were treated with Vitavax RTU.

Table 2. OSU statewide winter barley trial planted October 14, 1995, and harvested August 1, 1996, at Ontario, Oregon. Malheur Experiment Station, Oregon State University, Ontario, Oregon.

Variety	Yield[1]	Test weight	Protein	Plant height	Heading date	Lodging
	lb/ac	lb/bu	%	inches		%
Gwen	6,899	48.4	9.2	30	8	0
Hesk	7,603	44.8	8.3	29	15	0
Hesk (Baytan) [2]	7,479	45.3	8.4	28	13	0
Hundred	7,016	44.4	8.8	31	13	0
Kold	7,164	46.1	8.8	28	13	2
Scio	7,311	45.1	8.9	30	12	0
Steptoe	7,549	48.2	9	37	12	0
ORW 6	7,867	46.7	8.7	29	11	0
SDM 204B	9,445	45.3	7.4	34	18	0
OR81019	7,263	46.9	9.3	29	10	0
Mean	7,560	46.1	8.7	31	13	0
LSD (0.05)	1,071	1.4	0.3	3	3	ns

[1] Yield reported on basis of 10 percent moisture.

[2] Baytan seed treatment. All other entries were treated with Vitavax RTU.

Table 3. Malheur fall emergence wheat trial planted October 14, 1995, emerged late October 1996; harvested August 1, 1996. Malheur Experiment Station, Oregon State University, Ontario, Oregon.

Variety	Market class[1]	Yield[2]	Test weight	Plant height	Heading date	Lodging
		bu/ac	lb/bu	inches	May	%
Penawawa	SWS	151	60.8	36	13	13
Treasure	SWS	138	61.7	36	14	28
Pomerelle	SWS	140	61.1	37	14	25
Alpowa	SWS	141	63.7	38	12	0
Centennial	SWS	128	63. 0	36	13	0
Yolo	HRS	132	62.5	34	14	0
Anza	HRS	122	62. 0	35	13	0
Stephens	SWW	157	59.5	36	21	0
Malcolm	SWW	156	59.9	37	22	0
MacVicar	SWW	156	60.3	38	22	0
Mean		142	61.4	37	16	7
LSD (0.05)		11	0.7	2	1	ns

[1]Market classes were soft white spring wheat, hard red spring wheat, and soft white winter wheat.

[2] Yield reported on basis of 60 lb/bu at 12 percent moisture.

Table 4. Malheur winter emergence wheat trial planted on December 4, 1995, emerged during February, and harvested on August 1, 1996. Malheur Experiment Station, Oregon State University, Ontario, Oregon.

Variety	Market class[1]	Yield[2]	Test weight	Plant height	Heading date	Lodging
		bu/ac	lb/bu	inches		%
Penawawa	SWS	149	61.5	34	May 24	0
Treasure	SWS	126	59.9	36	May 28	37
Pomerelle	SWS	115	59.7	37	May 28	27
Alpowa	SWS	136	62.3	38	May 23	0
Centennial	SWS	134	62.7	37	May 24	0
Yolo	HRS	129	62.8	34	May 24	0
Anza	HRS	135	62.4	34	May 24	0
Stephens	SWW	131	59.9	37	June 3	0
Malcolm	SWW	128	57.9	37	June 5	0
MacVicar	SWW	119	57.3	37	June 6	0
Mean		130	60.6	36	May 28	6
LSD (0.05)		17	2.5	2	0.4 days	ns

[1] Market classes were soft white spring wheat, hard red spring wheat, and soft white winter wheat.

[2] Yield reported on basis of 60 lb/bu at 12 percent moisture.

Table 5. OSU statewide spring cereal trial planted March 15, 1996, and harvested July 30, 1996, at Ontario, Oregon. Malheur Experiment Station, Oregon State University, Ontario, Oregon.

Variety	Market class[1]	Yield[2]	Test weight	Protein	Plant height	Heading date	Lodging
		bu/ac	lb/bu	%	inches		%
Alpowa	SWS	108	63.4	8.5	34	June 3	0
Alpowa (Gaucho[3])	SWS	112	63.7	8.2	35	June 3	0
Centennial	SWS	105	62.2	7.9	34	May 31	0
ID 377S	HW	104	64.2	8.8	35	May 29	0
ID 488	SWS	108	62.1	9.7	34	May 31	0
ID 462	HRS	94	62.9	7.3	34	May 31	0
Klasic	HW	90	63.9	8.8	26	May 28	0
OR 3895181	HW	113	61.4	9.2	34	May 30	0
Penawawa	SWS	110	62.7	8.3	33	June 2	0
Pomerella (ID 448)	SWS	95	60. 0	9.6	34	June 5	0
SDM 405S	SWS	106	61.6	9.6	34	June 3	0
Sunstar Promise	SWS	115	61.9	8.3	36	June 4	0
Treasure	SWS	107	61. 0	8.3	32	June 4	0
TriCal 2700	Trit	89	54.8	7.8	51	June 5	0
WaWaWai	SWS	112	62.9	8.7	38	May 31	0
Whitebird	SWS	100	62.8	8.2	36	June 3	0
WPB 926R	HRS	99	61.9	9.8	35	May 29	0
Anza	HRS	102	62.6	8.7	30	June 4	0
Yecoora Rojo	HRS	106	63.5	11.2	27	May 28	0
Yolo	HRS	105	61.4	8.6	32	June 3	0
Mean		104	62. 0	8.8	34	June 1	0
LSD (0.05)		16	1. 0	1.6	2	2 days	ns

[1] Market classes were soft white spring wheat, hard white wheat, hard red spring wheat, and triticale.

[2] Yield reported on basis of 60 lb/bu at 10 percent moisture.

[3] Gaucho seed treatment. All entries were treated with Vitavax RTU.

Table 6. OSU statewide spring barley trial planted March 15, 1996, and harvested July 30, 1996, at Ontario, Oregon. Malheur Experiment Station, Oregon State University, Ontario, Oregon.

Variety	Market class	Yield[1]	Test weight	Protein	Plant height	Heading date	Lodging
		lb/ac	lb/bu	%	inches		%
Baronesse	2F	6,683	53.1	7.7	27	May 31	0
Colter	6F	5,738	49. 0	7.5	34	May 29	0
Crest	2M	5,572	53.4	8.2	29	May 31	0
Maranna	6F	6,218	48.7	8.5	25	May 29	0
Payette	6F	5,806	48.9	9.1	25	June 1	0
Russell	6M	4,994	48.6	8.2	30	May 26	0
Steptoe	6F	6,358	48.1	8.6	32	May 29	0
Steptoe (Baytan)[3]	6F	6,906	48.6	8.4	33	May 29	0
Bear (WA 11045-87)	hulless	5,531	59.2	8.8	33	June 1	0
Waxbar	hulless	4,038	58. 0	8.6	28	June 4	50
WPB BZ489-74	hulless	4,539	62.1	8.7	28	June 4	0
Galena	2F	5,885	51.6	7.6	24	June 4	0
Idagold	2F	5,315	51.5	7.9	24	June 5	0
Gustoe	6F	6,768	46.8	8.2	23	June 1	0
Mean		5,739	52. 0	8.3	28	June 1	4
LSD (0.05)		962	1. 0	0.6	3	1 day	19

[1] Market classes were two row feed barley, six row feed barley, two row malting barley, six row malting barley, and hulless.

[2] Yield reported on basis of 60 lb/bu at 10 percent moisture.

[3] Baytan seed treatment. All other entries were treated with Vitavax RTU.