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Malheur Experiment Station

Malheur County Crop Research 1990

Agricultural Experiment Station
Oregon State University

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Malheur County Crop

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Agricultural Experiment Station

Oregon State University, Corvallis

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CONTENTS

Weather Report 1

ALFALFA

Forage Alfalfa Variety Evaluation 10

An Evaluation of Soil and Foliar Active Herbicides for Weed Control in Seedling and Established Stands of Alfalfa Grown for Seed 17

Paraformaldehyde Fumigation For Chalkbrood Control in Leafcutting Bee Nesting Material 23

MINT

An Evaluation of Herbicides for Crop Tolerance and Weed Control in Peppermint and Spearmint Grown by Furrow Irrigation in Eastern Oregon and Southwest Idaho 25

ONIONS

Onion Variety Trials 34

An Evaluation of Herbicides for Weed Control and Onion Tolerance When Applied as Postemergence Treatments to Seedling Onions and Weeds 39

Resistance of Onion Cultivars to Basal Plate Rot 43

Estimating Yield Loss Due to Hail Damage in Onions 48

Insecticides for Onion Thrips (Thrips tabaci-Lindeman) Control in Sweet Spanish Onions - 1990 55

Improved Nitrogen Fertilizer Efficiency for Onion Production 66

POTATOES

Effects of Thimet and Temik Insecticides on Tuber Yield and Quality of Four Potato Varieties 75

Performance of Potato Varieties Under Water Stress 80

Potato Herbicide Trials 86

CONTENTS CONTINUED

SMALL GRAINS

A Report Concerning Cereal Trial for Estimating Cultivar Adaptation to Furrow Irrigation in the Treasure Valley 93

1990 Management of the Russian Wheat Aphid Outbreak in Malheur County . . . 111

An Evaluation of Uniroyl C-4243 for Weed Control in Winter Wheat 117

An Evaluation of Soil and Foliar Active Herbicides for the Control of Broadleaf Weeds and Wild Oats in Winter Wheat 120

Soil Nitrogen Recovery By Stephans Wheat and Hesk Barley 123

SUGAR BEETS

Sugar Beet Variety Testing Results 129

The Comparison of Betamix to SN-38584 and Four Different Adjuvents for Tolerance of Seedling Sugar Beets and Weed Control 133

Weed Control and Tolerance of Seedling Sugar Beets to Application of Betamix, Stinger, and Poast Herbicides Applied as Repeat Treatments at Low Rates 135

An Evaluation of Fall and Spring Applied Herbicides for Weed Control and Crop Tolerance in Sugar Beets 139

Postemergence Applied LDG2880 + Moract for Selective Weed Control in Sugar Beets 142

The Effect of Added Nitrogen on Yield and Quality of Six Varieties of Sugar Beets 146

Early Season Sugar Beet Nitrogen Requirements 155

Correcting Sugar Beet Nitrogen Deficiencies 159

Sugar Beet Nitrogen Recovery 166

A Preliminary Evaluation of Aerial Photography To Determine Sugar Beet Nitrate Status 171

The Phytotoxicity of Counter Insecticide to Sugar Beets 176

CONTENTS CONTINUED

WEED CONTROL

The Control of Yellow Nutsedge with Fall Applied Preplow and Postemergence Application of Metolachlor (DUAL) 179

NITROGEN MANAGEMENT

Nitrogen Uptake and Removal by Selected Crops 182

Malheur County Crop Survey of Nitrogen and Water Use Practices 187

Fertilizer Nitrogen Savings 199

WEATHER REPORT

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Ontario, Oregon, 1990

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. A recording soil thermometer was added in 1967 and instruments to monitor growing degree days and solar radiation in 1985.

In 1962 the station began cooperating with the U.S. Department of Commerce, Environmental Science Service Administration, National Weather Service. Each day the 8:00 A.M. air temperature, preceding twenty four hour air and soil temperature extremes and twenty four hour accumulated precipitation are recorded and transmitted to radio station KSRV in Ontario. KSRV then conveys this information, along with their 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.

Total precipitation of 7.21 inches (Table 1) represented the lowest amount since 1966 when only 5.74 inches was recorded. This made 1990 the seventh consecutive year with below average precipitation (Table 2).

The fall (October-December) 1989 and winter (January-March) 1990 seasonal moisture total of 2.62 inches was the lowest amount in the past 10 years (Table 3). This lack of precipitation set new records in that it represented the first time no monthly total within the period exceeded one inch (Figure 1) and it was the lowest amount ever recorded during that six-month interval at this station.

With near record temperatures recorded during August and evaporation exceeding the ten year average during April, May, July, and September the seasonal total evaporation was 1.50 inches above average (Table 4). The total miles of wind was the lowest recorded during the period since 1977.

A last spring frost, May 8, and first fall frost, October 9, resulted in a 153 day frost free period which equaled the thirty year, (1961 to 1990), average (Table 5).

Air temperature ranged from a high of 106°F on August 8 to a low of -21°F on December 24. An absence of snow cover coupled with the December 19 arrival of a severe cold front caused the four- inch soil temperature to drop to a record breaking 12°F from December 24 through 26 (Table 6). These conditions effectively reduced the mean air and four-inch soil temperatures well below the monthly averages (Table 7 and Figures 2 and 3).

Total cumulative growing degree days as of the end of September were relatively near the five year average (Table 8 and Figure 4).

Table 1. Precipitation in inches at Malheur Experiment Station, OSU, Ontario, Oregon, 1990.

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	T	.10	T			.08					.22		
2	.05		T				.04					.01	
3			.05				T						
4		.02	T								.15		
5	.01		.06						T		.32		
6		T								.01			
7	.04					.15							
8	.09			.02									
9	.19	T		T				T					
10		.07	T					T					
11	.01		.55				T	T		T		.07	
12													
13	.03	T				.05						T	
14	.04	T			T							.03	
15	T					.06				.06			
16		.10											
17		T			T	.02		.05					
18			T	.05	.03		T	.22					
19				T				.07		.20		T	
20				.08	.28			T				.03	
21		.06		.25	.10			.16					
22		T		.05	T			.09		.22	T		
23			.06	.24	T								
24	T			.04	.24			T					
25					.01			.02				.04	
26				.05					T		T	.09	
27				.03	T							T	
28	T			.64	.45							.02	
29	T			.01	.30								
30	.01			.06	.14					T			
31	.02				.15		T						
Tot.1990	.44	.35	.72	1.52	1.70	.36	.04	.61	.00	.49	.69	.29	7.21
10yr.avg.	.97	1.06	1.43	.68	.94	.77	.32	.42	.53	.61	1.34	1.54	10.60
30yr.avg.	1.27	.93	.96	.73	.73	.80	.25	.54	.56	.60	1.25	1.35	9.97

Table 2. Annual precipitation 1981 through 1990 and 43 year average at Malheur Experiment, OSU, Ontario, Oregon.

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	43 yr. Ave.
Annual Precipitation (in inches)	15.58	13.79	16.87	9.49	7.89	8.64	9.81	7.58	9.15	7.21	9.89

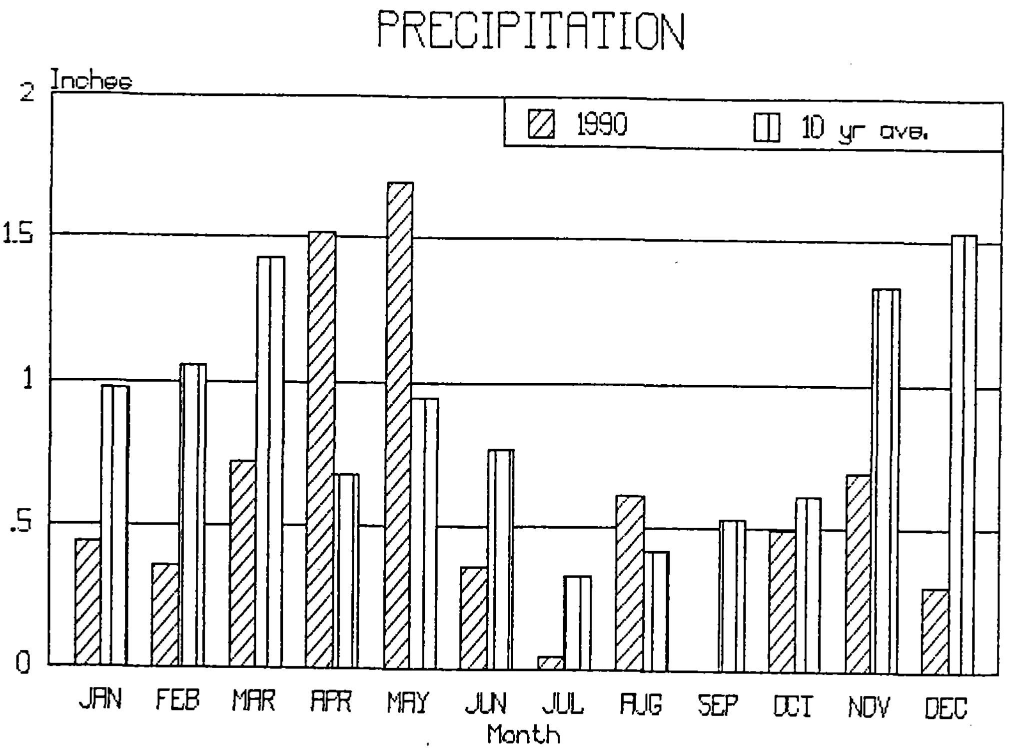

Figure 1. A comparison of the average monthly precipitation for 1990, to the ten year average, 1981 through 1990 at the Malheur Experiment Station, OSU, Ontario, Oregon.

Table 3. Ten year fall and winter precipitation - October through March, 1980-1990 at the Malheur Experiment Station, OSU, Ontario, Oregon.

Month	1980 / 81	1981 / 82	1982 / 83	1983 / 84	1984 / 85	1985 / 86	1986 / 87	1987 / 88	1988 / 89	1989 / 90	1990	30 Yr. Avg.
Oct	.17	.93	2.06	.33	.63	.71	.12	.00	.00	.86	.49	.60
Nov	.84	2.76	.91	2.08	1.59	1.05	.22	1.40	2.45	.24	.69	1.25
Dec	1.73	3.53	3.08	3.57	.84	.92	.22	1.46	1.48	.01	.29	1.35
Jan	1.07	1.73	1.46	.58	.11	.96	1.24	1.25	.88	.44		1.27
Feb	1.35	1.83	1.48	.72	.36	2.29	.77	.14	1.27	.35		.93
Mar	1.85	.68	3.73	1.36	.89	1.24	1.37	.26	2.17	.72		.96
F.Tot.[1]	2.74	7.22	6.05	5.98	3.14	2.68	.56	2.86	3.93	1.12	1.47	3.20
W.Tot.[2]	4.27	4.24	6.67	2.66	1.28	4.49	3.38	1.65	4.32	1.50		3.16
S.Tot.[3]	7.01	11.46	12.72	8.64	4.42	7.17	3.94	4.51	8.25	2.62		6.36

[1]F.Tot. = Total precipitation for fall quarter (October through December).
[2]W.Tot. = Total precipitation for winter quarter (January through March).
[3]S.Tot. = Total precipitation for season (October through March).

Table 4. Ten year total monthly evaporation in inches (from a standard 10" deep by $47^1/_2$" diameter pan) and total monthly wind in miles (measured at 6" above the pan) for the seven month irrigation seasons (April 1 through October 31) 1981 through 1990. Malheur Experiment Station, OSU, Ontario, Oregon.

Month		1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	10 yr. Avg.
		Evaporation in inches / Wind in miles										
Apr	E[1]	5.59	6.19	5.46	7.14	7.22	5.80	8.13	5.69	5.79	7.03	6.40
	W[2]	2634	3164	3030	4405	2823	2308	2354	1889	1929	1832	2637
May	E	8.64	9.85	8.99	7.61	8.93	8.31	9.55	8.76	8.74	10.07	8.95
	W	3529	3632	3073	3425	2787	2321	2432	2599	2620	2506	2892
Jun	E	8.31	9.32	10.23	9.64	10.86	10.91	9.51	11.17	10.78	10.05	10.08
	W	2294	2275	2707	2985	2492	1792	1898	2357	1872	1824	2250
Jul	E	11.76	9.74	10.60	11.69	12.68	12.00	11.46	13.35	12.84	12.12	11.82
	W	1976	3092	2284	2152	2111	2130	2161	2014	1707	1556	2118
Aug	E	11.87	10.56	9.55	11.39	10.58	11.61	11.08	11.25	9.73	9.78[3]	10.74
	W	1850	2084	1829	2139	2430	1740	1938	1879	1481	1276	1865
Sep	E	7.77	6.68	8.59	7.13	5.73	5.05	8.30	7.01	6.65	8.54	7.15
	W	1857	2488	2717	2251	2268	1413	1620	1604	1465	1357	1904
Oct	E	3.31	4.05	4.26	3.89	3.47	3.95	4.92	4.80	3.76	2.99	3.94
	W	1937	2356	2102	2290	2237	1544	1311	1294	1311	1427	1781
Annual Seasonal Total:												
	E	57.25	56.39	57.68	58.49	59.47	57.63	62.95	62.03	58.29	59.48	59.08
	W	16077	19091	17742	19647	17148	13248	13714	13636	12385	11778	15447

[1]E = Evaporation (inches)
[2]W = Wind (total miles)

[3]Due to an accidental draining of the evaporation pan at this station the value reported is from the Parma Experiment Station, University of Idaho, Parma, Idaho.

Table 5. Dates of latest spring frost and earliest fall frost and number of frost free days during growing season for past 30 years (1961 through 1990) at the Malheur Experiment Station, OSU, Ontario Oregon.

Year	Latest Spring Frost		Earliest Fall Frost		Frost-free Period (Total Days)
	Date	Temp. (^0F)	Date	Temp. (^0F)	
1961	May 5	31	Sep 22	30	139
1962	Apr 30	26	Oct 7	31	159
1963	Apr 21	28	Oct 24	32	186
1964	May 23	32	Oct 2	32	131
1965	May 5	30	Sep 17	30	134
1966	May 23	31	Oct 4	32	133
1967	May 11	32	Oct 15	32	156
1968	May 6	30	Oct 3	31	149
1969	Apr 30	28	Oct 5	30	157
1970	May 14	31	Sep 25	30	133
1971	Apr 27	32	Sep 18	30	143
1972	May 1	30	Sep 25	30	146
1973	May 11	31	Oct 3	31	144
1974	May 18	30	Sep 28	31	132
1975	May 25	27	Oct 8	31	135
1976*	Apr 23	32	Oct 5	32	164
1977	Apr 20	29	Sep 22	32	154
1978	Apr 23	31	Oct 14	30	173
1979	Apr 20	32	Oct 27	32	189
1980	Apr 13	31	Oct 17	28	186
1981	Apr 14	27	Oct 1	32	169
1982	May 5	30	Oct 5	32	152
1983	Apr 27	31	Sep 20	29	145
1984	May 7	31	Sep 25	26	140
1985	May 13	32	Sep 29	25	138
1986	May 23	32	Oct 12	25	141
1987	Apr 21	29	Oct 11	28	172
1988	May 2	31	Oct 30	31	180
1989	May 19	30	Oct 16	27	149
1990	May 8	31	Oct 9	32	153
30 Year Average	May 5	30	Oct 5	30	153

* On June 26, 1976, there was a severe killing frost at many locations around the Treasure Valley which effectively reduced the frost free period to 100 days for that year. The temperature at this station was 34 degrees.

Table 6. Five year (1986-1990) summary of weather at Malheur Experiment Station, OSU, Ontario, Oregon.

	1986	1987	1988	1989	1990
Total Precipitation (inches.)	8.64	9.81	7.58	9.15	7.21
Total Snowfall (inches)	13.0	15.5	34.8	25.0	8.5
First Fall Snowfall	Dec 19	Nov 25	Nov 7	Nov 23	Dec 22
Greatest amount of snow on ground at one time	Jan 5 10"	Jan 2 6"	Dec 25 9"	Feb 17 17"	Dec 28 3.5"
Coldest day of year Air Temperature	Jan 7 -2°F	Jan 20 2°F	Dec 27-30 -6°F	Feb 5-6 -24°F	Dec 22 -21°F
Hottest day of year Air Temperature	Aug 10 101°F	Jul 15,16&27 Aug 10 99°F	Jul 26,31 102°F	Jul 28 103°F	Aug 8 106°F
Number of days ≤0°F	5	0	7	14	9
Number of days >0°F and ≤32°F	132	139	145	156	144
Number of days ≥90°F and <100°F	62	59	61	42	63
Number of days ≥100°F	6	0	8	7	14
Date of last spring frost Air Temperature	May 23 32°F	Apr 21 28°F	May 2 31°F	May 19 30°F	May 7&8 31°F
Date of first fall frost Air Temperature	Oct 12 25°F	Oct 11 28°F	Oct 30 31°F	Sep 13 32°F	Oct 7 31°F
Frost free growing season days	141	172	180	149	153
Highest Soil Temperature	94°F May 30 -Jun 1	94°F Jul 15 & 31	97°F Jul 26 & 31	95°F Jul 28	96°F Aug 9
Lowest Soil Temperature	26°F Jan 1-2	26°F Jan 22	29°F Jan 4	28°F Dec 14, 27 & 31	12°F Dec 24 -26
Total days wind ≥125 miles					25
Total days wind ≥200 miles					4
Day of greatest miles of wind Miles					Apr 24 301

Record Extremes:
- Maximum Air Temperature: 108°F, August 4, 1961
- Minimum Air Temperature: -26°F, January 21 - 22, 1962
- Minimum Soil Temperature: 12°F, December 24 - 26, 1990
- Greatest amount of Precipitation in 24 hour period: 1.52 inches, September 14, 1959
- Greatest amount of Snowfall in 24 hour period: 7.5 inches, January 20, 1957

Table 7. Monthly average maximum, minimum and mean air temperature and four-inch soil temperature at Malheur Experiment, OSU, Ontario, Oregon, 1990.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Temperature °F											
Air Temp.												
Max.	42	45	59	71	71	82	93	89	83	66	51	29
Min.	24	21	31	41	44	59	59	56	53	34	27	8
Mean	33	33	45	56	58	70	76	72	68	50	39	18
10 Yr. Mean	24	31	43	52	58	68	74	73	62	50	38	26
48 Yr. Mean	26	34	43	51	59	67	75	73	63	51	38	29
Soil Temp.												
Max.	36	39	54	67	72	81	90	84	83	62	46	30
Min.	33	33	43	55	57	66	76	76	71	52	40	26
Mean	34	36	48	61	64	74	83	80	77	57	43	28
10 Yr. Mean	32	35	46	56	65	74	82	81	70	57	42	33
24 Yr. Mean	32	36	45	55	66	75	83	81	70	56	42	33

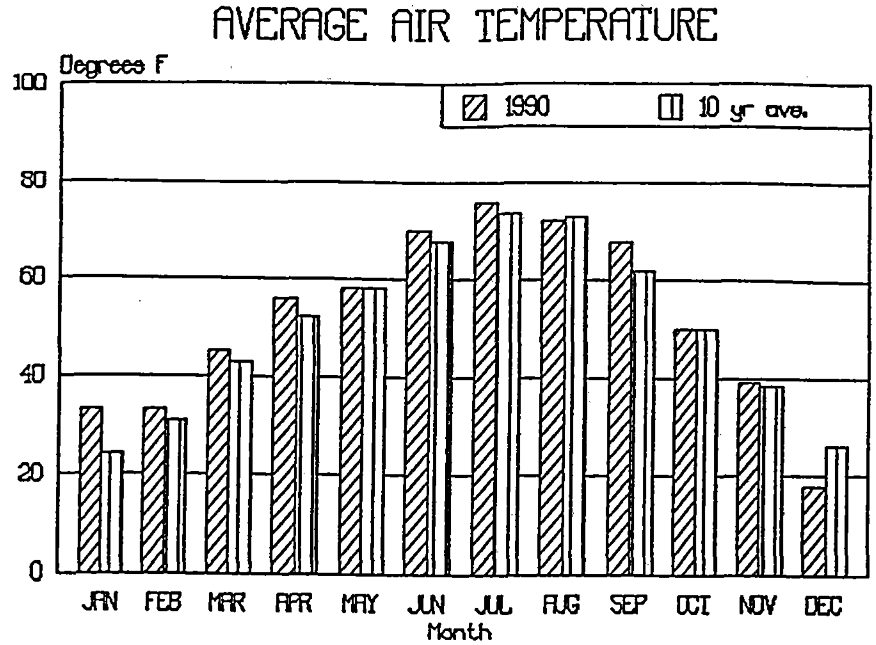

Figure 2. A comparison of the average monthly air temperature for 1990, to the ten year average, 1981 through 1990 at the Malheur Experiment Station, OSU, Ontario, Oregon.

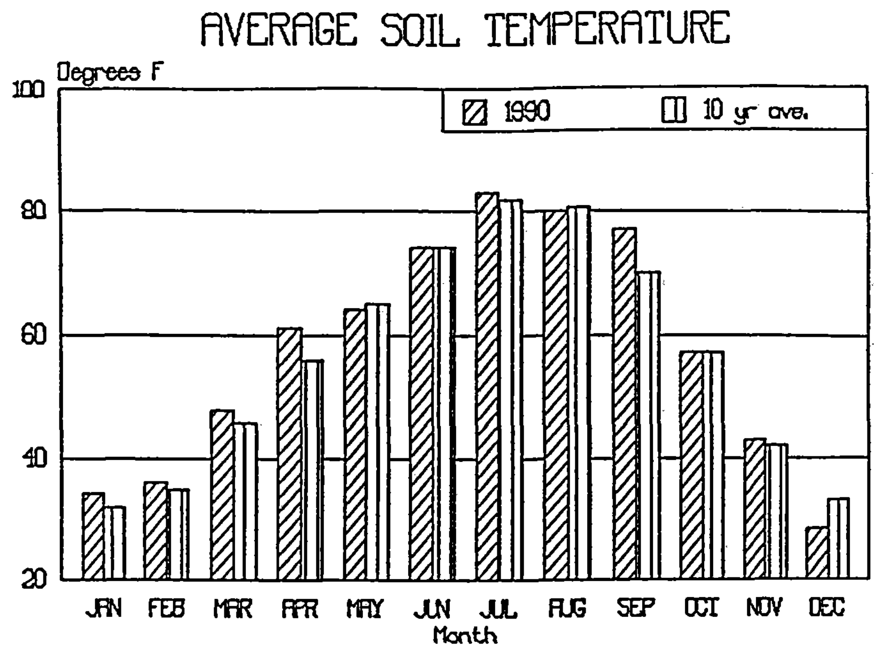

Figure 3. A comparison of the average monthly soil temperature for 1990, to the ten year average, 1981 through 1990 at the Malheur Experiment Station, OSU, Ontario, Oregon.

Table 8. Annual cumulative degree days (Lower Threshold = 50°F, Upper Threshold = 86°F) for five years (1986-1990) at Malheur Experiment Station, OSU, 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

Note: For each day that the average temperature is one degree above the lower threshold, one Degree day accumulates.

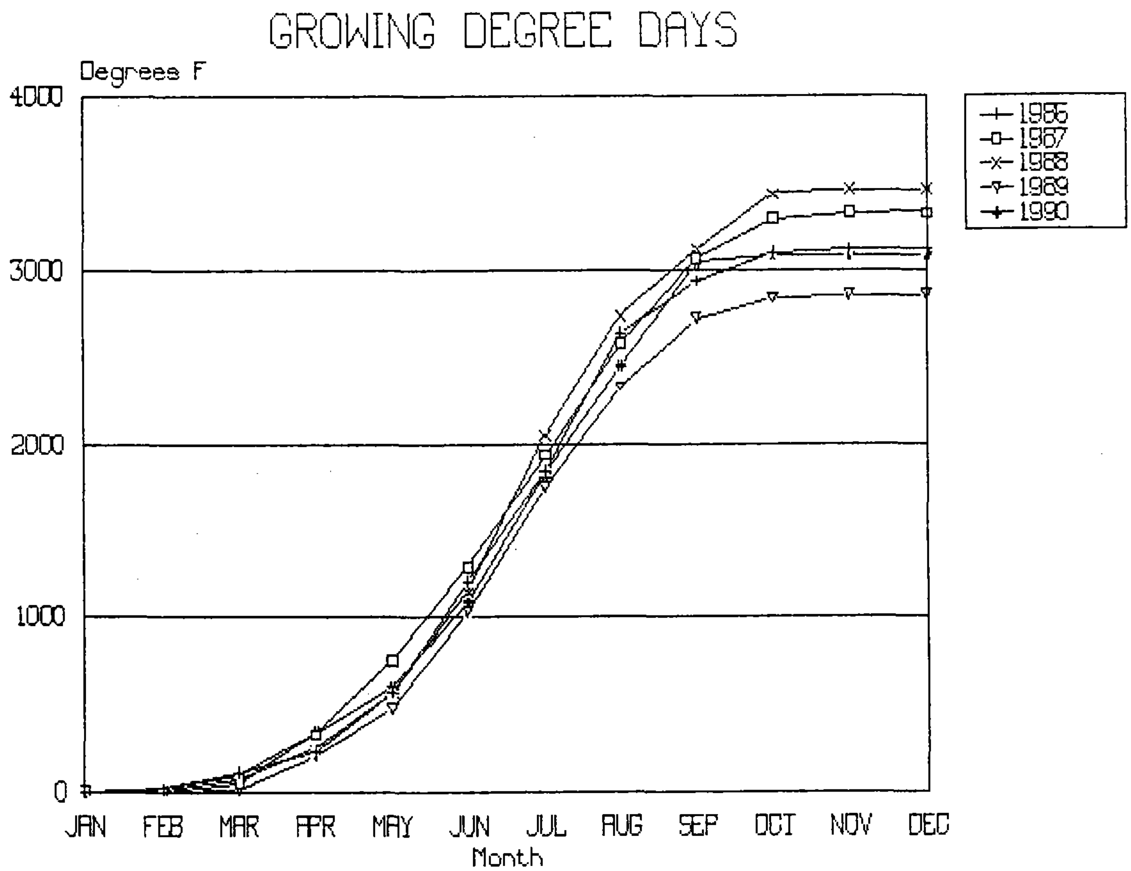

Figure 4. Comparison of annual cumulative degree days for 1985 through 1990, at Malheur Experiment Station, OSU, Ontario, Oregon.

FORAGE ALFALFA VARIETY EVALUATION

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Oregon State University
Ontario, Oregon, 1990

Purpose

The purpose of this alfalfa forage trial is to identify high yielding varieties and lines adapted to conditions in the Treasure Valley.

Procedure

An alfalfa variety trial, scheduled to run for five years, was established following winter wheat in the fall of 1987. It includes six public and twenty five proprietary alfalfa varieties and lines (Table 5). Individual plots 5 feet wide by 19 feet long and separated by 2-foot wide bare soil alleys were arranged in a randomized complete block design with four replications. Yield data were collected by cutting a three foot wide strip from the center of each plot with a flail-type forage harvester and then weighing the wet forage. Moisture content was determined by drying samples from eight randomly selected plots.

Following the 1987 wheat harvest the trial area was disked, furrowed, and irrigated to germinate volunteer grain and weed seed. After subsequent disking and ripping, 370 pounds of P_2O_5 per acre in the form of triple superphosphate were plowed down. Final seedbed preparation was achieved with a springtooth harrow followed by a spike tooth harrow and a cultipacker. The plots were hand-planted at the rate of 15.75 pounds per acre on September 8 and 9, and irrigated on the 10th. Shortly after emergence, the field was infested with spotted alfalfa aphids which were controlled with a broadcast application of Lorsban (chlorpyrifos) at one pound ai/ac on October 2.

In early March, 1988, the trial was sprayed with a tank mix of Buctril (bromoxynil) at 2 pounds ai/ac and Fusilade (fluazifop-butyl) at 1 pound ai/ac to control emerging broadleaf weeds and grasses and those plots with marginal seedling populations were overseeded to produce uniform stands throughout the trial.

In the spring of 1989, the alleys were treated with Stinger (clopyralid) to prevent weed growth. Subsequently the material moved into the ends of the plots effectively killing some alfalfa plants, thereby requiring that all plots be shortened to a length of 15 feet to assure homogeneity within the trial.

Although the trial is managed on a four cutting per year schedule, an unusually long and warm fall allowed a fifth cutting in 1988. The alfalfa was harvested four times in 1989 and 1990.

Results

The yield ranges, reported at 12 percent moisture, for each year and the three year average are as follows: 1988, from 12.7 to 9.7 tons per acre (Table 1); 1989, from 14.0 to 12.0 tons per acre (Table 2); 1990, from 14.5 to 11.3 tons per acre (Table 3); three year average, from 13.5 to 11.0 tons per acre (Table 4). Information pertaining to winter hardiness and insect and disease resistance is presented in Table 5.

Table 1. First year yield[1] of 31 alfalfa varieties and lines. Malheur Experiment Station, OSU, Ontario, Oregon, 1988.

Entry	Source	Cut 1 May 19	Cut 2 June 23	Cut 3 July 26	Cut 4 Aug. 31	Cut 5 Oct. 19	1988 Total	% of Lahontan	Stand[2] Rating March 1988
		tons/ac							
Lahontan	NV/USDA	2.3	2.7	2.8	1.9	1.4	11.1	100	7.8
Vernema	WA/USDA	2.7	2.8	2.5	1.6	1.1	10.7	96	8.0
Perry	NE/USDA	2.6	2.9	2.5	1.9	1.2	11.1	101	7.9
Sure	Union Seed	2.2	3.0	2.4	1.8	1.2	10.6	95	7.5
LL 3409A	Union Seed	2.6	3.0	2.7	1.9	1.3	11.5	104	8.0
LL3620	Union Seed	2.4	3.1	2.7	1.9	1.3	11.4	103	7.1
Centurion	Allied Seed	2.7	3.1	2.7	1.8	1.2	11.5	102	8.0
Excalibur	Allied Seed	2.9	3.3	2.5	1.9	1.4	12.0	107	7.9
Fortress	Northrup King	2.9	3.1	2.8	1.9	1.3	12.2	109	8.3
86637	Northrup King	2.6	3.0	2.9	1.9	1.5	11.9	107	8.0
PSS-311	Price & Sons	2.7	3.2	2.3	1.5	1.0	10.7	97	8.4
Sutter	Plant Genetics	2.2	3.0	2.9	2.0	1.7	11.8	107	7.4
** variety withdrawn **		2.6	3.0	2.5	1.9	1.1	11.1	99	7.9
** variety withdrawn **		2.9	3.1	3.0	1.9	1.3	12.2	110	7.8
Allstar	W.D. Seeds	2.7	3.1	2.6	1.8	1.3	11.5	104	7.9
Allegiance	United Agriseed	2.8	3.3	2.9	2.0	1.3	12.3	111	8.1
Promise	Americana/Hoffman	2.6	3.2	2.8	1.9	1.3	11.8	106	8.1
S-127	W-L Research	2.9	3.3	2.8	1.8	1.3	12.1	108	8.3
WL 317	W-L Research	2.8	3.1	2.9	1.8	1.3	11.9	108	8.3
H-171	Lohse Mill Inc.	2.4	3.1	2.8	1.9	1.5	11.7	106	7.6
IH-101R	Lohse Mill Inc.	2.6	3.1	2.9	1.9	1.7	12.2	110	8.0
Syn XX	NV/USDA	2.3	3.0	2.7	1.7	1.6	11.3	102	7.3
W-45 Syn 2	WA/USDA	2.6	3.0	2.7	1.9	1.3	11.5	104	8.3
$W12R_2W_1$	WA/USDA	2.5	3.1	2.4	1.7	1.1	10.8	97	7.5
Arrow	AgriPro	2.7	3.1	2.7	1.9	1.2	11.6	104	8.4
ABI-700	AgriPro	2.7	3.2	3.1	2.0	1.7	12.7	113	8.3
Archer	AgriPro	2.3	2.9	3.0	1.9	1.5	11.6	106	7.5
8650	AgriPro	2.5	2.9	2.9	1.9	1.5	11.7	105	8.1
Renegade	Geertson Seed	2.7	3.3	2.7	1.8	1.3	11.8	107	8.0
PC 17	Geertson Seed	1.8	2.8	2.3	1.8	1.0	9.7	87	5.5
HE 26	Geertson Seed	2.2	2.9	2.4	1.8	1.1	10.4	93	6.3
	Mean	2.6	3.1	2.7	1.8	1.3	11.5	104	7.8
	LSD (.05)	.4	.2	.2	.1	.1	.7		
	(.01)	.5	.3	.2	.2	.2	.9		

[1] Yield at 12% moisture.
[2] Average of 4 replications, 1 = no stand to 9 = excellent stand.

Table 2. Second year yield[1] of 31 alfalfa varieties and lines. Malheur Experiment Station, OSU, Ontario, Oregon, 1989.

Entry	Source	Cut 1 May 16	Cut 2 June 20	Cut 3 Aug. 2	Cut 4 Sep. 13	1989 Total	% of Lahontan
		tons/ac					
Lahontan	NV/USDA	3.2	2.7	3.5	3.2	12.6	100
Vernema	WA/USDA	4.6	2.5	3.1	3.0	13.2	105
Perry	NE/USDA	4.1	2.2	3.2	2.8	12.3	98
Sure	Union Seed	3.9	2.7	3.5	3.3	13.5	107
LL 3409A	Union Seed	4.4	2.3	3.5	3.3	13.5	108
LL3620	Union Seed	4.2	2.4	3.5	3.5	13.6	108
Centurion	Allied Seed	4.2	2.5	3.7	3.4	13.9	110
Excalibur	Allied Seed	3.8	2.5	3.6	3.4	13.3	106
Fortress	Northrup King	3.9	2.5	3.4	3.8	13.6	108
86637	Northrup King	3.8	2.5	4.0	3.4	13.7	109
PSS-311	Price & Sons	4.2	2.3	3.2	2.5	12.2	97
Sutter	Plant Genetics	3.6	2.7	3.6	3.2	13.1	104
variety withdrawn		4.0	2.5	3.4	3.3	13.2	105
variety withdrawn		4.4	2.8	3.3	3.5	14.0	111
Allstar	W.D. Seeds	3.8	2.4	3.6	3.5	13.3	106
Allegiance	United Agriseed	4.1	2.4	3.4	3.4	13.3	106
Promise	Americana/Hoffman	4.2	2.6	3.4	3.4	13.6	108
S-127	W-L Research	4.3	2.6	3.5	3.5	13.9	111
WL-317	W-L Research	4.3	2.6	3.6	3.3	13.8	110
H-171	Lohse Mill Inc.	3.6	2.4	3.4	3.0	12.4	99
IH-101R	Lohse Mill Inc.	3.7	2.6	3.4	3.3	13.0	104
Syn XX	NV/USDA	4.1	2.4	3.3	3.3	13.1	105
W-45 Syn 2	WA/USDA	4.0	2.6	3.4	3.3	13.3	106
$W12R_2W_1$	WA/USDA	4.2	2.5	3.4	3.0	13.1	105
Arrow	AgriPro	4.1	2.6	3.4	3.3	13.4	107
ABI-700	AgriPro	3.8	2.7	4.0	3.4	13.9	111
Archer	AgriPro	4.0	2.7	3.9	3.4	14.0	111
8650	AgriPro	4.4	2.7	3.5	3.3	13.9	110
Renegade	Geertson Seed	4.2	2.3	3.5	3.2	13.2	105
PC 17	Geertson Seed	3.6	2.3	3.3	2.8	12.0	95
HE 26	Geertson Seed	4.1	2.3	3.4	3.1	12.9	102
	Mean	4.0	2.5	3.5	3.3	13.3	
	LSD (.05)	.4	.4	.6	.3	1.0	
	(.01)	.5	.4	.7	.4	1.2	

[1] Yield at 12% moisture.

Table 3. Third year yield[1] of 31 alfalfa varieties and lines. Malheur Experiment Station, OSU, Ontario, Oregon, 1990.

Entry	Source	Cut 1 May 22	Cut 2 July 6	Cut 3 Aug. 8	Cut 4 Oct. 4	1990 Total	% of Lahontan
		---------- tons/ac			----------		
Lahontan	USDA/UNV	3.4	3.5	3.4	1.9	12.2	100
Vernema	USDA/WSU	4.2	3.8	3.0	1.8	12.8	105
Perry	USDA/U.Neb.	4.3	3.4	3.0	2.1	12.8	105
Sure	Union Seed	4.4	3.8	3.2	2.0	13.4	110
LL 3409A	Union Seed	4.7	3.6	3.5	2.1	13.9	114
LL 3620	Union Seed	4.4	3.8	3.2	1.8	13.2	108
Centurion	Allied Seed	4.6	4.1	3.7	2.1	14.5	119
Excalibur	Allied Seed	4.6	3.6	3.2	2.0	13.4	110
Fortress	Northrup King	4.4	3.6	3.2	2.1	13.3	109
86637	Northrup King	4.2	3.6	3.3	2.2	13.3	109
PSS-311	Price & Sons	4.2	4.4	2.6	1.4	12.6	103
Sutter	Plant Genetics	3.9	3.6	3.5	2.0	13.0	107
** variety withdrawn **		4.5	3.4	3.4	2.2	13.5	111
** variety withdrawn **		4.0	4.0	3.7	2.0	13.7	112
Allstar	W.D. Seeds	4.0	4.3	3.4	1.6	13.3	109
Allegiance	United Agriseed	4.0	3.7	3.5	2.2	13.4	110
Promise	Americana/Hoffman	4.3	3.3	3.5	2.3	13.4	110
S-127	W-L Research	4.6	3.7	3.6	1.9	13.8	113
WL 317	W-L Research	4.5	3.7	3.5	2.1	13.8	113
H-171	Lohse Mill, Inc.	4.0	3.6	3.4	2.0	13.0	107
IH-101R	Lohse Mill, Inc.	4.0	3.8	3.6	2.2	13.6	111
Syn XX	USDA/UNV	4.1	3.8	3.4	2.0	13.3	109
W-45 Syn 2	USDA/WSU	4.4	3.7	3.1	2.0	13.2	108
W12R2W1	USDA/WSU	4.1	3.7	3.0	1.7	12.5	102
Arrow	AgriPro	4.4	3.7	3.3	2.2	13.6	111
ABI-700	AgriPro	4.0	4.0	3.5	2.3	13.8	113
Archer	AgriPro	4.2	3.6	3.5	2.0	13.3	109
8650	AgriPro	4.2	4.0	3.5	2.0	13.7	112
Renegade	Geertson Seed	4.7	3.5	3.3	2.0	13.5	111
PC 17	Geertson Seed	3.9	3.2	2.8	1.4	11.3	93
HE 26	Geertson Seed	4.2	3.7	3.2	2.0	13.1	107
	Mean	4.2	3.7	3.3	2.0	13.3	
	LSD (.05)	.4	.5	.4	.4	1.0	
	(.01)	.5	.7	.5	.5	1.3	

[1]Yield at 12% moisture.

Table 4. Three year summary[1] of 31 alfalfa varieties and lines. Malheur Experiment Station, OSU, Ontario, Oregon, 1990.

Entry	Source	Year 1 1988	Year 2 1989	Year 3 1990	Total 3 years	3 year Average	% of Lahontan
		tons/ac					
Lahontan	USDA/UNV	11.1	12.6	12.2	35.9	12.0	100
Vernema	USDA/WSU	10.7	13.2	12.8	36.7	12.2	102
Perry	USDA/U.Neb.	11.1	12.3	12.8	36.2	12.1	101
Sure	Union Seed	10.6	13.5	13.4	37.5	12.5	104
LL 3409A	Union Seed	11.5	13.5	13.9	38.9	13.0	108
LL 3620	Union Seed	11.4	13.6	13.2	38.2	12.7	106
Centurion	Allied Seed	11.5	13.9	14.5	39.9	13.3	111
Excalibur	Allied Seed	12.0	13.3	13.4	38.7	12.9	108
Fortress	Northrup King	12.2	13.6	13.3	39.1	13.0	109
86637	Northrup King	11.9	13.7	13.3	38.9	13.0	108
PSS-311	Price & Sons	10.7	12.2	12.6	35.5	11.8	99
Sutter	Plant Genetics	11.8	13.1	13.0	37.9	12.6	105
** variety withdrawn **		11.1	13.2	13.5	37.8	12.6	105
** variety withdrawn **		12.2	14.0	13.7	39.9	13.3	111
Allstar	W.D. Seeds	11.5	13.3	13.3	38.1	12.7	106
Allegiance	United Agriseed	12.3	13.3	13.4	39.0	13.0	108
Promise	Americana/Hoffman	11.8	13.6	13.4	38.8	12.9	108
S-127	W-L Research	12.1	13.9	13.8	39.8	13.3	111
WL 317	W-L Research	11.9	13.8	13.8	39.5	13.2	110
H-171	Lohse Mill, Inc.	11.7	12.4	13.0	37.1	12.4	103
IH-101R	Lohse Mill, Inc.	12.2	13.0	13.6	38.8	12.9	108
Syn XX	USDA/UNV	11.3	13.1	13.3	37.7	12.6	105
W-45 Syn 2	USDA/WSU	11.5	13.3	13.2	38.0	12.7	106
W12R2W1	USDA/WSU	10.8	13.1	12.5	36.4	12.1	101
Arrow	AgriPro	11.6	13.4	13.6	38.6	12.9	107
ABI-700	AgriPro	12.7	13.9	13.8	40.4	13.5	112
Archer	AgriPro	11.6	14.0	13.3	38.9	13.0	108
8650	AgriPro	11.7	13.9	13.7	39.3	13.1	109
Renegade	Geertson Seed	11.8	13.2	13.5	38.5	12.8	107
PC 17	Geertson Seed	9.7	12.0	11.3	33.0	11.0	92
HE 26	Geertson Seed	10.4	12.9	13.1	36.4	12.1	101
	Mean	11.5	13.3	13.3	38.0	12.7	
	LSD (.05)	.7	1.0	1.0		.6	
	(.01)	.9	1.2	1.3		.7	

[1]Yield at 12% moisture.

Table 5. Published winter hardiness, disease and insect resistance levels for alfalfa varieties and brands planted at the Malheur Experiment Station, OSU, Ontario, Oregon, 1989.

Entry	Source	Year of release to public	Pathogen or Insect										
			WH	BW	FW	VW	PRR	AN	DM	PA	SAA	RKN	SN
Lahontan*	NV/USDA	1954	MH	MR	LR	S	LR	-	S	LR	MR	S	R
Vernema*	WA/USDA	1981	MH	MR	-	MR	LR	LR	-	-	MR	-	HR
Perry*	NE/USDA	1979	H	R	R	S	MR	LR	MR	R	MR	-	-
Sure*	Union Seed	1986	H	HR	HR	R	R	HR	-	HR	LR	-	-
LL 3409A	Union Seed	1988	H	HR	R	MR	R	MR	-	HR	MR	-	MR
LL3620	Union Seed	1988	H	R	R	MR	R	MR	-	HR	MR	-	R
Centurion*	Allied Seed	1985	H	HR	R	R	R	R	R	R	MR	-	-
Excalibur*	Allied Seed	1983	MH	R	HR	R	LR	MR	R	R	LR	LR	R
Fortress*	Northrup King	1987	H	R	R	R	HR	R	R	R	HR	-	HR
86637	Northrup King		MH	R	R	R	R	HR	R	R	R	-	HR
PSS-311	Price & Sons		MH	-	-	-	-	-	-	-	-	-	-
Sutter*	Plant Genetics	1987	MNH	R	HR	LR	HR	LR	-	R	HR	-	R
** variety withdrawn **			-	-	-	-	-	-	-	-	-	-	-
** variety withdrawn **			-	-	-	-	-	-	-	-	-	-	-
Allstar	W.D. Seed Growers	1988	MH	R	HR	R	HR	HR	MR	R	LR	-	R
Allegiance	United Agriseed	1988	MH	R	R	R	R	HR	-	R	LR	MR	R
Promise	Americana/Hoffman	1988	MH	HR	R	R	R	HR	-	R	LR	MR	MR
S-127	W-L Research		MH	R	R	R	HR	HR	-	-	-	R	-
WL 317	W-L Research	1988	H	R	HR	R	HR	R	-	HR	R	MR	R
H-171	Lohse Mill, Inc.		H	R	R	MR	MR	MR	MR	MR	MR	-	MR
IH-101R	Lohse Mill, Inc.		MH	MR	R	LR	R	MR	MR	MR	R	-	R
Syn XX	WA/USDA		-	-	-	-	-	-	-	-	-	-	-
W-45 Syn 2	WA/USDA		-	-	-	-	-	-	-	-	-	-	-
$W12R_2W_1$	WA/USDA		-	-	-	-	-	-	-	-	-	-	-
Arrow*	AgriPro	1985	H	HR	HR	R	HR	MR	-	-	-	-	MR
ABI-700	AgriPro	1990	MH	MR/LR	R	R/MR	R	R	-	R	R	R	R
Archer*	AgriPro	1990	H	R/MR	R	R/MR	R	R	-	R	R	R	R
8650	AgriPro		MH	MR	HR	MR	R	HR	-	-	HR	R	R
Renegade	Geertson Seed	1990	H	R	MR	LR	R	S	-	R	R	-	-
PC 17	Geertson Seed		-	-	-	-	-	-	-	-	-	-	-
HE 26	Geertson Seed		-	-	-	-	-	-	-	-	-	-	-

* Information confirmed by the National Alfalfa Variety Review Board.

WH = Winter Hardiness, BW = Bacterial Wilt, FW = Fusarium Wilt, VW = Verticillium Wilt, PRR = Phytophthora Root Rot, AN = Anthracnose, DM = Downy Mildew, PA = Pea Aphid, SAA = Spotted Alfalfa Aphid, RKN = Root Knot Nematode, SN = Stem Nematode.

VH = Very Hardy, H = Hardy, MH = Moderately Hardy, MNH = Moderately Non-Hardy.

Disease and Insect Resistance: 51% = HR (Highly Resistant), 31-50% = R (Resistant), 15-30% = MR (Moderately Resistant). 6-14% = LR (Low Resistance), 5% = S (Susceptible)

AN EVALUATION OF SOIL AND FOLIAR ACTIVE HERBICIDES FOR WEED CONTROL IN SEEDLING AND ESTABLISHED STANDS OF ALFALFA GROWN FOR SEED

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Purpose

The trials were conducted to evaluate several different herbicides with known soil and/or foliar activity for tolerance to seedling and established alfalfa and the control of summer annual grasses and broadleaf weeds, field dodder, yellow nutsedge, and Canada thistle.

Procedures

Trials were conducted off-station at three locations. Postemergence applications to seedling alfalfa were applied and evaluated at Sparks Farm, Nyssa, Oregon and Sisson Farms, Nyssa, Oregon. Herbicides applied to semi-dormant established alfalfa were located at Erstrom Farms, Vale, Oregon and Sisson Farms, Nyssa, Oregon. Postemergence treatments were evaluated on two separate fields at the Sisson site.

The postemergence treatments were applied to spring seeded alfalfa. The alfalfa stands were fully emerged and individual plants varied in size from one to three trifoliate leaves with a plant height of 2 - 4 inches. The alfalfa was planted in rows and individual plots were four rows wide and thirty feet long. Foliar active herbicides included Buctril, 2,4-DB amine , 2,4-DB ester, Pursuit, Basagran, and Poast. Surfactant X-77 was added to Pursuit at the rate of 0.25 percent of the spray volume. Poast was tank-mixed with Buctril and 2,4-DB to control annual grasses. Buctril and Pursuit were also tank-mixed with Prowl and Sonalan as two-way tank-mixes to evaluate for tolerance of these combinations to seedling alfalfa. Each herbicide was evaluated at several different rates. Refer to Tables 1 - 4 for rates and tank-mix combinations.

The postemergence herbicides were applied as broadcast double overlap applications using a single wheel bicycle plot sprayer equipped with teejet 8002 fan nozzles mounted at 10-inch spacing on a ten foot boom. Spray pressure was 42 pounds/sq inch and water was applied at a volume of 28 gallons per acre. Air temperatures varied between 62°F and 68°F at different locations on days treatments were applied.

Soils varied from sandy loam to clay loam textures between locations. Trial sites were selected within fields where soils and plant growth of seedling alfalfa and weeds were uniform. Weed species included sow thistle, kochia, pigweed, lambsquarters, mallow, sunflower, hairy nightshade, barnyardgrass, and green foxtail. Broadleaf weeds ranged in size from cotyledon to four true leaves and grasses one to four leaves when treatments were applied.

Prowl, Sonalan, and Treflan herbicides were applied to established alfalfa on April 9 and April 17 at Vale and Adrian locations respectively. The alfalfa was starting new spring growth with shoots one to two inches long. The fields had been tilled with triple-K field cultivators and the rows furrowed out with angle-iron corrugators. The herbicide treatments were applied with a twenty-one foot boom field sprayer as double overlap broadcast treatments. Spray pressure was 35 pounds/sq inch and water was applied at a volume of 33 gallons per acre. Spray nozzles were 8003 teejet. Individual plots were 50 feet wide and 100 feet long. Unsprayed strips on each side of individual plots were used as check plots to compare sprayed and unsprayed areas for weed control and crop tolerance. The applied herbicides were shallowly incorporated (approximately 1 inch) with a rotary-hoe passing over the field two times. The direction of travel the second pass was in a direction opposite to the first pass. The fields were recorrugated if needed to accommodate furrow irrigation.

A tank-mix combination of Basagran, 2,4-DB amine, and MorAct oil concentrate were evaluated as postemergence applications for the control of Canada thistle in seedling alfalfa. The treatments were applied as described previously for the postemergence applications to seedling alfalfa. The treatments were applied on May 22. The spring seeded alfalfa was four to six inches tall. The Canada thistle ranged in size from newly emerging plants to plants one foot high. Air temperature was 78°F and soil conditions were excellent for optimum plant growth and all plants were growing rapidly when herbicides were applied.

The yellow nutsedge trial was located at Sparks Farm near Nyssa, Oregon. The herbicide treatments were applied as strip applications across the width of the seven acre field. Each treated strip was 64 feet wide and each herbicide rate was replicated three times. The alfalfa and other crops in the trial were planted lengthwise in the field and across the herbicide strips. Crops were planted eight rows wide and each crop was planted at random in separate replicated blocks.

The control of yellow nutsedge emerging in spring seeded alfalfa was evaluated after receiving two applications of Dual. The first application of Dual was applied in the fall and mixed with the soil to a 12 inch depth as the soil was plowed with a moldboard plow. Dual was applied at four different rates (3, 4, 6, and 8 pounds ai/ac) as double overlap broadcast treatments with a farm sprayer. The herbicide was then incorporated with a triple-K field cultivator. The cultivator passes were lengthwise and crosswise of the field with the teeth set to work the soil the full length of the shanks. The field was then plowed with a moldboard plow, turning the soil over to a depth of twelve inches. After plowing, the field was worked down and bedded in preparation for planting alfalfa the following spring. Wrangler variety of alfalfa was planted on April 3. The second application of Dual was applied on May 18 at 4 pounds ai/ac as a broadcast treatment over the top of emerged alfalfa and emerging yellow nutsedge plants. The herbicide was activated by cultivation equipment (knives, discs, and duckfeet) during normal field cultivation and by furrow irrigation applied at weekly intervals through May, June, and July. The alfalfa and the emerged yellow nutsedge plants were three to four inches tall when the second application of Dual was applied.

All treatments in each of the studies for all trials were replicated three times using complete randomized experimental design.

Results

Established alfalfa was very tolerant to all rates of Prowl, Sonalan, and Treflan applied and incorporated as early spring preemergence treatments. These herbicides when incorporated in the top one inch of soil with a rotary-hoe effectively controlled kochia, pigweed, lambsquarters, barnyardgrass, and green foxtail but did not control hairy nightshade. Both Prowl and Sonalan had good herbicidal activity on dodder. Dodder control increased with both herbicides as rates increased. Treflan did not control dodder.

Buctril at 0.5 pounds ai/ac controlled many species of broadleaf weeds including kochia, hairy nightshade, lambsquarters, pigweed, and sow thistle. Pursuit was not as active on these weed species as Buctril. Pursuit did effectively control sunflower, seedling mallow, and annual grasses. Buctril and Pursuit tank-mix combination treatment was active on all broadleaf and annual grassy weeds. Poast tank-mixed with Buctril controlled barnyardgrass and green foxtail. Less activity on grasses by Poast was noted when Poast was tank-mixed with 2,4-DB. 2,4-DB ester was more active than 2,4-DB amine for control of nightshade and sow thistle but equal in control of kochia, pigweed, and lambsquarters. Prowl tank-mixed with Pursuit or Buctril increased herbicide activity of both Pursuit and Buctril which resulted in better weed control than by Pursuit applied alone. 2,4-DB reduced the activity of Pursuit on grasses when applied as a tank-mix combination. A three way tank-mix of Basagran, 2,4-DB and MorAct oil concentrate was very active on Canada thistle emerging in a new stand of alfalfa. A spring and mid-season application of these herbicides kept Canada thistle from seeding in alfalfa fields and did not affect growth and development of the alfalfa when compared to alfalfa growing in untreated plots.

Dual applied in the fall as plowdown treatments followed by spring postemergence applications kept the plots free of yellow nutsedge. Yellow nutsedge plants emerging when the postemergence treatment of Dual was applied were controlled. The control of emerged plants of yellow nutsedge by Dual was enhanced by water from rain (3/4 inch) which occurred two days after Dual was applied and by furrow irrigation.

Established alfalfa was not injured nor did herbicide symptoms occur with incorporated preemergence applied Prowl, Sonalan, or Treflan at any rate evaluated. Seedling alfalfa was very tolerant to Pursuit. Chlorosis and stunting of growth occurred to seedling alfalfa with Buctril, Basagran, and 2,4-DB. Stunting was more severe with Buctril than with Basagran or 2,4-DB. Even though these affects occurred they were only temporary and the alfalfa fully recovered and growth in treated plots appeared normal in growth and flower development compared to alfalfa in untreated check plots.

Alfalfa was not injured with Dual applied preplant plowdown or by spring applied postemergence applications.

Table 1. Percent weed control and crop injury ratings from herbicides applied to seedling alfalfa as postemergence applications. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Herbicide	Rate lbs ai/ac	Percent Weed Control						Crop Injury
		Night-shade	Kochia	Lambs-quarters	Pigweed	Sow Thistle	Annual[1] Grasses	
Buctril	0.33	95	98	98	75	92	98	0
	0.50	100	100	100	100	98	99	27
	0.75	100	100	100	100	100	99	62
2,4-DB amine	0.75	68	95	92	85	47	93	12
	1.00	83	96	96	95	63	94	16
2,4-DB ester	0.75	86	92	94	95	73	92	15
	1.00	92	95	98	95	82	94	18
Buctril + 2,4-DB	0.25+0.25	99	100	100	98	89	96	20
	0.25+0.5	100	100	100	99	95	98	23
Check	-	0	0	0	0	0	0	0

[1] Poast & MorAct added to Buctril and 2,4-DB for grass control.

Table 2. Percent weed control and crop injury ratings from herbicides applied to seedling alfalfa as post emergence applications. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Herbicides	Rate lbs ai/ac	Percent Weed Control								Crop Injury
		Night-Shade	Kochia	Lambs-Quarters	Pig-weed	Sow Thistle	Sun Flower	Mallow	Annual Grasses	
Pursuit[1]	0.062	76	68	42	78	38	86	84	94	0
	0.094	88	82	54	90	49	95	96	98	0
Pursuit+Prowl	0.094+1.5	99	96	92	97	76	98	98	96	15
	0.094+2.0	99	98	95	99	85	99	99	98	20
Pursuit+Sonalan	0.094+1.5	99	92	89	94	72	82	88	85	10
Buctril +Prowl	0.33+1.5	100	100	100	100	100	92	55	20	25
Check	-	0	0	0	0	0	0	0	0	0

[1] X-77 surfactant added to Pursuit treatments at rate of 0.25% v/v.

Table 3. Percent weed control from herbicides applied as postemergence applications to seedling alfalfa. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Herbicides	Rate lbs ai/ac	Percent Weed Control						
		Sow Thistle	Night Shade	Kochia	Sun Flowers	Canada Thistle	Mallow	Annual Grasses
Buctril + Pursuit	0.25 + 0.094	98	100	100	96	35	98	98
	0.5 + 0.094	100	100	100	99	42	98	98
Buctril + Basagran	0.25 + 1.0	100	100	100	100	86	38	15
	0.5 + 1.0	100	100	100	100	92	45	15
2,4-DB + Basagran	0.5 + 1.0	100	100	100	96	95	25	20
	1.0 + 1.0	100	100	100	98	97	45	23
Check	-	0	0	0	0	0	0	0

1. X-77 added to Pursuit treatments at rate of 0.25% v/v.
2. Poast and MorAct added to Buctril, Basagran, and 2,4-DB treatments for control of grasses.

Table 4. Percent weed control from soil active herbicides applied as preemergence applications to established alfalfa. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Herbicides	Rate lbs ai/ac	Percent Weed Control					
		Dodder	Nightshade	Kochia	Lambs-quarters	Pigweed	Annual Grasses
Prowl	2	92	76	96	98	98	9
	3	97	85	98	99	99	100
	4	99	92	99	99	99	100
Sonalan	1.50	88	86	97	97	98	98
	2.25	95	94	98	99	99	100
	3.0	97	96	99	99	99	100
Prowl + Sonalan	2.0 + 1.5	99	91	99	99	99	100
Treflan	2.0	35	0	89	92	93	97
Check	-	0	0	0	0	0	0

Table 5. The percent control of yellow nutsedge with Dual applied in the fall and spring as plowdown and postemergence applications. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Herbicide	Rate lbs ai/ac	Control with Plowdown Treatments				Control with Plowdown and Postemergence applications[1]			
		1	2	3	Average	1	2	3	Average
Dual	3	65	70	68	67	98	99	98	98
Dual	4	85	88	85	86	100	99	100	99
Dual	6	90	93	95	93	100	100	100	100
Dual	8	98	98	99	98	100	100	100	100
Check	-	0	0	0	0	0	0	0	0

[1] Dual applied postemergence at rate of 4 pounds ai/ac.

PARAFORMALDEHYDE FUMIGATION FOR CHALKBROOD CONTROL IN LEAFCUTTING BEE NESTING MATERIAL

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Purpose

A large-scale farm trial testing paraformaldehyde to fumigate empty Dority boards was conducted to evaluate efficacy in controlling chalkbrood disease. The paraformaldehyde-treated boards were compared to a set of empty Dority boards dipped in a chlorine solution and to a set of heat sterilized boards. Currently, paraformaldehyde is an experimental chemical and not registered for this use.

Procedure

A large insulated freight van (7' 7" X 7' X 14" 1') was used to fumigate approximately 500 empty Dority boards. Twenty g/m^3 (425 g total) of paraformaldehyde were used to fumigate the boards for 48 hours prior to placement in field shelters. The freight van was equipped with an electric space heater, air circulation fan, indoor/outdoor thermometer, and a hot plate to volatilize the paraformaldehyde. The space heater maintained the chamber temperature at around 90° F. Shallow pans with H_2O placed in the chamber elevated the humidity.

Following fumigation the van was ventilated for 24 hours and 80 boards closest to the fumigation source were placed in an empty field shelter along with 20 partially filled Dority boards. Sixty gallons of Canadian loose alfalfa leafcutting bee (*Megachile rotundata*) bee cells dipped in chlorine were incubated and released to nest in the treated Dorities.

Comparison treatments were set up in each of two other shelters. Eighty empty Dority boards were dipped in NaCl solution using full-strength household bleach. These were added to 20 partially filled boards in a separate domicile. Sixty gallons of Canadian loose cells were incubated and released to nest in this shelter. Another shelter had a similar arrangement but the 80 boards were baked in an oven using standard practices developed by Geertson Seed Farm, Adrian, OR.

In mid-October the boards were placed in cold storage at approximately 40°F. In late November the boards from the three treatments were punched out and representative samples of loose cells taken from the bee populations. The samples were analyzed for live larvae and chalkbrood counts.

<u>Results</u>

The results of the cell analyses are summarized in Table 1. The paraformaldehyde fumigation resulted in 46 percent live larvae in the cells that filled the treated Dority boards. This was roughly comparable to the survival of bees in heat sterilized boards (54 percent live larvae) and sodium hypochlorite dipped boards (53 percent live larvae). Fumigation of nesting material with paraformaldehyde appears to have potential as a sterilization method to control chalkbrood disease in leafcutting bees. Other experiments conducted by Dan Mayer, WSU, with growers in Washington produced even better results with paraformaldehyde fumigation. Paraformaldehyde fumigation has several advantages over other methods to control chalkbrood: 1) it is less labor intensive; 2) once the fumigation chamber is made, fumigation is cheaper; and 3) fumigation does not warp wooden boards. Further studies need to be conducted to test the efficacy of paraformaldehyde. Registration of this chemical for the fumigation use needs to be explored.

Table 1.
CHALKBROOD CONTROL IN ALFALFA LEAFCUTTING BEE DORITY BOARDS
LANGLEY ACRES FARMS, NYSSA, OREGON, 1990

		Cell Analysis					
Treatment	Sample Size	Live Larvae	Pollen Ball	Chalk-brood	Dead	Imma-ture Larvae	Para-sites
Paraformaldehyde	467	214	49	167	10	10	15
Bees/lb		932	213	727	44	52	65
%		46	10	36	2	3	3
Sodium Hypochlorite Dip 5.25% solution	941	502	106	2309	24	37	33
Bees/lb		1099	232	523	52	81	71
%		53	11.2	25.3	2.5	4	4
Heat Sterilization (Geertson's Oven)	479	259	32	147	15	13	13
Bees/lb		1029	127	584	60	52	52
%		54	6	31	60	52	52

AN EVALUATION OF HERBICIDES FOR CROP TOLERANCE AND WEED CONTROL IN PEPPERMINT AND SPEARMINT GROWN BY FURROW IRRIGATION IN EASTERN OREGON AND SOUTHWEST IDAHO

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Malheur Experiment Station
Oregon State University
Ontario, Oregon, 1990

Purpose

Identify herbicides that effectively control annual and perennial weeds in seedling and established stands of spearmint and peppermint without the herbicide treatments resulting in injury to these crops.

Procedures Used to Conduct Research Trials

Experiment 1: Prowl was applied to established spearmint in November 1989 to evaluate native spearmint for tolerance to Prowl and for control of redroot pigweed emerging after the crop was harvested in July of 1990. The trial was located at Stuart Batt's near Ontario. Prowl rates were 1.0, 1.5, 2.0, 2.5, 3.0, and 4.0 pounds ai/ac. Prowl was also applied in tank-mixes with Sinbar, Goal, Stinger, and Buctril to control blue mustard, prickly lettuce, and salisfy which were weed species within the trial area.

Experiment 2: Command and Pursuit herbicides were applied to native spearmint to evaluate these herbicides for control of blue mustard when applied in tank-mix combination with Paraquat, Stinger, and Prowl. Command herbicide was applied at 0.25 and 0.50 lbs ai/ac. Paraquat was tank-mixed with Command at 0.25 lbs ai/ac. Pursuit herbicide was evaluated at 0.062 and 0.094 lbs ai/ac. Pursuit was tank-mixed with Stinger (0.1 lbs ai/ac) and Prowl (2.0) lbs ai/ac). These treatments were applied in November 1989 to semi-dormant spearmint.

Experiment 3: Several herbicides were evaluated for control of winter and summer annual broadleaf and grassy weeds when herbicides were applied in March 1990 as new growth of spearmint and peppermint was emerging. Herbicides included Sinbar, Prowl, Pursuit, Buctril, and Goal and were evaluated in three and four-way tank-mixes. Weed species included prickly lettuce, blue mustard, salisfy, shepherds purse, tumbling mustard, pigweed, kochia, lambsquarters, barnyardgrass, and green foxtail. Prickly lettuce, blue mustard, salisfy, and shepherds purse were emerged when herbicide treatments were applied.

Experiment 4: Fusilade, Assure, Select, and Poast foliar active herbicides were evaluated for the control of downy brome. The grass active herbicides were evaluated for downy brome control when tank-mixed with Prowl, Buctril, and Stinger added to control other species of weeds. The herbicides were applied on April 6, 1990. Downy brome plants were 3 to 4 inches tall and populations were dense. Broadleaf weeds emerged included prickly lettuce, salisfy, kochia, green foxtail, and barnyardgrass. MorAct oil concentrate was applied with all herbicide treatments at a rate of 1 quart per acre.

Experiment 5: Soil active herbicides were applied as preplant incorporated and postplant preemergence incorporated applications for weed control in new plantings of peppermint. Herbicides included tank-mixes of Sinbar + Treflan (0.1 + 0.75 lbs ai/ac) and Sinbar + Sonalan (1.0 + 1.5 lbs ai/ac). The preplant herbicides were applied on November 27 as broadcast applications and incorporated with the soil 3 to 4 inches deep by tillage with a triple-K field cultivator. Spearmint was planted on November 28. The postplant preemergence treatments were applied on December 3 and incorporated in the top inch of soil with a rolling harrow.

Experiment 6: Repeat applications of foliar active herbicides were applied at low rates to control seedling annual broadleaf and grassy weeds emerging with new plantings of peppermint. Herbicides included Buctril, Basagran, Goal, Stinger, and Poast. Buctril was applied alone at 0.25 and 0.5 lbs ai/ac and in tankmix combinations with Goal, Basagran, and Singer at rates of 0.15 and 0.2 lbs ai/ac. Goal and Basagran were tank-mixed with Stinger at rates of 0.05, 1.0, and 0.10 lbs ai/ac. Poast was added to all treatments at a rate of 0.10 lbs ai/ac to control annual grasses. MorAct oil concentrate was added to all treatments at a rate of 1 quart/ac. The first herbicide application was applied on April 13. Repeat applications were applied on May 1 and May 29. Weed species included prickly lettuce, blue mustard, kochia, pigweed, lambsquarters, common mallow, and barnyardgrass. Weeds ranged from cotyledon to four leaves at the time the initial applications were applied. Peppermint was emerging with some growth as tall as 4 inches.

Experiment 7: Dual was evaluated for peppermint tolerance and control of yellow nutsedge when applied in the fall and incorporated by plowing twelve inches deep with a moldboard plow. Dual was applied as double overlap broadcast treatments in strips 64 feet wide across a seven acre field with a 21-foot field sprayer. Rates of Dual were 3, 4, 6, and 8 lbs ai/ac. Each rate was replicated three times and rates were spaced at random for the length of the field. The herbicide was mixed with the soil to a depth of six inches with a field cultivator before plowing. Peppermint was planted on November 29 and 30 in rows spaced thirty inches apart lengthwise of the field across the stripped herbicide rates.

All herbicides with the exception of the Dual/nutsedge trial were applied using a single bicycle wheel plot sprayer. Treatments were applied as double overlap broadcast applications using teejet fan nozzles size 8002, a spray pressure of 42 psi, and a water volume of 28 gallons per acre. Individual plots were 9 X 30 feet and all treatments were replicated three times. The spearmint at Stuart Batt's was watered by sprinkle irrigation. Trials located in other fields were all watered by furrow irrigation.

Results

Experiment 1: Prowl applied in the fall at 2.0 lbs ai/ac persisted to control 96 percent of pigweed emerging in spearmint after harvest. Plots treated with Prowl above 2.0 lbs ai/ac were free of redroot pigweed. Prowl was compatible with other herbicides when applied as tank-mix combinations. Control of blue mustard with Buctril applied in the fall at 0.5 lbs ai/ac was superior to spring applied Buctril at 0.75 lbs ai/ac. Stinger gave excellent control of prickly lettuce and salisfy. Spearmint was tolerant to all treatments. Prowl also controlled other summer annual weeds including kochia, lambsquarters, barnyardgrass, and green foxtail.

Table 1. Postharvest control of redroot pigweeed with Prowl applied the previous fall and activated by winter moisture. Malheur Experiment Station, Oregon State University, 1990.

Herbicides	Rate lbs ai/ac	Redroot Pigweed	Blue Mustard	Salisfy	Prickly Lettuce	Lambsquarters	Kochia	Grass
Prowl	1.0	76	93	99	100	75	65	70
Prowl	1.5	85	95	98	100	80	88	89
Prowl	2.0	96	93	100	100	98	98	99
Prowl	2.5	100	92	100	100	100	100	100
Prowl	3.0	100	95	100	100	100	100	100
Prowl	4.0	100	95	100	100	100	100	100
Prowl + Sinbar	2.0 + 1.5	98	93	40	68	99	98	99
Prowl + Goal	2.0 + 1.5	96	96	70	78	99	98	96
Check	-	0	0	0	0	0	0	0

Experiment 2: Command gave excellent control of blue mustard, and had good herbicidal activity on other species of weeds. Paraquat in combination with Command improved control of prickly lettuce, salisfy, and tumbling mustard. Spearmint had excellent tolerance to Command. Pursuit was also very active on blue mustard, but much less active on prickly lettuce and caused severe injury to spearmint.

Table 2. An evaluation of Command and Pursuit for control of blue mustard in spearmint. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

		------- Percent Weed Control --------			
Herbicides	Rate lbs ai/ac	Blue Mustard	Prickly Lettuce	Salisfy	Tumbling Mustard
Command	1/4	100	80	10	100
Command	1/2	100	95	25	100
Command + Paraquat	1/4 + 1/4	100	100	98	100
Command + Paraquat	1/2 + 1/4	100	100	99	100
Stinger + Paraquat	1/8 + 1/2	85	100	100	88
Stinger + Buctril	1/8 + 1/2	96	100	100	90
Stinger + Buctril	1/8 + 3/4	98	100	100	93
Stinger + Goal	1/8 + 3/4	60	100	100	85
Stinger + Goal	1/8 + 1	70	100	100	90
Stinger + Pursuit	1/8 + 0.062	100	100	100	100
Stinger + Pursuit	1/8 + 0.094	100	100	100	100
Stinger + Pursuit + Prowl	1/8 + 0.062 + 2	100	100	100	100
Stinger + Pursuit + Prowl	1/8 + 0.094 + 2	100	100	100	100
Check	-	0	0	0	0

Average of 3 replications.

Experiment 3: Neither spearmint or peppermint has tolerance to Pursuit, even at rates as low as 0.062 lbs ai/ac. Stinger and Prowl tank-mixed controlled prickly lettuce, salisfy, and all other species of winter and summer annuals with the exception of annual mustards. Buctril added as a tank-mix to Stinger and Prowl gave 90-95 percent control of the mustard species of weeds. Generally mustard control was better with Buctril added as the tank-mix than when either Goal or Sinbar was the third component of the three-way tank-mix.

Table 3. Control of winter and summer species of annual weeds with herbicide applied in March as tank-mix combinations. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Herbicides	Rate lbs ai/ac	Prickly Lettuce	Blue Mustard	Salisfy	Shepherds purse	Tumbling Mustard	Pigweed	Kochia	Lambs-quarters	Barnyard grass	Green Foxtail
Stinger+Pursuit+Prowl	1/8+1/16+2	100	100	100	100	100	100	100	100	100	100
Stinger+Pursuit+Prowl	1/8+1/12+2	100	100	100	100	100	100	100	100	100	100
Stinger+Goal+Prowl	1/8+3/4+2	100	100	100	96	93	99	99	99	100	100
Stinger+Buctril+Prowl	1/8+3/4+2	100	100	100	100	100	99	100	98	99	99
Stinger+Goal+Buctril+Prowl	1/8+1/4+1/4+2	100	100	100	100	100	100	100	100	100	100
Stinger+Goal+Buctril+Prowl	1/8+1/4+1/2+2	100	100	100	100	100	100	100	98	99	100
Stinger+Pursuit+Buctril+Prowl	1/8+1/16+1/4+2	100	100	100	100	100	100	100	100	100	100
Stinger+Pursuit+Goal+Prowl	1/8+1/16+1/4+2	100	100	100	100	100	100	100	100	100	100
Stinger+Sinbar+Buctril+Prowl	1/8+1+3/4+2	100	100	100	100	100	100	100	100	100	100
Check	-	0	0	0	0	0	0	0	0	0	0

Average of 3 replications from 5 locations.

Experiment 4: Fusilade, Assure, and Select gave excellent control of downy brome. Poast stunted the growth of downy brome but did not reduce plant populations. Downy brome treated with Poast resumed growth and grew to maturity. All herbicides controlled barnyardgrass and green foxtail. Tank-mixes were compatible.

Table 4. The control of downy brome with herbicides applied as foliar treatments. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Herbicides	Rate lbs ai/ac	Crop Injury	Downy Brome	Green Foxtail	Barnyardgrass
Fusilade	0.1275	0	100	78	98
Fusilade	0.1875	0	100	92	100
Assure	0.10	0	100	100	100
Assure	0.15	0	100	100	100
Assure	0.20	0	100	100	100
Select	0.094	0	98	100	100
Select	0.125	0	100	100	100
Poast	0.1875	0	20	96	95
Poast	0.25	0	25	100	100
Check	-	0	0	0	0

Evaluated May 25.

Experiment 5: Both Sinbar + Treflan and Sinbar + Sonalan delayed mint emergence in the spring, but the mint fully emerged with excellent stands. Oil yields from treated plots were higher than yields obtained from plots hand weeded. Weed control was excellent from all preplant treatments and somewhat better than weed control from herbicides applied postplant preemergence. Prowl and Sinbar postplant preemergence incorporated was superior to other treatments applied the same way. Prowl gave better weed control than prodiamine. Stinger did not enhance the control of weed species in this trial.

Table 5. Control of weeds and tolerance of new plantings of peppermint to preplant and postplant preemergence applications of herbicides. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Herbicides	Rate lbs ai/ac	How Applied	Crop Injury		Kochia		Lambsquarters		Pigweed		R. Thistle		Barnyardgrass	
			5/6	7/20	5/6	7/20	5/6	7/20	5/6	7/20	5/6	7/20	5/6	7/20
Sinbar + Treflan	1.0 + 0.75	PPI	50	0	99	96	100	98	100	99	100	100	100	100
Sinbar + Sonalan	1.0 + 1.5	PPI	60	0	99	98	100	98	100	99	100	100	100	100
Prowl + Stinger	2 + 1.8	PEI	0	0	96	93	96	93	98	95	60	40	98	98
Prowl + Sinbar	2 + 1.5	PEI	0	0	99	96	99	98	99	98	98	95	100	100
Prodiamine + Stinger	1 + 1/8	PEI	0	0	82	75	70	60	72	60	40	20	65	40
Prodiamine + Stinger	2 + 1/8	PEI	0	0	88	75	75	60	78	60	45	20	70	40
Prodiamine + Sinbar	1 + 1.5	PEI	0	0	75	45	80	80	60	45	88	80	85	70
Check	-	-	0	0	0	0	0	0	0	0	0	0	0	0

Experiment 6: All tank-mixes were compatible and weed control was excellent. Poast tank-mixed with broadleaf herbicides controlled barnyardgrass. Buctril controlled all broadleaf species except common mallow. Goal was very active on common mallow and when Goal was tank-mixed with Buctril or Basagran all weeds were controlled. Stinger caused some foliar injury to terminal leaves and stems of mint but was not considered to be a factor resulting in reduced yields of oil.

Table 6. Percent weed control and mint tolerance ratings from foliar active herbicide applied as repeat-low rate applications. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Herbicides[1]	Rate lbs ai/ac	Crop Injury	Prickly Lettuce	Blue Mustard	Kochia	Pigweed	Lambs-quarters	Mallow	Barnyard-grass
Buctril	1/4	0	95	98	100	100	100	63	100
Buctril	1/2	0	98	100	100	100	100	83	100
Goal + Buctril	0.5+0.15	0	100	100	100	100	100	100	100
Goal + Buctril	0.1+0.2	0	100	100	100	100	100	100	100
Goal + Basagran	0.05+1	0	100	100	100	100	100	100	100
Buctril + Basagran	0.15+1	0	100	100	100	100	100	98	100
Goal + Buctril + Stinger	0.05+0.15+0.1	0	100	100	100	100	100	100	100
Check	-		0	0	0	0	0	0	0

Results of final evaluation on July 12, 1990.

1 Poast + MorAct added to all treatments at rate of 0.1 lb ai/ac and 1 qt/ac respectively.

Ratings as average of 3 replications from 3 locations.

Experiment 7: Peppermint was tolerant to all rates of Dual when mint roots were planted in Dual treated soil incorporated by plowing to a depth of 12 inches with a moldboard plow. Rates of Dual at 4 lbs ai/ac and higher gave 85 to 98 percent control of yellow nutsedge. Ninety-eight percent control was obtained with eight pounds of Dual. Yellow nutsedge did not emerge in the fall in plots treated for 2 consecutive years with Dual at rates of 4, 6, and 8 lbs ai/ac. Dense stands of yellow nutsedge emerged in all untreated check strips.

Table 7. Percent control of yellow nutsedge and tolerance of spearmint and peppermint to Dual herbicide applied in the fall and incorporated by plowing the soil with a moldboard plow. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Herbicides	Rate lbs ai/ac	Crop Tolerance			% Control of Yellow Nutsedge[1]		
		4/15	5/25	7/15	4/15	5/25	7/15
Dual	3.0	0	0	0	83	72	65
Dual	4.0	0	0	0	98	95	90
Dual	6.0	0	0	0	100	100	100
Dual	8.0	0	0	0	100	100	100
Untreated check	-	0	0	0	0	0	0

[1]Evaluation after applying Dual in the fall for 2 consecutive years.

ONION VARIETY TRIALS

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Oregon State University
Ontario, Oregon 1990

Purpose

The trial was conducted to evaluate commercial and experimental lines of different varieties of yellow, white, and red onions for bulb yield and quality and to compare topped and untopped bulbs for storage quality when stored for approximately 100 days in air ventilated storage.

Procedures

The onions were planted on April 2 and 3 in an Owyhee silt loam soil which contains 1.2 percent organic matter and has a pH value of 7.3. Wheat and sugar beets had been grown in the field during 1989 and 1988 respectively. The wheat stubble was shredded and the field deep-chiseled, disced, irrigated and moldboard-plowed in the fall. One-hundred pounds per acre of P_2O_5 and 60 pounds of N per acre was broadcast before plowing. The field was left after plowing until spring without further tillage.

Seventy-one different varieties of onions were planted in plots four rows wide and 27 feet long. The onions were planted on twenty-two inch single row beds. Each variety was planted in five replications. Seed for each row was prepackaged using enough seed for a planting rate of twelve viable seeds per foot of row. Seed was planted using 12 inch diameter cone-seeders mounted on a John Deere Model 71 flexi-planter unit equipped with disc openers.

The onions were furrow irrigated during the growing season. The first irrigation was applied just after planting on April 6 to supply soil with moisture for seed germination and seedling emergence and growth.

On June 2 through June 6 the seedling onion plants were thinned by hand to a desired plant population of four plants per linear foot of row or to three inch spacing between individual onion plants. Two hundred and ten pounds of N per acre as NH_4SO_4 was sidedressed on June 8. Nitrogen was shanked on each side of the row. On June 27 laybye herbicides were applied and the onions were cultivated for the final time.

Ammo insecticide was aerial applied at two week intervals during June, July, and August for Thrip control.

Bulb maturity ratings for each plot was begun on July 30 and continued until September 17 at weekly intervals. Maturity ratings were recorded as percent of growing bulbs with leaves collapsed and laying on the ground.

The onion bulbs were lifted on September 15th and field dried for seven days. From September 22 through September 27 onion bulbs from two rows of each four row plot were hand-topped and put in burlap bags. Onion bulbs in the remaining two rows were put in burlap bags with tops remaining on the bulb or as untopped bulbs. The bagged onions were put in field storage boxes (4 X 4 X 6 feet) and left in the field for further air drying until October 7. On this date the boxes were placed in a storage equipped with forced air which is emitted through holes in a wall flume. The storage boxes were stacked four high and air was forced under each storage box.

The onion bulbs were removed from storage and graded on January 14 through January 17. Bulbs were graded according to diameter of bulbs. Size categories were bulbs 2¼-3 inch classed as medium, 3-4 inch classed as jumbos and bulbs larger than 4 inch diameter classed as colossal bulbs. Split bulbs were graded as number twos. Bulbs infected by <u>Botrytsis</u> neckrot were weighed and percent neckrot occurring during storage was calculated. The neckrot data is reported as average and potential neckrot. The average neckrot was determined as the average amount of neckrot occurring in the five replications. Potential neckrot is reported as the percent neckrot calculated from the amount of bulbs affected by <u>Botrytsis</u> in one replication where the greatest amount of neckrot occurred. The storage quality was evaluated from both the topped and untopped onion bulbs.

Results

Onion lines were received and evaluated from ten seed companies. Companies include American Takii, Aristogenes, Asgrow, Crookham, Ferry Morse, Golden Valley, Harris Moran, Petoseed, Rio Colorado, and Sunseeds. A total of seventy-one different lines were evaluated. Each variety and performance data is reported in table one. Varieties are listed by company in descending order and according to rank by number based on total yield of bulbs for all seventy-one varieties entered in the trial. Plant stands were good in all plots and onion growth appeared good during the entire season. All pests were controlled and were not a negating factor in varietal performance. The data reflects an accurate assessment of varietal performance in commercial field production. The onions stored well with a relatively low incidence of neckrot among most varieties. Differences in maturity dates occurred between onion lines but onion tops of all lines were pretty well down by the harvest date, although some tops were much greener than others when topped and placed in burlap bags. When the onions were removed from storage all onion tops from untopped onion bulbs were very dry regardless of how green they were when put in burlap bags at harvest time. The untopped onion bulbs stored very well. Bulb quality was excellent and percent neckrot was slightly lower than occurrence of neckrot in varieties with tops removed at harvest time.

Average bulb yields were 655 cwt/ac with 37 percent colossal sized bulbs and 53 percent jumbo's. Overall percent number two's was 1.04 and average neckrot for all varieties was 1.97 percent. Excellent performance data is reported for new experimental lines of yellow, whites, and reds. Very few onion bulbs bolted in 1990.

Statistical data are included in the tables and should be considered when comparisons are made between varieties for yield and quality performance potential. Differences equal to or greater than LSD values should exist before a single variety is considered superior to another.

Table 1. Yield and quality of commercial and experimental lines of onions evaluated in 1990 variety trials. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Company	Variety	Total Yield		Neckrot		Yield by Market Grade								Maturity Ratings					
				Avg.	Potential	+4 inches		3-4 inches		2¼-3 inches		No. 2's		7/30	8/06	8/13	8/21	8/27	9/17
		Rank	cwt/ac			cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac	%						
Amer. Takii	6404	35	662	0.6	1.52	272	40	363	55	26	4	0.4	0.06	55	85	95	98	99	99
Aristogenes	AX-1846	1	908	2.7	6.37	628	69	274	30	4	0.5	2.7	0.26	0	5	33	70	88	96
	El Padre	2	889	6.2	11.84	600	67	282	32	8	0.9	0	0	3	10	60	90	94	97
	AX-2246	3	881	6.2	23.85	504	57	362	41	12	1.3	2.7	0.30	7	45	75	92	85	98
	AX-1849	4	854	3.5	10.82	549	64	295	34	7	0.8	3.0	0.34	6	12	70	88	92	98
	El Charo	8	826	3.0	12.82	537	65	280	34	6	0.7	3.0	0.29	3	10	45	70	89	97
Asgrow	Armada	16	781	1.7	5.45	397	51	356	45	20	2.6	7.6	1.00	30	75	87	93	96	98
	XPH-3466	24	729	1.39	2.84	259	35	422	58	35	4.8	13.0	1.79	65	95	96	98	99	100
	Vega	25	707	1.5	4.42	295	42	385	55	25	3.5	1.5	0.21	10	75	88	90	98	99
	XPH-3326	37	641	0.12	0.61	214	33	391	61	31	4.9	5.5	0.89	70	95	98	98	99	99
	Cache	41	625	0.45	1.65	167	27	412	66	37	5.8	9.2	1.47	90	97	99	99	99	100
	XPH-3375	42	624	0.43	0.75	177	28	405	65	39	6.3	2.1	0.35	94	95	97	98	99	100
	Maya	49	582	7.51	30.59	71	12	420	72	85	14.5	6.2	1.10	90	90	96	98	100	100
	XPH-3481	54	570	1.51	4.41	133	23	363	63	75	13.0	0	0	5	28	80	90	96	100
	XPH-3246	61	514	0.10	0.52	9	2	407	79	96	19.0	2.4	0.50	70	90	96	99	100	100
	XPH-3465	62	514	1.23	3.38	128	25	333	65	52	9.9	0	0	70	98	99	99	100	100
	Benchmark	65	476	0.60	3.00	22	5	352	74	99	21.0	3.0	0.62	90	95	98	99	99	100
	Citadel	67	431	0	0	29	6	296	69	105	24.8	0.30	0.06	95	96	98	99	100	100
Crookham	Celebrity	7	830	3.13	6.25	529	64	278	33	12	1.5	10.5	1.30	0	5	30	70	85	93
	Sweet Perfection	13	798	2.58	5.56	469	59	307	39	14	1.8	8.0	0.95	30	80	90	93	96	97
	Sweet Amber	19	777	4.22	9.70	465	60	295	38	12	1.5	4.7	0.60	30	80	92	95	96	98
	Dai Maru	20	772	1.71	6.89	405	53	332	43	18	2.4	16.7	2.15	3	15	55	70	85	95
	XPH-87N43	27	705	3.67	9.73	273	39	400	57	25	3.7	6.6	0.91	70	92	95	97	97	99
	Ringmaker	34	673	2.11	5.91	331	49	304	45	20	3.0	17.9	2.63	15	45	80	90	96	98
	White Keiger	55	555	3.69	16.21	108	20	369	66	62	11.3	15.4	2.70	12	40	70	86	94	95
	White Delight	57	543	0.32	1.01	159	29	321	59	52	9.6	9.2	1.68	15	25	75	87	92	96
	XPH 89345	63	504	0.35	0.98	143	28	284	56	76	15.2	0.4	0.09	40	80	95	97	98	100
	Red Baron	68	429	0.07	0.37	24	5	239	56	163	38.5	3.3	0.74	30	75	90	95	98	100
Ferry Morse	FMX-263W20	6	831	2.11	4.78	542	65	274	33	9	1.0	5.8	0.67	3	15	50	70	90	95
	FMX-308W6	21	756	1.36	4.07	351	43	384	51	19	2.6	1.3	0.16	28	70	80	93	97	98
	Oro Grande	39	630	4.27	10.53	230	36	360	57	39	6.4	1.3	0.20	15	30	75	90	96	98
	Redman	64	479	0.93	2.70	58	11	260	54	145	30.9	17.1	3.64	35	70	90	95	99	100
	North Star	71	262	0.22	1.09	8	4	131	52	122	43.8	0.99	0.34	90	99	99	100	100	100

TABLE ONE CONTINUED ON NEXT PAGE

Table 1. (continued)

Company	Variety	Total Yield		Neckrot		Yield by Market Grade								Maturity Ratings					
				Avg.	Potential	+4 inches		3-4 inches		2¼-3 inches		No. 2's		7/30	8/06	8/13	8/21	8/27	9/17
		Rank	cwt/ac			cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac	%						
Golden Valley	GV 2882	5	838	1.53	3.66	492	59	320	38	15.5	1.78	10.90	1.27	0	7	45	70	90	97
	GV 2891	10	823	1.35	4.22	515	62	298	36	7.0	0.84	3.08	0.37	18	70	85	90	95	97
	GV 2803	11	820	2.41	5.73	467	57	333	41	14.5	1.79	4.81	0.57	35	70	85	92	95	98
	GV 2820	26	706	4.25	11.45	349	49	323	46	27.6	3.94	6.60	0.94	0	3	15	40	65	80
	GV 2850	40	627	4.30	13.10	151	24	401	64	66.4	10.52	9.67	1.56	7	18	70	85	90	95
	GV 2808	52	572	0.34	1.72	105	18	400	70	54.0	9.64	12.68	2.18	20	70	80	94	97	98
	GV 2855	53	571	2.31	3.33	152	27	349	61	60.3	10.52	9.55	1.68	10	35	70	85	90	95
Harris Moran	HMX 9087	15	783	3.63	9.92	429	55	323	41	26.0	3.42	5.43	0.68	3	25	50	75	85	96
	JK Special	23	737	4.97	18.21	378	51	328	44	18.9	2.45	12.03	1.64	0	7	35	70	88	97
	Target	33	676	0.36	0.95	259	38	366	54	45.3	6.77	6.05	0.89	7	20	70	75	88	95
	HMX 9620	69	392	0.73	2.24	6	2	222	57	122.8	31.75	41.41	10.06	40	80	93	96	98	100
Petoseed	PSR 70287	9	825	1.21	2.34	562	68	242	29	18.8	2.27	2.57	0.30	7	20	73	87	93	97
	PSR 73389	12	808	0.89	2.17	575	72	226	28	6.5	0.81	0	0	0	0	8	25	65	85
	PSR 73489	28	701	1.14	3.34	325	46	360	51	14.4	2.17	1.54	0.23	40	75	87	92	96	99
	PSR 72588	31	691	0.45	1.61	291	42	375	54	24.2	3.76	0	0	3	20	65	85	90	97
	PSR 62588	36	651	5.32	14.35	296	45	326	50	24.8	4.01	4.09	0.59	5	20	70	85	95	99
	PSR 74289	44	616	0.67	3.25	180	29	402	65	33.2	5.50	0	0	65	85	95	98	99	99
	PSR 64889	60	519	0	0	104	20	281	54	132.3	25.70	0.98	0.17	65	85	95	98	99	99
Rio Colorado	Rio Brillo	30	692	1.30	1.73	220	32	447	65	19.5	2.83	5.23	0.75	65	90	95	98	99	100
	Rio Altus	43	622	0.54	1.85	155	25	404	65	59.2	9.52	4.62	0.78	80	95	97	99	99	100
	Rio Linda	45	598	1.54	3.80	160	27	394	66	39.2	6.74	4.48	0.77	85	93	97	99	99	100
	Rio Durado	50	581	2.04	5.28	150	26	396	68	28.5	4.86	5.85	0.96	70	95	98	99	99	100
	Rio Nuevo	56	553	1.28	2.73	164	30	335	60	40.5	7.55	13.77	2.32	65	90	95	97	99	100
	Rio Perfecto	59	533	0.66	1.37	132	25	307	57	41.7	8.06	52.89	9.85	45	85	96	98	99	100
	Rio Nevada	70	386	0.65	1.58	32	8	148	38	200.3	52.14	5.67	1.47	45	80	93	97	98	99
Sunseeds	Bravado	14	798	1.42	3.75	462	58	313	39	19.4	2.41	2.57	0.34	3	7	45	75	85	95
	Valdez	17	778	0.37	0.80	384	49	368	47	22.1	2.81	3.27	0.40	5	20	50	80	90	95
	Winner	18	778	2.17	5.43	338	43	410	53	26.3	3.30	3.45	0.41	25	45	80	90	97	98
	Avalanche	22	743	3.11	2.95	353	47	365	49	17.2	2.37	8.78	1.20	0	5	20	50	70	90
	Sunre 1684	29	693	3.16	13.30	216	31	450	65	26.3	3.74	0	0	15	40	75	90	97	99
	Blanco Duro	32	689	2.60	6.27	259	38	409	59	20.2	2.99	0	0	5	15	45	85	87	97
	Golden Cascade	38	632	5.41	18.18	234	37	364	58	30.5	4.86	3.52	0.57	85	90	95	98	99	100
	Sunre 1488	46	597	2.81	6.88	224	37	329	55	40.7	6.88	2.93	0.48	5	15	70	85	95	100
	Bullring	47	592	2.12	3.55	139	23	408	69	41.5	6.98	3.60	0.59	75	90	95	98	99	100
	Cima	48	586	0.57	2.08	156	26	345	59	76.8	13.77	8.31	1.32	40	75	85	94	95	98
	Magnum	51	573	1.07	2.41	135	24	371	65	62.9	11.09	4.01	0.69	75	85	95	98	99	100
	Valient	58	534	0.90	4.52	140	26	325	61	70.4	13.40	0	0	50	75	90	98	97	100
	Tango	66	454	0.63	1.47	23	5	281	62	149.0	33.08	0	0	50	75	92	97	99	100
	Mean		655	1.97		265	37	338	53	46	9	6.28	1.04						
	LSD (.05)		55	4.00		42	5	37	5	24	5	8.00	1.48						
	CV (%)		6	32		12	10	9	7	19	20	31	38						

* P-value for all measured perimeters were .002044 or less.

AN EVALUATION OF HERBICIDES FOR WEED CONTROL AND ONION TOLERANCE WHEN APPLIED AS POSTEMERGENCE TREATMENTS TO SEEDLING ONIONS AND WEEDS

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Ontario, Oregon, 1990

Introduction

Postemergence treatments were evaluated as repeat applications of Goal, Buctril, Ronstar, Poast, and Fusilade 2000 when applied as single and tank-mix combinations. Herbicide treatments were varied by rates and time of initial application in relation to growth stage of seedling onions. Repeat applications were applied after the initial application as new weed emergence occurred or as weeds injured from previous herbicide treatments recovered and started to regrow. Each plot received at least three applications of herbicide. All herbicide treatments were evaluated for crop tolerance by visual ratings and plant counts. Weed control ratings were by visual observations.

Procedures

Goal herbicide was applied alone and in tank-mix combination with Buctril at rates of 0.05 and 0.10 pounds ai/ac. Buctril rates were 0.15 and 0.30 pounds ai/ac. Ronstar was applied alone and in tank-mix combinations with Buctril at rates of 0.50 and 0.75 pounds ai/ac. Fusilade 2000 and Poast at 0.1875 and 0.25 pounds ai/ac. respectively, were evaluated for grass control and compatibility as two-way tank mixes with either Goal or Buctril or as three way tank-mixes with Goal and Buctril. Initial applications were applied when onions were in the flag leaf, one true leaf, and two true leaf stage of growth. Each plot received at least two additional applications of herbicide treatments after the initial applications were applied to control weeds as they continued to emerge or as weeds injured by previous herbicide applications recovered and started to regrow. Repeat applications continued until weeds were controlled by herbicides activated as lay by treatments.

The onion variety was Golden Cascade, a yellow sweet Spanish line. It was seeded on March 30 in rows spaced 22 inches apart. Individual plots were four onion rows wide and 25 feet long. Herbicides were applied with a single wheel bicycle plot sprayer. Four nozzles, size 8002E teejet fan, were mounted on the spray boom so a nozzle was centered over each of the four rows in each plot while spraying. Spray pressure was 42 psi and water as the herbicide carrier was applied at 19.0 gallons per acre. Each treatment was replicated three times and placed at random within blocks using a randomized complete block experimental design.

The initial herbicide treatments for the flag, one and two true leaf stage of growth were applied on April 19, May 4, and May 15. On April 19 (flag leaf treatments) approximately 10 percent of the onion plants had first true leaf starting to show at the base of the flag leaf. The remaining plants were in different flag leaf growth stages.

The broadleaf species of weeds were cotyledon to first two true leaves showing. The grasses varied from one to three leaves. Spraying conditions were excellent, with no wind, bright sun, and an air temperature of 72° F. It was estimated that the Dacthal treated area had 75 percent fewer weeds than the non-Dacthal treated area where the postemergence treatments were applied. The one leaf treatments were applied on May 4. All onion plants were in the one leaf stage but the length of the true leaf varied from one to three inches long. Onions appeared healthy but weed populations were dense causing some growth stress to the seedling onions. The broadleaf weed species varied in size from two to six leaves, one to two inches tall or with 1.5 inch rosettes. Grasses had one to five leaves. Again spraying conditions were good with calm air, clear skies and air temperature at 72° F with expected high temperature for the next few days at 85° F. The two leaf onion treatments were applied on May 15. The length of the second leaf was from one to four inches long. The longest second leaf was about equal in length to the first true leaf on this date. Both broadleaf and grassy weeds were large and in many plots topped the onion growth and onion plants could not be observed without separating them from the weeds. Sow thistle and shepherds purse not controlled by Dacthal was very dominant in growth compared to the growth of other weed species. Air temperature was 79° F, air was calm with clear to partly cloudy while spraying.

Results

Flag leaf onions were very sensitive to some herbicide treatments and severe foliar injury with some stand loss occurred (table 1 and 2). Herbicide injury to onions did not occur until after the herbicides were activated at the soil surface by a hard rain storm which puddled water around the onion and burned the onion leaf causing them to fall over. Many onion plants that girdled at the soil surface resumed growth and recovered because of the depth of the growing point below the surface of the soil. Most of the injury at flag leaf stage occurred from the higher rates and combination treatments. Onion treated at the one leaf growth stage were tolerant to all herbicide treatments used at the lower rates. Onions in the two leaf stage were tolerant to herbicides at all rates.

Broadleaf weed control was good to excellent with all treatments. Repeat applications were necessary to control large weeds that occur when the initial treatment was not applied before the onions have two true leaves. Repeat applications continued to control weeds until lay by herbicides were applied and activated by cultivation and irrigation water.

Poast and Fusilade tank-mixed with Goal, Buctril and Ronstar were excellent combination treatments resulting in complete control of all grass species. All tank-mixes were compatible and the grass herbicide did not reduce the activity of Goal, Buctril, or Ronstar for broadleaf weed control.

Table 1. Percent weed control and crop tolerance to repeat application of postemergence applied herbicides when the repeat treatments followed initial applications of herbicides applied when the onions were flag leaf, one, or two true leaves. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

				Percent Weed Control								
Herbicides	Rate	Initial Application	Crop[1] Injury (%)	Pig Weed	Lambs Quarters	Kochia	Hairy Nightshd	Sow Thistle	Shepherds Purse	Barnyd Grass	Green Foxtail	Wild Oats
Goal	0.05	flag	55	100	98	98	95	98	73	88	92	45
Goal	0.10	flag	70	100	99	99	99	100	78	94	96	50
Buctril	0.15	flag	15	100	100	98	100	100	99	0	0	0
Buctril	0.30	flag	35	100	100	100	100	100	100	0	0	0
Ronstar	0.50	flag	25	100	100	100	95	98	83	35	40	10
Ronstar	0.75	flag	40	100	100	100	98	100	93	45	60	15
Goal+Buctril	0.05+0.15	flag	58	100	98	100	100	100	100	83	88	38
Goal+Buctril	0.10+0.30	flag	75	100	100	100	100	100	100	88	92	43
Buctril+Ronstar	0.15+0.25	flag	38	100	100	100	100	100	100	23	28	10
Goal+Buctril+Poast	0.05+0.15+0.15	flag	45	100	100	100	100	100	100	100	100	100
Goal+Buctril	0.05+0.15	1-leaf	5	100	100	99	100	100	100	73	78	10
Goal+Buctril	0.10+0.30	1-leaf	10	100	100	100	100	100	100	76	82	15
Buctril+Ronstar	0.10+0.25	1-leaf	5	100	100	100	100	100	100	20	28	5
Goal+Buctril+Poast[2]	0.05+0.15+0.25	1-leaf	3	100	100	100	100	100	100	100	100	100
Goal+Buctril+Fusilade	0.05+0.15+0.1875	1-leaf	3	100	100	100	100	100	98	100	98	100
Goal+Buctril	0.10+0.30	2-leaf	5	93	95	95	95	98	100	63	72	0
Goal+Buctril	0.20+0.50	2-leaf	10	98	98	96	98	99	100	65	75	0
Buctril+Ronstar	0.15+0.25	2-leaf	3	99	99	100	100	100	92	5	15	0
Goal+Buctril+Poast	0.15+0.30+0.25	2-leaf	5	98	98	98	99	99	98	100	100	100
Goal+Buctril+Fusilade	0.10+0.30+0.1875	2-leaf	5	98	99	98	99	99	98	100	95	100
Check			0	0	0	0	0	0	0	0	0	0

1) Ratings: 0 = no effect from herbicide, 100 = all plants killed
Evaluation: crop injury ratings taken 7 days after initial applications applied. Weed control ratings taken on June 20.

2) Adjuvants were not added to tank mixes containing Poast or Fusilade.

Table 2. Onion plant counts from plots treated with herbicide applied as repeat postemergence application to seeding onions when initial application was begun when onions were in the flag, one or two leaf stage of growth. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

			Number of Onion Plants per Forty Feet of Planted Row									
			Dacthal PPI 6 lbs ai/ac.					No PPI Herbicides				
Herbicide	Rate Lbs. ai/ac.	Initial Application	R1	R2	R3	Mean	% ck	R1	R2	R3	Mean	% ck
Goal	0.05	flag	444	529	528	500	98	674	321	592	529	106
Goal	0.10	flag	445	453	247	382	75	205	480	396	344	69
Buctril	0.15	flag	565	382	485	477	93	Grass too dense to make counts				
Buctril	0.30	flag	259	203	207	223	44	Grass too dense to make counts				
Ronstar	0.50	flag	369	439	468	426	83	357	442	390	396	80
Ronstar	0.75	flag	412	353	294	353	69	360	352	276	329	66
Goal+Buctril	0.15+0.15	flag	291	294	290	292	57	185	186	208	193	39
Goal+Buctril	0.10+0.30	flag	126	109	155	130	25	88	60	116	88	18
Buctril+Ronstar	0.15+0.25	flag	203	353	208	255	50	235	361	268	288	58
Goal+Buctril+Poast	0.05+0.15+0.15	flag	414	379	455	416	81	312	267	399	326	66
Goal+Buctril	0.5+0.15	1-leaf	476	502	489	489	96	619	704	615	646	131
Goal+Buctril	0.10+0.30	1-leaf	377	410	341	376	74	497	461	475	478	96
Buctril+Ronstar	0.15+0.25	1-leaf	480	431	555	489	96	467	462	424	451	91
Goal+Buctril+Poast	0.05+0.15+0.25	1-leaf	496	548	501	515	101	615	542	560	572	115
Goal+Buctril+Fusilade	0.05+0.15+0.1875	1-leaf	535	577	539	550	108	712	596	654	654	132
Goal+Buctril	0.10+.030	2-leaf	652	476	475	534	105	512	534	568	538	108
Goal+Buctril	0.20+0.50	2-leaf	417	642	448	502	98	347	499	484	443	89
Buctril+Ronstar	0.15+0.25	2-leaf	532	378	330	413	81	574	499	519	531	107
Goal+Buctril+Poast	0.10+0.30+0.25	2-leaf	497	473	449	473	93	504	504	485	497	100
Goal+Buctril+Fusilade	0.10+0.30+0.25	2-leaf	603	490	487	527	103	578	502	479	519	104
Hand weeded check	-	-	485	576	472	511	100	496	519	478	497	100

Plant counts taken on June 21, 1990. Counts taken from 2 center rows of 4 row plots. Check plots were hand weeded.

RESISTANCE OF ONION CULTIVARS TO BASAL PLATE ROT

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Introduction

Basal plate rot is widespread and occurs wherever onions are grown. The disease can occasionally cause extensive losses. Crop rotation, fumigation, and planting of resistant varieties reduces the incidence of disease. There are many reports of differences among onion varieties in resistance to plate rot. However, there has been no attempt to compare the level of plate rot resistance in onion varieties adapted to the Treasure Valley. This research was designed to compare the level of plate rot resistance in locally adapted onion varieties and new lines under development by seed companies. The level of pink root infection during the season was also evaluated because some studies suggest that pink root predisposes the bulbs to plate rot.

Procedures

Seed of sixteen varieties was planted on April 13 in a randomized block design at the Malheur Experiment Station. The field chosen was known to be heavily infested with the plate rot pathogen (Fusarium oxysporum cepae) and was cropped to onions the previous season (1989). A local source of Fusarium infested soil had been brought into the field approximately 20 years ago to build up the disease population. Each variety was planted in five replications, with individual plots four rows wide and 25 feet long.

Onions received a total of 200 lbs/acre of nitrogen. Weeds were controlled by a combination of Goal, Buctril, Poast, cultivation, and hand weeding. Thrips were controlled with a single application of Ammo. Yellow Spanish onion varieties were thinned to a 3-inch spacing on June 9. White dehydrator-type onion varieties were not thinned.

Four varieties from the previous season's trial were included in this year's trial (see results of L. Jensen's thrips trial, 1989). Valdez and Winner were the most susceptible varieties in 1989, while Cima and Golden Cascade were the most resistant. The other 12 varieties were submitted by five companies.

Pink root infection, and root health were evaluated on a sample of 20 bulbs from each plot on September 10. Pink root was rated on a 0 to 3 scale (0 = No disease; 3 = more than 50 percent roots dark pink). Root health was rated on a 1 to 5 scale (1 =

few roots, mostly dead; 5 = large number of roots, all healthy). Onions were lifted on September 27. Onions in the middle two rows of each plot were topped into boxes and placed in storage on October 3. On October 15 the bulbs were graded into the following size categories:

Small	< 2 1/4 inches
Medium	2 1/4 to 3 inches
Jumbo	3 to 4 inches
Colossal	> 4 inches

Split onions were considered number twos. Each bulb was examined for signs of plate rot. Onions from each plot were evaluated for total weight and weight by size category. All healthy bulbs were returned to storage until December 3, when incidence of plate rot was evaluated on a 100 bulb sample from each box.

Results and Discussion

The incidence of pink root was high in all plots. ODI 1051, Southport White, and SR2316-5 had the lowest incidence of pink root on September 10 (Table 1). These same varieties also had the healthiest roots, as indicated by the high root health ratings.

Average plate rot infection varied from 2.5 to 9.6 percent of bulbs (Table 1). Most of the numbered lines and new varieties submitted by seed companies had less plate rot than Valdez, Winner, and Cima. Golden Cascade was one of the most resistant varieties in 1989, and had one of the lowest potential rot readings again in 1990. Oro Grande and Cache also tended to have few bulbs infected with plate rot. SR2316-3, ODI 1060, SR2311-4, SR2392-5, and PSR57289 tended to have the lowest average plate rot infections. There was no relationship between pink root rating and average plate rot infection for the sixteen varieties.

Bulb yields in this trial were not very high due to the incidence of pink root and generally poor condition of the soil during a second consecutive onion crop. Yield comparisons would be more useful if these same varieties were also grown in an adjacent field with a low incidence of pink root. This would allow determination of relative pink root resistance based on yield reduction, rather than root infection alone. Because root growth tends to decrease with bulb maturity early maturing varieties would tend to have more pink root and less new root production.

SR2392-5, SR2316-3, and SR2311-4 tended to produce as high a total yield as Valdez and Winner, (Table 1). SR2308-3 out-yielded all other varieties in this trial. The white dehydrator-type onions generally yielded less than the yellow Spanish hybrids. ODI1060 was the highest yielding dehydrator variety.

Summary

Several numbered onion lines produced relatively high yields and had lower plate rot infection than most named varieties. SR2316-3 (Sunseeds) was particularly notable because it also had low pink root infection late in the season. Efforts by seed companies to incorporate basal plate rot and pink root resistance into new lines appears to be increasing the level of resistance available to growers.

Valdez and Winner were very susceptible to plate rot in both 1989 and 1990, and should not be planted where there is a history of problems with *Fusarium*. Golden Cascade, Oro Grande and Cache all tended to have lower plate rot infection than Valdez and Winner.

The four white dehydrator-type varieties also exhibited a wide range of disease resistance and yield. ODI 1060 would appear to have some potential where *Fusarium* is a problem.

Table 1. Pink root, root health and basal plate rot incidence of sixteen onion varieties. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Company	Variety	Pink Root Rating[1]	Root Health Rating[2]	Average Rot[3]	Potential Rot[4]
Yellow Spanish Hybrids		(0 to 3)	(1 to 5)	%	%
Sunseeds	SR2392-5	2.5	1.5	4.3	7.7
	SR2316-3	1.9	2.0	2.5	3.9
	SR2311-4	2.6	1.4	4.1	8.4
	SR2308-3	2.3	1.7	7.4	12.2
	Valdez	2.3	1.7	8.3	13.4
	Winner	2.7	1.5	9.3	14.5
	Cima	2.6	1.5	8.8	13.3
	Golden Cascade	2.8	1.3	5.9	7.4
PetoSeed	PSR 57289	2.5	1.6	4.9	6.8
Ferry Morse	Oro Grande	2.5	1.3	4.7	7.1
Asgrow	Cache	2.8	1.4	5.3	7.7
	XPH 3326	2.9	1.2	7.4	9.5
White Dehydrators					
Dorsing Seed	Southport White	1.7	2.2	7.4	10.0
Oregon Dehydrators	ODI 1060	2.1	1.9	3.3	6.9
	ODI 1051	1.6	2.2	7.0	14.3
	ODI 1055	2.7	1.2	9.6	21.7
LSD (0.05)		0.5	0.3	3.9	

[1] 0= No disease, 1= <10 percent Roots dark pink; 2= 10-50 percent Roots dark pink; 3= > 50 percent Roots dark pink.
[2] 1= Few roots, mostly dead; 2= Few roots, mostly healthy; 3= Moderate roots, mostly healthy; 4= Large root no., mostly healthy; 5= Large root no., all healthy.
[3] Average percent of total bulbs with plate rot, mean of five replications.
[4] Percentage plate rot in the replications with the highest incidence.

Table 2. Yield and grade of sixteen onion varieties. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Company	Variety	Total Yield	Yield by Market Grade			
			Colossal	Jumbo	Medium	Small
Yellow Spanish Hybrids		---------- cwt/acre[1] ----------				
Sunseeds	SR2392-5	375	0	145	222	4
	SR2316-3	389	5	246	126	1
	SR2311-4	338	2	130	193	8
	SR2308-3	496	60	345	79	3
	Valdez	401	29	251	96	2
	Winner	348	7	234	88	3
	Cima	272	3	113	118	12
	Golden Cascade	300	0	142	147	4
PetoSeed	PSR 57289	204	0	6	173	22
Ferry Morse	Oro Grande	290	14	169	99	4
Asgrow	Cache	293	0	122	160	5
	XPH 3326	293	5	137	134	4
White Dehydrators						
Dorsing Seed	Southport White	212	0	5	107	100
Oregon Dehydrators	ODI 1060	257	0	26	93	113
	ODI 1051	165	0	5	70	90
	ODI 1055	112	0	5	16	88
LSD (.05)		80	16	74	46	16

[x] Values are means of five replications.

ESTIMATING YIELD LOSS DUE TO HAIL DAMAGE IN ONIONS

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Introduction

Onions are produced on a large number of acres in the Treasure Valley. Yield losses due to hail damage occur sporadically throughout the area. Because of the high costs of inputs needed to produce onions, many growers purchase crop insurance to protect against financial losses due to hail. The level of yield loss from hail depends on the level of defoliation and the stage of onion growth at the time damage occurs. Data relating crop growth stage and defoliation to actual yield loss of commercial varieties grown in the Treasure Valley is needed. This research was initiated to determine the relationship between level of defoliation, crop growth stage and yield.

Procedures

Onions were planted on three dates in a field at the Malheur Experiment Station in a randomized split-block design with four replications. Planting dates were April 17, April 24, and May 18. The following three varieties were planted with a John Deer Model 71 flexi-planter with disc openers: White Keeper (white skin), Celebrity (yellow skin), and Bennies Red (red skin).

Individual plots were four rows wide and 25 feet long. Seed for each row was prepackaged with enough seeds for a planting rate of 12 seeds per foot of row. The onions were hand-thinned on June 14 to a population of four plants per linear foot of row. Onions in the second planting date had poor germination due to heavy rain and soil crusting, which reduced final stands compared to the April 17 and May 18 planting dates.

Onions received a total of 200 lbs/acre of nitrogen. Weeds were controlled by a combination of Dacthal, Goal, Buctril, Poast, cultivation, and hand weeding. Thrips were controlled with two applications of Ammo. Plots were furrow irrigated as needed throughout the season.

On August 3 hail treatments were applied with a blower-type hail machine mounted on the back of a tractor. Tractor speed and ice input was adjusted to apply an average of 40 lbs of cubed ice per pass over the middle two rows.

Hail levels applied were:

0	-	No ice applied
1X	-	1 pass with ice (approx. 40 lbs ice/plot)
2X	-	2 passes with ice (approx. 80 lbs ice/plot

Following hail treatments, plots were irrigated by overhead sprinklers for 18 hours. The sprinkler irrigation was used to simulate the heavy rains that often accompany hail storms, perhaps increasing the risk of fungal organisms being able to infect hail injured onions.

Onions were evaluated for growth stage and defoliation level by five crop insurance adjusters on August 13. Growth stage and defoliation level for each planting date were recorded (Table 1).

Onions were lifted on September 27. Bulbs in the middle two rows were topped into boxes, then placed in storage. On December 19 the onions were graded and weighed by the following categories based on bulb diameter:

Size class		Bulb diameter
Small	-	< 2 1/4 inches
Medium	-	2 1/4 to 3 inches
Jumbo	-	3 to 4 inches
Colossal	-	> 4 inches
# 2		Split or double onions of any size

All bulbs were examined for signs of decay, and the weight of bulbs in each category was recorded.

Results

The 2X hail treatment injured more leaves than the 1X treatment, regardless of the plant growth stage (Table 1). Both hail treatments caused less defoliation damage on small plants (May 18 planting) than on large plants (April 17 and April 24 plantings). Growth stage and defoliation level were very similar in the first two planting dates.

Hail treatments decreased total yield and changed bulb size distribution at all growth stages (planting dates) compared to the undamaged treatment (Table 2). The 1X hail treatment tended to reduce total yield more at the May 18 planting than in the April 17 and April 24 plantings (Figure 1). The 2X hail treatment reduced total yield to the same extent (130 to 140 cwt/acre) at all planting dates compared to the undamaged treatment. Hail damage increased the yield of Small and Medium size classes, and reduced yield of Jumbo, Colossal, and # 2 onions. Hail damage caused a larger increase in small onions, and larger decrease in Jumbo onions at the May 18 planting than in earlier plantings. Hail damage had no consist effect on the percentage of rotten bulbs.

The three onion varieties in this trial responded similarly to hail damage (Table 3). Hail treatments decreased total yield and yield of Jumbo plus Colossal sizes, especially in onions planted on April 24 and May 18. The percentage reduction in total and large-size onion yields was generally greater at later planting dates (Table 4, Figure 2). The percentage reduction in Jumbo yield was consistently higher than the reduction in total yield. The 2X hail treatment caused a larger reduction in total and Jumbo yield than the 1X treatment.

Discussion

The smallest plants (May 18 planting date) exhibited the lowest amount of defoliation, but had the largest percentage yield reduction due to hail. This indicates that plants in the 1 to 1 1/2 inch diameter bulb stage are more sensitive to hail injury than plants with larger bulbs. Plants in the April 17 planting had the largest bulbs at the time of the hail treatments. Because they were so near the diameter required for the jumbo class, a light hail (1X) did not greatly reduce total or marketable yields. However, a severe hail (2X) on the April 17 planting restricted further bulb growth, causing a larger decrease in bulb size and yield.

In almost all instances hail damage reduced yield of Jumbo and Colossal onions more than total yield. Traditionally, the Treasure Valley has been recognized for marketing large onions. Over 70 percent of the onions sold are in the Jumbo category. Medium onions are often discounted, and there is little demand. Therefore, the reduction in bulb size may be more important than the reduction in total yield in determining grower returns.

Table 1. Bulb diameter, average defoliation and direct bulb damage on August 13, 10 days after hail treatment. Values are averaged over three varieties. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Planting Date	Bulb Diameter[1]	Hail Treatment	Average Defoliation[2]	Average Direct Bulb Damage[3]
	inches		%	%
April 17	2 to 3	1X	51.2	3.3
		2X	72.7	6.7
April 24	2 to 2½	1X	48.7	0.0
		2X	73.0	13.3
May 18	1 to 1½	1X	39.0	0.0
		2X	52.3	0.0

[1] Bulb diameter at time of hail treatments.
[2] Percent of green leaves damaged.
[3] Damage that penetrated outer two scales.

Table 2. Effect of planting date and hail on yield, size distribution and decay in onions. Values are averaged over three varieties. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Planting Date	Hail Treatment	Size Class					Total Yield	Rot
		Small	Medium	Jumbo	Colossal	# 2		
		cwt/acre						%
April 17	None	6.1	75.2	172.8	101.9	33.4	389.4	3.5
	1X	8.8	91.2	158.0	72.8	22.7	353.6	3.3
	2X	12.6	99.5	108.1	13.1	21.0	254.1	4.0
April 24	None	3.2	24.6	122.1	147.4	29.8	327.1	4.8
	1X	2.9	44.6	107.7	55.0	26.0	236.1	5.9
	2X	4.9	58.7	93.6	20.7	18.5	196.4	4.0
May 18	None	5.9	85.8	162.0	43.3	22.2	319.2	5.0
	1X	15.1	79.9	79.4	11.4	13.3	199.2	4.0
	2X	20.0	88.2	48.4	7.0	17.5	181.1	6.2
LSD (0.05)[1]		3.7	26.6	34.7	53.2	8.9	59.6	3.4
Planting Date X Hail Interaction[2]								
		**	NS	**	NS	NS	NS	NS

[1] Values within a planting date that differ by more than LSD value are significantly different at the 5 percent level.
[2] Response to hail damage significantly affected by planting date (**) or not significantly affect by planting date (NS).

Table 3. Effect of hail on total yield, and yield of Jumbo and Colossal sizes of three onion varieties planted on three dates. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Variety	Planting Date	Hail Treatment	Total Yield	Jumbo & Colossal Yield
			-------- cwt/acre --------	
White Keeper	April 17	None	294.0	192.5
		1X	209.9	76.2
		2X	174.6	44.6
	April 24	None	195.5	141.9
		1X	98.9	42.7
		2X	97.9	41.8
	May 18	None	274.5	165.0
		1X	189.5	51.4
		2X	158.1	23.7
Celebrity	April 17	None	618.4	506.2
		1X	601.5	494.1
		2X	434.5	285.9
	April 24	None	527.2	466.4
		1X	480.3	400.3
		2X	357.4	268.8
	May 18	None	420.0	331.7
		1X	298.0	204.3
		2X	265.7	135.9
Bennies Red	April 17	None	255.8	125.3
		1X	249.4	122.3
		2X	153.3	32.9
	April 24	None	258.5	200.2
		1X	129.1	45.0
		2X	133.9	32.2
	May 18	None	262.9	119.2
		1X	109.9	16.8
		2X	119.6	6.9

Table 4. Reduction in total and marketable size onion yields at two levels of hail damage. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Variety	Planting Date	Hail Treatment	Yield Reduction	
			Total[1]	Jumbo & Colossal[2]
			%	
White Keeper	April 17	1X	28.6	60.4
		2X	40.6	76.8
	April 24	1X	49.4	69.9
		2X	49.9	70.5
	May 18	1X	30.9	68.8
		2X	42.4	85.6
Celebrity	April 17	1X	2.7	2.4
		2X	29.7	43.5
	April 24	1X	8.9	14.2
		2X	32.2	42.4
	May 18	1X	29.0	38.4
		2X	36.7	59.0
Bennies	April 17	1X	2.5	2.4
		2X	40.1	73.7
	April 24	1X	50.0	77.5
		2X	48.2	83.9
	May 18	1X	58.2	85.9
		2X	54.5	94.2

[1] Reduction in total yield vs no-hail treatment.
[2] Reduction in Jumbo & Colossal yield vs the no-hail treatment.

INSECTICIDES FOR ONION THRIPS (Thrips tabaci-Lindeman) CONTROL IN SWEET SPANISH ONIONS - 1990

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Introduction

Permethrin (Pounce, Ambush) is the only new insecticide registered for thrips control in onions during the past seven years. It was used during the 1989 growing season, with disastrous consequences for growers because of poor thrips control, resulting in reduced size and yields. New insecticides need to be screened to develop efficacy data to be used in helping manufacturers secure full registrations and to help with intermediate Section 18 emergency registrations. Because thrips develop resistance to insecticides fairly rapidly and because of the loss or threatened loss of insecticides by the Environmental Protection Agency, new products should be screened annually to keep the industry in the forefront of new technology.

Many of the products used in this study are not presently registered for use on onions. If in doubt, read the label or consult your fieldman or county agent.

Objective

The purpose of this study was to screen as many products as possible and determine their effectiveness on onion thrips. New insecticides as well as combinations of old and new insecticides were evaluated for thrips control.

Materials and Methods

The plots were four double rows (two beds) wide by thirty feet in length and were replicated four times. They were located on the Paul Skeen Farm two miles southwest of Nyssa. The treatments were applied with a CO_2 pressure plot sprayer set at 45 p.s.i. and 24 g.p.a. The center two rows of each plot were used for evaluation with the total number of thrips on ten plants per plot counted. Readings were made prior to spraying and at 3, 7, and 14 days after treatment. Border areas around the plots were hand sprayed and the rest of the field was sprayed with ground equipment to minimize the possibility of spray drift into the treated area. The onion variety was Vega. Initial treatments were delayed to ensure an adequate thrips population for evaluation. No attempt was made to determine yield effects since that work has been done previously.

Results

Percent control increased for most treatments between three days and fourteen days after treatment counts. This increase in control was due to a decreased number of thrips per plant at fourteen days for the better treatments. Other treatments suppressed thrips buildup to less than the check but higher than the three day counts. Table 1 lists the average number of thrips per plant for all treatments throughout the counting period. Table 2 shows the data as a percent of the check.

The top five treatments for 3, 7, and 14 days after treatment are listed in Tables 3, 4 and 5, respectively. The treatments of Furadan and Furadan + Cymbush were very effective and gave excellent control over the two week time period. The addition of Cymbush to Furadan did not enhance control. ICIA 0321 at the high rate (.03 lb. a.i./A) performed well over the two week time period.

Three Penncap formulations were tried. Penncap M is the standard formulation and "S" and "E" were formulations with different micro-encapsulation techniques. Table 7 and Figure 1 show this information. The "S" formulation was very poor while the "E" and M were similar. None of the formulations were effective by themselves. The addition of Cymbush to the Penncap "S" formulation did give better control than either alone, particularly at the 14-day counts.

Cymbush was combined with several other insecticides, most of which previously have not performed well against onion thrips, to see if the combination would improve control. The results are listed in Table 7 and Figure 2. In each case the thrips control was better than with only Cymbush at the 14-day interval.

Figure 3 compares two rates of the synthetic pyrethroid Capture against Cymbush. Capture worked better than Cumbush. Figure 4 compares 1X and 2X label rates for Ambush and Cymbush. Doubling the rate for Ambush greatly increased control, but had little effect for Cymbush. Combining Ambush and Cymbush did not increase control. Figure 5 compares the synthetic pyrethroid Baythroid against Cymbush. It performed superior to Cymbush but the rates used in this trial may be higher than will be recommended if the product is labeled for onions. Graph 6 is a comparison of ICI 0321 against Cymbush. The two highest rates look most promising. Graph 7 is a recap of the best rates of the synthetic pyrethroid insecticides used in this study.

Two formulations of a numbered insecticide BAY NZN 33893 were studied. Neither had any effect on thrips. All four treatments were similar to the check treatment.

Conclusions

There were a number of insecticides screened for effectiveness against onion thrips. None of the currently registered insecticides were effective. Cymbush has been used for several years under a Section 18 emergency label. It is the most likely material to have available for 1991 but had not received an emergency label at the time of this presentation. Lorsban performed very well but is not currently registered on onions, nor is it likely too be in the near future. Because it has systemic activity, there may be a potential for insecticide carry-over in the harvested crop. The synthetic pyrethroids Capture, Baythroid, and ICIA 0321 all appear to be effective but are not yet registered for onions. The respective companies are considering applying for a federal label for Baythroid and ICIA 0321 for future years. If Cymbush is again registered, the addition of Penncap, Diazinon, or Ambush may increase control in those situations where Cymbush may not be effective.

Experience with the synthetic pyrethroid class of insecticides has been that repeated use leads to mite flare-ups because the mite predators are susceptible to these materials. The addition of parathion to the last application of Cymbush may reduce the potential for problems with mites.

Table 1. Average thrips/plant for 3, 7, & 14 days after treatment. Nyssa, OR, 1990.

Treatment	a.i. Per Acre	Ave. Number Thrips/Plant			
		P.T.	3 DAT	7 DAT	14 DAT
Baythroid	0.75	24.6	15.8	11.3	4.6
Furadan	1.00	12.2	1.2	1.6	7.0
Furadan + Cymbush	1.0 + 0.08	22.6	0.2	0.8	9.6
Baythroid	0.375	22.2	22.2	22.0	11.2
ICIA 0321	0.03	14.2	7.5	10.7	13.5
Ambush	0.6	12.4	13.0	21.5	14.8
Penncap "S: + Cymbush	0.5 + 0.08	22.2	10.7	16.0	15.6
Daizinon + Cymbush	0.5 + 0.08	11.1	9.9	17.6	17.7
Ambush + Cymbush	0.3 + 0.08	13.7	19.7	26.9	18.0
Capture	0.1	22.6	4.6	5.2	18.2
ICIA 0321	0.015	15.5	16.9	18.4	20.7
Capture	0.06	19.8	11.1	11.6	22.6
Cymbush	0.16	20.6	19.7	28.1	25.3
Lorsban + Cymbush	0.5 + 0.08	14.8	13.8	22.8	27.7
ICIA 0321	0.025	24.0	9.6	12.8	27.9
ICIA 0321	0.02	25.8	17.4	17.4	29.7
Cymbush	0.08	10.5	16.7	29.6	30.4
Penncap M + Parathion	0.5 + 0.5	17.4	10.2	22.1	42.2
Penncap "E"	0.5	17.8	19.2	30.5	49.8
Parathion	0.5	17.7	21.9	43.9	50.5
Penncap M	0.5	15.8	16.9	30.7	62.6
Ambush	0.3	19.2	28.9	60.4	66.4
Check	-	20.1	28.2	56.9	84.1
Penncap "S"	0.5	20.7	26.5	47.3	95.2

Table 2. Percent thrips control compared to the check for 3, 7 & 14 days after treatment. Nyssa, OR, 1990.

Treatment	a.i. per acre	% Control		
		3 DAT	7 DAT	14 DAT
Baythroid	0.75	44.0	80.1	94.5
Furadan	1.0	95.7	97.2	91.7
Furadan + Cymbush	1.0 + 0.08	99.3	98.6	88.6
Baythroid	0.375	21.3	61.3	86.7
ICIA 0321	0.03	73.4	81.2	83.9
Ambush	0.6	53.9	62.2	82.4
Penncap "S" + Cymbush	0.5 + 0.08	62.1	71.9	81.5
Diazinon + Cymbush	0.5 + 0.08	64.9	69.1	79.0
Ambush + Cymbush	0.3 + 0.08	30.1	52.7	78.6
Capture	0.1	83.7	90.9	78.4
ICIA 0321	0.015	40.1	67.7	75.4
Capture	0.06	60.6	79.6	73.1
Cymbush	0.16	30.1	50.6	69.9
Lorsban + Cymbush	0.5 + 0.08	51.1	59.9	67.1
ICIA 0321	0.025	66.0	77.5	66.8
ICIA 0321	0.02	38.3	69.4	64.7
Cymbush	0.08	40.8	48.0	63.9
Penncap M + Parathion	0.5 + 0.5	63.8	61.2	49.8
Penncap "E"	0.5	31.9	46.4	40.8
Parathion	0.5	22.3	22.8	40.0
Penncap M	0.5	40.1	46.0	25.6
Ambush	0.3	0	0	21.0
Penncap "S"	0.5	6.0	16.9	0
Check	-	0	0	0

Table 3. Top five treatments - 3 days after treatment. Nyssa, OR, 1990.

Treatment	a.i. per acre	% Control
Furadan + Cymbush	1.0 + 0.08	99.3
Furadan	1.0	95.7
Capture	0.1	83.7
ICIA 0321	0.03	73.4
ICIA 0321	0.025	66.0

Table 4. Top five treatments - 7 days after treatment. Nyssa, OR, 1990.

Treatment	a.i. per acre	% Control
Furadan + Cymbush	1.0 + 0.08	98.6
Furadan	1.0	97.2
Capture	0.1	90.9
ICIA 0321	0.03	81.2
Baythroid	0.75	80.1

Table 5. Top five treatments - 14 days after treatment. Nyssa, OR, 1990.

Treatment	a.i. per acre	% Control
Baythroid	0.75	94.5
Furadan	1.0	91.7
Furadan + Cymbush	1.0 + 0.08	88.6
Baythroid	0.375	86.7
ICIA 0321	0.03	83.9

Table 6. Thrips control with Penncap formulations. Nyssa, OR, 1990.

		% Control		
Treatment	a.i. per acre	3 DAT	7 DAT	14 DAT
Penncap "S" + Cymbush	0.5 + 0.08	62.1	71.9	81.5
Penncap M + Parathion	0.5 + 0.5	63.8	61.2	49.8
Penncap "E"	0.5	31.9	46.4	40.8
Parathion	0.5	22.3	22.8	40.0
Penncap M	0.5	40.1	46.0	25.6
Penncap "S"	0.5	6.0	16.9	0

Table 7. Thrips control with Cymbush combinations. Nyssa, OR, 1990.

		% Control		
Treatment	a.i. per acre	3 DAT	7 DAT	14 DAT
Furadan + Cymbush	1.0 + 0.08	99.3	98.6	88.6
Penncap "S" + Cymbush	0.5 + 0.08	62.1	71.9	81.5
Diazinon + Cymbush	0.5 + 0.08	64.9	69.1	79.0
Ambush + Cymbush	0.3 + 0.08	30.1	52.7	78.6
Lorsban + Cymbush	0.5 + 0.08	51.1	59.9	67.1
Cymbush	0.08	40.8	48.0	63.9

Figure 1. Penncap treatments, thrips trials. Nyssa, Oregon, 1990.

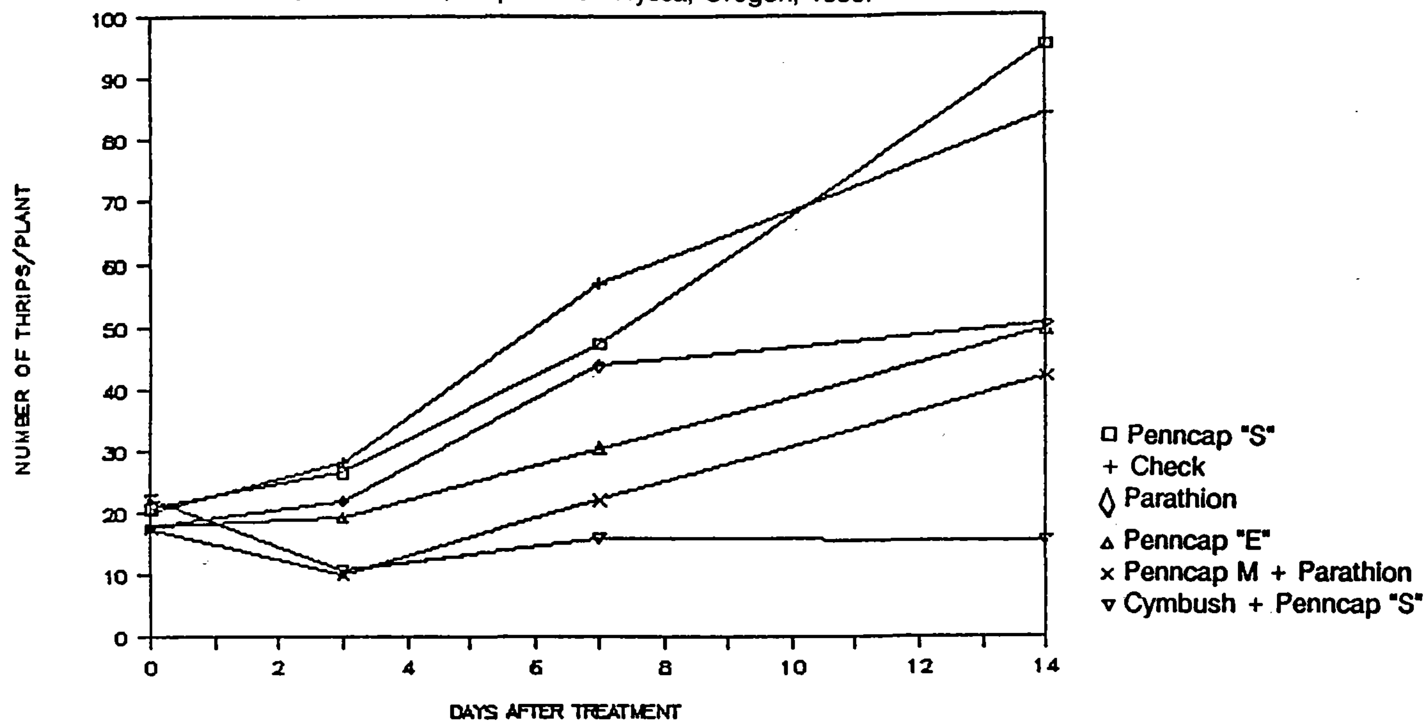


Figure 2. Cymbush combinations, thrips trials. Nyssa, Oregon, 1990.

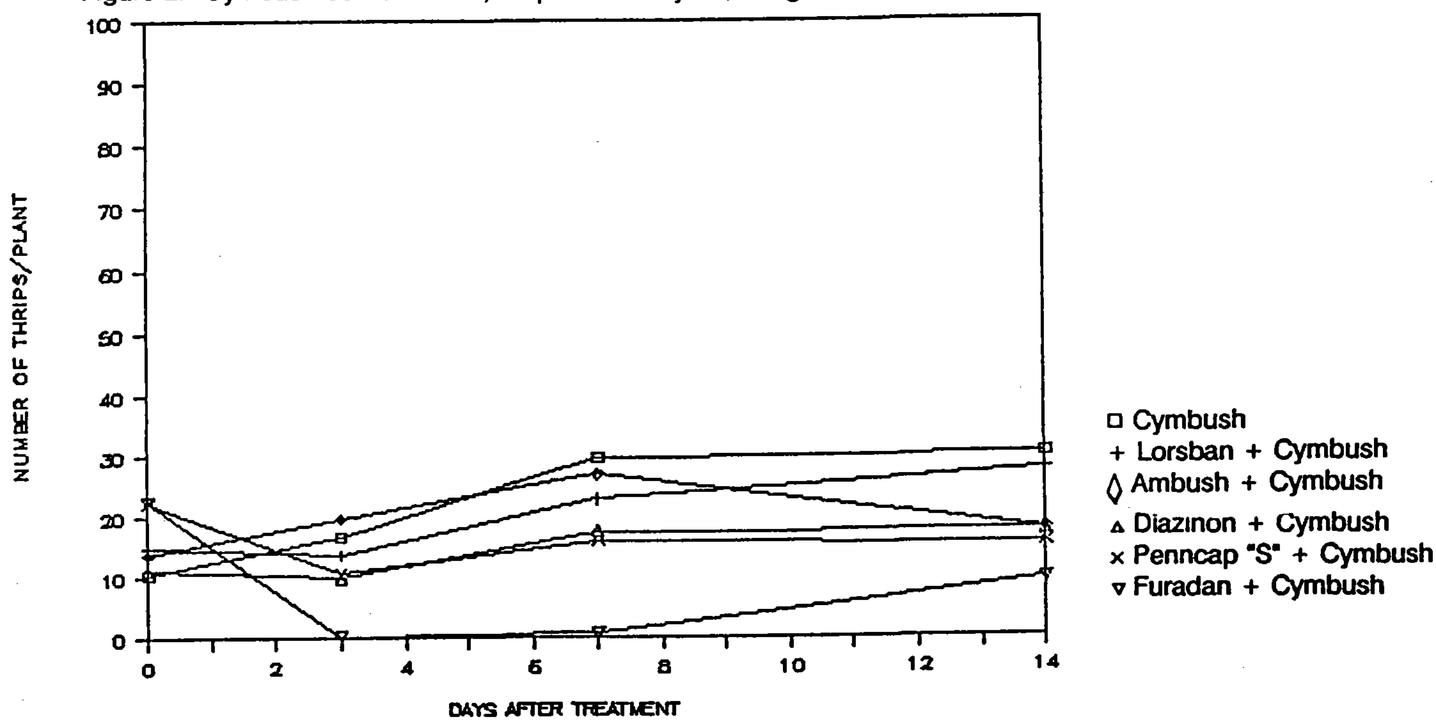


Figure 3. Capture vs Cymbush, thrips trials. Nyssa, Oregon, 1990.

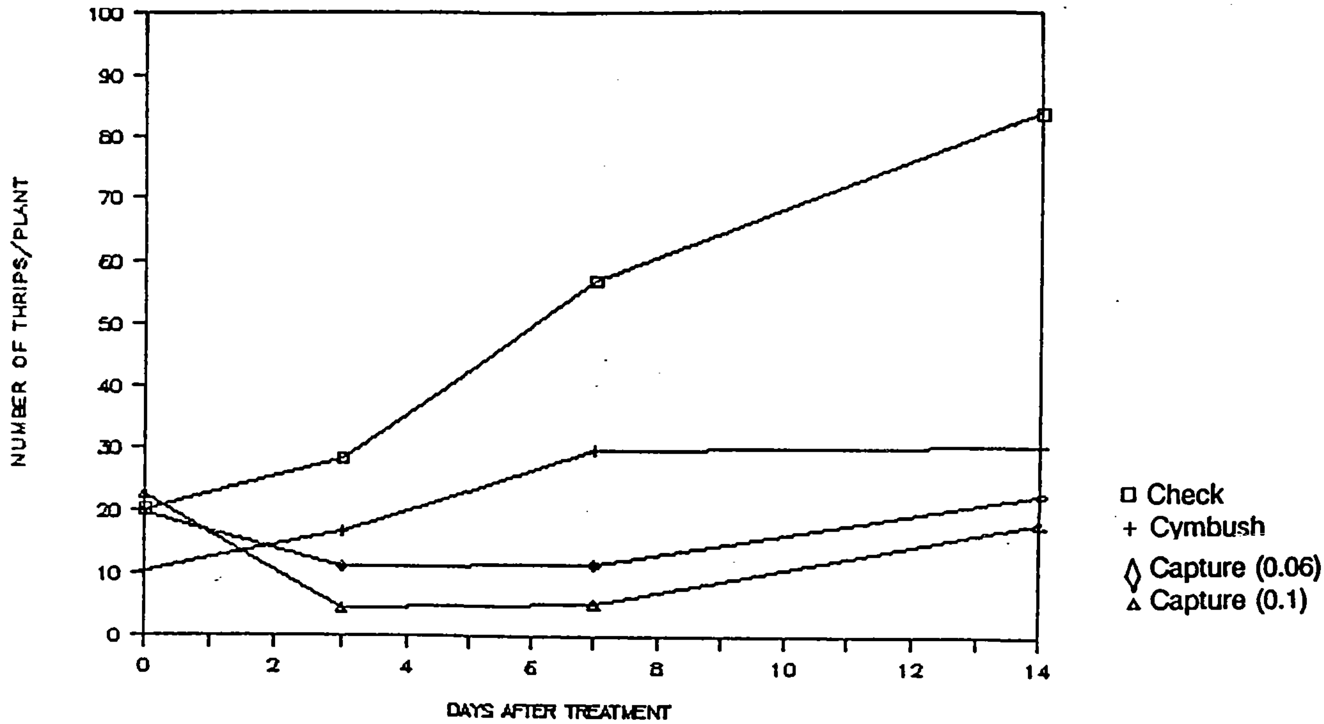


Figure 4. Ambush vs Cymbush, thrips trials. Nyssa, Oregon, 1990.

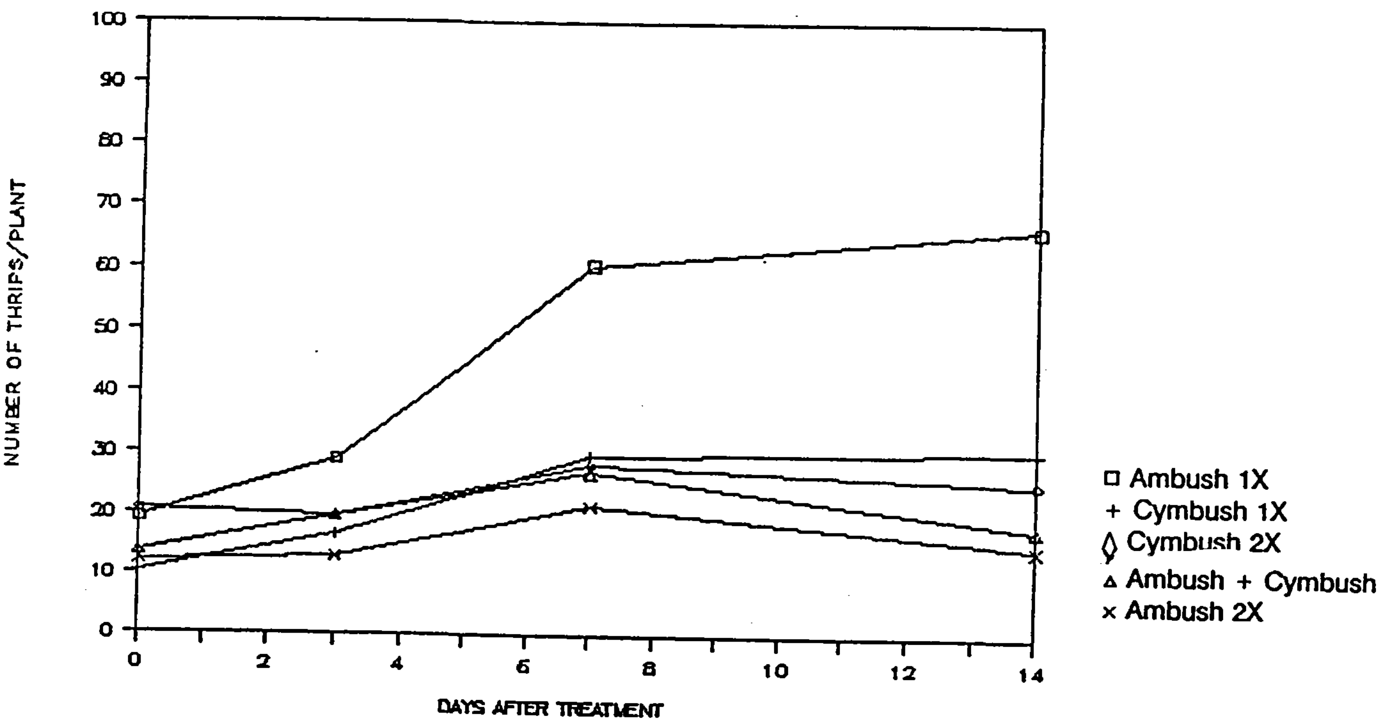


Figure 5. Baythroid vs Cymbush, thrips trials. Nyssa, Oregon, 1990.

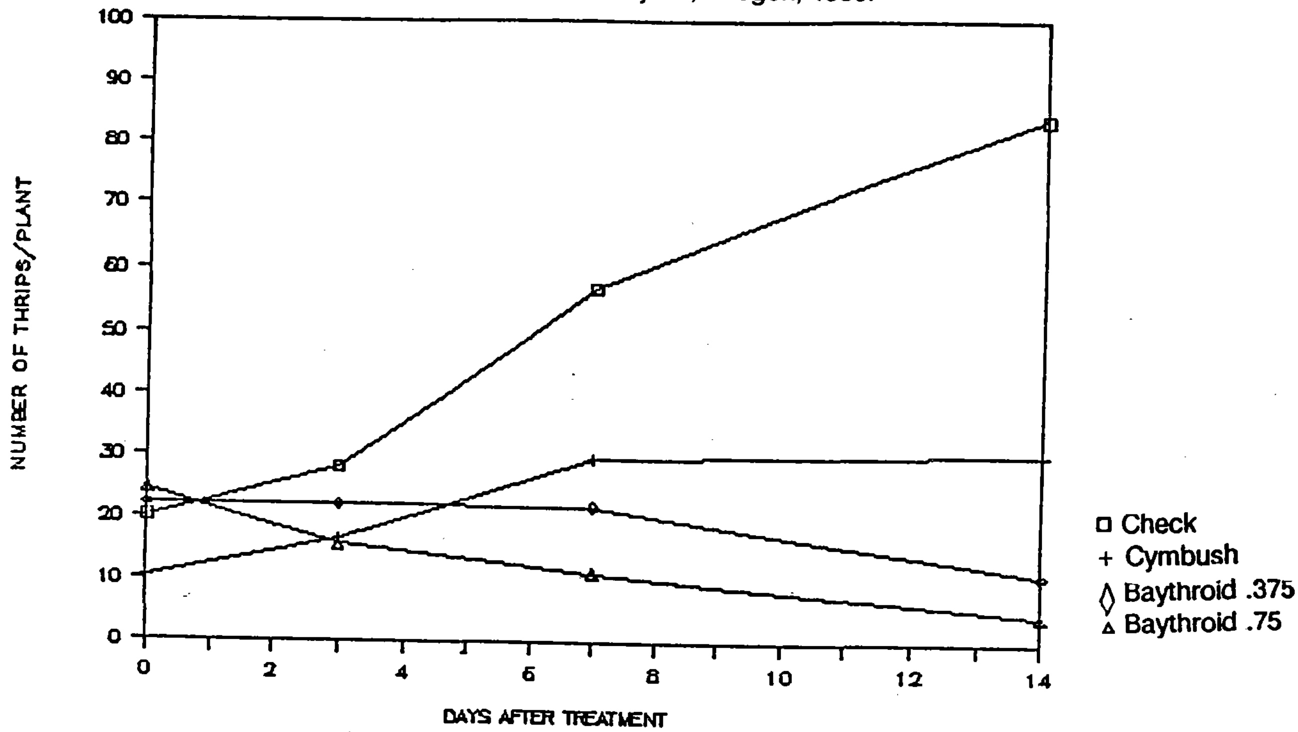


Figure 6. ICIA 0321 vs Cymbush, thrips trials. Nyssa, Oregon, 1990.

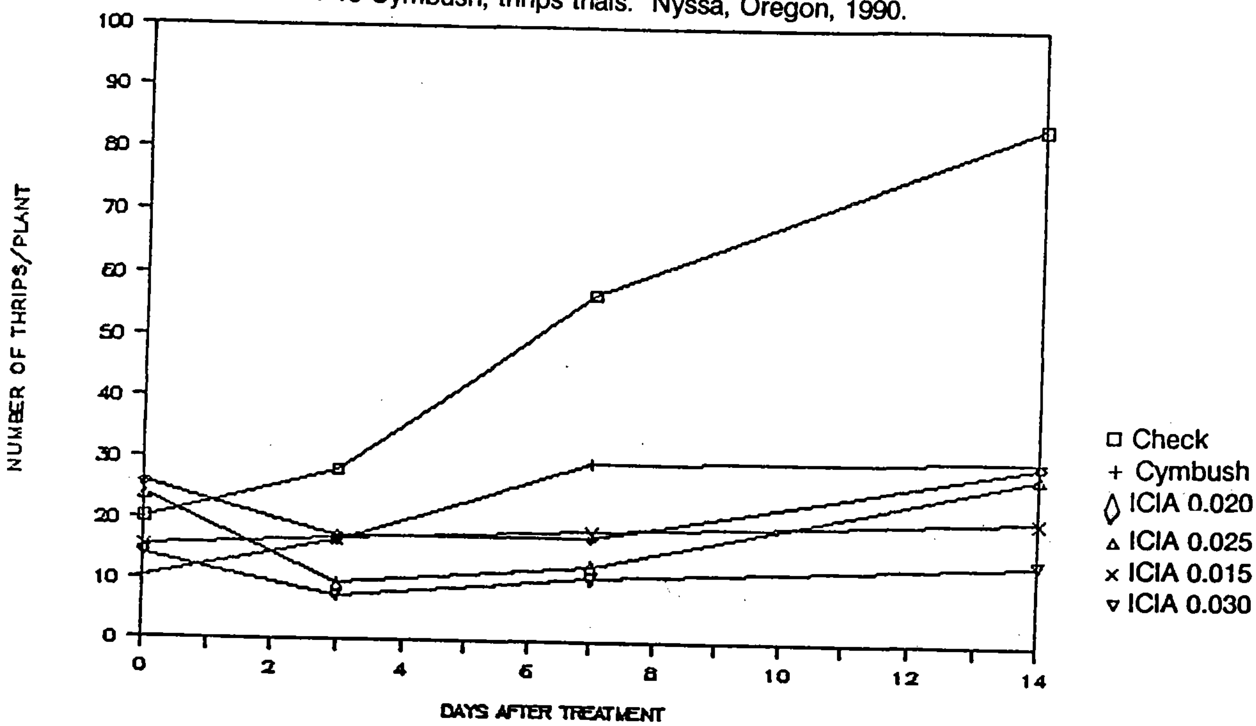
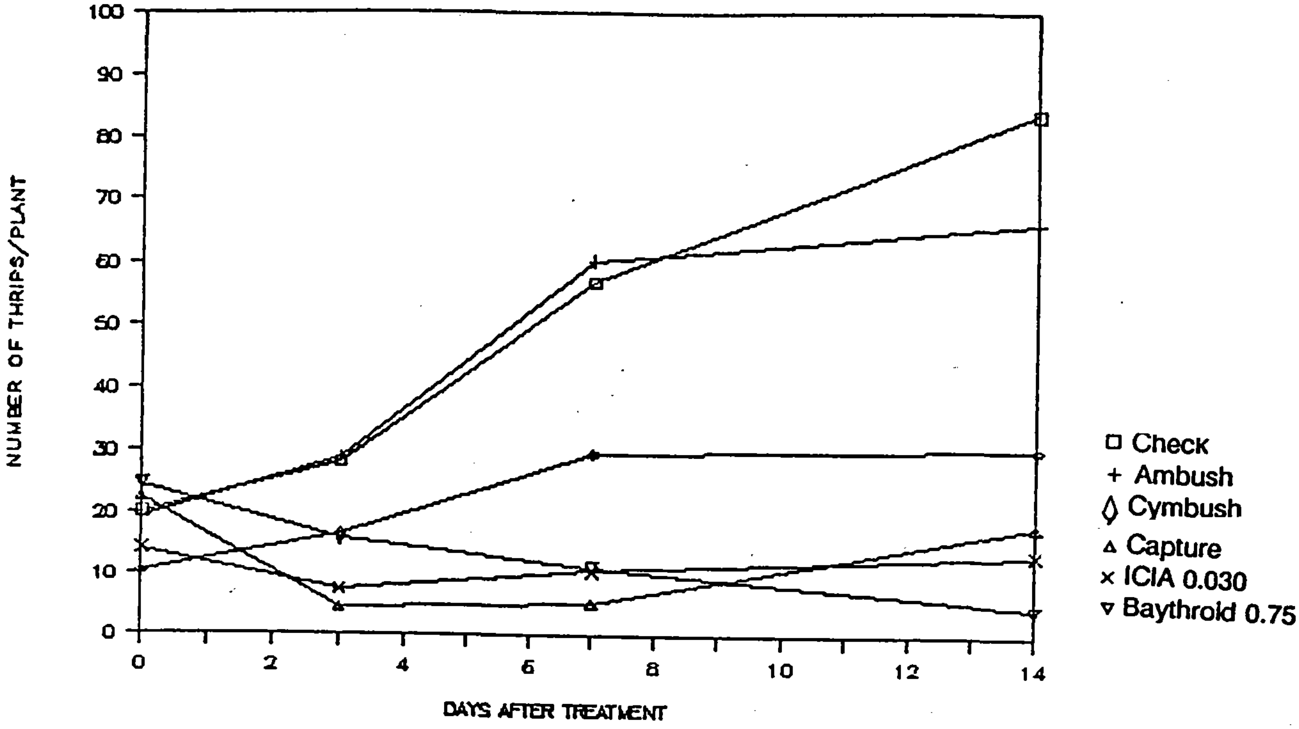


Figure 7. Synthetic Pyrethroid comparisons, thrips trials. Nyssa, Oregon, 1990.



IMPROVED NITROGEN FERTILIZER EFFICIENCY FOR ONION PRODUCTION

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Objectives

Improve the efficiency of nitrogen fertilization of onions by testing nitrogen timing, forms and rates. Determine N fertilization practices that lead to reduced nitrate leaching losses. Describe the effects of irrigation management for onions on nitrate movement below the root zone.

Introduction

Onions are an important horticultural crop in Malheur County and adjoining areas of southwestern Idaho. Typical nitrogen rates on onions range between 200 to 400 lbs/ac. However, onion nitrogen requirements are not completely defined. Nitrogen uptake by onions ranges from 80 to 150 lbs/ac based on yields of 700 cwt/ac. Nitrogen fertilizer inputs may exceed crop uptake. Nitrogen leaching losses from onion production are not known.

Agricultural areas with intensive crop production utilize large inputs of fertilizer and pesticides. Deep percolation and runoff from these lands can carry fertilizer and pesticides from the soil to the groundwater and into streams and lakes. The Oregon Department of Environmental Quality has identified the intensely farmed areas of north eastern Malheur County, Oregon as having endangered ground water and has declared this region a groundwater management area. Groundwater is the principle drinking water source. Nitrate nitrogen contamination exceeding public health standards (10 ppm nitrate-N) and small amounts of Dacthal herbicide breakdown products have been found in shallow well water under parts of the intensively irrigated crop land (Bruch, 1986). Groundwater contamination is also found in the adjoining areas of Idaho.

Management practices are needed to assure grower returns while protecting groundwater. Any reliable way to improve fertilizer nitrogen use efficiency on onions would simultaneously reduce costs and reduce nitrogen losses. Possible alternatives are the following:

A. Time fertilizer use closer to plant needs. For example, nitrogen during growth should be more efficient than broadcast fertilizer during the previous fall or preplant.

B. Place fertilizer for greater efficiency. For example, sidedressed nitrogen should be more efficient than broadcast nitrogen. Precision in sidedress N location should increase efficiency.

C. Use forms of nitrogen less subject to loss. For example, slow release fertilizers or nitrification inhibitors should increase nitrogen use efficiency.

D. Apply only the fertilizer that is needed. For example, soil and tissue tests can be used to apply the right amount of nitrogen at the right time.

E. Reduce leaching of nitrogen. For example, irrigate sufficiently to satisfy onion water needs without excessive irrigation that could lead to nitrate leaching.

Materials and Methods

Methods common to the experiments are listed after the specific treatments of each experiment.

Experiment 1: The effect of N timing and rate on the N response of onions N use efficiency, and nitrate movements through the soil.

Nitrogen fertilizer timing and rates were tested on onions. Onions followed an unfertilized crop of winter wheat. Treatments included spring broadcast applications at 50 and 100 lbs N/ac as urea. Cima sweet spanish onions were planted in April on bedded ground. Sidedressed treatments consisted of 50 and 100 lbs N/ac as urea all at once or in split applications for a total of seven treatments.

Experiment 2: The potential of N-Serve and controlled release S coated urea to reduce onion N fertilizer requirements and reduce nitrate movement and loss.

Dai Maru onions followed an unfertilized crop of winter wheat. Wheat stubble was incorporated and the land was bedded for onions. Urea, urea plus N-Serve, and sulfur coated urea were sidedressed on onions. Urea was applied as a single spring sidedress application at N rates of 0, 50, 100, 200, or 400 lbs/ac with and without N-Serve. Sulfur coated urea rates were 100 and 200 lbs N/ac. Sulfur coated urea was a new generation product with N release characteristics matching crop needs over a short period matching the growing season.

Experiment 3: The role of excessive irrigation in nitrogen losses from onions.

The experiment consisted of Cima onions with two fertilization regimes and two irrigation rates for a total of four treatments. The fertilization regimes were 400 lbs N/ac as urea with 1 lb ai/ac of N-Serve and 200 lb N/ac as controlled release sulfur coated urea. Irrigation rates were normal and excessive. Normal irrigation consisted of water in every other furrow as required. Excessive irrigation consisted of irrigating every furrow from mid June through the remainder of the season.

General Procedures:

The soil was sampled in six and twelve inch increments throughout the profile to five feet in March 1990 prior to planting. Soil samples were analyzed for nitrate and ammonium nitrogen to determine the amount of available nitrogen in the root zone and the amount of available nitrogen that might be subject to loss. After harvest the soil was sampled again and analyzed for nitrate and ammonium nitrogen.

Nitrogen losses from the profile were calculated by adding fertilizer nitrogen to available soil nitrogen in the spring and subtracting the estimated crop nitrogen removal and residual available soil nitrogen in the fall.

Onions were grown in 1990 according to commercial practices in 22-inch rows to provide results directly applicable to commercial production. Onions from all treatments were harvested and evaluated for yield and market grade. Onions tops and bulbs were sampled from every plot before harvest. Bulbs and tops were evaluated for dry matter content and analyzed for total N and nitrate. Nitrogen uptake per acre and N fertilizer use efficiency were calculated.

Each experiment was conducted as a randomized complete block with five replicates, with the exception of limited randomization and from replicates in experiment three.

Results and Discussion

Before planting, the soil profile to five feet contained 286 lbs/ac of available nitrogen (Table 1). Unexpectedly high levels of ammonium-N were encountered. The onion crop in 1990 followed an unfertilized wheat crop in 1989. Potatoes and wheat in 1988 and 1987 respectively were grown in the same field with minimal fertilization. Residual available soil nitrogen after harvest, amounted to 184 lbs N/ac in the soil profile to six feet where the onion crop was unfertilized.

Malheur County onion fertilizer recommendations are based on soil nitrate-N alone. The accounting of surface soil ammonium-N would allow reduction in nitrogen fertilization at a cost savings to growers. Onion yield responses to nitrogen fertilizers were weak, regardless of application strategy (Tables 2 and 4).

Dry weight of Cima onions averaged 13% of fresh weight while the dry weight of Dai Maru onions averaged 11%. The onion dry weight contained 1.13 to 1.50 percent nitrogen (Tables 3 and 5). Crop nitrogen removal in the bulbs plus tops averaged 73.3 to 127.1 lbs N/ac depending on the treatment.

Nitrogen losses to groundwater are of particular concern. Estimates of nitrogen losses under onion production cannot be totally attributed to leaching losses since volatile ammonia losses, runoff N losses, denitrification losses and other unquantified nitrogen transformations occur. Nitrogen loss estimates are useful for comparison purposes between fertilization treatments, even if they are not a precise estimate of the actual nitrogen loss.

In the nitrogen timing experiment, greater nitrogen losses were anticipated from the spring broadcast treatments than from the sidedressed treatments. Split sidedressed urea could be even less subject to loss than a single side-dressed urea treatment. Results in Figure 1 are consistent with the expectations. Nitrogen accounting showed a loss of 33.8 lbs N/ac following spring broadcast urea, whereas nitrogen losses following sidedressed or split sidedressed urea were less. In the second experiment unaccounted nitrogen increased rapidly with sidedressed nitrogen rate (Figure 2). At 400 lbs N/ac sidedressed as urea, N-Serve reduced nitrogen losses from the soil profile (Table 6). High sidedressed nitrogen plus N-Serve lead to high levels of soil nitrogen throughout the season and reduced onion production (Table 4).

Controlled release sulfur coated urea at 100 lbs N/ac was a favorable treatment in 1990, both in terms of onion yields (Table 4), onion nitrogen recovery (Table 5), and nitrogen losses (Figure 3).

Unaccounted nitrogen increased from 73 to 145 lbs N/ac with excessive irrigation (Figure 4).

Conclusions

Broad conclusions from one year's field data are not warranted. Management experiments require a minimum of three years of repetition for valid research. Promising management strategies then need further verification and adaption in growers fields. Accounting for soil ammonium-N can help reduce unnecessary fertilizer N applications and reduction of grower costs if residual soil ammonium-N proves to be widespread.

Reduction of N losses may prove possible through careful management of N timing, N rates, N form, and irrigation.

Table 1. Available soil nitrogen before and after the production of onions without fertilization. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Soil Depth	Available Soil Nitrogen					
	At Planting			At Harvest		
	Nitrate-N	Ammonium-N	Total Available N	Nitrate-N	Ammonium-N	Total Available N
	ppm	ppm	lb/ac	ppm	ppm	lb/ac
0-6"	12.5	13.0	37.5	20.2	6.2	38.8
6-12"	8.1	11.7	29.2	2.8	5.4	12.1
1-2'	2.6	9.7	39.5	2.0	5.8	25.2
2-3'	2.7	12.8	54.0	2.2	5.2	26.0
3-4'	3.7	12.7	57.1	6.1	5.8	41.4
4-5'	4.9	14.9	69.1	7.4	4.4	40.9
5-6'	-	-	-	6.2	4.2	39.3
Total 0-6'	-	-	286.4	-	-	184.4

Table 2. Yield and grade of Cima onions with variable nitrogen fertilizer rates and timing. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Treatment		Yield by Market Grade						Total Yield
Nitrogen Application	N Rate	Rot	Cull	Small	Medium	Jumbo	Colossal	
	lbs/ac	---------------% ---------------						cwt/ac
None	0	1.3	3.8	1.1	16.6	52.1	25.1	463.0
Spring Broadcast	50	2.7	4.9	0.9	13.4	53.2	24.9	439.9
Spring Broadcast	100	2.1	4.5	1.2	12.5	50.8	29.0	440.9
Sidedressed	50	1.4	5.4	1.3	13.8	52.5	25.6	495.8
Sidedressed	100	3.0	3.8	1.0	14.2	49.1	28.9	444.7
Split-sidedressed	35+25	3.1	3.9	1.3	13.4	50.0	28.3	478.3
Split-sidedressed	50+50	2.6	3.6	1.4	13.8	51.8	26.9	454.1

Table 3. Dry matter, nitrogen content, and crop nitrogen removal by Cima onions as influenced by nitrogen fertilizer rates and timing. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Treatment		Onion Composition			Crop N Removal		
Nitrogen Application	N Rate	Dry Matter	Total Nitrogen	Nitrate Nitrogen	Bulb	Tops	Total
		%	% DW	ppm	lb/ace		
None	0	13.17	1.36	287	83.3	17.3	100.6
Spring Broadcast	50	13.07	1.41	393	80.9	21.1	102.0
Spring Broadcast	100	12.99	1.40	370	79.9	20.2	100.1
Sidedressed	50	13.25	1.33	411	87.7	21.5	109.2
Sidedressed	100	13.64	1.45	484	87.6	21.2	108.8
Split-sidedressed	35+25	13.25	1.29	490	81.5	19.1	100.7
Split-sidedressed	50+50	13.59	1.31	475	81.1	17.8	98.9

Table 4. Yield and grade of Dai Maru onions with sidedressed urea rates and forms. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Treatment		Yield by Market Grade						Total Yield
Urea N Rate	Additive or Coating	Rot	Cull	Small	Medium	Jumbo	Colossal	
lbs/ac		%						cwt/ac
0	none	2.6	6.6	1.3	13.7	49.7	26.2	528
50	none	3.2	3.8	1.1	7.1	42.9	41.9	578
100	none	3.1	3.4	1.2	11.0	47.3	34.0	567
200	none	1.9	3.4	1.2	14.7	51.4	27.4	492
400	none	2.1	2.0	2.6	22.4	51.7	19.2	497
50	N-serve	2.7	6.3	0.9	9.8	47.0	33.3	539
100	N-Serve	2.5	4.0	2.3	18.2	44.8	28.2	495
200	N-Serve	2.4	2.4	1.9	16.6	47.5	29.2	574
400	N-Serve	2.0	1.1	6.2	38.8	39.7	12.1	345
100	S Coated	4.2	2.7	1.0	6.7	41.1	44.4	569
200	S Coated	2.3	3.4	0.4	9.0	44.9	39.1	552

Table 5. Dry matter, nitrogen content, and crop nitrogen removal by Dai Maru onions as influenced by sidedressed urea rates and forms. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Treatment		Onion Composition			Crop N Removal		
Urea N Rate	Additive or Coating	Dry Matter	Total Nitrogen	Nitrate Nitrogen	Bulb	Tops	Total
lbs/ac		%	% DW	ppm	lbs/ac		
0	none	10.98	1.13	272	65.7	23.6	89.3
50	none	10.66	1.29	354	79.7	25.7	105.4
100	none	10.94	1.39	501	86.4	17.4	103.8
200	none	10.58	1.44	468	75.1	24.0	99.1
400	none	10.46	1.50	586	79.0	20.5	99.5
50	N-Serve	11.31	1.17	415	73.8	19.0	92.8
100	N-Serve	10.73	1.23	318	65.2	25.6	90.8
200	N-Serve	10.47	1.43	430	85.8	25.8	111.6
400	N-Serve	11.10	1.48	947	54.7	18.6	73.3
100	S Coated	12.11	1.41	413	96.7	30.4	127.1
200	S Coated	10.89	1.32	399	79.1	30.0	109.1

Table 6. Available soil nitrogen at harvest following onions sidedressed with 400 lbs N/ac as urea with and without N-Serve at 1 lb ai/ac. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Soil Depth	Available Soil Nitrogen					
	400 lbs N/ac as Urea			400 lbs N/ac as Urea + N-Serve		
	Nitrate-N	Ammonium-N	Total Available N	Nitrate-N	Ammonium-N	Total Available N
	ppm	ppm	lb/ac	ppm	ppm	lb/ac
0-6"	62.1	6.8	101.6	82.4	12.6	140.0
6-12"	9.6	6.4	23.6	30.4	6.7	54.6
1-2'	14.1	6.4	66.1	22.9	4.4	87.8
2-3'	15.7	5.2	72.6	26.4	5.1	109.6
3-4'	23.7	5.2	100.6	33.8	4.9	134.8
4-5'	15.8	6.2	76.6	23.7	4.8	99.3
5-6'	10.0	8.1	63.0	16.9	4.6	74.9
Total 0-6'	-	-	504.1	-	-	701.0

Figure 1. UNACCOUNTED SOIL NITROGEN AS INFLUENCED BY N TIMING ON ONIONS

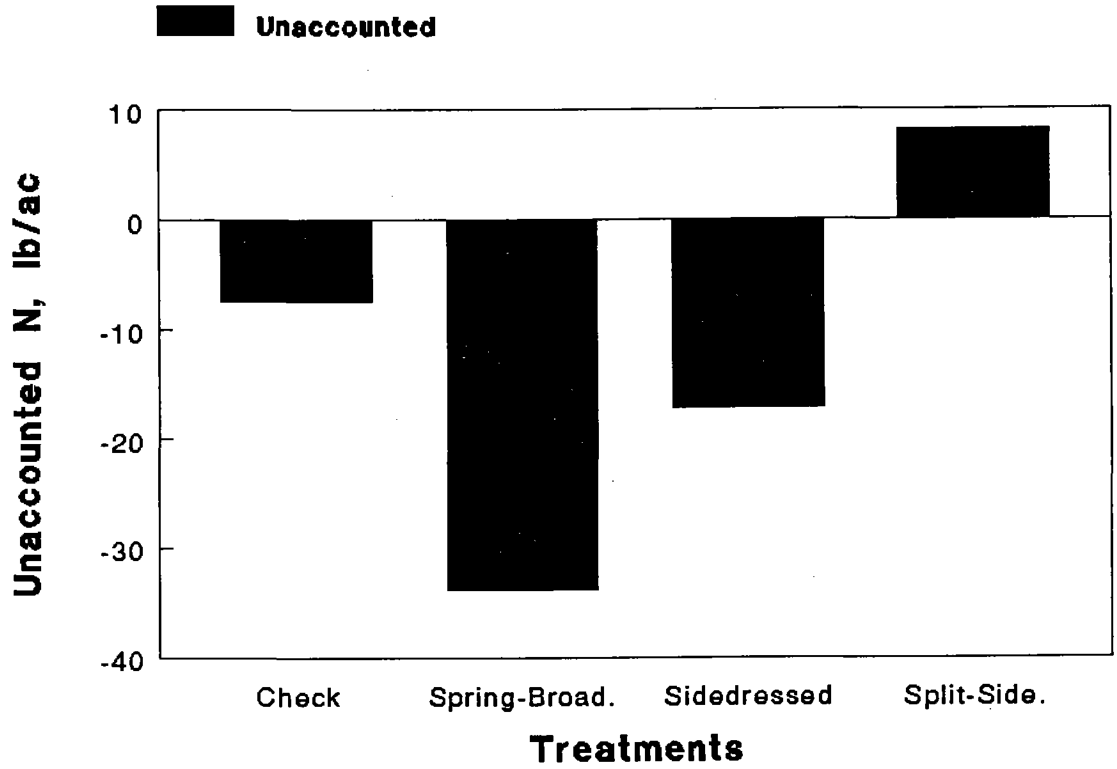


Figure 2. UNACCOUNTED SOIL NITROGEN AS INFLUENCED BY N RATE ON ONIONS

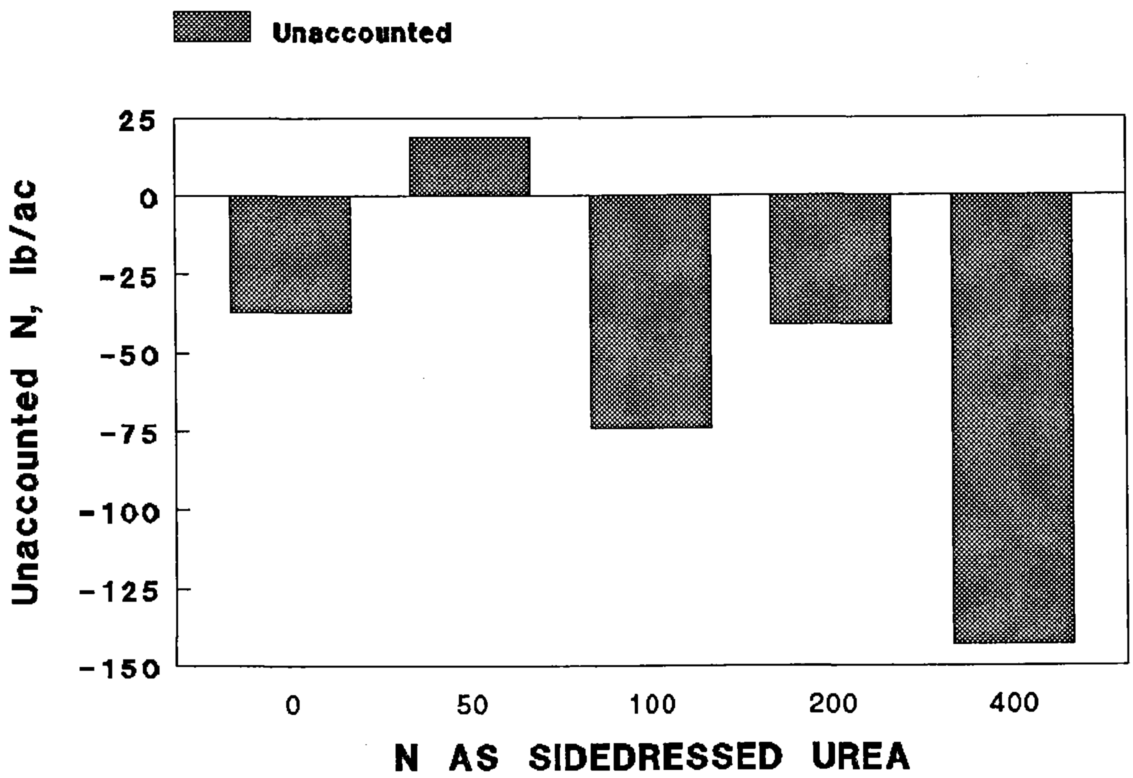


Figure 3. SOIL N AS INFLUENCED BY SIDE DRESSED N RATE AND FORM

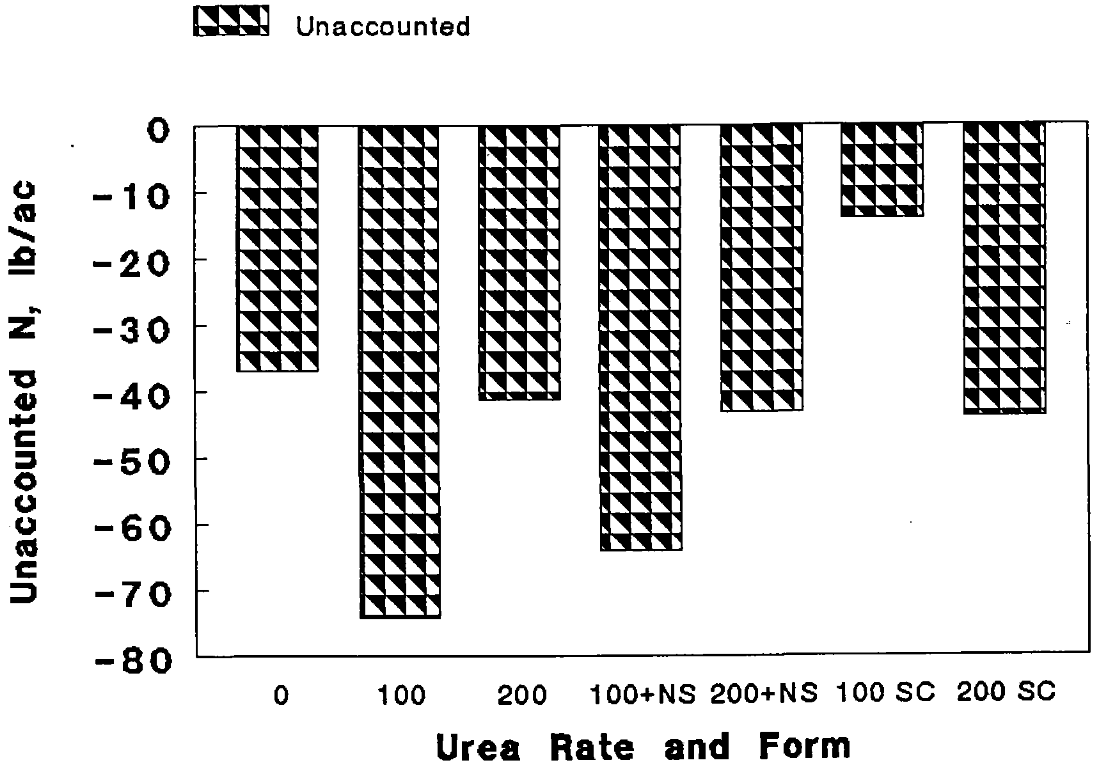
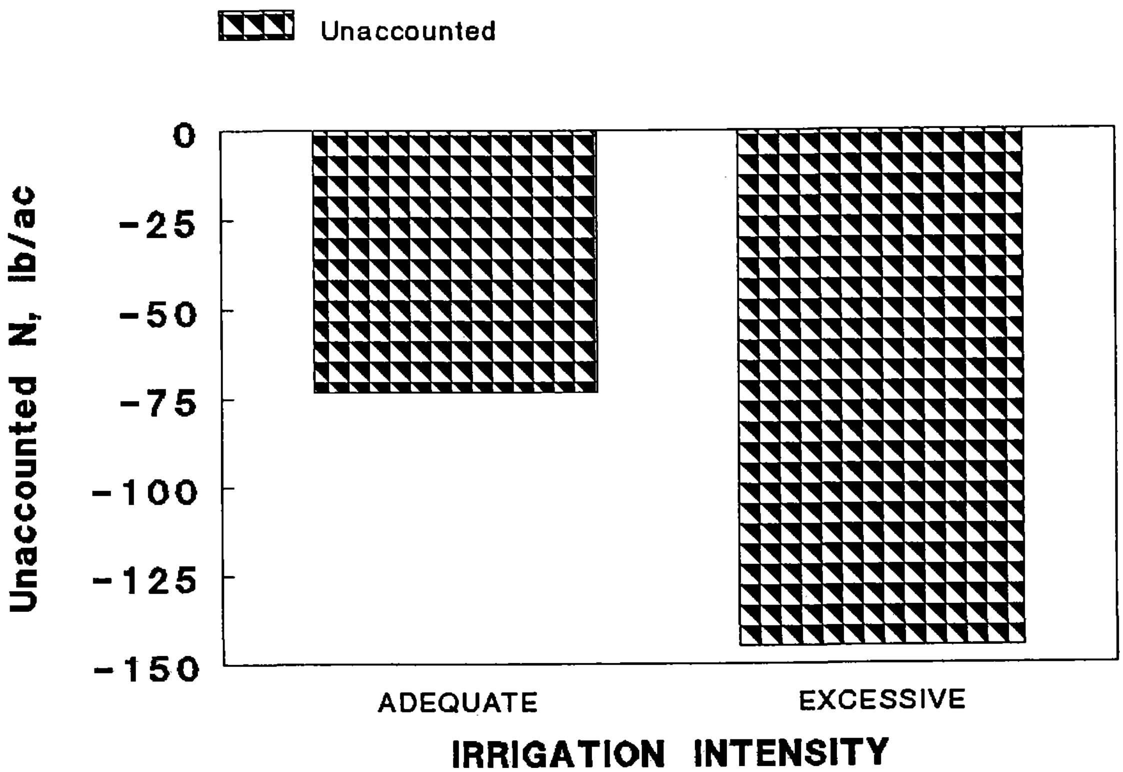


Figure 4. SOIL N AS INFLUENCED BY OVER-IRRIGATION



EFFECTS OF THIMET AND TEMIK INSECTICIDES ON TUBER YIELD AND QUALITY OF FOUR POTATO VARIETIES

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Objective

Temik (aldicarb) and Thimet (phorate) insecticides applied were compared as sidedressed treatments on four potato varieties (Russet Burbank, Shepody, Frontier Russet, and A74212-1 L) grown for processing and fresh market.

Introduction

Potatoes are particularly susceptible to viruses transmitted by aphids. Viruses usually reduce yields and quality. For example, potato leaf-roll virus (PLRV) causes tuber "net necrosis" making the tubers unsuitable for processing. The presence of PLRV in a potato seed crop makes it unacceptable for certified seed.

The principle insecticide for virus control has been Temik. Temik was voluntarily removed from the market in the spring of 1990 by Rhone-Poulenc due to excessive residues in a few potato samples. Potato growers were left with few insect control options including Thimet. Potato growers need to know how Thimet compares with Temik for insect control, crop yield, and tuber quality.

Material and Methods

Four potato varieties were selected for the study. Shepody and Frontier Russet are two new processing varieties for the area, A74212-1 L is a fresh market entry, and Russet Burbank is the area's standard multipurpose variety.

Two-ounce potato seed pieces were treated with Tops 2.5 fungicide planted April 30, 1990 in 36-inch beds, nine inches deep and nine inches between seed pieces. Plots were single rows 37.5 feet long, separated within each bed with red potatoes. Treatments were arranged in a randomized complete block with five replications of variety and insecticide for a total of 40 plots.

The soil was an Owyhee silt loam with less than 1 percent slope and a high water-holding capacity. The field was plowed out of alfalfa in the fall of 1989 and fall bedded. No fertilizer was applied because residual soil fertility was adequate and petioles never became deficient during the season. On May 9, Temik or Thimet insecticide was sidedressed at 3 lbs ai/ac. No additional insect control was used. The field was furrow irrigated every four to seven days from June 5 through August. About 38 acre-inches of water were applied. Eight watermark sensors were installed in the plots to measure soil water potential. Sensors were read four to five times per week from June 19 to August 28.

Russet Burbank petiole samples were sampled throughout the season and petiole nitrate levels remained. Residual soil nitrogen and decaying of alfalfa residues provided adequate nitrogen all season.

Potatoes were harvested October 10 and graded into the following categories: US Number One, 10 ounce and larger; US Number One, 6 to 10 ounce; US Number One, 4 to 6 ounces; US Number Two, 10-ounce and larger; US Number Two, 4 to 10 ounces; undersized potatoes, (less than 4 ounces); and culls caused by decay. Representative tubers from each plot were evaluated for specific gravity, average fry color, and percent dark-end fry color. Specific gravity and stem-end fry color were determined using potato samples stored until early December.

Results and Discussion

Plant development was normal and no insect predation was recorded in either insecticide treatment. There was concern that check plots with no applied insecticide would introduce a large number of pests into the field so no check was included in the trial.

Yield and Grade

No statistically significant yield and market grade differences were observed between Temik and Thimet (Table 1). There was a trend toward increased US Number Ones for Thimet in all four varieties. Although the experiment was designed to examine insecticide effects it also provided a valuable comparison of new potato varieties. Statistically significant variety effects were recorded for all yield and grade categories except yield of decayed tubers (Table 1). Frontier Russet produced the lowest overall yield with 399 cwt/ac and the fresh market line A74212-1 L showed the highest with 780 cwt/ac. Of the three processing varieties, Frontier Russet had the largest percentage of US Number One tubers and the lowest percentage of US Number Two tubers. Shepody had the lowest yield of undersized (<4 oz) tubers and the highest yield of marketable tubers without dark-ends (Table 2). A large proportion of undersized tubers commonly fall through grower digger chains and grow in subsequent crops as weeds. Most of the rotten tubers had jelly-end rot.

Specific Gravity and Fry Color

Temik was associated with a significant decrease in percent USDA No.4 dark-ends (Table 2). Insecticide did not significantly alter specific gravity, average photovolt readings, or USDA No.3 dark-ends.

The 1990 growing season was hot and may have contributed to the high incidence of dark-end tubers in the Russet Burbank variety. Shepody and Frontier Russet had significantly less dark-end tubers, especially critical USDA No.4 dark-ends. The fresh market variety was fried to evaluate of insecticide effects and not necessarily to compare it to the processing lines.

Table 1. Effect of sidedressed Temik and Thimet insecticides on tuber yield and market grade. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Variety	Insecticide	US NUMBER ONE 10+ oz	US NUMBER ONE 6-10 oz	US NUMBER ONE 4-6 oz	US NUMBER ONE Total	US NUMBER TWO 10+ oz	US NUMBER TWO 4-10 oz	US NUMBER TWO Total	Undersized tubers <4 oz	Rot	Total Yield	Percent By Grade Ones	Percent By Grade Twos
		cwt/ac										%	
Russet Burbank	Temik	33	68	81	183	32	105	137	184	10.5	515	33.5	26.8
	Thimet	40	78	85	203	53	114	167	163	11.4	545	39.3	30.5
	Average	36	73	83	193	42	109	152	173	10.9	530	36.5	28.6
Shepody	Temik	112	112	82	306	104	83	187	92	8.0	593	50.7	31.7
	Thimet	121	146	85	352	86	66	151	93	1.9	599	55.9	26.9
	Average	116	129	83	329	95	74	169	93	5.0	596	53.3	29.3
Frontier Russet	Temik	41	106	89	235	6	8	14	110	4.5	304	64.2	3.6
	Thimet	47	118	108	272	4	15	19	136	5.7	434	62.0	4.7
	Average	44	112	98	254	5	12	17	123	5.1	399	63.1	4.2
A74212-1 L	Temik	264	212	128	605	22	35	57	84	8.0	755	80.0	7.7
	Thimet	263	236	153	652	24	23	47	103	3.5	805	81.2	5.8
	Average	263	244	140	628	23	29	52	94	5.8	780	80.6	6.8
Averages	Temik	113	125	95	332	41	58	99	118	7.7	557	57.1	17.4
	Thimet	118	144	108	370	42	54	96	124	5.6	596	59.6	17.0
LSD (.05)	Insecticide	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
LSD (.05)	Variety	30	27	19	53	24	15	25	20	ns	74	4.8	3.0

Table 2. Effect of sidedressed Temik and Thimet insecticides on tuber specific gravity, fry color, and marketable yield. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Variety	Insecticide	Specific Gravity	DECEMBER FRY COLOR				Marketable Yield without USDA No.4 Dark-ends*
			Average Photovolt Reading	USDA No.3	USDA No.4	Dark-ends	
				%			
Russet Burbank	Temik	1.081	34.5	44	5	49	304
	Thimet	1.084	32.5	35	10	45	332
	Average	1.082	33.5	39	8	47	318
Shepody	Temik	1.086	48.2	7	0	7	493
	Thimet	1.084	44.7	17	2	19	495
	Average	1.085	46.5	12	1	13	494
Frontier Russet	Temik	1.085	41.7	13	4	13	250
	Thimet	1.082	39.0	17	6	23	274
	Average	1.083	40.3	15	5	18	262
A74212-1 L	Temik	1.083	34.4	35	0	39	638
	Thimet	1.085	32.6	42	6	48	658
	Average	1.084	33.5	38	3	43.5	647
Temik Average		1.084	39.7	25	2	27	421
Thimet Average		1.084	37.2	28	6	34	440
LSD (.05) Insecticide		ns	ns	ns	3.8	ns	ns
LSD (.05) Variety		.002	10.8	7.7	(3.1)**	9.4	62

* Total of US Number Ones and Twos minus the proportion of USDA No.4 dark-ends.
** 90% confidence

PERFORMANCE OF POTATO VARIETIES UNDER WATER STRESS

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Objective

Effects of water stress were evaluated on Russet Burbank and promising new potato lines. Effects of late June water stress were measured on tuber yield, market grade, internal sugars and solids, and fry color. Shepody, Frontier Russet and Century Russet and experimental potato lines were included.

Introduction

The negative effects of water stress on Russet Burbank potatoes are well documented. Water stressed tubers are typically irregular in shape with chaining, dumbbells, pointed ends, knobs, and growth cracks. Internal defects include low specific gravity, dark stem-end fry colors, and reduced starch at the stem-end of the tuber. Extremely stressed tubers may develop jelly-ends.

Potato breeding and selection procedures are providing a wealth of varieties with potentially useful properties for processing. Variety trials are normally conducted under favorable cultural practices. A stress-tolerant variety would be useful for growers and processors because raw material characteristics would not fluctuate widely with variations in weather and growing conditions. Increased water stress tolerance would decrease water management input costs and allow less water to be applied to the crop.

A water stressed potato variety trial has been conducted at the Malheur Experiment Station each year starting 1987.

Materials and Methods

Fourteen potato lines demonstrating low indices of dark-ends, light fry color, high specific gravity, and high yields of Number One tubers were chosen from Oregon potato variety trial entries. Five other varieties with long histories of testing at Ontario were included as check treatments. PC169 is a clone of Russet Burbank selected at Ontario in 1988.

Two-ounce potato seed treated with Tops 2.5 percent fungicide was planted May 1, 1990, in 36-inch beds, 9 inches deep and 9 inches apart. Due to a shortage of seed, only 13 of 20 varieties were replicated four times. The number of replicates of each variety is indicated in Table 1. Plots were single rows 18.75 to 30 feet long. Varieties were separated within each bed with red potatoes. Treatments were arranged in a randomized complete block design.

The soil was a Nyssa silt loam with high water-holding capacity. No fall fertilization was applied due to residual fertility from 1989. Thimet granular insecticide was applied at 3 lbs ai/ac on May 9. No additional fertilizer or insecticides were applied.

The field was furrow irrigated once per week from June 8 through August, except during a three week water stress period when irrigations were omitted. Soil moisture levels were measured four to five times per week with granular matrix sensors (Watermark Model 200X, Irrometer Co.) from June 19 to August 28. Water stress was imposed by omitting furrow irrigations from June 21 to July 11. Only 0.04 inches of precipitation fell during the water stress period. Maximum air temperatures during the first 9 days of the non-irrigated period averaged 93° F and 90° F for the second half of this period. The average soil water potential (of 8 field measurements) reached -1.22 bars, 8 inches deep in the beds, on July 10.

Potatoes were harvested October 10 and graded into the following categories: US Number One 10-ounce and larger, US Number One 6 to 10 ounce, US Number One 4 to 6 ounces, US Number Two 10-ounce and larger, US Number Two 4 to 10 ounces, undersized potatoes (less than 4 ounces), and decayed tubers. Rotten potatoes had predominately jelly-end symptoms. A representative sample of potatoes from every plot was evaluated for specific gravity, solids distribution, average fry color, percent of tubers with dark-end fry color, glucose content (glucose plus other reducing sugars), and sucrose content. The glucose forming potential (GFP) was calculated by dividing the molar concentration of glucose by the molar concentration of sucrose.

Results and Discussion

Plant development was slower than normal during early June due to extremely dry soil and the May 1 planting date. Therefore, the stress period continued into early July to coincide with early tuber bulking.

Yield and Grade

Total tuber yields were not markedly reduced in all potato lines tested. This is consistent with past observations for water stressed potatoes at Ontario. Generally, potato quality parameters are more sensitive to water stress than is yield. Seven of 20 lines produced more than 20 cwt/ac of decayed tubers at harvest. Removing this level of rot from the digger chains is costly and successful storage is difficult if a high level of rot exists. Russet Burbank and A085165-2 produced over 100 cwt/ac of undersized (<4 oz) tubers which have little economic value. Small tubers also fall through the digger chain and regrow as weeds in subsequent crops.

Despite the severe soil moisture stress imposed, 11 lines produced over 70 percent US Number One tubers (Table 2), while Russet Burbank, PC 169, and A085224-1 produced 26 percent, 46 percent, and 39 percent US Number One tubers, respectively.

The yield of marketable tubers without dark-ends ranged from 82 cwt/ac with PC 169 to 535 cwt/ac with A085066-2.

Solids and Solids Distribution

Lines with specific gravities (a measure of overall solids) below 1.080 included PC169, A083177-6, Norkotah, and A085165-1. Seven lines had specific gravities above 1.090 despite the imposed water-stress. Century Russet was among the 9 lines which had 90 percent or more tubers in the 20 percent or above solids category (Table 3).

Fry Color and Dark-ends

Potatoes were evaluated for dark-end fry color in early December; consequently the number of dark-ends and the extent of dark-ends are greater than potatoes fried at harvest. Only Century Russet, A74212-1, and PC169 had average fry color darker than 3.0 on the USDA color scale (Table 3). These varieties had a sugar accumulation throughout the tuber in response to the imposed moisture stress. Four of the six fresh market lines had more dark-ends than Russet Burbank. Three processing lines, A085164-2, A085165-2, and A085257-2, had less than 7 percent dark-ends. The chipping line C0085004-1 had the lightest fry color and no dark-ends.

Shepody, Frontier Russet, and Russet Burbank

The processing varieties Shepody and Frontier Russet are new processing varieties to the Treasure Valley. Shepody produced 25 percent dark-end tubers in the 1989 water-stressed trial and 27 percent in 1990, about one half of that produced by Russet Burbank in the same trials. Frontier Russet produced 18 percent dark-ends in 1990. Out of 20 varieties Shepody ranked 10th for the production of dark-end free marketable tubers while Frontier Russet ranked 8th and Russet Burbank ranked 19th (Table 1).

Conclusions

Potato lines differ in response to soil moisture stress. Although Russet Burbank does not lose total yield unless moisture stress is severe, tuber grade, and internal quality are reduced. Some lines maintain tuber grade under stress but have poor internal quality, and the reverse situation exists. Still others maintain tuber grade and internal quality but at reduced yields.

A knowledge of moisture effects on performance of specific potato lines is useful to potato breeders for identifying dark-end tolerant processing lines, further breeding work, or for variety release.

Table 1. Performance of 20 potato varieties evaluated in 1990 water stressed trial at Ontario. Malheur Experiment Station, Oregon State University, Ontario, Oregon 1990.

Entry #	Variety	Intended Commercial Usage	Replications	1990 Yield and Tuber Quality: Water Stressed Plants: Yield	Water Stressed: US Number Ones	Water Stressed: USDA #3 & #4 Dark-ends After Storage	Water Stressed: Marketable Yield Without USDA No.4 Dark-ends[1]	Marketable Yield: rank	Non Stressed Plants: Yield	Non Stressed: US Number Ones	Non Stressed: USDA #3 & #4 Dark-ends After Storage
				cwt/ac	%	%	cwt/ac	rank	cwt/ac	------ % ------	
1	Russet Burbank	Multi-Purpose	4	500	26.0	49	159	19	554	52.2	60
2	Shepody	Multi-purpose	4	403	64.0	27	285	10	593	57.0	13
3	A74212-1 (late)	Fresh Market	4	545	67.8	82	203	18	637	85.9	37
4	Frontier Russet	Multi-purpose	4	383	77.5	18	291	8	399	64.0	18
5	Century Russet	Fresh Market	4	571	78.4	85	249	13	583	75.1	20
6	PC 169	Experimental	4	287	45.8	73	83	20	na*	na	na
7	A083177-6	Process	3	463	67.9	43	221	16	490	72.6	17
8	A085004-3	Process	2	507	76.6	43	343	6	480	63.5	10
9	A085010-1	Process	2	499	85.7	15	401	3	627	75.9	7
10	A085010-10	Process	3	424	78.8	24	270	11	645	73.3	5
11	A085027-1	Fresh Market	4	473	62.8	51	234	15	716	80.2	37
12	C0085004-1	Chip	4	377	90.6	0	352	5	432	91.7	0
13	Norkotah	Fresh Market	4	323	73.9	70	213	17	412	74.8	27
14	A085066-2	Fresh Market	2	558	89.9	3	535	1	532	86.8	0
15	A085164-2	Process	4	412	77.6	6	317	7	612	65.5	0
16	A085165-1	Fresh Market	4	390	76.1	19	290	9	637	79.7	15
17	A085165-2	Process	3	467	89.4	2	422	2	515	78.0	10
18	A085205-2	Process	4	370	69.3	35	255	12	525	73.3	2
19	A085224-1	Process	4	372	39.4	38	248	14	515	58.2	0
20	A085257-2	Process	3	400	90.4	2	377	4	443	81.5	0
	LSD (.05)			121	10.3	24	108				

1) Total of US No. Ones and Twos minus the proportion of USDA No.4 dark-ends.
* Not available at Ontario in 1990.

Table 2. Yield and market grade of 20 potato varieties subjected to water stress during early tuber bulking. Malheur Experiment Station, Oregon State University, Ontario, Oregon 1990.

Variety	US NUMBER ONE				US NUMBER TWO			Under-sized tubers	Rot	Total Yield	Percent By Grade	
	10+ oz	6-10 oz	4-6 oz	Total	10+ oz	4-10 oz	Total				Ones	Twos
	cwt/ac										%	
1. Russet Burbank	16	56	57	129	14	91	105	108	158	500	26.0	20.7
2. Shepody	104	105	47	255	72	27	99	33	16	403	64.0	23.8
3. A74212-1 (late)	180	111	67	359	15	5	20	32	135	545	67.8	3.5
4. Frontier Russet	82	122	93	297	11	11	22	64	0	383	77.5	5.6
5. Century Russet	250	150	46	446	22	15	37	31	56	571	78.4	6.5
6. PC 169	13	62	54	129	6	24	30	59	69	287	45.8	10.3
7. A083177-6	84	153	76	314	17	24	41	59	50	463	67.9	8.6
8. A085004-3	55	199	146	400	0	24	24	81	1	507	76.6	3.5
9. A085010-1	136	201	91	428	12	19	31	37	2	499	85.7	6.4
10. A085010-10	67	156	111	335	4	16	20	69	1	424	78.8	4.5
11. A085027-1	163	93	41	298	51	10	61	22	92	473	62.8	13.0
12. C0085004-1	244	70	27	341	5	5	10	26	0	377	90.6	2.6
13. Norkotah	43	120	75	239	5	18	23	58	3	323	73.9	7.1
14. A085066-2	236	175	82	493	10	32	42	18	5	558	89.9	5.7
15. A085164-2	79	125	119	323	0	4	4	82	3	412	77.6	0.9
16. A085165-1	95	122	80	297	8	11	19	72	2	390	76.1	4.2
17. A085165-2	178	158	82	417	1	3	4	41	4	467	89.4	0.9
18. A085205-2	33	116	111	260	1	1	2	103	4	370	69.3	0.6
19. A085224-1	39	72	36	147	19	132	151	53	21	372	39.4	40.8
20. A085257-2	162	154	45	361	2	13	15	19	4	400	90.4	3.7
LSD (.05)	73	54	39	103	18	20	27	27	48	121	10.3	5.2

Table 3. Tuber characteristics of 22 potato varieties subjected to late June water stress. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Variety	Specific Gravity	Solids Distribution Category				Fry Color		Sugar Content		Glucose Forming Potential
		≤ 18	18-20	20-22	22+	Average USDA	Dark-Ends	Glucose	Sucrose	
		%				0-4	%	%		mole/mole
1. Russet Burbank	1.083	3.5	9.25	35.5	51.8	2.5	49	2.21	3.19	1.32
2. Shepody	1.088	0	11.7	22.0	66.3	1.8	27	1.36	1.92	1.37
3. A74212-1 L	1.085	10.8	7.5	25.5	56.5	3.3	82	2.01	1.48	2.92
4. Frontier Russet	1.086	0	19.7	17.5	62.8	1.8	18	1.53	1.70	1.70
5. Century Russet	1.086	3.0	7.0	28.0	62.0	3.3	85	2.44	1.34	3.96
6. PC 169	1.072	17.0	48.0	33.5	1.5	3.1	73	1.97	1.55	3.03
7. A083177-6	1.077	0	28.0	63.3	8.7	2.3	43	1.20	1.78	1.30
8. A085004-3	1.080	25.5	18.0	15.5	41.0	2.2	43	1.86	2.77	1.76
9. A085010-1	1.095	0	1.5	15.5	81.0	1.3	15	0.99	1.20	1.60
10. A085010-10	1.097	0	2.3	2.0	95.7	1.4	24	1.24	1.24	2.04
11. A085027-1	1.084	1.3	12.3	39.3	47.3	2.6	51	1.64	1.33	3.42
12. C0085004-1	1.098	0	0	11.0	89.0	0.5	0	1.03	2.85	0.89
13. Norkotah	1.072	19.8	61.0	16.3	3.0	2.8	70	2.65	1.54	3.64
14. A085066-2	1.091	0	7.0	8.5	84.5	0.8	3	0.56	1.27	0.87
15. A085164-2	1.093	1.5	1.3	14.0	83.3	1.0	6	0.91	2.14	0.84
16. A085165-1	1.079	1.2	27.8	52.5	18.5	1.8	19	1.73	1.79	2.33
17. A085165-2	1.088	0	5.7	32.7	61.7	0.8	2	1.16	1.46	1.63
18. A085205-2	1.091	0	1.2	23.0	75.7	2.1	35	2.18	2.75	1.55
19. A085224-1	1.086	1.2	12.3	23.5	63.0	2.1	38	2.13	1.69	2.41
20. A085257-2	1.093	0	0	2.3	97.7	0.6	2	1.71	1.42	2.56
LSD (.05)	0.002	8.8	15.3	20.7	25.6	0.7	24.3	0.74	1.04	1.63

POTATO HERBICIDE TRIALS

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Ontario, Oregon, 1990

Purpose

Two trials were conducted with Dupont experimental herbicide E9636. The first trial was to evaluate E9636 for control of annual broadleaf and grassy weeds and for tolerance to Russet Burbank potatoes when applied as early postemergence treatments. The second trial was to evaluate the soil persistence of E9636 and the tolerance of onions and sugar beets as 1991 spring planted crops following applications of E9636 at several rates to potatoes in 1990.

Procedures

Russet Burbank potatoes were planted in silt loam textured soil with a pH of 7.2 and 1.2 percent organic matter on April 12. The previous crop was spring wheat. Following wheat harvest the wheat stubble was shredded, the field disced, irrigated and deep-chisled. One-hundred pounds of phosphate and 200 pounds of nitrogen per acre was broadcast before chiseling. The field was chiselled twice then bedded on 36 inch centers and left overwinter. In the spring the bed tops were harrowed, the potatoes planted and the beds rehilled.

The postemergence herbicide treatments included E9636, E9636 + Lexone, E9636 + Lorox, and Lexone + Prowl. Rates of E9636 were 0.25, 0.375, and 0.5 ounces ai/ac. Lexone tank-mix rates with E9636 were 0.25 and 0.375. E9636 and Lorox tank-mix rates were 0.25 +16.0 and 0.375 + 16.0 ounces ai/ac respectively. Lexone + Prowl rate was 8 + 24 ounces ai/ac. The herbicides were applied on May 21. The potato foliage was about 4 inches tall. Emerged weeds were hairy nightshade, lambsquarters, redroot pigweed, kochia, and occasional plants of russian thistle and barnyardgrass. Weeds ranged in size from cotyledon to plants 1.5 inches tall. The largest hairy nightshade plants had four true leaves and barnyardgrass had three leaves.

Spraying conditions were ideal. Skies were partly cloudy, air temperature 72°F, and soil surface moist from rain the previous day. Herbicides were sprayed as double overlap broadcast treatments using 8002 teejet fan nozzles, a spray pressure of 43 psi and water at 41.0 gallons/ac. Individual plot size included two rows of potatoes and one unplanted row separated adjacent plots and served as a buffer. Each treatment was replicated three times.

Rainfall for 10 days following herbicide application is recorded below. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Date	May									
	21	22	23	24	25	26	27	28	29	30
Amount	0.10	trace	trace	0.24	0.01	trace	0.45	0.30	0.14	0.15

On June 1 the weather cleared.

Estimated weed density by species of weeds: (plants/sq ft.)	
Hairy nightshade	6
Redroot pigweed	6
Lambsquarters	1
Kochia	1
Barnyardgrass	3
Russian Thistle	0.5

E9636 rates in the soil persistence trial were 0.5, 1.0, and 2.0 ounces ai/ac. The treatments were applied on May 21. The potatoes were 4 inches tall. The plot area had been previously treated with Sonalan herbicide applied at a rate of 1.5 lbs ai/ac as a preemergence incorporated application. The individual plots were eight rows wide and fifty feet long. Each herbicide rate was replicated two times. Soil samples were taken on July 23 and after harvest on November 17 from the 0.5, 1.0 ounces/ac rate and from the untreated check. Each rate was sampled to 4 and 6-inch depth using a 4-inch core width.

The weed control data trial was watered by furrow irrigation. The residue study was under sprinkler irrigation.

The trials were harvested on September 12 and 13. The tubers in the weed control trial were graded by size and shape to determine yield and quality. The soil in the residue study was disced after harvest and bedded on twenty-two inch centers in preparation for planting onions and sugar beets in the spring of 1991. The crops will be evaluated for rate of emergence and seedling growth to determine if carry-over of E9636 exists.

Results

Injury ratings (Table 1) taken on May 29 show that some chlorosis to leaves occurred at all rates of E9636. The degree of chlorosis increased with rate. Lexone in combination with E9636 increased the amount of leaf chlorosis. Lorox injury was severe to both potato leaves and plant growth. Plants on this date were only about half the size of plants in check plots. Both chlorosis and necrosis on leaf margins was showing. On June 13 when the second injury ratings were taken no injury showed on the potato foliage treated with E9636 or E9636/Lexone combination, (Table 2). The potato plants in the E9636/Lorox plots were still smaller than in checks but new leaf growth was normal in color and appearance.

Potato tuber yields were reduced significantly in the Lorox plots from herbicide injury and in the check plot because of growth competition from weeds when tuber yields in these treatments were compared to E9636 and E9636/Lexone.

Weed control was good with E9636 at 3/8 and 0.5 ounce rate and with all E9636 combination treatments. Combination treatments improved the control of lambsquarters over straight E9636. E9636 was very active on hairy nightshade which is a big plus for this herbicide since hairy nightshade is a serious weed, not effectively controlled by most potato herbicides. Lexone/Prowl combination gave good control of redroot pigweed, lambsquarters, kochia, and annual grasses, but was less active on hairy nightshade than other herbicide treatments as noted in evaluations taken on August 26 (Table 3).

Table 1. Crop injury and percent weed control from potato herbicide trial. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Herbicides	Rate	Crop Injury				Percent Weed Control															
						Pigweed				Lambsquarters				Hairy nightshade				Kochia			
		1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
	ozs ai/ac																				
E-9636	1/4	20	15	25	20	99	100	96	97	45	65	60	57	93	80	80	83	99	99	99	99
E-9636 + Lexone	1/4 + 4	35	40	35	37	100	100	100	100	100	100	100	100	95	90	93	93	100	99	100	99
E-9636 + Lexone	1/4 + 6	45	55	50	50	100	100	100	100	100	100	95	98	100	90	95	95	100	100	100	100
E-9636	3/8	60	70	65	65	100	100	100	100	65	70	70	68	100	90	98	96	100	100	100	100
E-9636 + Lexone	3/8 + 4	75	70	75	72	100	100	100	100	100	100	100	100	100	95	98	97	100	100	100	100
E-9636 + Lexone	3/8 + 6	80	85	80	82	100	100	100	100	100	100	100	100	100	80	85	88	98	100	100	100
E-9636	1/2	60	65	60	62	100	100	100	100	75	70	70	72	100	96	96	97	100	100	100	100
E-9636 + Lorox	1/4 + 16	100	100	100	100	100	100	100	100	100	100	100	100	100	92	92	94	100	100	100	100
E-9636 + Lorox	3/8 + 16	100	100	100	100	100	100	100	100	100	100	100	100	100	95	95	97	100	100	100	100
Lexone + Prowl	8 + 24	20	25	20	22	100	100	100	100	100	100	100	100	90	95	95	93	100	100	100	100
Check	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Crop injury ratings taken on May 29. Foliage was about 12" tall in check plots. Ratings indicate the percent of leaves that show spots of leaf chlorosis or all leaf area chlorotic. E9636 + Lorox are causing chlorosis and quite severe necrosis with only about 1/2 the foliage growth found in the check plots. The preemergence applications could not be applied because of wet soils from a continuous rain. If Lorox + E9636 could have been applied as preemergence applications this sort of injury may not have occurred. Ratings for weed control were taken on June 7.

Table 2. Crop injury and percent weed control from potato herbicide trial. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Herbicides	Rate	Crop Injury				Percent Weed Control															
						Pigweed				Lambsquarters				Hairy nightshade				Kochia			
		1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
	oz ai/ac																				
E-9636	1/4	0	0	0	0	100	100	100	100	40	50	40	43	100	100	100	100	93	90	90	91
E-9636 + Lexone	1/4 + 4	0	0	0	0	100	98	99	99	100	100	100	100	100	100	100	100	100	100	100	100
E-9636 + Lexone	1/4 + 6	0	0	0	0	100	96	100	98	100	100	100	100	100	100	100	100	100	100	100	100
E-9636	3/8	0	0	0	0	100	100	100	100	50	45	50	48	100	100	100	100	95	98	95	96
E-9636 + Lexone	3/8 + 4	0	0	0	0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
E-9636 + Lexone	3/8 + 6	0	0	0	0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
E-9636	1/2	0	0	0	0	100	97	99	98	60	50	60	57	100	100	100	100	98	98	95	97
E-9636 + Lorox	1/4 + 16	20	20	20	20	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
E-9636 + Lorox	3/8 + 16	20	20	20	20	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Lexone + Prowl	8 + 24	5	5	5	5	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Check	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Evaluated June 13, 1990 - Potato plants in most plots had started covering water furrows. Weeds in check plots were 6-8 inches tall. E9636 is giving excellent control of pigweed, barnyardgrass, and hairy nightshade. it is less active on lambsquarters and there is also some kochia plants escaping E9636 applied without Lexone. Lorox applied postemergence caused early injury to potatoes, but potato foliage has recovered, is green but plants are smaller (20-30 percent less foliage). Lexone and Prowl is also controlling weeds well. Grass control was still excellent.

Table 3. Crop injury and percent weed control from potato herbicide trial. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Herbicides	Rate	Percent Weed Control																			
		Pigweed				Lambsquarters				Hairy nightshade				Kochia				Barnyardgrass			
		1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
	oz ai/ac																				
E-9636	1/4	100	100	100	100	25	30	20	25	85	80	90	85	85	90	90	88	100	100	100	100
E-9636 + Lexone	1/4 + 4	100	100	100	100	90	95	90	92	90	85	85	87	95	90	95	93	100	100	100	100
E-9636 + Lexone	1/4 + 6	100	100	100	100	95	98	98	97	90	90	85	88	98	98	98	98	100	100	100	100
E-9636	3/8	100	100	100	100	35	40	35	37	95	93	93	94	92	90	93	92	100	100	100	100
E-9636 + Lexone	3/8 + 4	100	100	100	100	98	98	98	98	99	98	92	97	98	95	98	97	100	100	100	100
E-9636 + Lexone	3/8 + 6	100	100	100	100	100	99	99	99	98	99	99	98	100	99	99	99	100	100	100	100
E-9636	1/2	100	100	100	100	50	40	40	42	100	100	99	99	95	93	93	94	100	100	100	100
E-9636 + Lorox	1/4 + 16	100	100	100	100	100	100	100	100	95	90	90	93	99	99	99	99	100	100	100	100
E-9636 + Lorox	3/8 + 16	100	100	100	100	100	100	100	100	98	98	100	98	100	99	99	99	100	100	100	100
Lexone + Prowl	8 + 24	100	100	100	100	100	100	100	100	80	75	85	80	98	95	95	96	100	100	100	100
Check	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Evaluated August 26 just before potato vines were beat-off in preparation for harvest of tubers.

Table 4. Tuber yield and quality from potato herbicide trial. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Herbicides	Rate	US Number Ones						No. Twos		Culls		Total Yield No. Ones		Total Yield
		>10 oz		6-10 oz		4-6 oz		4-10 oz		<4 oz				
	oz ai/ac	cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac
E-9636	0.25	39	6	291	45	168	26	75	11	72	11	498	77	647
E-9636 + Lexone	0.25 + 4	44	7	298	47	156	25	56	9	76	12	498	79	631
E-9636 + Lexone	0.25 + 6	34	6	281	46	132	22	79	13	78	13	447	74	606
E-9636	0.375	52	8	280	44	153	24	68	11	78	12	485	77	633
E-9636 + Lexone	0.375 + 4	53	9	272	45	129	22	70	12	72	12	454	76	598
E-9636 + Lexone	0.375 + 6	34	6	269	46	153	26	50	8	78	13	456	78	585
E-9636	0.5	36	6	249	42	140	24	95	16	74	12	425	72	594
E-9636 + Lorox	0.25 + 16	23	4	187	36	148	29	61	12	100	19	358	69	519
E-9636 + Lorox	0.375 + 16	18	4	174	35	143	29	66	13	96	19	335	67	498
E-9636 + Prowl	8 + 24	42	8	234	43	140	26	50	9	69	13	416	77	538
Check	-	45	8	256	48	111	21	50	9	74	14	412	77	536
LSD (0.05)		13	2	27	4	19	3	28	4	16	3	33	5	45
CV (s/mean)		19	18	6	5	8	7	25	21	12	12	5	4	4.5
P-Value		.000	.000	.000	.000	.000	.000	.069	.036	.014	.000	.000	.000	.000
Mean		38	6	254	44	143	24	65	11	79	14	435	75	580

A REPORT CONCERNING CEREAL TRIALS FOR ESTIMATING CULTIVAR ADAPTATION TO FURROW IRRIGATION IN THE TREASURE VALLEY

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Purpose

Advanced cereal selections and new varieties are planted and evaluated at the Malheur Experiment Station to determine their relative suitability for the agricultural practices in the Treasure Valley.

Procedures

Late summer and fall-seeded trials were planted September 9, 1989 on fallow soil, and October 12, 1989 where corn stover from the summer's corn crop was recently plowed. Spring seeded trials were planted March 28, 1990. A four-row double-disc opener research drill mounted on a small tractor was used for planting. Individual plots are 4 by 15 feet. They are bordered and divided by V-shaped rills which formed two 14-inch wide raised beds on which seed was planted in two rows, ten inches apart. Trials were arranged in randomized complete blocks with four replications. A fall application of 24 pounds per acre of nitrogen was applied as a starter fertilizer on the early planted small grains, followed by 70 lbs/ac broadcast as urea in the spring. The field used for the normal fall planting date and spring planting had 340 lbs N/ac available in the fall of 1989 and 380 lbs N/ac available in the spring so the crop received no nitrogen fertilizer. Plots were trimmed to 11 feet, and were harvested with a plot combine the last week of July, 1990.

Results and Discussions

The six experiments reported in Table 2 (Eastern Oregon Red Winter Wheat), Table 3 (Eastern Oregon White Winter Wheat), and Table 4 (Eastern Oregon Winter Triticale) were planted to compare trials infested with Diuraphis noxia, Russian wheat aphid (RWA), with trials planted after the aphid populations had more or less disappeared. Though cereals emerged in time to attract migrating late summer aphid flights, Russian wheat aphid infestations in the plots were nil. Consequently, the most prominent general effects were early versus "normal" planting with the early being hot and dry and the "normal" being subjected to infection by Fusarium species hosted in the preceding corn crop.

Grain yields and test weights were better in the normal seeding date trials as summarized in Table 1. Yields for the red winter wheats were better than the white winter wheats; however, that may be due to trial position effects since the in-common check, Malcolm, yielded 109 vs 135, and 97 vs 123 bushels per acre in the early and normal trials respectively.

The difference in grain yields between dates was more for the white wheats than either the red wheats or the triticale.

Table 1. Average grain yields and test weights of early and normal fall seeded winter red wheat, white wheat and triticale. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Experiment	Grain Yield			Test Weights		
	Early	Normal	Gain	Early	Normal	Gain
	------ bu/ac ------			------ lbs/bu ------		
Red Winter Wheat	99	119	+20	57.2	58.8	+1.6
White Winter Wheat	89	121	+32	57.9	59.0	+1.1
Triticale	93	112	+19	51.7	52.5	+0.8

Three entries in Tables 2, 3, and 4 yielded less for the normal seeding date. Ute, hard red winter, was the only named entry which yielded less when seeded at the later date.

Table 2. Eastern Oregon Red Winter Wheat; grain yield and test-weight comparisons of 18 winter wheats planted September 9, 1989 (early) and October 12, 1989 (normal) and evaluated in a trial at the Malheur Experiment Station, Ontario, Oregon.

Name	Yield			Test Weight		
	Early	Normal	Gain	Early	Normal	Gain
	bu/ac			lbs/bu		
1 FW741037-006	112	126	24	57.2	57.0	-0.2
2 FW771595G305	96	137	41	57.9	57.6	-0.3
3 FW771595G306	108	130	22	60.1	60.3	0.2
4 FW741037G304	113	110	-03	59.4	60.7	1.3
5 FW75344-105	74	125	51	58.5	61.8	3.3
6 Ute	110	108	-02	60.5	59.4	-1.1
7 FW84039H5039	112	116	04	59.6	60.5	0.9
8 FW84040 B6015	117	126	09	59.8	57.4	2.4
9 FW81255-Y6004	96	108	12	52.8	54.6	1.8
10 FW83291B5004	82	100	18	55.0	53.0	-2.0
11 FW84045 H5012	90	116	26	60.9	61.8	0.9
12 MALCOLM	109	135	26	60.9	57.2	3.7
13 FW88P-A-004	107	126	19	60.9	61.2	0.3
14 FW88P-A-004	108	120	12	56.3	62.3	6.0
15 FW81255-P8001	80	112	32	49.7	56.8	7.1
16 FW81255-P8003	93	96	03	49.1	57.6	8.5
17 FW81255-P8006	92	110	18	51.3	57.4	6.1
18 FW82215 P8011	104	132	28	60.1	61.2	1.1
Experiment average	99	119	+20	57.2	58.8	+1.6

Stephens, Hill, FW75336-103, FW-301, Lewjain, FW-333, and FW83116 B801 (Table 3) yielded over 130 bushels per acre at the normal seeding date and over 25 bushels more than for the early date. FW75336-103 and FW-301 are being considered for release to growers.

Table 3. Eastern Oregon White Winter Wheat; grain yield and test-weight comparisons of 18 soft-white winter wheats planted September 9, 1989 (early) and October 12, 1989 (normal) at the Malheur Experiment Station, Ontario, Oregon.

Name	Yield			Test Weight		
	Early	Normal	Gain	Early	Normal	Gain
	bu/ac			lbs/bu		
1 Stephens	100	135	35	61.6	59.3	-2.3
2 Hill	79	124	45	58.9	59.9	1.0
3 Malcolm	97	123	26	59.0	60.9	0.9
4 FW75336-103	98	134	36	58.1	61.4	3.3
5 FW771697G19	76	114	38	58.9	60.7	1.8
6 FW-301	110	135	25	58.5	61.9	3.4
7 Dusty	110	124	14	55.5	58.0	2.5
8 Lewjain	94	133	39	59.2	59.3	0.1
9 FW-333	89	133	44	59.8	59.1	-0.7
10 FW82202-324	84	129	45	56.5	58.7	2.2
11 FW 205-19B	98	102	04	54.3	56.4	2.1
12 FW83115	83	118	35	60.7	60.7	0.0
13 FW83205 H5043	86	100	14	53.9	58.8	4.9
14 FW83083 H5001	78	113	35	57.9	58.2	0.3
15 FW83116 B801	99	132	33	59.0	59.8	0.8
16 FW82241 P8006	93	103	10	52.7	58.0	5.3
17 FW83185 D5044	57	111	54	57.7	58.5	0.8
18 OR855	77	121	44	58.7	60.9	2.2
Experiment Average	89	121	+32	57.9	59.0	+1.1

Winter triticale yields (Table 4) averaged almost 10 bushels less than the wheats in the normal date of seeding. Entry FW75336-103 wheat yielded 84 vs 110 (in the triticale trial) 94 vs 134 (in the white wheat trial) bushels per acre in the early and normal seeding date trials respectively. In this instance though, it may be better to consider the normal seeded triticale date as representative of fall seeded triticale at the Malheur Station (previous annual station reports). The low wheat yield within the triticale trial is probably due to competition from the triticale. Triticale yields may improve if the triticale were seeded at higher rates and nearer to October 1.

Table 4. Eastern Oregon Winter Triticale; grain yield, and test weight comparisons of 18 winter triticale planted September 9, 1989 (early) and October 12, 1989 (normal) and evaluated in a trial at the Malheur Experiment Station, Ontario, Oregon.

	Name	Yield			Test Weight		
		Early	Normal	Gain	Early	Normal	Gain
		bu/ac			lbs/bu		
1	B82-3319H6006	114	118	4	48.2	53.4	5.2
2	B82-3319H6002	106	117	11	50.9	56.2	5.3
3	B82-3319H6003	96	117	21	50.4	51.1	0.7
4	B82-3319H6001	104	125	21	52.8	51.9	0.9
5	B82-3319H6004	101	112	11	49.5	49.2	-0.3
6	B82-3319H6005	104	108	4	45.0	51.3	6.3
7	FT88P-A-005	67	124	57	48.7	48.9	0.2
8	FW75336-103	84	110	26	60.7	59.2	-1.5
9	FT86008 PS002	81	97	16	50.3	54.3	4.0
10	FT85007 PS001	71	107	36	52.4	54.3	4.0
11	FT86704	100	117	17	50.4	49.1	-1.3
12	M81-8046	67	109	42	52.4	52.3	-0.1
13	FT85007 PS001b	109	103	-6	56.0	55.1	-0.9
14	FT87663	100	103	3	54.3	53.0	-1.3
15	B82-3319BR005	81	110	29	51.3	52.6	1.0
16	R85-3001 002	95	111	16	56.1	51.3	-4.8
17	B82-3319H6008	102	118	16	47.8	47.5	-0.3
18	B81-420 h8007	112	118	6	53.4	53.8	0.4
Experiment Average		93	112	+19	51.7	52.5	+0.8

Table 5 is a summary of 18 white winter wheats tested in eight irrigated trials planted near Ontario, Hermiston, Boardman, and Irrigon. Planting dates range from August 31 to October 12, 1989. Soils ranged from the very slow infiltration Sagehill series to the Winchester sandy loam.

FW-301 at 93 bushels per acre and FW75336-103 at 92 bushels per acre ranked first and second respectively.

Test weights were lower than desirable at 57.6 for Hill down to 54.1 pounds per bushel for Dusty. The low test weights reflect drought stress near Boardman. Near Hermiston there were heavy aphid infestations and a severe wheat streak mosaic infection which caused yield and test weight reductions.

FW-333 headed earliest at 133 days after January 1 (June 13). Average plant height only varied 3 inches. Most lines are stiff strawed but entry 15 lodged more than desirable at 20 percent.

OR 855, Entry 18, is the only club wheat in the trial. Its performance has been very good in irrigated trials. It is one of very few advanced Pacific northwest club wheats which lodges at such low percentages in irrigated trials. Breeders seed of OR 855 is being purified and produced by Dr. Pamela Zwer, wheat geneticist at the Columbia Basin Agricultural Research Center, Pendleton, Oregon.

Table 5. Eastern Oregon White Winter Wheat; summary of grain yield, rank, test-weight, date headed, plant height, and percent lodged of 18 fall planted wheats evaluated at eight irrigated sites in 1990.

	Name	Yield	Rank	Test Weight	Date Headed	Plant Height	Lodging
		bu/ac		lbs/bu	Jan. 1	inches	%
1	Stephens	89	8	56.9	132	35	0
2	Hill	86	12	57.9	134	38	5
3	Malcolm	91	4	56.1	132	35	10
4	FW75336-103	92	2	56.9	132	35	5
5	FW771697G19	84	15	57.3	132	36	5
6	FW-301	93	1	56.9	132	35	5
7	Dusty	91	3	54.1	132	35	10
8	Lewjain	90	7	55.6	132	35	5
9	FW-333	90	6	57.0	131	36	10
10	FW82202-324	85	13	55.4	134	37	10
11	FW 205-19B	79	17	54.5	137	35	1
12	FW83115	89	9	57.2	131	35	0
13	FW83205 H5043	87	10	56.5	134	37	0
14	FW83083 H5001	82	16	56.5	134	37	0
15	FW83116 B801	90	5	56.7	133	36	20
16	FW82241 P8006	84	14	54.6	136	37	5
17	FW83185 D5044	75	18	56.0	136	38	10
18	OR855	86	11	56.9	133	36	10

Table 6 summarizes eight 18 entry winter triticale trials. These trials were grown in the same proximity as the white winter wheat trials in Table 5. Though the triticale did not yield as well as the wheats for the normal date at the Ontario station, the lowest yielding triticale at 95.3 bushels per acre (60 pound bushels) is higher than the highest white wheat, FW-301 at 93 bushels per acre.

Test weights for the triticale ranged from 46.6 to 53.7 pounds per bushel and averaged 50.6 pounds per bushel. The wheat check FW75336-103 had an average test weight of 55.9 pounds per bushel. Heading dates are generally earlier than for wheat. Anthesis, for triticale, however is nearly the same as the wheats. Plant heights average a little taller than wheats, but these triticales are very stiff strawed.

Entry 12, M81-8046 and a sister plant selection of entry 18, B81-420 h8007 is being purified for breeders seed production.

Table 6. Eastern Oregon Winter Triticale; summary of grain yield, multiple comparisons (students LSD's), test-weight, date headed, plant height of fall planted triticale evaluated at eight irrigated sites in 1990.

	Name	Yield	LSD Comparisons	Test Weight	Date Headed	Plant Height
		bu/ac	5%	lbs/bu	Jan. 1	inches
1	B82-3319H6006	107.4	DE	47.8	133	36
2	B82-3319H6002	108.5	EF	51.0	133	40
3	B82-3319H6003	107.7	DE	50.6	133	38
4	B82-3319H6001	107.3	DE	51.7	133	36
5	B82-3319H6004	101.1	ABCD	48.0	134	35
6	B82-3319H6005	100.2	ABCD	48.1	134	36
7	FT88P-A-004	98.2	ABC	47.9	125	37
8	FW75336-103	96.7	A	55.9	131	41
9	FT86008 PS002	96.3	AB	50.6	131	41
10	FT85007 PS001	95.3	A	51.9	133	46
11	FT86704	100.2	ABCD	48.9	131	35
12	M81-8046	104.0	CDE	50.4	133	44
13	FT85007 PS001b	103.0	BCDE	53.7	132	41
14	FT87663	106.0	DE	52.4	130	39
15	B82-3319BR005	102.0	ABCDE	51.0	132	40
16	R85-3001 002	98.2	ABC	51.2	132	41
17	B82-3319H6008	106.0	DE	46.6	132	37
18	B81-420 h8007	114.7	F	52.0	132	45
Average		103.2		50.6	132	39
Mean Square		340.3		43.89	33.06	103.6
Standard Error		3.723				

Though the wheats in Table 7 were not tested near Ontario, resistance to Dwarf Smut, Tilletia controversa (TCK), is a concern to wheat producers near the Treasure Valley at the higher elevations where snow cover occurs for long periods. This table also demonstrates the relative yield ability of FW-301 and FW75336-103 in another stress condition (ie. Flora). The data also introduce yield performances of advanced lines from Project 0396. Breeding ordered priorities of stand establishment, winter survival, resistance to frost heaving, earliness, Dwarf Smut resistance, and resistance to other common diseases. The warm winter of 1989-1990, however offered an ideal environment for the mite that carry and spread wheat streak mosaic. Consequently, the yields at the Hermiston sites were severely reduced.

Table 7. White Seeded Dwarf Smut Trials: Grain yields of 18 winter wheats evaluated in two 1990 irrigated trials near Hermiston where Wheat Streak Mosaic depressed and confused yield estimates and a trial near Flora, Oregon.

Name	YIELD				Rank
	Hermiston		Flora	Average	
	lbs/bu				
1 Nugaines	71	60	79	70	16
2 Hyslop	79	77	104	87	8
3 FW75336-103	91	82	93	89	6
4 FW79293-377	85	88	102	92	5
5 FW-301	87	99	97	94	2
6 FW82202-B5020	84	90	92	89	7
7 FW83115-D5065	87	94	99	93	3
8 FW83115 D5081	97	84	97	93	4
9 FW83117 D5071	90	86*	125	101	1
10 FW83158-D5077	75	72	103	84	10
11 FW83162-D5050	68	56	86	70	15
12 FW83170 D5008	59	51	97	69	18
13 FW83170 D5012	68	77	94	80	12
14 FW83177 D5021	62	75	78	72	14
15 FW83185 D5044	63	59	99	74	13
16 FW83187 D5034	73	66	68	69	17
17 FW83189 D5003	78	80	101	87	9
18 FW84111 F6005	79	82	88	83	11
Experiment means	78	77	95	83	
Standard error = 6.661					
* FW82264 B6006 Substitution.					

Table 8 presents observations of the Eastern Oregon Irrigated Winter Barley Trial grown in 1990 at the Malheur Station. Yields ranged from 6,295 pounds per acre for FB77796 to 6,295 pounds per acre for entry 5, FB84243 H7114. FB77796 is being considered for release for dry-land production on shallow soils. It is the most cold-hardy and the earliest maturing line in the trial. Test weights and kernel plumpness (percent over 6/64) were satisfactory. Lodging is still a problem. These barley entries were planted in an early trial like the wheats were, but they lodged and intermingled with other plots so extensively that the plots were abandoned.

Table 8. Eastern Oregon Irrigated Winter Barley; grain yield, rank, test-weight, date headed, plant height, percent lodged and percent plump of 18 fall planted barleys evaluated in 1990 at the Malheur Experiment Station, Ontario, Oregon.

	Name	Yield	Rank	Test Weight	Date Headed	Plant Height	Plump	Lodging
		lbs/ac		lbs/bu	Jan. 1	inches	%	%
1	Hesk	5103	9	48.6	129	38	90	80
2	Eight Twelve	5403	6	51.7	128	36	91	60
3	FB77796 H6001	2975	18	54.6	126	36	89	80
4	FB81019-4032	5876	3	53.0	144	34	92	10
5	FB84243 H7114	6295	1	52.1	139	34	91	10
6	FB84378 H7011	5588	5	49.7	139	35	88	20
7	FB81019-BR008	5084	10	48.2	130	36	86	30
8	FB81161-BR012	5150	8	53.0	136	37	91	30
9	Mal	3929	15	52.8	130	37	82	50
10	FB84370 H7005	3751	17	51.7	135	38	92	80
11	FB84370 H7102	4532	13	54.8	135	39	92	80
12	FB84378 H7101	4576	12	49.5	139	38	93	60
13	FB84231 H7011	3879	16	50.6	128	39	90	90
14	FB84243 H7115	5934	2	49.5	140	39	69	70
15	FB84243 H7121	4754	11	50.8	140	39	79	90
16	FB84243 H7126	5808	4	49.5	140	39	87	50
17	FB84243 H7130	5284	7	49.3	140	40	76	10
18	Scio	4388	14	51.7	130	39	94	10

The long term yield averages in Table 9 point to the general yield ability of entry number 3, FB81019-4032, a short stature type which has accumulated a good yield record over 16 experiments in four years. Its winter hardiness, however is no improvement over Hesk, Mal, or Scio.

The variety Eight-Twelve (AB-812, PI 537437, 72Ab83/Wintermalt) is a six row winter barley recently released jointly by the USDA Agricultural Research Service, and the experiment stations of Idaho and Oregon. It has had better test weights than Hesk, Mal, and Showin. It is shorter than Hesk or Mal. Its winter hardiness is similar to Hesk and Mal. Stands are reduced by Fusarium snow mold. Station tests have demonstrated that it is well adapted to the irrigated areas of the Treasure Valley.

Table 9. Eastern Oregon Irrigated Winter Barley; a four-year grain yield summary of winter barleys evaluated in yield trials grown near Boardman, Hermiston, Irrigon, and Ontario, Oregon.

	Name	YIELD					
		1987	1988	1989	1990	Average	LSD**
		lbs/ac					
1	Check***	5419	5631	5153	5365	5375	BCDE
2	Eight-Twelve	5678	6477	4684	4971	5358	ABC
3	FB81019-4032	5887	6858	5588	5775	5959	E
4	FB77796 H6001			5248	4681	4925	A
5	FB84243 H7114			5964	5674	5803	DE
6	FB84378 H7011			6043	5493	5737	CDE
7	FB81019-BR008			6180	5045	5549	ABCD
8	FB81161-BR012			5224	5112	5161	ABCD
9	Mal		5631		4815	5121	ABCD
10	FB84370 H7005				4693	4693	A
11	FB84370 H7102				5058	5058	ABCD
12	FB84378 H7101				4984	4984	ABC
13	FB84231 H7011				4954	4954	AB
14	FB84243 H7115				5454	5454	BCDE
15	FB84243 H7121				5352	5352	BCDE
16	FB84243 H7126				5510	5510	CDE
17	FB84243 H7130				5238	5238	ABCDE
18	Scio				4995	4995	ABC

* Yields are from four locations in 1987, three locations in 1988, four locations in 1989, and five locations in 1990.

** LSD 1990 Contrast coefficients multiple comparisons based on Students LSD, standard error is 333.9.

*** Hesk was the check for 1987, 1988, and 1990; Mal was the check for 1988. To compare equal years: the check average for 1988 and 1990 is 5465 bu/ac and for 1989 and 1990 is 5271 bu/ac.

Table 10 reports the Ontario and Hermiston portion of the total results of the Oregon Cooperative Trial coordinated by Dr. Russ Karow, cereal extension specialist, at Corvallis. The trials are conducted state-wide to estimate the potential of new and promising cereal cultivars for Oregon. The trial at Hermiston once again illustrates the damage done by wheat streak mosaic to yield potential and test weights. FW-301 ranked first in yield. Whitman and Flora are triticale varieties.

Table 10. Oregon Cooperative Winter Cereal Yield Trial: grain yield, test-weight, date headed, plant height of 18 fall seeded winter cereals evaluated in trials grown in 1990 near Ontario (O) and Hermiston (H), Oregon.

Name	Yield			Test Weight			Date Headed	Plant Height
	O	H	Average	O	H	Average		
	bu/ac			pounds			Jan. 1	inches
1 Stephens	123	102	112	59	55	57	131	37
2 Hill 81	120	91	105	62	57	59	133	41
3 Malcolm	120	90	105	62	57	59	131	36
4 Oveson	129	84	106	58	57	57	132	37
5 Dusty	118	98	108	59	55	57	133	36
6 Tres	117	72	94	60	55	57	133	41
7 OR855	128	88	108	57	57	57	133	38
8 Daws	115	78	96	59	54	56	134	38
9 Hyak	117	51	84	58	54	56	133	39
10 Madsen	130	94	112	60	55	57	133	39
11 Whitman	101	118	109	55	49	52	126	44
12 OSU-21	128	74	103	59	55	57	130	38
13 FW75336-103	138	81	114	58	49	53	133	35
14 Flora	119	93	105	45	39	42	132	38
15 ORCW8632	128	103	115	61	53	57	132	38
16 CW84-1073H	119	75	97	60	55	57	130	37
17 FW-301	135	103	119	59	53	56	131	38
18 FW-333	113	96	104	58	52	55	133	38
Average	122	90	106					

Standard Error = 7.197

Project 0396 has been investigating the feasibility of planting durum wheats in the fall. Durum wheats are generally spring seeded and tiller less than common wheats. They appear to be more sensitive to warming temperatures in the spring prior to and during stem elongation. As a consequence of several hot days, as often happens during the spring months in Oregon, a main tiller in the plant will elongate and probably in its dominance prevent other tillers from growing.

The objective of searching for and developing durum that will survive Oregon's winters is to have larger older plants in place when and if hot spring days do occur. The supposition is that more highly developed tillers will develop independently of the primary tiller.

The winter durums, though often originating in Turkey, have been wintered under snow cover and are not as hardy as required. Durum has two sets of seven pairs of chromosomes. Common winter wheats have three sets of seven pairs. The set missing in the durum contain the better winter survival genes. So to achieve hardiness it is probably necessary to go to a wild specie having the same chromosome sets as durum, but have evolved as winter hardy types. Those wild type times domestic crosses require a significant effort to achieve success. In the meantime, the project has availed itself of bulk populations of winter type durum. The yields are not equal to the common wheats, but are close. The quality factors are very promising, though they are not equal to the spring types.

The winter durum in Table 11 are not very hardy, and only about half of them require vernalization. The test weights are excellent. Our row spacing is not the best for durum. Although the seeding rates for durum are about one-third higher than for wheat, a narrower row spacing that distributes the plants more would help compensate for their lack of tillering.

Table 11. Advanced Winter Durum Wheat; grain yield, test-weight, date headed, and plant height of 18 winter durum wheats evaluated in a trial on the Malheur Experiment Station, Ontario, Oregon.

Name	Yield	Percent of One	Test Weight	Date Headed*	Plant Height*
	bu/ac	%	lbs/bu	Jan. 1	inches
1 FD87813 D7001b	83	100	63.1	129	29
2 FD87813 D7009	101	122	62.5	129	32
3 FD87813 D7028	86	104	60.7	129	30
4 FD87813 D7018	75	90	61.8	130	28
5 FD87813 D7060	96	116	60.9	128/	24
6 FD87813 D7076	80	96	62.7	127	26
7 FD87813 D7060	114	137	59.6	125	26
8 FD89179	96	116	64.5	124	24
9 FD89186	110	133	63.6	124	24
10 FD89171	110	133	64.7	124	30
11 FD89164	109	131	64.7	124	32
12 FD89169	118	142	62.5	124	34
13 FD89157	116	140	64.2	123	30
14 FD89173	116	140	63.4	123	32
15 FD89180	108	130	63.8	123	34
16 FD89162	102	123	62.0	126	36
17 FD89174	115	139	63.6	124	30
18 FD89170	122	147	63.1	126	26
Average yield	103				
Standard error for difference=	3.5				
LSD (0.05)=	7.7				

* Heading date and plant height recorded from a trial near Hermiston.

Table 12 gives a summary of spring wheats entered into the western regional nursery. Owens, Entry 3, has the best long term average yield. Weed and insect control was not as effective as previous years. Consequently grain yields are reduced severely for 1989 and 1990.

Table 12. Western Regional Spring Wheat; a five year grain yield summary and test weight of spring wheats evaluated in 1989 at the Malheur Experiment Station, Ontario, Oregon.

Name	YIELD						Percent of one*	Test Weight
	1986	1987	1988	1989	1990	Average		
	bu/ac						%	lbs/bu
1 McKay	98	119	115	51	70	90.6	100	61.5
2 Federation	96	95	92	56	64	80.6	89	58.7
3 Owens	106	123	131	62	89	102.2	113	61.2
4 Penawawa	103	124	131	61	82	100.2	110	58.9
5 Spillman	96	111	115	58	77	91.4	101	59.4
6 Wakanz	91	119	113	64	73	92.0	102	58.2
7 WA 7176	99	117	116	66	69	93.4	103	60.4
8 WA 7496		107	116	62	62	86.7	98	55.6
9 OR 487316			108	55	71	78.0	99	57.4
10 ID367			124	52	78	84.7	108	59.1
11 ID 415				67	76	71.5	118	59.4
12 ID 417				59	70	64.5	107	60.5
13 ID 419				61	71	66.0	109	61.9
14 Borah				58	52	55.0	91	59.6
15 UT 580646				62	84	73.0	121	56.1
16 UT 002464				59	100	79.5	131	62.4
17 OR 487355				52	70	62.0	102	59.9
18 OR 487456				48	78	63.0	104	63.6
19 OR 487475				42	80	61.0	100	61.7
20 OR 487400				58	70	60.0	100	62.9
21 Klasic				34	81	57.5	95	64.3
22 Serra				56	86	71.0	117	63.3
23 Waverly					80	80.0	114	56.8
24 WA 007668					84	84.0	120	60.8
25 OR 487462					91	91.0	130	61.4
26 ORS 08427					74	74.0	106	61.7
27 OR487380					76	76.0	109	56.7
28 OR 487279					69	69.0	99	61.3
29 OR 487453					72	72.0	103	59.9
30 UC 000784					77	77.0	110	61.0
31 UC 000786					64	64.0	91	61.7
32 UC 000785					65	65.0	93	58.1
33 UT 001601					80	80.0	114	58.6
34 UT 613945					84	84.0	120	54.8
35 UT 002534					78	78.3	111	60.0
36 ID 000392					79	79.0	113	59.1
37 ID 000405					85	85.0	121	60.1
38 ID 000408					86	86.0	123	59.3
39 ID 000409					70	70.0	100	62.3
40 ID 000412					64	64.0	91	64.3
41 LEWIEM 01					64	64.0	91	62.4
42 LEWIEM 05					61	61.0	87	62.1
43 LEWIEM 04					80	80.0	114	60.5
44 FD85813					74	74.0	106	62.0
45 5085-24					69	69.0	99	60.5

Average for 1989 = 75.0 bushels per acre.
LSD at 5 percent = 13.3

* Percent of one. Yields used to calculate percent of one for 4 year average = 88.7, 3 year average = 78.6, 2 year average = 60.5 bushels per acre.

When offers are given to growers to produce seed for spring hay barleys, seedsmen are asked about seed production of those hay types. A common rule-of-thumb is to expect nearly one fourth less than for other spring grain barleys.

Haybet, Ridawn, and FB757318, entries 2, 3, and 4 in Table 13 are hooded or awnless hay and forage types. Their grain yield in this experiment is about 20 percent less than grain barley and oats.

Table 13. Spring Hay Barley For Grain Yield; grain yield and test weight from a 1990 small grain yield trial estimating seed production for forage barleys versus other grains at the Malheur Experiment Station, Ontario, Oregon.

Name	Yield	Percent of one	Test Weight
	lbs/ac	%	lbs/ac
1 Klages (barley)	5108	100	50.2
2 Haybet (forage)	4279	84	48.6
3 Ridawn (forage)	4033	79	46.4
4 FB757318 (forage)	4202	82	42.2
5 Borah (wheat)	3619	71	57.2
6 Monida (oats)	5055	99	35.9

1990 was the second year in recent testing, that the Western Regional Spring Oats Nursery was grown at the Malheur Station (Table 14). Grain yields were quite good and compared favorably with spring wheat in the trials area. The varieties Border and Monida should be good choices for growers in the Treasure Valley if they should desire to plant spring oats.

Table 14. Western Regional Spring Oats Nursery; a two year grain yield summary and test weights of spring oats evaluated in 1989 at the Malheur Experiment Station, Ontario, Oregon.

Name	YIELD 1989	YIELD 1990	YIELD Average		Percent of One	Test Weight
	lbs/ac			bu/ac*	%	lbs/ac
1 Park	5462	4272	4867	152	100	33.1
2 Cayuse	5968	4932	5450	170	112	33.6
3 Otana	6225	4159	5192	162	107	33.1
4 Appaloosa	6814	4475	5644	176	116	34.2
5 Border	6737	5198	5967	186	123	36.0
6 Monida	6857	5351	6104	191	125	35.2
7 Ogle	5166	5189	5177	162	106	33.5
8 Calibre	6612	4400	5506	172	113	35.9
9 Dumont	6715	3747	5231	163	107	35.9
10 81AB 5792	6387	6060	6223	194	128	35.7
11 Riel	6500	4766	5633	176	116	29.7
12 80AB 988	5137	4743	4940	154	102	33.2
13 80AB 5807	6185	5228	5706	178	117	31.6
14 Valley	5688	4634	5161	161	106	37.1
15 80AB 5322	5916	5478	5697	178	117	38.0
16 82AB 248	6512	4678	5595	175	115	36.4
17 82AB 1178	5732	4603	5167	161	106	34.4
18 82AB 1142	5300	5529	5414	169	111	35.5
19 Robert	5594	4850	5222	163	107	37.9
20 NPB 871742	5300	5098	5199	162	107	32.1
21 83 AB 3119	6386	5501	5943	186	122	34.9
22 83 AB 3250	7490	4881	6185	193	127	35.4
23 83 AB 3725	5320	5410	5365	168	110	35.3
24 NPB 871754		5144	5144	161	120	32.0
25 NPB 88301		4450	4450	139	104	31.9
26 NPB 88304		5185	5185	162	121	29.8
27 86Ab664		5125	5125	160	120	30.0
28 86Ab1867		6106	6106	191	143	38.8
29 Minimax		4640	4640	145	109	33.8

* bu/ac. calculated at 32 pounds per acre.

Table 15. Western Regional Spring Barley Nursery; a five year grain yield summary, test weight, and percent plump of spring planted barleys evaluated in 1990 at the Malheur Experiment Station, Ontario, Oregon.

Name	YIELD						Test Weight	Percent Plump*
	1986	1987	1988	1989	1990	Average		
	lbs/ac						lb/bu	%
1 Trebi	5760	5376	6816	4184	5204	5468	50.0	85
2 Steptoe	6720	5136	8688	4537	4770	5970	51.0	79
3 Klages	6432	5280	6288	4154	4534	5338	52.0	62
4 Morex	5712	5952	7248	4146	5151	5642	49.0	80
5 ID 71966			7680	4059	5330	5690	50.0	73
6 WA 9448-83			6528	4455	5885	5623	49.0	72
7 BA 2601				3701	4768	4234	50.0	81
8 ID 8540				3494	5431	4462	49.0	84
9 MN 52				4456	5531	4993	52.0	91
10 ND 9866				3934	5561	4747	53.0	83
11 OR 1				3818	4972	4395	49.0	39
12 PB 107				3540	3751	3645	49.0	35
13 UT 502358				3644	5463	4553	45.0	70
14 WA 9029				4016	5231	4623	50.0	80
15 WP 584118				3938	5973	4955	46.0	83
16 BA 854026					4768	4768	53.0	77
17 BA 865169					5721	5721	52.0	32
18 ID 842974					5291	5291	53.0	85
19 MT 851012					4452	4452	51.0	78
20 MT 851195					5495	5495	51.0	72
21 MT 860756					5456	5456	52.0	78
22 ND 10277					5370	5370	51.0	83
23 ND 10278					5038	5038	52.0	84
24 FB78444-006					5350	5350	50.0	78
25 FB741209					5009	5009	51.0	55
26 OR 2					5931	5931	48.0	72
27 OR 3					5959	5959	50.0	78
28 UT 1378					6779	6779	50.0	76
29 UT 1705					6675	6675	49.0	74
30 WA 903584					5001	5001	50.0	85

* Percent plump. Percent on 6/64 by 3/4 inch slotted screen.

Steptoe still has the better long term average at the Malheur Station in the (Table 15). Western Region Spring Barley Nursery at Ontario. It does not, however have the best average over all locations. Entries 24 and 25 are new entries from Project 0396. They have done well in Oregon. They were ranked 8 and 22 respectively over 17 locations ranging from Alaska to North Dakota to Kansas to California. Two more years of testing will determine if they are suitable for release.

The Eastern Oregon Spring Barley nursery was only grown in two locations in 1990 since the spring barley work is being phased out in Project 0396 and turned over to campus personnel (Table 16). Only one entry, Gus, yielded better than Entry 1.

Table 16. Eastern Oregon Spring Barley; a six year grain yield summary of spring barleys evaluated in yield trials grown at the Malheur Experiment Station, Ontario, Oregon.

Name	YIELD					Percent of One	Test Weight
	1987	1988	1989	1990	Average		
	lbs/ac					%	lbs/bu
1 FB78444-006	6240	7647	3602	6114	5901	100	45.1
2 Gus			4336	6730	5533	114	50.2
3 Hazen			3734	5025	4379	90	48.3
4 Robust			4001	5474	4737	97	49.6
5 B 2601			3948	5709	4828	99	49.2
6 FB741209				5496	5496	90	47.4
7 FB84980				5259	5259	86	47.2
8 FB841426				4638	4638	76	48.6
9 FB84738				4832	4832	79	43.0
10 FB84747				5801	5801	95	46.2
11 FB841478				4897	4897	80	48.3
12 Triumf				5301	5301	87	48.3
13 Gloria				6012	6012	98	48.0
14 FB841555				5438	5438	89	47.3
15 FB841437				5239	5239	86	46.3
16 FB841243				5412	5412	84	43.3
17 B 1202				5690	5690	93	52.0
18 B 1215				6025	6025	98	52.9

1990 MANAGEMENT OF THE RUSSIAN WHEAT APHID OUTBREAK IN MALHEUR COUNTY

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Introduction

Since 1986 Russian wheat aphid, a serious pest of small grains, has rapidly expanded its range throughout the western United States. In parts of the northwest, the Russian wheat aphid (RWA) has become a primary pest of small grains with an economic impact measured in millions of dollars. In southwest Idaho and Malheur County, Oregon the pest was first discovered in 1987. Dick Jackson of the Oregon Department of Agriculture and the author located the first Oregon infestation of RWA in a wheat field near Nyssa in October of 1987.

The early fears of widespread infestations and damage from RWA surprisingly did not occur during the 1988 and 1989 production seasons. With the exception of a few sporadic hits by the pest, most growers and fieldmen did not experience any problems with this aphid. In general aphid populations were so low, that surveys of fields could not even detect infestations until the wheat crop was beginning to mature. Widespread infestation common in the fall virtually disappeared during the winter months and the pest was not a factor during spring and summer growing periods. For biological reasons not completely understood, overwintering female RWA did not successfully survive our local winter and early spring climate. The 1990 season was a completely different story.

The exceptionally mild and open winter of 1989-90 permitted the widespread survival of overwintering RWA. During routine surveys of winter wheat plots at the Malheur Experiment Station a reproducing female was found as early as March 7, 1990. On March 29 one of the first seriously infested commercial winter wheat fields between Ontario and Nyssa was discovered and an insecticide treatment recommended. Two days later widespread infestation and reproducing colonies with winged RWA.

From late March through June, growers and fieldmen had to scout virtually every field in the county to check for infestations, monitor population levels, and make treatment decisions for RWA. In 1990 Malheur County experienced the most serious outbreak of a new insect pest in recent history.

Economic Impact

Malheur County produces roughly 30,000 acres of wheat, predominantly of winter varieties. Typical yields range from 90-130 bushels/ac. The estimated sale of wheat brought county producers $11.6 million in 1989. However on an individual farm basis wheat is usually considered a low input, low profit rotation crop necessary for sustainable production of onions, potatoes and sugar beets. Additional management time and input costs to control RWA are discouraging considering the low profit margin for wheat, especially at current market prices. But the damage potential of this pest is high and documented losses by RWA of 50 percent or more have occurred in Malheur County.

Based on a survey of area fieldmen, approximately 87 percent of the county winter wheat acreage required at least one insecticide treatment for RWA. The percentage of spring wheat treated was even higher, but spring varieties represented only 10 percent of overall wheat production in 1990. A summary of treatment percentage by area fertilizer/pesticide retailers is provided in Table 1.

Table 1. Fertilizer/pesticide retailers estimates of required RWA treatments, Malheur County, 1990.

Company	Retailer								Average
	A	B	C	D	E	F	G	H	
	%								
percent winter wheat treated once	85	80	100	95	75	85	85	90	86.9
percent winter wheat treated twice	5	2	20	10	5	25	0	3	8.8
percent spring wheat treated once	--	100	100	--	--	100	100	75	95.0
percent spring wheat treated twice	--	0	55	--	--	0	0	0	11.0

Assuming the 1990 acreage for wheat is again about 30,000, an 87 percent treatment record would indicate a total 26,070 acres of wheat was treated at least once this year for RWA in Malheur County. Factoring in insecticide and application costs this pest cost area farmers in excess of $275,000 in 1990.

Insecticide Selection and Performance

Wheat growers are fortunate they have several cost effective insecticides registered for use to control RWA. The three most widely used compounds were Mobay's Di-

Syston, American Cyanamid's Cygon, and Dow Elanco's Lorsban. Lorsban was legal for use in Oregon under a special emergency (Sec. 18) registration during 1990.

Based on a survey of eight fertilizer/pesticide retail companies operating in Malheur county, Di-Syston was the most frequently recommended insecticide representing about 55.6 percent of the market share. Cygon and Lorsban shared the remaining sales at 21.7 percent and 22.7 percent respectively (see insecticide selection Table 2).

Table 1. Fertilizer/pesticide retailers estimates percent of acres treated with 3 RWA insecticides[1], Malheur County, 1990.

Insecticide	Retailer								Average
	A	B	C	D	E	F	G	H	
	%								
Cygon 400	80	25	0	0	48.1	10.6	10	0	21.7
Di-Syston	20	70	50	100	36.4	48.4	80	40	55.6
Lorsban	0	5	50	0	15.5	41.0	10	60	22.7

[1] Represents first treatment for RWA only.

Generally, all the insecticides performed adequately and single spring treatments on winter wheat suppressed populations of RWA for the remainder of the season. Two retailers reported having to retreat for aphids a second time in 20 percent and 25 percent of acres they handled. The remaining six retailers on less than 10 percent of their fields.

Di-Syston - The performance of this contact and systemic insecticide was unanimously rated good to excellent by fieldmen. In all but a relatively few cases, treatments held RWA at bay for the duration of the growing season. Two negative concerns of the product are: 1) its high toxicity category and concern for product safety particularly with the farmer applicator, 2) potential for phytotoxicity of the formulation which caused serious burning symptoms to appear in several area fields. Recommended rate three-fourths pt/ac; suggested retail price $5/ac.

Lorsban - Lorsban was the "sleeper" product of the season. Under a recently issued emergency registration in Oregon the product was not promoted as aggressively as the other products. However several fieldmen report satisfactory to very good results with the product. Lorsban controls RWA by both a contact and a fuming mode of action. The product is compatible with most herbicides and was a popular tank mix for farmers controlling weeds and RWA with a single application. Because of the product's lower toxicity rating, Lorsban was frequently recommended where wheat fields were adjacent to sensitive areas such as dwellings, feedlots, pastures or dairies. One firm did report Lorsban less than satisfactory and most of their second RWA outbreaks followed treatments with this product. Recommended rate 1 pt/ac; suggested retail price $5/ac.

Cygon 400 - Overall the product was the least utilized of the three although two individual retailers recommended it heavily. The insecticide got a mixed bag of reports on RWA effectiveness; some good, some O.K. and some marginally acceptable. Cygon has the lowest cost of the three popular RWA chemicals. Recommended rate three-quarters pt/ac; suggested retail price $3/ac.

The three primary insecticides provided a satisfactory arsenal for RWA control. Other products are also registered and could play a role in the future. Selection of any insecticide treatment requires evaluation of several factors including population levels, stage of wheat growth, applicator safety, off target safety, preharvest interval, and cost.

Field Survey Practices and Action Thresholds

Current university recommendations suggest taking 100 random samples of plants or tillers, depending on stage of growth, along a diagonal transect of a field. These samples are then dissected in the field to determine a percentage RWA infestation rate. University action thresholds in the spring range from 5-10 percent based on the growth stage of the wheat.

Interviews of 12 fieldmen representing eight retailers reveal poor acceptance of the university recommendations and unanimous concern for the current spring treatment thresholds and sampling methods. The sampling method is described as too cumbersome, time consuming and impractical. There is low incentive to field scout hundreds of acres of wheat at a time when fieldmen are also providing products and services for the high valued row crops. Individual farmers are also strapped for time and devoting critical management efforts toward onions, potatoes, sugar beets, and seed crops. Growers are not inclined to regularly scout wheat fields for RWA and rely heavily on the assistance of their fieldmen to make treatment decisions.

There is also widespread concern about the 1990 university recommendation of a 10 percent infestation level as a treatment threshold. The consensus was that this level was probably too high for high yield in irrigated winter wheat produced in the western Treasure Valley. For example a Cygon treatment including application could cost as little as $10.50/ac. This cost is equivalent to the value of three to four bushels of wheat at current market prices and represents only 3-4 percent of the total per acre value of the crop (100 bu/ac X $2.50/bu = $285/ac.)

Another reason the 10 percent threshold was perceived as too high is because of the documented plant and tiller densities in winter wheat fields. A postharvest tiller density survey conducted by Malheur County Extension this summer indicates very high plant populations per square foot in wheat fields. Based on 150 one sq. ft. samples from 30 fields it was determined the mean number of tillers per sq. ft. was 77. Based on the results of this survey and using a 10 percent tiller infestation threshold, a typical wheat field could have as many as five to six infested tillers in every sq. ft. and not be considered a treatable level.

Current practices of surveying fields for RWA infestations rely heavily on visually searching for symptomatic plants or tillers with occasional spot checks of individual plants to determine presence of RWA. If numerous symptomatic plants or tillers were easily found throughout the field, including the interior areas, a treatment recommendation was generally made. This "quick scan" method was more practical and less time consuming but not very quantitative. The quick scan method probably resulted in treatment thresholds closer to 1 percent infested plants or tillers rather than 10 percent. However because of the tremendous reproductive potential and lack of detailed knowledge of RWA population dynamics in this production area, it was the fieldmens' consensus that this more conservative approach was economically sound. As a result of a conservative respect for RWA's damage potential and the diligent effort of fieldmen, yield losses from this pest were held to very low levels.

Biological Control

Beneficial organisms were observed working on RWA in area wheat fields. Ladybird beetles and other common aphid predators were noticeable in most fields. Specimens of a native wasp parasite that had opportunistically hosted in RWA were collected in a field southwest of Nyssa. An entomaphagous fungi was observed infecting a population of RWA in a field just outside Ontario. None of these biocontrol agents appear to have any significant impact on reducing populations below damaging levels.

Needs Assessment

Interviews with area farmers and fieldmen were conducted to establish a needs list for improving the overall management of this new pest. The following suggestions were recorded:

1. Develop a less time consuming survey method which still quantifies RWA population levels. A method which correlates a rapid scan of symptomatic plants or tillers with estimates of actual infestation levels would be helpful.

2. Develop economic injury levels tailored for southwestern Idaho and Malheur County irrigated soft white wheat production. Distinguish both fall and spring thresholds.

3. Develop a better understanding of RWA population dynamics under the Western Treasure Valley climate and microclimates.

4. Monitor the possible impact of RWA insecticide treatments on local pheasant populations. Insecticide treatments probably have minimal effect on bird populations relative to other mortality factors such as weather and predation.

5. Continue to educate producers on identification and control of RWA. Include discussions on pesticide stewardship including posting wheat fields for re-entry intervals as required by some insecticide labels.

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AN EVALUATION OF UNIROYAL C-4243 FOR WEED CONTROL IN WINTER WHEAT

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Ontario, Oregon 1990

Purpose

Apply Uniroyal C-4243 herbicide at several rates to the soil surface as a postplant preemergence application and evaluate the effectiveness of the herbicide for control of winter and summer annual weeds and for the tolerance of winter wheat to these treatments. The effectiveness of C-4243 was compared to a standard treatment consisting of a tank-mix combination of Harmony Extra and Buctril applied as a postemergence treatment when the wheat was tillering.

Procedures

Malcolm variety of winter soft white wheat was planted on October 26, 1989 in a soil classified as an Owyhee silt loam. This soil has an organic matter content of 1.23 percent and a pH value of 7.3. After planting the field was corrugated into furrows spaced 28 inches apart in preparation for irrigation during the summer of 1990. The planting seedbed was prepared by moldboard plowing, discing, and harrowing. The previous crop was spring wheat. Fertilizer included 100 pounds of phosphate and 60 pounds of nitrogen plowed down and an additional 100 pounds of nitrogen as NH_4NO_3 was applied in the early spring as a broadcast application.

The C-4243 herbicide treatments were applied on November 1, 1989 after the field had been corrugated. Individual plot size was 16 X 50 feet and each treatment was replicated four times. Treatments were randomized within each block utilizing a randomized complete block experimental design. A strip of ground 15 feet wide at the bottom of each block was left unplanted to evaluate weed control without competition from wheat growth.

The herbicide treatments were applied using a single wheel bicycle plot sprayer. The spray boom was eight feet long and teejet fan nozzles size 8002 were spaced ten inches apart on the boom applying the herbicides as double overlap broadcast treatments. Spray pressure was 45 pounds per square inch and water applied at the rate of 31.2 gallons per acre.

Weather conditions during application of treatments are as follows: air temperature 49° F, soil temperature 46° F, skies clear, and wind was NW at 2 to 4 mph.

The soils were moist on the surface. There were a few small clods but soil conditions were generally good for herbicide application. Light rain showers occurred three days after the herbicides were applied.

The postemergence, Harmony Extra and Buctril, treatment was applied on April 9. On this date the wheat was tillering with the largest plants having three to four tillers and from 6 to 9 inches tall. Weeds emerged in these plots included tansy and tumbling mustard, and lambsquarters, kochia, hairy nightshade, and pigweed. The mustard species were 4 to 8 inches tall and the summer annuals were 1 to 2 inches tall with rosettes 1 to 1.5 inches across. Weather conditions were clear skies, 70° F air temperature, calm air, soil moisture good following one irrigation, and plant growth and condition was also good. X-77 surfactant was added at a rate of 0.25 percent of water volume.

Results

Weed control ratings were taken and are reported in Table 1 for May 30 and June 24. Control ratings were taken from the unplanted area at the bottom of the blocks to evaluate soil residual control without the wheat competitive effect on weed emergence and growth. C-4243 resulted in excellent weed control at all rates on May 30. On June 24 some weeds were starting to emerge in the unplanted area, but weed control remained good in the planted wheat. From observations of trial area during the growing season the intermediate rate of 0.125 lbs ai/ac would probably be a good use rate. Lower rates may miss some mustard species particularly tumbling mustard.

Malcolm wheat showed excellent tolerance with no injury as shown by both visual ratings recorded in Table 1 and yield and test weighed shown in Table 2.

Table 1. Percent weed control and crop injury ratings from herbicides applied in the fall as postplant, preemergence, soil active treatments to fall planted wheat. Malheur Experiment Station, Oregon State University, Ontario, Oregon 1990.

Herbicides	Rate	Percent Weed Control														
		Kochia		Lambs Quarters		Pig Weed		Hairy Nightshade		Tansy Mustard		Tumbling Mustard		Wild Oats		Crop Injury
	lbs ai/ac	5/30	6/24	5/30	6/24	5/30	6/24	5/30	6/24	5/30	6/24	5/30	6/24	5/30	6/24	6/24
C-4243	0.063	100	95	100	96	100	98	100	96	96	96	94	92	0	0	0
C-4243	0.125	100	98	100	98	100	99	100	98	99	98	96	96	0	0	0
C-4243	0.188	100	100	100	99	100	99	100	98	100	100	100	100	0	0	0
Harmony Extra + Buctril	0.0234 + 0.25	100	68	100	65	100	75	100	65	96	93	97	95	0	0	0
Check	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2. Wheat yields and test weights of Malcolm winter wheat treated with C-4243 herbicide in the fall as postplant preemergence applications. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Herbicides	Wheat Yields (bushels/acre)					Wheat Test Weight				
	1	2	3	4	Avg	1	2	3	4	Avg
C-4243	102.3	111.4	107.6	113.7	108.8	59.2	57.7	58.4	58.9	58.6
C-4243	105.6	110.5	104.4	112.1	108.2	57.6	58.6	58.5	59.1	58.4
C-4243	106.2	110.9	101.9	109.8	107.2	58.4	57.9	58.9	59.0	58.6
Harmony Extra + Buctril	101.9	108.6	105.6	111.1	106.7	59.1	57.5	58.7	58.9	58.5
Check	103.6	107.9	107.4	110.9	107.7	58.7	58.4	57.9	58.6	58.4
LSD .05					NS					NS

AN EVALUATION OF SOIL AND FOLIAR ACTIVE HERBICIDES FOR THE CONTROL OF BROADLEAF WEEDS AND WILD OATS IN WINTER WHEAT

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Ontario, Oregon 1990

Purpose

To compare soil and foliar active herbicides for weed control and crop tolerance when applied alone and in tank-mix combinations.

Procedures

Malcolm variety of winter wheat was planted on October 26, 1989. The previous crop was Bliss variety of spring wheat. Soils in the trial area are classified as Owyhee silt loam having a pH value of 7.1 with approximately 1.2 percent organic matter. Fertilizer applied included 100 pounds of phosphate and a total of 200 pounds of nitrogen. The phosphate and 60 pounds of nitrogen was applied broadcast and plowed under with a moldboard plow. The remaining amount of nitrogen was broadcast on the soil surface on March 3, 1990.

The soil active herbicide (C4243) was applied on November 1, 1989 to the soil surface after the wheat was planted and corrugated in preparation for surface irrigation during the summer of 1990. The trial received its first application of irrigation water on May 2, 1990. When the treatments were applied the soil surface was moist, air and soil temperatures were 49° and 46° F respectively. Skies were clear and wind out of the NW at 2-4 mph. Individual plots were 16 X 50 feet and each treatment was replicated four times and treatments arranged at random within each replication using a complete block experimental design.

The foliar active herbicide treatments were applied at different times depending on stage of wheat growth. The early treatments were applied on April 9. The wheat had five to six leaves with one to three tillers and a height of 4-6 inches. The late treatments were applied on April 23 and May 3. On April 23 wheat was 10-12 inches tall with three to four tillers and the shoots were starting to elongate. On May 3 the wheat was fully tillered to the third node. Weed species in the trial included kochia, lambsquarters, pigweed, hairy nightshade, tansy and tumbling mustard and wild oats. On April 9 the summer annual weeds were small and not fully emerged when the early treatments were applied. The mustard species had rosettes ranging from 2-4 inches in diameter. The wild oats were 3-4 inches tall, four to five leaves with 1 tiller. On April 23 when the late treatments were applied the summer annual broadleaf weeds were 4-8 inches tall, fully emerged. The mustard species were also 6-8 inches tall and the wild oats with three to four tillers. Individual plots in the foliar treated plots were 9 X 50 feet. Each treatment was replicated four times and arranged at random in blocks as described for the soil treated trial.

All treatments were applied as double overlap broadcast applications using a single wheel bicycle plot sprayer. Nozzles were teejet fan size 8002. Spray pressure was 45 psi and water as the carrier applied at 31.2 gallons per acre. X-77 surfactant was added to all foliar treatments at the rate of 0.25% of water volume as indicated in the data tables.

Weed control evaluations were taken from an area at the bottom of each plot which was not planted to wheat thus competition from wheat plants did not affect weed emergence and growth.

Results

Crop injury and weed control ratings were taken on May 30 and again on June 24 (Table 1). Crop injury did not occur from any treatment thus ratings for crop injury was omitted from Table 1.

All herbicide treatments gave good control of weeds emerged at time of application. Summer weeds continued to emerge after the early treatments were applied on April 9. Herbicides applied later on April 23 and May 3 controlled all weeds including the late emerging weeds, thus ratings taken on May 30 show improved weed control for these treatments.

Herbicide C-4243 persisted as a fall applied preemergence treatment to control weeds emerging during the winter and through the growing season. Tank-mixes of Harmony Extra with Buctril, Bronate and 2,4-D were compatible and resulted in good control of all broadleaf weed species.

Tank mixes of Bronate with Puma or Tiller resulted in good control of broadleaf weeds. Puma was clearly superior to Tiller for control of wild oats.

Table 1. Percent control of weeds and crop injury ratings from foliar active herbicides applied to Malcolm variety of winter wheat. Malheur Experiment Station, Oregon State University, Ontario, Oregon 1990.

Herbicides	Rate Lbs ai/ac	Applied	Percent Weed Control[1]													
			Kochia		Lambs Quarter		Pig Weed		Hairy Night-shade		Tansy Mustard		Tumbling Mustard		Wild Oats	
			5/30	6/24	5/30	6/24	5/30	6/24	5/30	6/24	5/30	6/24	5/30	6/24	5/30	6/24
			100	95												
C-4243	0.063	Preemergence	100	98	100	96	100	98	100	96	96	96	94	92	0	0
C-4243	0.125	Preemergence	100	100	100	98	100	99	100	98	99	98	96	96	0	0
C-4243	0.188	Preemergence	100	68	100	99	100	99	100	99	100	100	100	100	0	0
Harmony Extra + Buctril	.0234+0.25	Early Post	0	0	100	65	100	75	100	65	96	93	97	95	0	0
Check	-	Check			0	0	0	0	0	0	0	0	0	0	0	0
			93	58												
Bronate	0.5	Early Post	97	68	96	62	100	72	100	60	95	93	96	95	0	0
Harmony Extra	0.014	Early Post	98	65	96	65	100	70	100	65	95	93	96	94	0	0
Buctril + Harmony Extra	0.187+0.014	Early Post	94	65	95	65	100	75	100	65	96	93	97	95	0	0
Bronate + Harmony Extra	0.375+0.014	Early Post	100	98	94	67	100	73	100	63	96	92	98	95	0	0
Buctril + Harmony Extra	0.187+0.014	Late Post	100	98	100	97	100	96	100	97	100	100	100	100	0	0
Bronate + Harmony Extra	0.375+0.014	Late Post	100	98	100	98	100	95	100	98	100	100	100	100	0	0
Harmony Extra	0.014	Late Post	100	98	100	98	100	97	100	98	100	100	100	100	0	0
Harmony Extra + 2,4 D	0.014+0.375	Late Post	100	99	100	99	100	98	100	98	100	100	100	100	0	0
Bronate + Puma	0.5+0.1	Late Post	100	99	100	99	100	99	100	99	100	100	100	99	100	100
Bronate + Tiller	0.5+1.0	Late Post	0	0	100	98	100	95	100	96	100	100	100	98	73	70
Check	-	-			0	0	0	0	0	0	0	0	0	0	0	0
			100	97												
Banvel SGF + MCPA	0.125+0.5	Late Post	100	98	100	100	100	100	100	98	100	99	100	99	0	0
WB3153 + MCPA + X-77	0.125+0.5	Late Post	100	99	100	99	100	99	100	98	100	99	100	99	0	0
WB3153 + MCPA	0.125+.05	Late Post	99	97	100	99	100	99	100	99	100	99	100	99	0	0
Banvel SGF + MCPA + X-77	0.125+0.5	Late Post	0	0	100	99	100	99	100	99	100	99	100	99	0	0
Check	-	-			0	0	0	0	0	0	0	0	0	0	0	0

X-77 applied with all Harmony Extra at a rate of 1 qt/100 gallons of water and to Banvel and WB3153 treatments at a rate of 0.25% of water volume.

1) Ratings: 0 = no herbicide effect, 100 = all plants killed. Average of 4 replications.

SOIL NITROGEN RECOVERY BY STEPHENS WHEAT AND HESK BARLEY

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Introduction

Standard soil tests are used to evaluate residual nutrient supplies in the soil as an aid for determining the amount of fertilizer to apply for each crop. Recommendations are based on the analysis of samples taken from the 0-2 ft and 2-6 ft soil depths. In practice, the surface soil is tested and available nutrients provided by the subsoil are not considered when estimating fertilizer application rates. Nitrogen fertilizer recommendations are made with respect to nitrate-N (NO_3^--N) content in the soil (Table 1). Since available nutrients in the subsoil and ammonium-N (NH_4^+-N) within the profile are not accounted for, excess fertilizer (particularly nitrogen fertilizer) may be added to the soil.

Negatively charged plant nutrients such as nitrate (NO_3^-) are capable of moving through the soil profile below the rooting depth of crops such as potatoes and onions. If surplus nitrogen fertilizer is applied to the soil for shallow rooting crops, nitrate concentrations may accumulate lower in the profile or move down into the water table. Deeper rooting crops such as wheat and barley may be useful in a potato or onion crop rotation by utilizing nitrogen lower in the profile.

Objectives

A. Assess and compare the extraction of nitrate-N and ammonium-N throughout the soil profile by winter wheat and barley.
B. Determine if subsoil test analyses for nitrate-N and ammonium-N are useful for determining nitrogen fertilizer rates.

Procedures

A field trial was conducted in the fall of 1989 on Owyhee silt loam. Stephens wheat and Hesk barley were planted following onions. Soil samples were taken from the upper five feet of the profile three times during the trial and analyzed for NH_4^+-N and NO_3^--N. Soil samples were collected in the fall of 1989 prior to planting, in the spring of 1990 prior to the first irrigation, and after harvest.

Three spring urea fertilizer treatments were applied by broadcasting. The treatments consisted of 0, 100, and 200 lbs N per acre with either three or four irrigations resulting in six treatments on both wheat and barley. Five treatment replications were used in a randomized complete block design. Each plot covered an area of thirteen feet by thirty feet.

At harvest, straw and grain samples were analyzed for nitrogen content and nitrogen uptake per acre was calculated for each crop. Grain samples were also evaluated for test weight, protein, and yield.

Results

At planting, available nitrogen in the upper five feet of the soil profile, was calculated at 339.6 lbs. N per acre (Table 2). Analysis of the samples collected before the first irrigation showed 379.5 lbs N per acre (Table 3). Comparing the fall and spring analyses, 39.9 lbs. per acre of available nitrogen accumulated during the winter months. The increase may be attributed to nitrogen mineralization because of favorable, mild weather conditions that occurred during the winter and negligible nitrate losses due to leaching.

The results from the straw tissue and grain analyses (Table 4) indicate that Stephens wheat extracted significantly more nitrogen from the soil than did Hesk barley. This inference is supported by the post harvest soil analysis (Table 5) which shows that more plant available nitrogen remained in the barley plots than in the wheat plots. Closer inspection of Table 5 reveals that Stephens wheat had a greater ability than Hesk barley to extract NH_4^+ from the soil.

A nitrogen balance was developed to compare the available nitrogen remaining in the soil plus nitrogen taken up by the crops with the total available nitrogen supply prior to spring growth (Table 6). The results demonstrate close accounting of the nitrogen within the system. Both wheat and barley were grown successfully under furrow irrigation with recovery of substantial residual soil nitrogen. Without fertilization, Hesk barley recovered 134.9 lbs N/ac while Stephens wheat recovered 209.1 lbs N/ac.

Residual soil nitrogen was sufficient to produce 105.7 bu/ac of barley and 138.8 bu/ac of wheat (Table 7). Hesk barley demonstrated no statistically significant yield response to spring urea fertilization. Wheat yields increased to 174.2 bu with 100 lbs N/ac as urea while recovering 276.8 lbs N/ac. Both wheat and barley can be used effectively to recover nitrate and ammonium in the soil profile.

Discussion

Growers often estimate the soil nitrogen supply based on surface soil nitrate-N content. Neglecting ammonium-N reserves near the surface and both nitrate-N and ammonium-N deeper in the root zone may result in underestimating total nitrogen available to crops such as wheat and barley.

Stephens soft white winter wheat was highly efficient at recovering nitrogen with a total N uptake of 209, 277, and 313 lbs N per acre at 0, 100, and 200 lbs per N acre applied as urea. Of the nitrogen uptake, 161, 223, 249 lbs N per acre was removed from the field in the grain.

Table 1. Recommended nitrogen fertilizer rates for irrigated wheat in eastern Oregon. Oregon State University Fertilizer Guide #40, Irrigated Wheat for eastern Oregon, 1983.

NO_3^--N soil test lbs/acre	N application rate lbs/acre
0-50	250-200
50-100	200-150
100-150	150-100
150-200	100-50
200-250	50-0
over 250	none

Table 2. Available nitrogen supply in the soil by depth prior to planting. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Soil depth	NH_4^+-N	NO_3^--N	Total available N
(ft.)	lbs N/acre		
0-1	29.5	96.0	125.5
1-2	19.5	52.5	72.0
2-3	13.0	35.8	48.8
3-4	11.6	37.4	49.0
4-5	9.7	34.6	44.3
Total available N = 339.6			

Table 3. Available nitrogen supply in the soil by depth prior to the first spring irrigation and fertilization. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Soil depth (ft.)	NH_4^+-N	NO_3^--N	Total available N
	lbs N/acre		
0-1	32.2	77.1	109.3
1-2	34.6	33.6	68.2
2-3	29.4	31.4	60.8
3-4	42.3	30.1	72.4
4-5	42.3	26.5	68.8
Total available N = 379.5 lbs/acre			

Table 4. Nitrogen uptake analysis of Hesk barley and Stephens wheat. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Barley Nitrogen Content			
treatment	straw	grain	total
	lbs N / acre		
0	30.7	104.2	134.9
100	46.4	141.0	187.0
200	49.7	154.1	203.7
LSD(0.05)	ns	45.5	46.4
Wheat Nitrogen Content			
treatment	straw	grain	total N
	lbs N / acre		
0	47.8	161.3	209.1
100	53.4	223.4	276.8
200	63.9	249.1	313.0
LSD(0.05)	ns	45.2	46.4

Table 5. Plant available nitrogen remaining in the soil after harvesting Hesk barley and Stephens to a depth of five feet. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Soil nitrogen content after harvest				
Crop	Applied Urea-N	Soil N		
		NH_4^+-N	NO_3^--N	total N
	lbs N/acre			
barley	0	163.7	67.5	231.2
	100	189.1	93.1	282.2
	200	211.1	149.6	360.7
wheat	0	105.6	73.9	179.5
	100	123.0	124.7	247.7
	200	113.2	153.2	266.4

Table 6. Nitrogen balance of the Stephens wheat and Hesk barley nitrogen recovery trial. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Treatment	Initial N level	Soil N after harvest	Plant recovery	Unaccounted N
------------------- lbs N/acre -------------------				
Barley				
0	379.5	231.2	134.9	-13.4
100	479.5	282.2	187.0	-10.3
200	579.5	360.7	203.7	-15.1
Wheat				
0	379.5	179.5	209.1	+9.1
100	479.5	247.7	276.8	+45.0
200	579.5	266.4	313.0	-0.1

Table 7. Yield quality results from the Stephens wheat and Hesk barley nitrogen recovery trial. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Barley			
treatment (lbs N/acre)	grain yield (bu/acre)	test weight (lbs/bu)	grain protein %
0	105.7	49.9	9.4
100	113.8	49.6	12.1
200	115.0	47.1	13.0
LSD(0.05)	ns	ns	2.0
Wheat			
treatment (lbs N/acre)	grain yield (bu/acre)	test weight (lbs/bu)	grain protein %
0	138.8	60.3	11.1
100	174.2	59.8	12.5
200	166.9	57.6	14.6
LSD(0.05)	17.0	1.6	2.0

SUGAR BEET VARIETY TESTING RESULTS

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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 accumulative performance data for the varieties and restricts growers in Idaho and Malheur County of Oregon to planting only those varieties ranking above minimum requirements.

Procedures

Twenty-four commercial and 22 experimental lines of sugar beets were evaluated in trials conducted at the Malheur Experiment Station. Seed for evaluation was received from American Crystal, Betaseed, Holly, Mono-Hy, and TASCO companies. The sugar beets were planted in Owyhee silt loam soil where wheat was planted the previous two years. Soil pH is 7.3 and the soil organic matter is 1.2 percent. The field was plowed in the fall of 1989. One hundred pounds of phosphate and 60 pounds of N was applied as a broadcast treatment before plowing. An additional 150 lbs of nitrogen was added by sidedressing ammonium sulfate after thinning. Two lbs ai/ac of Nortron was broadcast and incorporated by using a spike-tooth harrow before planting.

The commercial varieties and experimental lines were planted in separate trials. Each entry was replicated eight times and arranged in a complete randomized block experimental design. Each plot was four rows wide and 23 feet long with four-foot alley ways separating each plot. Approximately 12 viable seeds per foot of row were planted. The seed was planted on April 3 and 4 with a cone-seeder mounted on a John Deere model 71 flexi-planter equipped with disc openers. After planting the sugar beets were corrugated and surface-irrigated to assure moisture for uniform seed germination and seedling emergence.

The sugar beets were hand-thinned during the second week of May. Spacing between plants was approximately eight inches. In mid-July, 60 lbs/ac powdered sulfur, was spread by aerial application over the foliage to protect the sugar beet leaves from powdery mildew infection.

The sugar beets were harvested on October 19, 20, 22, 23, and 24. 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 22 feet of row were weighed to calculate root yields. A sample of seven beets was taken from each of the harvested rows and analyzed for percent sucrose, NO_3, and conductivity by Amalgamated research laboratory to measure root quality.

Results

Varieties (Table 1 and 2) have been grouped by seed companies. Each variety is ranked within each company's group by yield of recoverable sugar per acre. The data was analyzed statistically for LSD value at 0.05 percent level of significance, coefficient of variation, P values, and means for all evaluated parameters.

Yields of recoverable sugar from commercial varieties ranged from a high of 7.434 tons of sugar per acre to a low of 6.023 tons per acre, with a variety mean of 6.788 tons per acre. Thirteen varieties had sugar yields equal to or greater than the mean.

Yield of recoverable sugar from experimental lines ranged from 7.649 tons of sugar/acre to a low of 6.582 tons of sugar/acre, with an entry mean of 6.998 tons of sugar per acre. Ten of the 32 lines tested had sugar yields above the trial mean. Five experimental lines had sugar yields significantly better than the mean (Table 2).

Root yields were higher this year than in 1989. Sugar beet quality was very good, the higher root yields resulted in about 0.43 tons/ac higher yield of recoverable sugar for 1990 when these data are compared to 1989 results.

Table 1. Performance data from sugar beet lines evaluated at commercial varieties. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Company	Variety	Beet Yield	Sucrose	Conductivity	Root NO_3	Extraction	Recoverable Sugar	Curly Top Ratings
		tons/ac	%		ppm	%	tons/ac	
American Crystal	ACH-191	46.78	17.42	735	534	85.27	6.939	5.6
American Crystal	ACH-200	47.89	16.92	718	481	85.38	6.910	5.3
American Crystal	ACH-177	44.38	17.77	665	411	86.25	6.795	5.7
American Crystal	ACH-190	44.91	17.21	715	471	85.49	6.610	5.5
American Crystal	ACH-199	47.76	16.40	831	539	83.80	6.560	4.2
American Crystal	ACH-31	45.87	16.76	722	532	85.30	6.554	5.0
American Crystal	ACH-173	45.06	16.79	689	449	85.75	6.485	4.1
American Crystal	ACH-139	41.44	16.91	679	435	85.90	6.023	6.1
Betaseed	Beta 8450	49.88	16.67	772	467	84.63	7.034	5.7
Betaseed	Beta 8654	48.23	16.65	751	480	84.91	6.818	4.5
Betaseed	Beta 8251	48.50	16.50	729	507	85.17	6.814	5.0
Betaseed	Beta 9380	47.89	16.49	751	502	84.88	6.699	4.7
Betaseed	Beta 8428	44.28	17.44	746	463	85.12	6.560	5.8
Holly	HH-39	48.77	16.55	762	456	84.74	6.838	5.3
Holly	HH-68	45.56	17.24	723	494	85.40	6.706	5.5
Hilleshog Mono-Hy	HM-R2	49.34	16.41	771	424	84.59	6.848	5.4
Hilleshog Mono-Hy	HM-2905	49.24	16.34	768	433	84.63	6.807	5.5
Hilleshog Mono-Hy	HM-176	47.52	16.52	707	473	85.46	6.706	4.0
Hilleshog Mono-Hy	HM-55	47.99	16.40	758	496	84.76	6.675	5.0
Hilleshog Mono-Hy	HM-R1	47.96	16.34	740	505	84.99	6.657	5.1
White Satin	WS-PM9	53.70	16.28	736	471	85.03	7.434	4.5
White Satin	WS-91	49.44	17.01	721	498	85.37	7.180	4.4
White Satin	WS-41	49.92	16.85	738	463	85.12	7.159	5.4
White Satin	WS-88	50.52	16.60	757	447	84.82	7.115	4.1
LSD.05		2.079	0.412	49	102	0.686	0.3135	-
P-Value		.0000	.0000	.0000	0.620	.0000	.00000	-
CV(S/mean)		4.421	2.488	6.692	21.69	0.8157	4.677	-
Mean Value		47.62	16.77	737	476	85.11	6.788	-

Table 2. Performance data from sugar beets evaluated as experimental lines. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Company	Variety	Beet Yield	Sucrose	Conductivity	Root NO_3	Extraction	Recoverable Sugar	Curly Top Ratings
		tons/ac	%		ppm	%	tons/ac	
American Crystal	ACH-203	49.58	17.22	677	340	85.99	7.337	5.4
Betaseed	8BG-6384	47.52	17.35	742	315	85.16	7.015	5.9
Betaseed	9BG-6389	44.35	18.23	683	302	86.09	6.953	5.8
Betaseed	8BG-6325	47.62	17.19	758	340	84.92	6.953	5.6
Betaseed	6BC-6253	47.32	17.04	768	380	84.77	6.835	6.1
Betaseed	7BG-6177	46.24	17.07	815	346	84.15	6.641	5.2
Holly	89N158-026	48.19	17.18	714	326	85.50	7.077	5.6
Holly	87N147-018	48.03	17.13	724	344	85.35	7.023	5.6
Holly	87C143-016	47.82	16.87	642	344	86.38	6.965	4.9
Holly	87N157-020	48.27	17.08	827	327	83.98	6.954	5.8
Holly	89N156-03	45.87	17.18	689	317	85.82	6.759	5.3
Holly	89N158-028	44.85	17.52	725	306	85.43	6.714	5.9
Holly	89N158-03	45.43	17.09	693	378	85.75	6.653	5.0
Holly	89N155-017	47.08	16.66	817	356	84.03	6.582	4.8
Hilleshog Mono-Hy	HM-2912	51.23	16.72	716	348	85.38	7.313	4.8
Hilleshog Mono-Hy	HM-2911	47.82	17.20	703	328	85.65	7.041	5.5
Hilleshog Mono-Hy	HM-1311	44.48	17.68	710	336	85.65	6.737	5.3
Hilleshog Mono-Hy	HM-RH2	44.52	17.32	678	331	85.99	6.628	5.4
White Satin	E-7325	51.23	17.33	668	316	86.13	7.649	4.1
White Satin	6244-08	50.73	17.19	649	320	86.35	7.527	4.3
White Satin	E-8170	50.73	16.98	645	331	86.36	7.435	4.6
White Satin	WS-88	50.19	16.76	724	342	85.29	7.172	4.1
LSD		1.888	0.3128	39.26	52.52	0.5431	0.2855	-
P-Value		.0000	.00000	.00000	0.3459	.00000	.00000	-
CV(S/mean)		4.005	1.843	5.543	15.86	0.6431	4.128	-
Mean		47.69	17.18	716.8	335.1	85.46	6.998	-

THE COMPARISON OF BETAMIX TO SN-38584 AND FOUR DIFFERENT ADJUTANTS FOR TOLERANCE OF SEEDLING SUGAR BEETS AND WEED CONTROL

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Ontario, Oregon, 1990

Purpose

SN-38584, a wettable powder formulation of phenmedipham herbicide, was compared to Betamix ec for weed control and crop tolerance when SN38584 was tank-mixed with Tween 20, X-77, MorAct, or X2-5309 adjutants and applied to seedling sugar beets as postemergence treatments.

Materials and Methods

SN38584 was applied at two rates, 0.5 and 0.75 lbs ai/ac, with each surfactant (adjuvant) when the sugar beets had two to four true leaves. The surfactants were Tween 20, X-77, MorAct and X2-5309. Tween 20 and X-77 were tank-mixed with SN38584 at a rate of 1.0 percent of the spray volume. The rate of MorAct and X2-5309 was 1 quart and 0.75 pints/ac respectively. Betamix ec, as the standard for comparison, was applied at 0.5 and 0.75 lbs ai/ac without the addition of a surfactant.

The herbicide treatments were applied on May 2. Individual sugar beet plants varied in size from two to four true leaves. Two leaf plants had fully developed cotyledon leaves with the leaf blades of the true leaves about 1.5 inches long. The three and four true leaves were starting to develop and were about the size of pea seeds. The first true leaves of the four leaf plants had leaf blades 2.5 inches long and the second set of true leaves were 1 to 1.5 inches long. The cotyledons were shriveled and drying. Weed species in the trial area included redroot pigweed, lambsquarters, hairy nightshade, shepherds purse, kochia, barnyardgrass, green foxtail and wild oats. Broadleaf weeds were cotyledonary size to four true leaves. Grasses had one to three leaves. White satin WS-88 variety of sugar beets was used in the study.

Each plot was four rows wide and 25 feet long. Distance between rows was 22 inches. Treatments were replicated three times and placed at random in each replication using a randomized block experimental design. Spray treatments were applied with a single wheel bicycle sprayer equipped with a four nozzle boom and a nozzle was centered over each row of the four-row flats. Nozzles were teejet fan size 6502E. Spray pressure was 43 psi and water was applied at the rate of 18.7 gallons/ac. When spraying skies were cloudy, air temperature was 62° F and wind was 1-3 mph from the northwest. Soils were silt loam texture, pH 7.3 and organic matter content 1.25 percent. The soil temperature at the 4-inch depth was 58° F. The soils were dry on the surface and moist below one inch.

Results

SN38584 was more active with Tween 20 than when tank-mixed with other adjutants, which is indicated by crop injury and percent weed control ratings as listed in Table 1. MorAct was the least active of all adjutants tested. X-77 and X2-5309 were about equal in effectiveness as adjutants. SN38584 activated by Tween 20, X-77 and X2-5309 resulted in weed control equal too or superior to Betamix ec. Weed control was quite ineffective because weeds were too large when herbicide treatments were applied. In future trials, SN38584 with adjutants should be evaluated at lower rates, perhaps ranging around 0.3 pounds ai/ac and applied when sugar beets are in full cotyledon or early two leaf stage. Weeds at that stage of beet growth are small and more susceptible to phytotoxic effects of herbicide treatments.

Table 1. Percent weed control and crop injury ratings from postemergence applications of four adjutants and SN38584 and emulsifiable Betamix to four leaf sugar beets. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Herbicide Treatments	Rate	Crop Injury	Redroot Pigweed	Lambs Quarters	Hairy Nightshade	Shepherds Purse	Kochia	Barnyd Grass	Green Foxtail	Wild Oats
	lbs ai/ac	%								
SN38584+Tween 20	0.5+1%	27	75	94	65	70	73	25	33	5
SN38584+Tween 20	0.75+1%	42	82	98	76	78	85	35	42	10
SN38584+X-77	0.5+1%	15	80	95	83	80	68	38	45	5
SN38584+X-77	0.75+1%	20	82	99	87	85	81	40	55	10
SN38584+MorAct	0.5+1qt	5	52	70	40	55	55	15	20	0
SN38584+MorAct	0.75+1qt	7	60	82	43	65	65	15	25	5
SN38584+X2-5309	0.5+1pt	14	73	85	60	70	75	22	35	5
SN38584+X2-5309	0.75+1pt	23	82	93	65	80	88	25	45	10
Betamix ec	0.5	5	30	65	45	65	70	12	25	5
Betamix ec	0.75	30	78	90	63	75	83	33	33	8
Untreated check	-	0	0	0	0	0	0	0	0	0

Rating: 0 = no effect, 100 = all plants killed. Crop injury ratings indicate percent injury from leaf necrosis. Stand reduction did not occur. Injury ratings taken 7 days after herbicides were applied. Sugar beets outgrew all foliar injury within 2 weeks after herbicide application. Weed control ratings taken.

WEED CONTROL AND TOLERANCE OF SEEDLING SUGAR BEETS TO APPLICATION OF BETAMIX, STINGER, AND POAST HERBICIDES APPLIED AS REPEAT TREATMENTS AT LOW RATES

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Purpose

Experiments were continued to evaluate the tolerance of sugar beets to tank-mix and single applications of Betamix, Stinger, and Poast, with and without preplant incorporated Ro-neet and to determine if these herbicide treatments were effective in controlling all species of weeds when applied at low rates as repeat postemergence applications.

Materials and Methods

Betamix was applied alone at four rates (0.2, 0.3, 0.4 and 0.6 lbs ai/ac) and in tank-mix combinations at three rates (0.2, 0.3 and 0.6 lbs ai/ac) with Stinger (0.05 lbs ai/ac) and/or Poast (0.09 lbs ai/ac) to sugar beets. Initial applications of these herbicide treatments were begun at three different stages of sugar beet growth (80 percent emergence to early cotyledon, full cotyledon to one true leaf, and four true leaf). Three repeat applications followed the initial application to control newly emerging weeds or weeds injured, but not killed, by the previous application. Each of the postemergence treatments were evaluated both with and without a preplant incorporated application of Ro-neet applied at the rate of 4.0 pounds ai/ac. Ro-neet was applied in the spring and incorporated with a triple-k field cultivator and spike tooth harrow as the seed bed was prepared for planting.

Soils in the trial area are silt loam in texture with an organic matter content of 1.2 percent and a pH of 7.3. Individual plots were four rows wide and 25 feet long. Sugar beets were planted on 22-inch row spacing. Each treatment was replicated three times and randomized within each replication using a randomized block experimental design. The herbicides were applied using a single bicycle wheel plot sprayer with four 6502 togaed fan nozzles spaced 22 inches apart so a nozzle was centered over the middle of each row of the 4-row plots. Spray pressure was 42 psi and water as the herbicide carrier was applied at the rate of 19.0 gallons/ac. WS-88 variety of sugar beets was planted on March 29 and furrow irrigated on April 2. Weed species included hairy nightshade, lambsquarters, pigweed, kochia, mustard species, barnyardgrass, green foxtail, annual ryegrass, and wild oats. Weed species emerging in the Ro-neet treated plots included lambsquarters, kochia, mustard species, and wild oats. Weed species ranged in size from cotyledon to four small leaves when the initial herbicide treatments were applied during sugar beet emergence or full cotyledon. Weeds were 4 inches tall with six to eight leaves when sprayed at the four leaf stage of sugar beet growth. All plots received three repeat applications after the initial herbicide treatments were applied. Plots receiving the initial application when the sugar beets were emerging and in the full cotyledon stage of growth were kept weed free. Many weeds were too large to control by the initial or repeat treatment when herbicide applications were delayed until the sugar beets had developed four true leaves. Sequential applications were applied from 10-14 days following the previous application as new weeds emerged.

Results

Betamix and Betamix tankmix combinations with Stinger and/or Poast resulted in excellent weed control when applied to weeds between the cotyledon and four leaf stage of growth. Larger weeds were injured but recovered and continued to grow. Betamix rates at 0.2 and 0.3 lbs ai/ac were just as effective as the 0.4 and 0.6 lbs ai/ac rates for control of all species of weeds when sprayed before the exceeded they four leaf stage of growth. Weeds larger than four leaves were not controlled effectively at any rate of Betamix or Betamix combinations. Ro-neet treated sugar beets were more sensitive to Betamix at the higher rates (0.4 and 0.6 lbs ai/ac) than non Ro-neet treated sugar beets. Betamix at 0.2 and 0.3 lbs ai/ac did not affect sugar beets receiving Ro-neet as a preplant incorporated treatment. Betamix was effective in controlling some barnyardgrass, green foxtail and annual ryegrass but did not have activity on wild oats. Betamix was compatible when tankmixed with Poast. Poast at 0.09 lbs ai/ac controlled all grass species when applied with Betamix in the initial and repeat applications. Stinger is compatible as a tankmix with Betamix and Poast and could be used to control weed species in the composite family (cockleburr, sunflower, canada thistle) and legume families when these species are problem weeds in commercial sugar beet fields.

Betamix and Betamix combinations did not control broadleaf weed species when applications were delayed until sugar beets had four true leaves because of tolerance of large weeds to Betamix and canopy effect of weeds growing beneath the leaves of sugar beet plants. Grassy weeds were controlled with Poast, applied as repeat treatments when the initial application was delayed until sugar beets had four true leaves.

Application Information:

A. First application - sugar beets 80% emerged to small cotyledon leaves.
   1. Applied on April 11th.
   2. Weed species were all in cotyledon to 1 true leaf.
   3. Sprayed between 9 and 10:30 a.m.
   4. Skies cloudy during morning with clearing in afternoon.
   5. Air temperature 70° F for high temperature of the day.

B. Second initial application - sugar beets in full cotyledon to very small true leaves (less than 1/2 inch long).
   1. Applied on April 19th.
   2. Weed species were cotyledon to 4 true leaves. Grasses 1 to 3 leaves.
   3. Sprayed between 11 a.m. and 2 p.m.
   4. Skies partly cloudy.
   5. Air temperature 80° F for high temperature of the day.

C. Third initial application - sugar beets in 4 leaf stage.
   1. Applied on May 4th.
   2. Weeds varied in size from 2 to 6 leaves, 1 to 4 inches tall. Grasses 1 to 5 leaves.
   3. Sprayed between 8:30 to 10:30 a.m.
   4. Skies clear.
   5. Air temperature 72° F when spraying with high of 80° F for the day.

Table 1. Percent weed control and crop injury ratings from herbicides applied as postemergence treatments to seedling sugar beets. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Herbicides	Rate lbs ai/ac	Sugar beets Applied	Crop Injury	Pigweed	Hairy Nightshade	Lambs-Quarters	Kochia	Barnyard grass	Green Foxtail	Annual Ryegrass	Wild Oats
Betamix	0.2	emergence	0	100	100	100	100	75	80	80	20
Betamix	0.3	emergence	0	100	100	100	100	80	85	85	25
Betamix	0.4	emergence	0	100	100	100	100	90	95	95	30
Betamix	0.6	emergence	20	100	100	100	100	95	98	98	35
Betamix + Stinger	0.2 + 0.05	emergence	0	100	100	100	100	75	83	85	23
Betamix + Stinger	0.3 + 0.05	emergence	0	100	100	100	100	80	88	88	28
Betamix + Stinger	0.6 + 0.05	emergence	20	100	100	100	100	95	98	98	35
Betamix + Stinger + Poast	0.2 + 0.05 + 0.09	emergence	0	100	100	100	100	100	100	100	100
Betamix + Stinger + Poast	0.3 + 0.05 + 0.09	emergence	0	100	100	100	100	100	100	100	100
Betamix + Stinger + Poast	0.6 + 0.05 + 0.09	emergence	20	100	100	100	100	100	100	100	100
Betamix	0.2	full cotyledon	0	98	96	99	96	70	75	75	20
Betamix	0.3	full cotyledon	0	100	100	100	100	75	80	83	25
Betamix	0.4	full cotyledon	0	100	100	100	100	78	83	85	30
Betamix	0.6	full cotyledon	15	100	100	100	100	83	87	89	35
Betamix + Stinger	0.2 + 0.05	full cotyledon	0	100	100	100	100	70	75	75	20
Betamix + Stinger	0.3 + 0.05	full cotyledon	0	100	100	100	100	75	80	85	25
Betamix + Stinger	0.6 + 0.05	full cotyledon	20	100	100	100	100	80	85	85	30
Betamix + Stinger + Poast	0.2 + 0.05 + 0.09	full cotyledon	0	100	100	100	100	100	100	100	100
Betamix + Stinger + Poast	0.3 + 0.05 + 0.09	full cotyledon	0	100	100	100	100	100	100	100	100
Betamix + Stinger + Poast	0.6 + 0.05 + 0.09	full cotyledon	20	100	100	100	100	100	100	100	100
Betamix	0.2	4 leaves	0	45	40	50	43	25	35	35	0
Betamix	0.3	4 leaves	0	60	48	65	48	30	40	40	10
Betamix	0.4	4 leaves	0	65	52	75	55	33	40	45	15
Betamix	0.6	4 leaves	15	75	65	80	65	40	45	50	20
Betamix + Stinger	0.2 + 0.05	4 leaves	0	48	35	45	40	20	30	35	0
Betamix + Stinger	0.3 + 0.05	4 leaves	0	60	40	55	45	30	35	45	5
Betamix + Stinger	0.6 + 0.05	4 leaves	15	70	45	65	55	30	45	45	15
Betamix + Stinger + Poast	0.2 + 0.05 + 0.09	4 leaves	0	45	35	42	38	100	100	100	100
Betamix + Stinger + Poast	0.3 + 0.05 + 0.09	4 leaves	0	55	40	45	40	100	100	100	100
Betamix + Stinger + Poast	0.6 + 0.05 + 0.09	4 leaves	15	65	45	50	45	100	100	100	100
Check	-	-	0	0	0	0	0	0	0	0	0

Ratings: 0 = no effect, 100 = all plants killed
Evaluated: June 27, 1990
Ratings are average from three replications of plots not treated with Ro-neet.

AN EVALUATION OF FALL AND SPRING APPLIED HERBICIDES FOR WEED CONTROL AND CROP TOLERANCE IN SUGAR BEETS

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Objective

Roneet, Antor, and Nortron herbicides are registered for use to control weeds selectively in sugar beets when applied as preplant incorporated applications. Roneet and Antor are registered for application in the fall or spring. Nortron is registered for application only in the spring. Individual herbicides vary in the weed species they control. When single herbicides are applied certain species of weeds escape and become problem weeds in the sugar beet crop. The objective of this study was to evaluate each herbicide as tank-mix combinations at several combination rates for control of weeds and for crop tolerance when applied both in the fall and spring as incorporated applications. Control of the following weed species will be evaluated. They include kochia, lambsquarters, redroot pigweed, hairy nightshade, barnyardgrass, and green foxtail. The trial was conducted to furnish data to the sugar beet growers in the Nyssa-Nampa District and to NorAm Chemical Company.

Procedures

The fall treatments were applied on November 15, 1989. The same herbicide treatments applied in the fall were applied as spring preplant incorporated applications on March 23, 1990. Both fall and spring applications were applied in bands eleven inches wide in the center of twenty-two inch rows. The fall treatments were applied during fall bedding and incorporated approximately 1 inch deep with the soil at the base of the bed and covered-over with the soil forming the bed. Incorporation and bedding was done with the use of an Alloway bedding machine. The land where the spring treatments were applied was also bedded in the fall. In the spring the soil forming the hills was harrowed to level the tops of the beds in preparation for planting sugar beets. The spring herbicide treatments were applied after the bed tops were removed by harrowing, then incorporated in the top 2 inches of soil in the center of the beds with a rotary incorporator.

The herbicides were applied with a bicycle wheel plot sprayer equipped with a 7.5 foot boom. Four teejet fan nozzles size 6506 were spaced on the boom so one nozzle was centered over each row of the four row plots. Spray pressure was 35 psi and water as the carrier for the herbicide was applied at the rate of 42 gallons/acre.

Fall wheat was the crop grown in the trial area preceding this study. The wheat straw was worked into the soil by shredding the straw with a metal flail beater. The field was then disced, irrigated, and moldboard plowed. After plowing the soil was worked down in preparation for applying herbicides and fall bedding. One-hundred pounds of phosphate and sixty pounds of nitrogen were applied before plowing. Soils were of the Owyhee silt loam series having 1.2 percent organic matter and a pH value of 7.3.

Raw sugar beet seed of the WS-88 variety was planted on March 25, 1990. The field was recorrugated after planting and furrow irrigated on March 27 to furnish soil moisture for uniform seed germination and seedling emergence.

Results

The percent weed control and crop injury ratings for each herbicide treatment are listed in Table 1. The treatment effects for both fall and spring applications were recorded on May 8. Weed species include redroot pigweed, lambsquarters, kochia, hairy nightshade, barnyardgrass, and green foxtail.

Nortron and Nortron tank-mixed with Roneet, Antor, or Hoelon resulted in excellent weed control and sugar beet tolerance when these herbicides were applied in the fall or spring. Nortron overwinters very well to remain active for control of spring and early summer germinating broadleaf weeds. Roneet did overwinter and gave good control of pigweed, hairy nightshade, barnyardgrass, and green foxtail. It was less active on kochia and lambsquarters. Antor did not persist overwinter and was a much better treatment for weed control when applied in the spring. Some kochia escaped all Roneet and Antor treatments whether fall or spring applied regardless of rates. Sugar beets were less tolerant of Roneet and Antor applied in the spring, indicating loss of herbicide activity from Antor when applied in the fall. Crop injury rating values were an indication of the initial injury to seedling sugar beets during emergence and early seedling growth. Injury was only temporary and the sugar beet plants soon outgrew the herbicide symptoms and fully recovered. Sugar beet stands were not reduced by herbicide treatments.

Based on these results Antor should only be applied as a spring preplant treatment. Roneet, Nortron, and Hoelon are effective as fall and spring applications. Both Roneet and Antor are less active on kochia than other weed species and kochia escapes would be expected in commercial fields from these herbicide treatments. Nortron was effective on all broadleaf weed species but less active on grassy weeds. Nortron tank-mixed with Roneet, Antor, or Hoelon gave control of both broadleaf and grassy weeds.

Table 1. The percent weed control and crop injury ratings from soil active herbicides applied in the fall of 1989 and the spring of 1990 before planting sugar beets on March 25, 1990. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Herbicides	Rates	Crop Injury		Percent Control of Weeds: Pigweed		Kochia		Lambs-quarters		Hairy Nightshade		Barnyardgrass		Green Foxtail	
		Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
	lbs ai/ac														
Roneet	4	5	10	93	98	60	70	85	88	90	100	95	99	97	100
Antor	4	0	0	75	100	63	87	65	85	40	100	60	100	65	100
Nortron	2	0	5	100	100	99	100	100	100	99	100	85	75	70	75
Roneet + Antor	2 + 2	0	10	92	100	60	73	80	100	95	100	99	100	99	100
Roneet + Antor	2 + 3	0	10	93	100	63	75	82	100	93	100	97	100	99	100
Roneet + Antor	3 + 2	0	10	95	100	65	75	80	100	98	100	99	100	99	100
Roneet + Antor	3 + 3	0	15	98	100	68	77	87	100	98	100	98	100	99	100
Roneet + Antor	4 + 3	5	20	99	100	73	85	90	100	98	100	99	100	99	100
Roneet + Antor	3 + 4	5	30	98	100	85	85	95	100	96	100	98	100	99	100
Roneet + Antor	4 + 4	5	40	98	100	88	95	93	100	98	100	100	100	100	100
Roneet + Nortron	2 + 1	0	5	100	100	100	100	95	100	100	100	99	100	100	100
Roneet + Nortron	3 + 1	10	12	100	100	100	100	95	100	100	100	100	100	100	100
Antor + Nortron	2 + 1	0	0	99	100	100	97	93	100	98	100	97	100	99	100
Antor + Nortron	3 + 1	0	5	99	100	100	100	95	100	98	100	97	100	100	100
Nortron + Hoelon	2 + 1	0	0	100	100	100	100	100	100	100	100	98	100	100	100
Check	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Ratings - 0 = no herbicide effect, 100 = all plants killed
Ratings are average from 3 replications.
Ratings taken on May 8, 1990.

POSTEMERGENCE APPLIED LDG2880 + MORACT FOR SELECTIVE WEED CONTROL IN SUGAR BEETS

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Ontario, Oregon, 1990.

Purpose

Evaluate Mobay LDG2880 at several rates applied as three sequential applications for tolerance of seedling sugar beets and control of several species of seedling annual broadleaf and grassy weeds.

Procedures

Tasco sugar beet variety WS-88 raw seed was planted on March 25 in silt loam textured soil which has a pH of 7.3 and an organic matter content of 1.1 percent. Stephen's variety of winter wheat was the previous crop. The stubble of the wheat straw was chopped with a steel-flail beater after harvest and the field was disced, irrigated, and moldboard plowed in the fall of 1989. The seed bed for planting sugar beets was prepared in the spring of 1990. The sugar beets were planted without the use of preplant applied herbicides in rows spaced 22 inches apart. After planting, the sugar beet trial area was watered by furrow irrigation to furnish soil with moisture for seed germination and seedling growth.

Application of LDG2880 and Betamix was begun on April 23. The sugar beets had two true leaves. The length of the first and second true leaves varied from 1/4 to 1.0 inch in length between individual plants. MorAct, trade name for an oil concentrate, was applied with LDG2880 at the rate of 1 qt/ac with each application. Sequential applications following the initial application on April 23 were applied on May 2nd and May 11th. Visual ratings for crop injury and weed control were taken one week following each application. The herbicide rates and rating are included in Table 1. Each individual plot was four rows wide and 25 feet long. Each treatment was replicated three times and randomly arranged using a complete block experimental design. The herbicides were applied with a single wheel bicycle plot sprayer. Four 6502 fan teejet nozzles were mounted on the boom so a spray nozzle was centered over each row of the four row plots. Spray pressure was 43 psi and water as the herbicide carrier was applied at the rate of 18 gallons per acre.

Annual broadleaf weed species included redroot pigweed, lambsquarters, hairy nightshade, and kochia. Grassy weed species were barnyardgrass, green foxtail, wild oats, and annual ryegrass. When applications were begun on April 23 the broadleaf weeds ranged in size from cotyledon to one inch tall or rosettes one inch across. Grasses were one leaf to three leaf plants with the exception of wild oats which was tillering. All plants including sugar beets and weeds were vigorously growing when herbicide treatments were applied.

Spray conditions at the time of each application are outlined below:

<u>April 23:</u>
1. Air temperature 58°F
2. Soil temperature 54°F
3. Partly cloudy skies following four days of showers and full cloud cover
4. Wind was calm

<u>May 22:</u>
1. Sugar beets 2-4 true leaves
2. Air temperature 57°F
3. Soil temperature 55°F
4. Skies mostly cloudy
5. Wind SW 5-7 mph

<u>May 11:</u>
1. Sugar beets 5-6 leaves
2. Air temperature 65°F
3. Soil temperature 57°F
4. Skies clear
5. Wind NW 1-3 mph

Results

Sugar beets were tolerant to LDG2880 and Betamix in all treatments as indicated by the 0-ratings in Table 1. Normal sugar beet growth was inhibited by dense weed populations in the untreated check plots and crop injury ratings from 10-35 in Table 1 indicates the reduction is size of the sugar beet plants between the treated and untreated plots.

LDG2880 was very active on three of the four broadleaf weed species present and also showed fair activity on each of the four grass species present in the trial. Both LDG2880 and Betamix controlled all the lambsquarters and hairy nightshade. Some redroot pigweed escaped treatments primarily because of the sugar beet leaf canopy effect. Kochia plant populations were light but uninjured plants were present in all plots treated with LDG2880 indicating the tolerance of kochia to LDG2880 herbicide. Kochia plant populations were equal between LDG2880 and untreated check plots. Betamix controlled kochia.

LDG2880 and Betamix do have grass control activity. The percent control was estimated to range between 30-70. Although a rather high percentage of grass plants had been killed some grass plants were starting to regrow and accurate ratings for control were difficult to determine at this time. Wild oat plants were larger when treatments were applied and less control of wild oats was obtained than with barnyardgrass, green foxtail, or annual ryegrass.

Table 1. Percent crop injury and broadleaf weed control from sequential applications of LDG2880 and Betamix applied postemergence to seedling sugar beets. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Herbicides	Rate	Days[1]	Crop Injury				Percent Weed Control															
							Pigweed				Lambsquarters				Hairy Nightshade				Kochia			
			1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
	lbs ai/ac																					
1-Betamix (E)	0.33	7	0	0	0	0	95	98	93	95	100	99	100	99	100	100	100	100	100	100	100	100
(M)	0.33	14	0	0	0	0	95	95	95	95	100	100	100	100	100	100	100	100	100	100	100	100
(L)	0.45	23	0	0	0	0	98	95	95	96	100	100	100	100	100	100	100	100	100	100	100	100
2-LDG2880 (E)	0.31	7	0	0	0	0	100	100	98	99	100	100	100	100	100	100	100	100	0	0	0	0
(M)	0.31	14	0	0	0	0	99	98	98	98	100	100	100	100	100	100	100	100	0	0	0	0
(L)	0.31	23	0	0	0	0	98	96	96	96	100	100	100	100	100	100	100	100	0	0	0	0
3-LDG2880 (E)	0.44	7	0	0	0	0	99	98	98	98	100	100	100	100	100	100	100	100	0	0	0	0
(M)	0.44	14	0	0	0	0	98	96	98	97	100	100	100	100	100	100	100	100	0	0	0	0
(L)	0.44	23	0	0	0	0	99	98	98	98	100	100	100	100	100	100	100	100	0	0	0	0
4-LDG2880 (E)	0.44	7	0	0	0	0	98	98	96	97	100	100	100	100	100	100	100	100	0	0	0	0
(M)	0.67	14	0	0	0	0	99	99	98	98	100	100	100	100	100	100	100	100	0	0	0	0
(L)	0.89	23	0	0	0	0	99	99	98	98	100	100	100	100	100	100	100	100	0	0	0	0
5-LDG2880 (E)	0.67	7	0	0	0	0	100	99	99	99	100	100	100	100	100	100	100	100	0	0	0	0
(M)	0.67	14	0	0	0	0	99	96	98	97	100	100	100	100	100	100	100	100	0	0	0	0
(L)	0.67	23	0	0	0	0	99	96	98	97	100	100	100	100	100	100	100	100	0	0	0	0
6-LDG2880 (E)	0.89	7	0	0	0	0	98	100	98	98	100	100	100	100	100	100	100	100	0	0	0	0
(M)	0.67	14	0	0	0	0	98	99	98	98	100	100	100	100	100	100	100	100	0	0	0	0
(L)	0.44	23	0	0	0	0	98	98	98	98	100	100	100	100	100	100	100	100	0	0	0	0
7-Check (E)	-	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(M)	-	14	10	15	15	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(L)	-	23	25	35	35	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[1] number of days after initial application when ratings for crop injury and weed control were taken.

Table 2. Percent control of grass weeds from sequential applications of LDG2880 and Betamix applied postemergence to seedling sugar beets. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Herbicides	Rate	Days[1]	Percent Weed Control															
			Barnyardgrass				Green Foxtail				Annual Ryegrass				Wild Oats			
			1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
	lbs ai/ac																	
1-Betamix (E)	0.33	7	25	20	30	25	40	35	40	38	20	30	30	27	10	15	15	13
(M)	0.33	14	30	30	35	32	45	40	45	43	35	35	35	35	30	20	25	25
(L)	0.45	23	40	45	45	43	50	55	60	55	40	45	40	42	25	20	25	23
2-LDG2880 (E)	0.31	7	30	20	20	23	35	30	30	32	20	25	30	25	10	15	10	12
(M)	0.31	14	35	30	30	32	40	35	40	38	30	35	35	33	25	25	20	23
(L)	0.31	23	50	60	65	58	60	65	65	63	40	40	45	42	30	35	30	32
3-LDG2880 (E)	0.44	7	25	35	35	31	40	45	45	43	20	30	25	25	15	20	15	17
(M)	0.44	14	38	45	45	42	60	50	50	53	30	40	35	35	30	35	35	33
(L)	0.44	23	65	60	65	63	70	60	60	63	45	45	45	45	40	40	40	40
4-LDG2880 (E)	0.44	7	30	35	30	32	40	40	45	42	25	30	35	30	15	20	20	18
(M)	0.67	14	45	50	50	48	55	65	65	58	40	45	45	43	30	30	35	32
(L)	0.89	23	65	60	65	63	65	70	70	67	50	50	50	50	35	35	40	37
5-LDG2880 (E)	0.67	7	35	40	40	38	45	40	45	43	30	35	35	33	20	20	25	22
(M)	0.67	14	60	55	55	57	60	55	55	57	45	50	50	47	30	35	30	32
(L)	0.67	23	70	65	70	68	70	75	70	72	55	60	60	58	35	35	35	35
6-LDG2880 (E)	0.89	7	40	45	45	43	50	45	50	48	40	45	40	42	25	30	25	27
(M)	0.67	14	65	65	60	63	65	55	60	60	55	60	55	57	35	40	40	38
(L)	0.44	23	65	65	65	65	75	75	70	73	65	70	65	67	45	45	50	47
7-Check (E)	-	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(M)	-	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(L)	-	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[1] Number of days after initial application when ratings for crop injury and weed control were taken.

THE EFFECT OF ADDED NITROGEN ON YIELD AND QUALITY OF SIX VARIETIES OF SUGAR BEETS

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Purpose

Six commercial sugar beet varieties were treated with three rates of side-dressed fertilizer nitrogen to determine if differences exist between varieties in their response to nitrogen uptake, residual nitrogen left in the soil, and utilization in production of sugar.

Procedure

The study was conducted using a strip-plot experimental design. Soil characteristics were silt loam texture, 7.3 pH and 1.2 percent organic matter. Fall wheat was the crop grown before planting sugar beets in this study. The wheat straw was shredded by a flail beater equipped with steel teeth. The field was then disced, deep chiseled, furrow irrigated, and moldboard plowed. One-hundred pounds of phosphate and sixty pounds of nitrogen was broadcast before plowing. Further tillage did not occur until spring.

In the spring of 1990 the field was tilled with a triple-K cultivator and trailing spike-tooth harrow and bedded with beds spaced on twenty-two inch centers. Soil samples were taken after bedding to determine nitrogen concentration at one-foot increments to a soil depth of six feet. Soil samples were taken with a one inch auger bit powered by an electric bit. Samples consisted of soil collected from nine locations and three replications for each area where different rates of nitrogen would be sidedressed. The soil samples were analyzed for NO_3 nitrogen in the spring and for NO_3 and NH_3 nitrogen from samples taken postharvest. All samples were analyzed by Western Laboratories at Parma, Idaho.

WS-88, PM-9, Betaseed 8654, MH-55, American Crystal 173, and Holly Hybrid 39 varieties of sugar beets were seeded on April 3. Individual plots were four rows wide and twenty-five feet long. Each variety was planted in six replications in each of the three nitrogen treatments. The soils were irrigated after planting to provide uniform moisture for optimum seed germination and seedling growth.

Counter insecticide was applied at planting for control of root maggot.

The four-six leaf seedling sugar beets were hand-thinned to an eight inch spacing on May 16 and 17. Nitrogen treatments were sidedressed on May 19. Sidedress nitrogen rates were 0, 100, and 200 pounds of nitrogen applied as ammonium sulfate.

Ammonium sulfate was shanked four inches deep and five inches from the planted row. Water furrows were made between every row and all furrows were irrigated at regular intervals during the growing season. Four rows between plot rows served as buffers between nitrogen rates.

Nitrate uptake and utilization by plants for each sugar beet variety was monitored by sampling petioles at weekly intervals from June 9 to August 28. A final petiole sample was taken on October 18 just before the sugar beets were harvested. Sampling of petioles and analysis was done by research personnel of Amalgamated Sugar Company at Nyssa, Oregon. Petioles were collected from sugar beet plants in the same row in all plots on each sampling date and were never collected from plot rows to be harvested for yield and quality data. Irrigation water from the Shoestring Canal and from a shallow well on Min Okuda's farm located near the trial were collected and analyzed as sources of nitrogen available to the sugar beet crop during the growing season. After petiole sampling began the sugar beets were irrigated weekly on Tuesdays and the petioles always sampled on Monday, one day before irrigation. Irrigations were for 24-hour periods with alternate rows irrigated for 12 hours.

To determine total nitrogen used per acre for each sugar beet variety in each nitrogen rate, nitrogen content in roots, crowns, and tops was determined from samples containing five sugar beets taken from each plot. Nitrogen ($NO_3^- + NH_4^+$) analysis was done by Western laboratories. Nitrogen used per acre for each variety of sugar beet was calculated from harvested root yields.

The sugar beets were harvested on October 23-24. Tops and crowns were removed by flail beaters and rotating disc scalping knives. All of the roots from the two center rows were weighed to calculate root yields per acre. Eight roots per sample were taken from each of the two rows for percent sucrose, conductivity, and NO_3^-N content determination. Percent extraction and estimated recoverable sugar per acre were calculated for each variety in each nitrogen rate.

After harvest the soil was again sampled in the same manner as described for soil samples taken before planting. On January 11 additional soil samples were taken at the one and two foot levels to determine mineralizable nitrogen.

Results

Total N uptake by each sugar beet variety at harvest was linearly related to the total available N that was varied by the addition of sidedressed N (Table 4). Residual soil nitrogen did not increase as a result of added nitrogen according to soil samples collected before planting and after harvest. The amount of nitrogen utilized by plant growth increased with all varieties as sidedressed fertilizer nitrogen rates were increased (Table 6). Significant increases in top growth at the higher nitrogen rate accounted for the greater amount of nitrogen use (51 percent).

Root yields were increased with varieties WS-88, WS-PM9, Mono Hy 55 and ACH-173 as fertilizer N was increased from 60 to 160 pounds/ac. Root yields increased slightly with Betaseed 8654 and Holly Hybrid 39 but were below yield increases required for significance. Significant decreases occurred in percent sucrose as fertilizer nitrogen increased for varieties WS-88, WS-PM9, Mono Hy 55, Betaseed 8654 and ACH-173. Both root yield and percent sucrose decreased for most varieties as fertilizer nitrogen increased from 160 to 260 pounds/ac but the decrease was not great enough to be significant. The higher percent extraction of sugar occurred with all varieties at the lowest (60 pounds) fertilizer rate where conductivity readings were lowest and percent sucrose highest. The higher yield of recoverable sugar were associated with all varieties when treated with the intermediate fertilizer nitrogen rate (160 pounds).

Sugar beet plants were very efficient in extraction of soil nitrogen, especially at low concentrations of soil nitrogen. A wide range in ppm petiole NO_3 occurred between fertilizer nitrogen rates. Sugar beet petiole readings for sugar beet varieties in the 60 pound fertilizer nitrogen rate on July 9 averaged 727 ppm NO_3 and decreased to 196 ppm NO_3 by August 28 yet produced nearly 48 tons of roots and 7.00 tons of recoverable sugar (Table 3). Data from Table 6 shows these plants contained 290 pounds of nitrogen per acre at harvest time. This exceeds the amount of nitrogen made available by sidedressed fertilizer nitrogen, measured nitrogen in the soil at planting, and nitrogen from the irrigation water, (Table 5) and strongly suggests significant amounts of nitrogen were extracted from soil during the growing season when supplied from mineralizable sources.

Soil samples collected from the trial site for each fertilizer nitrogen rate in January 1991 show that approximately 240 pounds of nitrogen was made available by mineralizable sources (Table 8). The amount of nitrogen supplied from soil mineralization in a uniformly cropped and fertilized field is expected to remain reasonably constant if adequate but not excess nitrogen fertilizer is supplied each year to the crop grown.

Table 1. Sugar beet root yield, percent sucrose and recoverable sugar per acre from six varieties and three sidedressed rates of nitrogen. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Fertilizer Nitrogen	Sugar Beet Varieties																	
	WS-88			WSPM-9			Mono Hy-55			Betaseed 8654			ACH-173			Holly 39		
	Roots	Sucrose	Sugar	Roots	Sucrose	Sugar	Roots	Sucrose	Sugar	Roots	Sucrose	Sugar	Roots	Sucrose	Sugar	Roots	Sucrose	Sugar
lbs/ac	T/ac	%	T/ac	T/ac	%	T/ac	T/ac	%	T/ac	T/ac	%	T/ac	T/ac	%	T/ac	T/ac	%	T/ac
0	49.2	17.40	7.298	49.1	17.13	7.192	45.4	17.33	6.640	47.7	17.36	7.025	45.49	17.68	6.925	48.06	17.24	7.060
100	52.7	16.66	7.463	54.4	16.65	7.700	48.3	16.73	6.885	49.2	16.83	7.060	50.71	16.96	7.337	48.74	17.22	7.218
200	51.8	16.75	7.312	53.8	16.40	7.417	48.0	16.52	6.630	49.9	16.46	6.877	48.42	16.92	6.962	51.48	16.60	7.183

LSD .05
Roots - 3.1
Sucrose - 0.35
Sugar - 0.458

Table 2. Percent Extraction, conductivity, and root NO_3-N from six sugar beet varieties and three sidedressed rates of nitrogen. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Fertilizer Nitrogen	Sugar Beet Varieties																	
	WS-88			WSPM-9			Mono Hy-55			Betaseed 8654			ACH-173			Holly 39		
	Extraction	Conduct	NO_3	Extraction	Conduct	NO_3	Extraction	Conduct	NO_3	Extraction	Conduct	NO_3	Extraction	Conduct	NO_3	Extraction	Conduct	NO_3
lbs/ac	%		ppm	%		ppm	%		ppm	%		ppm	%		ppm	%		ppm
0	85.26	736	218	85.56	709	239	85.66	737	221	85.34	720	225	86.23	665	264	86.21	673	164
100	84.98	746	287	85.04	741	315	85.12	779	262	85.08	748	337	85.35	722	272	85.03	736	215
200	84.26	802	444	84.13	806	386	83.60	848	370	83.61	846	415	84.92	754	361	84.10	811	398

LSD .05
Extraction - 0.74
Conductivity - 54
NO_3 - 85

Table 3. Nitrate nitrogen readings from petioles of six varieties of sugar beets and three rates of sidedressed nitrogen. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Varieties	Nitrogen Rates	Parts/million Nitrogen from Petiole Readings Taken on Seven Dates							Recoverable Sugar
		7/19	7/16	7/23	7/30	8/14	8/28	10/18	
									tons/ac
WS-88	0	1015	691	283	349	300	216	762	7.298
	100	6533	6000	3817	3050	1563	1445	1004	7.463
	200	9917	10350	7217	6600	3300	2533	1075	7.312
WSPM-9	0	750	421	238	212	461	139	888	7.192
	100	7666	6283	3742	3845	1352	1002	925	7.700
	200	11650	11100	7367	6700	3017	2033	1117	7.417
Mono Hy 55	0	865	667	398	280	441	293	1004	6.640
	100	6500	4967	3517	2582	928	808	1100	6.885
	200	11067	10500	6833	6716	2958	1906	1000	6.630
Betaseed 8654	0	373	297	162	106	65	131	842	7.025
	100	4933	3817	1978	2070	708	857	1288	7.060
	200	8817	8300	5983	4317	2193	1190	683	6.877
ACH-173	0	1191	757	508	280	270	195	712	6.925
	100	6333	5250	3492	2550	960	1009	645	7.337
	200	9367	9433	6883	6467	3675	1636	646	6.962
Holly 39	0	771	489	236	312	89	206	721	7.060
	100	6567	4342	2568	2952	767	978	1179	7.218
	200	9783	9267	9217	6133	3342	2091	956	7.183

Table 4. Results of preplant and postharvest soil samples for nitrogen taken at one-foot increments to a six-foot depth. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Soil Depth	Preplant Soil Samples (lbs N/ac) NO_3N			Post Harvest Soil Samples (lbs N/ac) NO_3N		
	0	100	200	0	100	200
ft						
0-1	43.2	43.2	46.8	7.2	10.8	32.4
1-2	18.0	7.2	10.8	7.2	7.2	7.2
2-3	7.2	7.2	7.2	7.2	7.2	7.2
3-4	7.2	7.2	7.2	7.2	7.2	7.2
4-5	7.2	7.2	7.2	7.2	7.2	7.2
5-6	7.2	7.2	7.2	7.2	7.2	7.2
Total	90.0	90.0	86.4	43.2	46.8	68.4

Table 5. Pounds of nitrogen per acre foot of irrigation water sampled on four different dates when water was being applied to sugar beets. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Sampling Date	Irrigation Water		
	NO_3N	NH_4N	Total[1)]
7/30	3.24	4.16	7.40
8/01	3.51	12.96	16.47
8/08	3.32	11.31	14.63
8/14	9.45	17.55	27.00

[1)] pounds of nitrogen per acre foot of water

Table 6. Pounds of nitrogen per acre in crowns, tops, and roots of six varieties of sugar beets and three rates of sidedressed nitrogen. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Variety	0 - Nitrogen				100 pounds of Nitrogen				200 pounds of Nitrogen			
	Roots	Crown	Tops	Total	Roots	Crown	Tops	Total	Roots	Crown	Tops	Total
WS-88	172	30	90	292	199	75	138	414	210	77	154	441
WSPM-9	159	28	72	263	191	68	124	382	197	62	144	403
Mono Hy-55	149	45	84	278	175	55	154	384	198	92	270	560
Betaseed 8654	153	38	110	301	177	81	148	435	202	96	176	446
ACH-173	156	46	101	303	186	68	153	407	184	78	158	419
Holly 39	169	25	109	302	169	64	147	380	202	61	212	476
Mean	160	35	94	290	183	68	144	400	198	78	186	457
LSD .05	21	24	49	57	21	24	49	57	21	24	49	57

Table 7. Pounds of nitrogen utilized to produce one ton of sugar beets roots and recoverable sugar for six sugar beet varieties at three rates of sidedressed nitrogen. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Sidedressed Nitrogen (lbs/ac)	Pounds of Nitrogen per ton of Sugar Beets for Three Nitrogen Rates				
	Variety	Tons Roots/ac	Total N in Plants	Pounds N/ton Roots	Pounds N/ton Sugar
0	WS-88	49.23	292	5.93	40.01
	WSPM-9	49.14	263	5.35	36.56
	Mono Hy 55	45.40	278	6.12	41.86
	Betaseed 8654	47.70	301	6.31	42.85
	ACH-173	45.49	303	6.66	43.75
	Holly 39	48.06	302	6.28	42.78
100	WS-88	52.74	414	7.85	55.47
	WSPM-9	54.45	382	7.02	49.61
	Mono Hy 55	48.33	384	7.94	55.77
	Betaseed 8654	49.18	435	8.84	61.61
	ACH-173	50.71	407	8.02	55.47
	Holly 39	48.74	380	7.80	52.64
200	WS-88	51.80	441	8.51	60.31
	WSPM-9	53.77	403	7.49	54.33
	Mono Hy 55	48.01	560	11.66	84.46
	Betaseed 8654	49.99	446	8.92	64.85
	ACH-173	48.42	419	8.65	60.18
	Holly 39	51.48	476	9.25	66.27

Table 8. The amount of mineralizable nitrogen at one and two foot depths from Owyhee silt loam soils treated with three rates of fertilizer nitrogen for sugar beet production at the Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Rates of fertilizer nitrogen	Soil Depth	Initial NO_3N		Mineralizable NO_3N		Total NO_3N/two feet
		PPM	lbs/ac	PPM	lbs/ac	
0	0-12"	9.1	33.7	38.7	143.2	
	13-24"	2.8	10.4	21.1	78.1	
						221.3
100	0-12"	11.0	40.7	45.1	166.9	
	13-24"	2.8	10.4	23.2	85.8	
						252.7
200	0-12"	10.6	39.2	38.2	141.3	
	13-24"	2.7	10.0	20.3	75.1	
						216.4

Soil samples were incubated at 30°C for three weeks at 30% moisture to measure the mineralizable N. In July maximum rate of nitrogen release by mineralization is approximately 1.2 pounds/acre/day.

Soils analyzed by Dr. Dale Westermann, USDA-ARS, Kimberly, Idaho.

EARLY SEASON SUGAR BEET NITROGEN REQUIREMENTS

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Oregon State University
Ontario, Oregon, 1990.

Objectives

Determine the effect of nitrogen rates on early season sugar beet plant growth under furrow irrigation. Evaluate whether N fertilizer is needed before the crop is sidedressed and if early N contributes to loss of plant stand.

Introduction

Growers typically apply much of the nitrogen for sugar beets in the fall or spring before planting. Sugar beets may need very little nitrogen for plant establishment. Large amounts of nitrogen applied preplant or near planting may contribute little to early plant growth and even less to resultant crop yield. Early applied N has greater chance of leaching loss prior to crop utilization than N applied later in the season.

High rates of applied N fertilizer, inadequate initial irrigation, and high initial soil salt concentrations can combine to produce severe salt damage to seedlings. The amount of precipitation over winter and the previous crop grown may result in elevated salt levels in the soil surface layers. However, growers can still adjust early season fertilizer and irrigation practices to minimize the potential for salt injury to the crop. Sprinkler irrigation could be applied evenly to a field to leach salts deeper into the soil profile. Light frequent sprinkler irrigation can offset high soil salt levels. Under furrow irrigation, irrigating until the wetting front passes the seedlings may be adequate to avoid beet injury, even with high early N applications.

Materials and Methods

Sugar beets (WS-PM9) were planted on 22-inch rows April 11, 1990 in a dry Owyhee silt loam soil at the Malheur Experiment Station. Seed was placed at 1.5 inch spacing and Counter insecticide was applied at 1.8 lbs ai/acre. Five initial N rates (0, 20, 40, 60, and 100 lbs N/ac as urea) were applied April 16 (Table 1). Each treatment was replicated five times. Field plot size was four rows of beets 22 inches apart and 40 feet long. Weed control consisted of Nortron applied April 10 at 3 lbs ai/acre and mechanical cultivation. Insect control in addition to Counter was Comite at 1.5 pints per acre and Orthene at 2 lbs per acre applied August 22. Fungicides applied were Baylaton at 8 oz per acre on August 4 and 22, and two quarts flowable sulfur on August 22.

Table 1. Nitrogen applied to early season nitrogen requirement trial in field B-6, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Treatment	Soil Test Nitrate-N	April 16 Initial N	June 14 Sidedressing N	Total N
	------------ lbs/acre ------------			
1	50	0	230	280
2	50	20	210	280
3	50	40	190	280
4	50	60	170	280
5	50	100	130	280

Initial nitrogen rates were established by applying urea seven inches from each side of the seed and two inches deep. Initial nitrogen was shallow to keep N near the soil surface to simulate what occurs when dry weather following N application accumulates fertilizer salts in the soil surface. Corrugates were reopened after sidedressing. The effective planting date was April 17 when the field was irrigated.

Plant stands were evaluated on May 4 and May 21. Several plots had areas in which extra soil had covered the seed during tractor operations and resulted in poor stand. These areas were flagged and not used for plant stand evaluation or harvest data. Early season plant growth was measured on June 1 by harvesting 20 plants from each plot and obtaining a total dry weight of tops and roots.

The plant stand in each plot was hand thinned June 7 to a plant spacing of approximately eight inches. On June 14, the plots were sidedressed to bring the total available N in each plot to 280 lbs per acre, the total N supply for a 35 ton/acre beet yield according to the 1989 Sugar Beet Grower's Guide Book pp.6-7.

On November 2, the beets were harvested and beets sampled for lab analysis. The Amalgamated Sugar Tare Lab at Nyssa, Oregon, analyzed the beet samples for nitrate, conductivity, and percent sucrose. Recoverable sugar was calculated as if the plots were growers' crops using Amalgamated Sugar Company's formula.

Results and Discussion

The shallow placement of nitrogen was only two inches deep to increase the potential for salt injury to emerging seedlings. However, irrigation was managed to minimize salt injury, by irrigating until the wetting front went past the plants.

The results of the two plant stand counts were significant at the 90% confidence level (Table 2). Averaged across the five replicates, the highest number of plants were counted where no N was sidedressed preemergence and the least number of plants were found where 120 lbs of N as urea was sidedressed (Table 2). June 1 plant size increased with higher rates of early sidedressed N but these differences were not statistically different. The plants harvested June 1 did not appear N deficient nor was the difference in plant size readily apparent in the field.

The total available N for each plot was made equivalent by the June 14 sidedressing, and plant stand was thinned to 8 inches between plants in each plot. Therefore, differences in resultant yield would not be expected. There were no statistical differences in root yield, root nitrate, or recoverable sugar (Table 3). Differences at the 90 percent confidence level were detected for beet conductivity, percent sucrose and extraction (Table 3). The data suggest that only a small amount of nitrogen (40 lbs N/ac) is needed by or at planting. Sidedressing additional nitrogen is effective. Beet nitrate at harvest and beet leaf appearance during July and August suggest that less than 230 lbs N/ac would have saved money and resulted in equivalent or higher recoverable sugar yields. The best strategy for providing a continual supply of N to a crop is to split fertilizer N applications. Some early N may be required to establish the crop if soil N levels are low at planting. However, to reduce the risk of stand loss to salt injury, applications should be low. Once the crop is established, N fertilizer can be applied with much lower risk of injury.

Table 2. Effect of preemergence urea sidedressing on WS-PM9 sugar beet stand and early season plant weight. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Initial N Applied	Plant Stand		Plant Dry Matter on June 1
	May 4	May 21	
lbs/acre	plants per 20 feet		grams per 10 plants
0	97	104	42.7
20	78	85	46.3
40	80	86	51.9
60	88	94	55.6
120	73	82	57.9
Correlation with Initial N rate	-32*	-.32*	+.24*

* Significant at the 5% level.

Table 3. Root yield and quality and recoverable sugar from WS-PM9 sugar beets in response to initial N rates as urea. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Initial N Applied	Root Yield	Root Nitrate	Conductivity	Sucrose	Extraction	Recoverable Sugar
lbs/acre	tons/acre	ppm		----- % -----		tons/acre
0	40.1	287	0.92	15.05	82.3	4.98
20	42.3	395	0.96	14.82	81.7	5.12
40	41.2	320	0.87	15.52	83.1	5.32
60	43.9	342	0.92	15.16	82.3	5.47
100	41.3	336	0.88	15.32	82.8	5.24
LSD (.10)	ns	ns	0.05	0.40	0.8	ns

CORRECTING SUGAR BEET NITROGEN DEFICIENCIES

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Objectives

Beets that run short of nitrogen have reduced tonnage and sugar yields. Sugar beet petiole nitrate levels provide growers and fieldmen indications of plant nitrogen status, allowing mid-season corrections of nitrogen supply. Once nitrogen deficiency has been determined, choices are made as to how to apply the nitrogen and how much to apply. The Amalgamated Sugar Company and the Nyssa-Nampa Sugar Beet Growers Association sponsored research this summer to help answer the question of how to add supplemental nitrogen to furrow irrigated beets and how much nitrogen to add.

Procedures

Sugar beets (WS-PM9) were planted on 22-inch rows April 11, 1990 into dry Owyhee silt loam soil at the Malheur Experiment Station. Seed was spaced 1.5 inches in the row and Counter insecticide was applied at 1.8 lbs ai/acre at planting. Plant stand was thinned to a spacing of approximately eight inches between plants on June 8.

Preplant soil samples revealed 45 lbs per acre nitrate nitrogen in the top three feet of soil. One hundred lbs per acre N was sidedressed as urea on June 14. The nitrogen treatments described below were imposed on August 14 and 15. The treatments for each experiment were replicated four times in a randomized complete block design. Plots were four 22-inch rows wide by 200 feet long (rate trial) or 240 feet long (methods trial).

Method of N Application Trial Treatments

1. Check, no N applied on August 14.
2. Uran was applied as a foliar spray at 20 lbs N per acre two times.
3. Granular urea was broadcast to provide 40 lbs N per acre.
4. Uran was water run during the entire duration of an eight hour irrigation set; 40 lbs N per acre applied.
5. Uran was applied during the last 30 minutes of an eight hour irrigation set; 40 lbs N per acre applied.
6. "30-90", uran was applied only during the beginning of an eight hour irrigation set. Uran turned on after the water had advanced 30 percent through the field and turned off when the rows were 90 percent through; forty lbs N per acre were applied.

Rate of N Trial Treatments

1. Check, no N applied on August 15
2. 20 lbs N per acre applied using "30-90" strategy.
3. 40 lbs N per acre applied using "30-90" strategy.
4. 60 lbs N per acre applied using "30-90" strategy.
5. 100 lbs N per acre applied using "30-90" strategy.

Weed control consisted of Nortron applied April 10 at 3 lbs ai/acre and mechanical cultivation. Insect control in addition to Counter was Comite at 1.5 pints per acre and Orthene at 2 lbs per acre applied August 22. Fungicides applied were Baylaton at 8 oz per acre on August 4 and 22 and two quarts flowable sulfur on August 22.

Bulk petiole samples were taken from the field on July 2 and 18 to determine if the field was entering N deficiency. Petiole samples from each plot were taken July 26, August 9, 21, 29, September 5, and 18 to determine the effect of each application method and rate on petiole nitrate response.

Water samples were taken of water runoff from each plot throughout the eight hour irrigations in which the N treatments were applied. Inflow water was adjusted to 3 gallons per minute and samples were also taken. Ammonium-N and nitrate-N were measured on the water samples.

On October 26, plant samples were taken in the Rate Trial (0, 40, 120 lbs N/ac plots). Ten beets in each replicate of these plots were harvested and divided into tops, roots, and crown portions. These samples were analyzed for total N.

Results and Discussion

Applications of all nitrogen treatments were delayed into August because of delays in the drop in petiole rates.

Petiole Response

All five methods of N application increased petiole nitrate levels within one week (Figure 1). The water-run treatments increased petiole nitrate levels more than foliar or granular broadcast methods during the first two weeks after application (Figure 1). Petiole nitrate levels varied widely by treatment three to five weeks after application.

As in 1989, petiole nitrate increases (compared to check) was highly correlated to applied water run N (Figure 2). The response curve for 1990 was not as dramatic as in 1989 because the beets were not as deficient when the treatments were applied. In 1989, each 10 lbs of N applied gave a beet petiole response of about 750 ppm nitrate. In 1990, each 10 lbs of N applied resulted in about a 220 ppm petiole nitrate increase. Both plant N status prior to N application and available soil N reserves influence sugar beet petiole response to varying rates of N fertilizer.

Nitrogen Lost in Runoff Water

The amount of N lost from the field in runoff water provided a way to compare the efficiency of the treatments. Water-run uran throughout the irrigation set (Treatment 5) was the only application method which showed significant N losses in the irrigation water in 1990 (Table 1). Applying uran during the last 30 minutes of the irrigation set resulted in significant losses in 1989 but not in 1990. Applying water-run fertilizer evenly across a field without significant loss into the tail water relies on technique. Results from this study and others conducted at the Malheur Experiment Station in 1989 and 1990 indicate that the "30-90" strategy is somewhat more difficult to implement if soil is too dry or wet. Under dry conditions infiltration rate of the soil is fast and advance rate will be slow and vary considerably between furrows. Under wet conditions (within two to three days of last irrigation) the infiltration rate of the soil will be slow and advance rate down the furrow will be fast which will also make it difficult to use the "30-90" method. As a rule of thumb, if the irrigation water is through the field and the liquid fertilizer is still running, there is potential for sizeable loss of N from the field. One option is to place a tank with the required amount of liquid N at the irrigation supply ditch and use the "30-90" strategy on two or three irrigations in a row until the fertilizer is gone. Nearly all the fertilizer will be in the field and the crop should utilize more of the applied N since split N applications are more efficient.

Rate of applied water run uran was correlated to the amount of N lost in irrigation runoff in 1989 but not in 1990 (Table 2). The amount of N lost was less than 2 lbs N/acre in 1989 for any applied N rate. The amount of N lost in runoff water was variable in 1990, primarily because of plot to plot variation in advance rate of the irrigation water. When advance rate was fast, N was lost because there was runoff from the furrows while the liquid fertilizer was still applying at the top of the field. The data does show that up to 120 lbs N/acre can be water run with less than 2 lbs per acre of loss in the irrigation run-off.

Beet Yield and Quality

No statistical differences in beet yield or quality were detected between the methods of N application (Table 3). The beet crop was not under severe N deficiency at the time of the N applications. The check plots had high yields which supports the weak petiole response data (Figure 2). The Methods Trial check plots had the lowest root nitrate levels while the beets which had a foliar N application had the highest (Table 3).

Significant correlations were measured between beet yield and quality and applied N fertilizer (Table 4). Increasing rates of N decreased yield and beet quality in 1990 (Table 4). Clearly there is potential for negative economic returns with regard to midseason N applications. Petiole nitrate levels need to be measured two or three times prior to a midseason N application to determine if petiole levels are falling, rising, or staying the same. Rapid changes in petiole nitrates can indicate that beets are running out of N, if root systems are extending into soil which contains reserves of N, if beets are becoming water stressed, or if irrigation water is carrying significant quantities of N. Fertilizer N applications should be budgeted to take into account residual soil nitrate and ammonium in at least the top three feet of soil. Sugar beets are a long season crop and receive a significant amount of irrigation water throughout the season. Mineralized organic N and N in applied irrigation water are likely to contribute to the N supply available in sugar beets.

Overall Effect of Supplemental Nitrogen Fertility

Sugar beet nitrogen fertilizer needs were less than the requirements predicted by soil analyses and the fertilizer guide. The petiole nitrates indicated that no additional nitrogen was needed and in fact, supplemental nitrogen reduced recoverable sugar yields in these trials in 1990. Careful examination is needed of other possible sources of nitrogen for sugar beets that could reduce grower costs and improve beet quality. Other possible natural N sources include:

1. N in the irrigation water
2. N in the soil in the form of ammonium
3. N in ammonium and nitrate from 3 to 6 feet deep in the soil profile
4. N from the mineralization of soil organic matter.

Table 1. Nitrogen lost during one eight hour furrow irrigation set on sugar beets in relation to five N application methods. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

N Application Method	N Rate	Nitrogen Lost In Runoff Water		
		NH_4-N	NO_3-N	Total
	lbs/acre	------ lbs/acre ------		
1. Check	0	0.2	0.5	0.7
2. Foliar URAN	40*	0.1	0.2	0.3
3. Granular Urea	40	0.2	0.3	0.5
4. Water Run (30-90)	40	0.3	0.3	0.6
5. Water Run (whole)	40	7.3	1.5	8.8
6. Water Run (end)	40	0.3	0.4	0.7
LSD (.05)		4.3	0.7	5.0

* Foliar application consisted of 2-20 lb/acre N applications 1 week apart to prevent leaf injury.

Table 2. Nitrogen losses in runoff water as affected by water-run uran rates during and eight hour irrigation set. All rates were applied using the "30-90" strategy. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989 and 1990.

N Rate	N Lost in Runoff		
	Reduced-N	Nitrate-N	Total N
lbs/acre	---------- lbs/acre ----------		
1989			
0	0.00	0.09	0.09
20	0.12	0.25	0.37
40	0.00	0.38	0.38
80	0.26	0.93	1.19
120	0.35	0.65	1.00
Correlation R =	+.48*	+.51*	+.55*
1990			
0	0.45	0.34	0.80
20	0.72	2.12	2.85
40	3.11	12.69	15.81
80	2.14	7.99	10.14
120	0.26	0.81	1.08
LSD (.05)	ns	ns	ns
Correlation R =	-.32ns	-.29ns	-.30ns

* significant relationship to N rate at 95% level.

Table 3. Root yield, root quality, and recoverable sugar from WS-PM9 sugar beet in response to six N application methods. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

8-14-90 N Application Method	Root Yield	Nitrate	Sucrose	Extraction	Recoverable Sugar
	tons/ac	ppm	%	%	tons/acre
1. Check	44.5	265	15.99	84.2	5.98
2. Foliar URAN	44.0	453	15.92	84.2	5.90
3. Granular Urea	43.1	306	15.72	84.7	5.69
4. Water Run (30-90)	43.7	296	15.81	83.9	5.79
5. Water Run (whole)	42.3	282	15.98	84.4	5.70
6. Water Run (end)	45.7	284	15.68	83.9	6.00
LSD (.05)	ns	ns	ns	ns	ns

Table 4. Root yield, root quality, and recoverable sugar from WS-PM9 sugar beet in response to mid-August water-run nitrogen. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

8-15-90 Water-run N Rate	Root Yield	Nitrate	Sucrose	Extraction	Recoverable Sugar
lbs/acre	tons/acre	ppm	%	%	tons/acre
0	43.9	481	14.96	82.3	5.40
20	43.1	513	14.86	81.9	5.25
40	44.6	573	14.74	81.8	5.38
80	43.6	680	14.45	81.1	5.11
120	42.6	708	14.30	80.8	4.92
LSD (.05)	ns	84	0.35	0.7	ns
Correlation R =	-.39*	.86***	-.75***	-.77***	-.66**

* 5% level of significance / ** 1 % level of significance / *** 0.1% level of significance

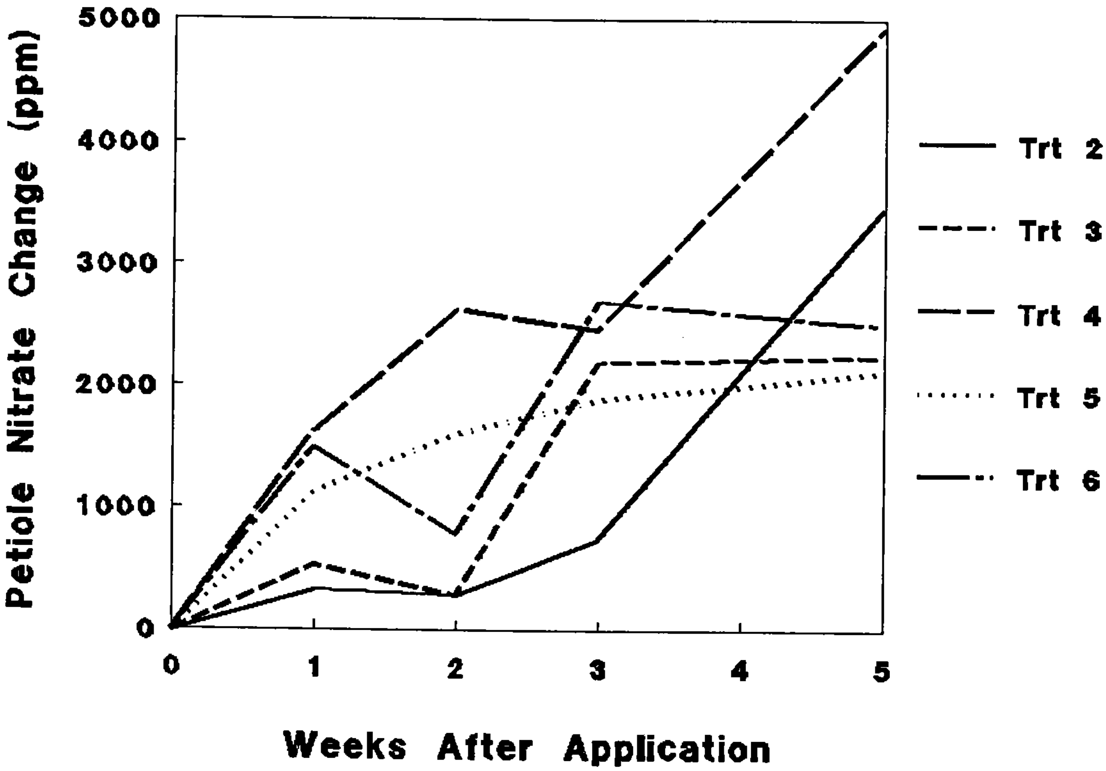

Figure 1. Methods trial petiole response. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

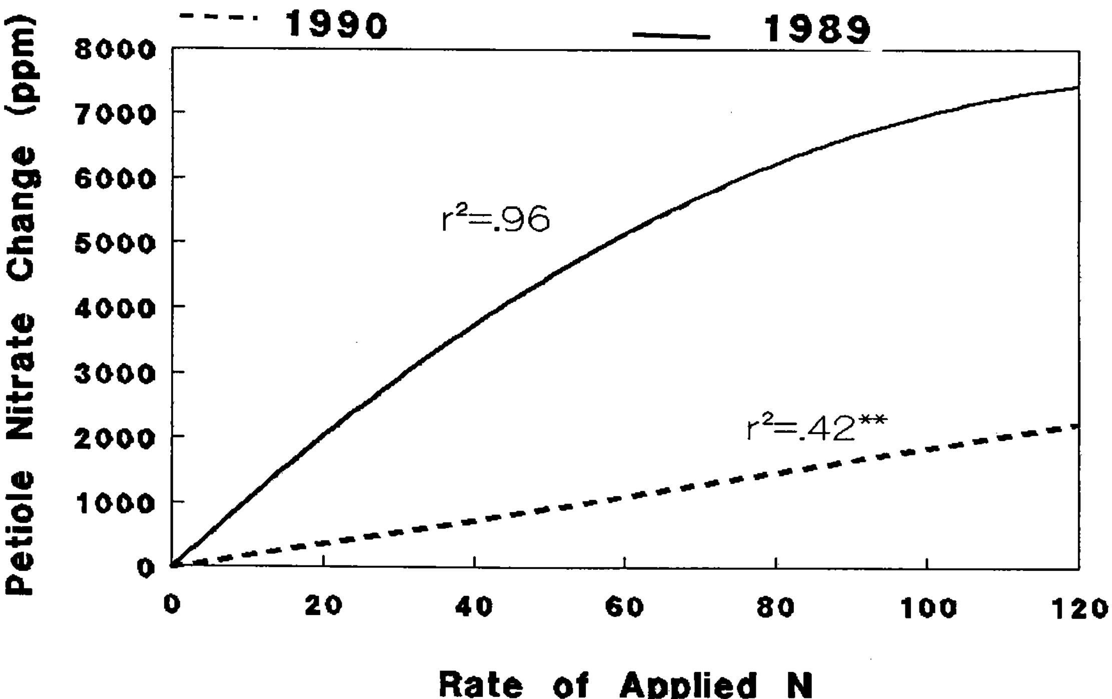

Figure 2. Rate trial petiole response. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989 and 1990.

SUGAR BEET NITROGEN RECOVERY

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Objectives

Measure sugar beet plant N uptake and plant N uptake per unit yield of roots over a range of N fertilization. Determine what fraction of total plant uptake is in the roots, tops, and crowns at harvest. Compare sugar beet N uptake to apparent N supplied by the soil.

Procedures

Sugar beets (WS-PM9) were planted on 22-inch rows April 11, 1990 into dry Owyhee silt loam soil at Malheur Experiment Station. Seed was spaced 1.5 inches in the row and Counter insecticide was applied at 1.8 lbs ai/acre at planting. Plant stand was thinned to a spacing of approximately eight inches between plants on June 8.

Preplant samples revealed 45 lbs per acre nitrate nitrogen in the top three feet of soil. One hundred lbs per acre N was sidedressed as urea on June 14. The nitrogen treatments described below were imposed on August 15. The treatments were replicated four times in a randomized complete block design. Plots were four 22-inch rows wide by 200 feet long.

Weed control consisted of Nortron applied April 10 at 3 lbs ai/acre and mechanical cultivation. Insect control in addition to Counter was Comite at 1.5 pints per acre and Orthene at 2 lbs per acre applied August 22. Fungicides applied were Baylaton at 8 oz per acre on august 4 and 22 and two quarts flowable sulfur on August 22.

Water samples were taken from water runoff from each plot throughout the eight hour irrigations in which the supplemental N treatments were applied. Inflow water was adjusted to 3 gallons per minute and samples were also taken. Ammonium-N and nitrate-N were measured on the water samples so that the actual amount of N applied to the field could be determined.

Three treatments from the previously outlined "Rate of N Trial" were selected to study plant N uptake at harvest. These were:

1. Check, no N applied on August 15.
2. 40 lbs N per acre applied using "30-90" strategy.
3. 120 lbs N per acre applied using "30-90" strategy.

The liquid uran fertilizer was applied only during the beginning of an eight hour irrigation set. Uran was turned on after the water advanced 30 percent through the field and turned off when the rows were 90 percent through the field.

On October 26, ten beets from each plot were divided into tops, roots, and crown portions. The crowns and tops were dried and weighed to obtain some estimation of total dry matter per acre of these portions. The samples were analyzed for total N.

On October 31, 50 feet of the center two rows of each plot were harvested. The number of beets in the harvested area were counted so actual field plant population could be used in calculations. Beet quality was analyzed at Amalgamated Sugar Tare Lab at Nyssa, Oregon. The beet quality response to N rate is discussed in the previous report.

Results and Discussion

Plant Tissue N Concentration

Total N concentration of tops and crowns did not increase with increasing N applied (Table 1). Nitrogen concentration in the roots increased but the trend was not statistically different (Table 1). The beet crop was not under severe N deficiency at the time of the N applications. Nitrate-N levels in the beet pulp were significantly elevated by the addition of midseason N in 1990. The conductivity also increased which adversely affects sugar extraction (Table 1).

Nitrogen Uptake

Rate of applied midseason N did not statistically alter the total pounds of N taken up by the crop (Table 2). Sugar beets have the ability to extract large amounts of N from the soil regardless of applied fertilizer. Beets may be very useful for utilizing deep soil profile N that has been leached past the root zone of shallow rooted crops. In 1990, about 40 percent of the total plant uptake was returned to the field at harvest as tops and crowns. In 1989, about 35 percent of the total plant uptake was returned to the field. Breakdown of these residues will provide N and other nutrients to subsequent crops.

Nitrogen Content Per Unit Yield

Nitrogen content per unit beet yield was calculated for data collected in 1989 and 1990 (Table 3). Midseason N application did not significantly alter root N per unit yield or total uptake per unit yield. Averaging both years, about 4.6 pounds of N was contained in 1 ton of beets. Beets are usually over 80 percent water at harvest. Seven to eight pounds of N was taken up by the plant per ton of beet yield (Table 3). This means that, on average,. 2.6 lbs of N is returned to the soil in plant residues for each ton of beet yield.

Nitrogen Recovery

Using spring and fall soil tests to three foot depth and the plant recovery data, an N accountability table was constructed (Table 4). The fields used for both the 1989 and 1990 trials were uniform over the field with respect to nitrate-N in the top three feet of soil (Table 4). The lower yields and greater degree of N deficiency obtained in 1989 was likely due to differences in soil N three to six feet in the profile or to ammonium-N level differences. Rather high levels of ammonium-N were measured in nearby fields in the fall of 1990. In addition, nitrogen could have been unknowingly applied to the trials in the irrigation water. The inflow water averaged 8.0 ppm N during the irrigation in which the treatments were applied. Inflow N was not measured for other irrigations. Ditch irrigation water was measured six other times during the season with nitrate-N plus ammonium-N ranging from 2 to 8.9 ppm. Malheur County average water application for sugar beets is 3.63 acre feet applied during 17 irrigations. If 36 inches of water actually infiltrated the soil and the water was 6 ppm N season long, 49 lbs of N per acre would be applied. Mineralization of organic matter was also not taken into account since these estimations vary widely with experimental technique and interpretation.

The plots where no N was applied had the largest amount of N from unaccounted sources. The plants not supplied midseason N were capable of significant N uptake, possibly from greater root foraging.

Further work to define all the possible sources of N for sugar beets could lead to more predictable sugar beet responses to midseason N fertilization. These N sources include:

1. N in the irrigation water.
2. N in the soil in the ammonium form.
3. N as ammonium and nitrate from 3 to 6 feet deep in the soil profile.
4. N from the mineralization of soil organic matter.

Table 1. Nitrogen concentration at harvest and beet extract conductivity of WS-PM9 sugar beets grown on an Owyhee silt loam soil. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Aug. 15, 1990 Water run N rate	Reduced N Content			Nitrate-N Beet Pulp	Beet Conductivity
	Tops	Crown	Roots		
lbs/ac	---------- % ----------			ppm	
0	2.48	1.86	1.09	481	0.92
40	2.36	1.88	1.16	573	0.95
120	2.31	1.80	1.28	708	1.02
Average	2.38	1.85	1.18	587	0.96
LSD (.05)	ns	ns	ns	84	0.06

Table 2. Nitrogen content at harvest of WS-PM9 sugar beets grown on an Owyhee silt loam soil. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Aug. 15, 1990 Water run N rate	Total N Content			Total Plant Uptake*
	Tops	Crown	Roots	
-------------------- lbs N per acre --------------------				
0	114	25.4	182	322
40	108	22.9	188	319
120	100	25.7	196	322
Average	107	24.7	189	321
LSD (.05)	NS	NS	NS	NS

* Does not include fine roots and root parts lost during harvest.

Table 3. Nitrogen content per unit root yield at harvest of PM-9 (1989) and WS-PM9 (1990) sugar beets. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989 and 1990.

Water run N rate	Beet Yield		Root N per Ton Root Yield		Total Plant Uptake per ton of Root Yield	
	1989	1990	1989	1990	1989	1990
lbs/acre	tons/acre		lbs N/ton		lbs N/ton	
0	38.2	43.9	4.94	4.15	6.96	7.33
40	39.0	44.6	4.62	4.21	6.54	7.15
120	38.8	42.7	5.03	4.64	7.29	7.07
Average	38.7	43.7	4.86	4.33	6.93	7.38
LSD (.05)	ns	ns	ns	ns	ns	ns

Table 4. Comparison of sugar beet N recovery and apparent available N supplied by the soil. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989 and 1990.

Midseason Water run N rate	Initial N Level[1]	Total Available N[2]	Soil After Harvest[3]	Apparent N Supplied[4]	Total Plant Recovery	Unaccounted N
lbs/acre	------------------- lbs/acre -------------------					
1989						
0	180	180	24	156	266	+110
40	180	220	26	194	255	+61
120	180	300	25	275	283	+8
1990						
0	146	146	16	130	322	+192
40	145	185	19	166	319	+153
120	145	265	21	244	322	+78

[1] Soil nitrate-N 0-3' + early season sidedressed fertilizer.
[2] Initial N plus water-run N treatments.
[3] Soil nitrate-N 0-3' after harvest.
[4] Total available N minus soil after harvest.

A PRELIMINARY EVALUATION OF AERIAL PHOTOGRAPHY TO DETERMINE SUGAR BEET NITRATE STATUS

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Objectives

Evaluate the use of aerial photography nitrate maps to estimate sugar beet nitrate status on commercial sugar beet fields. Examine if the SPAD 502 Chlorophyll Meter (Minolta[1]) readings can be used to predict sugar beet leaf or petiole nitrogen status or beet yields or quality.

Introduction

Aerial photography has been used successfully to examine soil differences, variations in crop temperature, and variations in plant vigor. Recent attempts to provide aerial mapping of crop nitrogen status would allow more efficient nitrogen sidedressing and tissue sampling. Two commercial sugar beet fields (120 acres and 40 acres) were used to test the relationship between sugar beet nitrate mapping, petiole nitrate and leaf nitrogen status, and beet yields and quality.

The Spad 502 Chlorophyll Meter has been promoted as a measuring device to evaluate sugar beet nitrogen status. Spad 502 Chlorophyll Meter readings were made throughout the same two commercial fields.

Materials and Methods

Aerial nitrate mapping, sugar beet plant nitrogen status, and sugar beet yield, and quality were examined on two commercial fields. Fields were chosen based on grower interest and fields that demonstrated high color contrasts on aerial photography false color image nitrate maps. Fields were flown on September 17, 1990 and interpreted (Intermountain Technologies, Pocatello, ID[1]). False color images were generated for low to high nitrate through the color spectrum and numbered yellow < light green < dark green < pink < dark red.

Beet petioles and lamina were randomly chosen September 20 from each false color region of each field using standard sugar beet petiole sampling techniques; petiole

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[1] The use of trade names in this publication is for identification purposes only, and does not imply endorsement by Oregon State University Agricultural Experiment Station of products so identified or criticism of similar products not named.

and lamina were chosen from the newest mature leaf, a leaf from the fourth leaf whorl. Petioles were analyzed for nitrate. Lamina were analyzed for nitrate, total N, P, K, S, Ca, Mg, Na, Zn, Mm, Cu, Fe, and B. Before drying, lamina were individually measured for chlorophyll content with a Spad 502 Chlorophyll Meter.

On October 11 and 12, sugar beets were dug from three areas within each of the nitrate map false color within each field to determine beet yield and quality. The area harvested for each plot was thirty feet long and consisted of two, 22-inch rows.

Representative soil samples were dug from each of the false colors from both fields. Soil samples were analyzed for all standard chemical analyses.

Results and Discussion

Beet yields showed no significant variation due to nitrate map false color within each field (Table 1). Sugar concentrations showed significant variations by false color on both fields but recoverable sugar had significant variations only at Skyline Farms. There was no clear trend of nitrate map false color with beet yields, sucrose concentration, percent extraction, or recoverable sugar.

Chlorophyll meter readings showed no significant variation according to nitrate map false color image (Table 2) on the two fields tested. Chlorophyll meter readings were not significantly correlated ($p \geq 95$) with lamina nutrient content (Table 3).

Petiole nitrate and lamina nitrate, calcium and magnesium were negatively associated with recoverable sugar yield (Table 3). Lamina phosphorous and sulfur were positively associated with recoverable sugar.

Results from these two fields are consistent with the notion that sound phosphorous and sulfur nutrition along with carefully limited nitrogen supplies are essential for excellent yields of recoverable sugar. Neither the aerial nitrate map false color images nor the Spad 502 Chlorophyll Meter readings were associated with beet nitrogen status, beet yield, or beet quality in the two fields studied.

Acknowledgements

The authors gratefully acknowledge the cooperation of Rodney Wood (Intermountain Technologies), Mike Barlow, and Bob Salisbury.

Table 1. Aerial photograph nitrate mapping and sugar beet yield and quality at Skyline Farms and Barlow Farms. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Aerial Photo Color	Root Yield tons/acre	Sucrose %	Extraction %	Recoverable Sugar tons/acre
Skyline Farms Ontario, OR				
Yellow	40.3	11.98	76.8	3.72
Light Green	39.8	13.97	81.8	4.54
Dark Green	38.1	12.29	77.6	3.63
Dark Green & Pink	41.8	12.71	78.3	4.16
Red	34.1	12.86	79.9	3.50
LSD (.05)	ns	0.76	2.4	0.56
Barlow Farms Nyssa, OR				
Light Green	32.0	15.58	86.6	4.31
Dark Green	36.6	14.78	85.4	4.63
Pink	38.4	14.58	87.1	4.89
Dark Red	35.6	16.03	85.8	4.89
LSD (.05)	ns	0.62	ns	ns

Table 2. Sugar beet leaf and petiole nitrate, leaf N content, Spad 502 Chlorophyll Meter performance on aerial photograph sugar beet sample areas. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Aerial Photograph Color	Actual Tissue Concentration			Spad 502			Number of Leaves Measured
	Petiole NO_3	Lamina NO_3	Lamina N	Average Reading	Standard Deviation	Range	
	---- ppm ----		%				
Skyline Farms Ontario, OR							
Yellow	4750	4800	4.84	44.0	5.5	19.8	22
Light Green	4400	2600	3.35	45.6	5.4	18.9	23
Dark Green	4750	5000	3.86	47.1	4.9	15.9	21
Dark Green & Pink	4800	3100	4.28	45.0	4.9	14.2	22
Red	5350	3500	1.47	41.1	5.1	17.2	21
Barlow Farms Nyssa, OR							
Light Green	1000	1600	1.35	45.6	4.2	17.0	20
Dark Green	1450	2000	5.21	43.9	2.3	8.6	23
Pink	1500	1950	3.80	48.1	4.1	13.9	29
Dark Red	1050	1600	4.38	46.2	4.2	14.6	21
Correlation to Spad 502, r =	-0.43	-0.20	+0.26				
Statistical Significance	ns	ns	ns				

Table 3. Correlation of Spad 502 Chlorophyll Meter and sugar yield to September sugar beet tissue nutrient levels. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

	Correlation Coefficients, r			
	Spad 502 Chlorophyll Meter		Recoverable Sugar tons/acre	
	r	Significance	r	Significance
Petiole NO_3	-0.43	ns	-0.79	**
Lamina NO_3	-0.20	ns	-0.85	**
Lamina %N	0.26	ns	0.30	ns
Lamina Phosphorous	-0.32	ns	0.72	*
Lamina Potassium	0.12	ns	0.48	ns
Lamina Sulfur	0.18	ns	0.71	*
Lamina Calcium	-0.63	ns(p=.94)	-0.74	*
Lamina Magnesium	-0.38	ns	-0.81	**
Lamina Sodium	0.04	ns	-0.01	ns
Lamina Zinc	0.33	ns	-0.12	ns
Lamina Manganese	-0.12	ns	-0.13	ns
Lamina Copper	-0.21	ns	-0.26	ns
Lamina Iron	-0.05	ns	-0.01	ns
Lamina Boron	-0.11	ns	0.23	ns
Sugar Yield	-0.54	ns	1.00	

THE PHYTOTOXICITY OF COUNTER INSECTICIDE TO SUGAR BEETS

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Purpose

In the spring of 1990, sugar beet growers experienced reduced crop stands as a result of suspected herbicide, fertilizer, and salt injury. In addition, injury was thought to have occurred from the use of Counter insecticide. Information was needed to describe how Counter rate and placement could affect crop stand. The objective was to determine if Counter can produce phytotoxic affects to WS-PM9 sugar beets by varying the rate or placement, and to describe counter phytotoxicity symptoms on WS-PM9 sugar beets.

Procedures

Counter 15G is labeled for application on sugar beets at 8 oz of 15 percent material per 1000 feet of 22-inch row. The label recommends placement in a five to seven-inch band over the top of the seed and lightly incorporated or pressed into the soil (treatments 6 & 7 on Table 1). Other placements tested were a single narrow band over the top of the seed (treatments 2 & 3 on Table 1), and placed directly with the seed (treatments 4 & 5 on Table 1). Three Counter 15G rates were used with the different placement methods; the maximum label rate of 11.9 pounds per acre, double the label rate and 0. Plots consisted of 100 seeds per plot in a single 24-foot row. Treatments were replicated seven times with the exception of treatment 6 which was replicated six times. Counter 15G should only be applied at the labeled rate. Rates higher than the labeled rate were used to help describe phytotoxicity and should not be considered as a recommendation to growers.

Results

Cold conditions and light hail reduced plant stands at emergence. Hail damaged seedlings in all treatments and reduced plant stands. The soil crusted after the hail and rain impeding further emergence. Observations were taken on June 4 for plant stand counts, plant deformities and early plant growth. Plant stand counts can be seen in Tables 2 and 3. Plant top growth and foliage deformities were judged to be un-related to the treatments on June 4. All beets were dug by hand on July 27 and visually evaluated for deformed roots. The percent of malformed roots was calculated based on the total number of beets in the harvested plot. Significant differences in root malformations were found to relate to different Counter rates, the highest percentage of damage relating to the application of no Counter insecticide. No significant difference in root malformations were found between the Counter placement methods, however, significant stand differences were found to relate to the method of Counter placement.

Table 1. Treatments of application methods and rate differences of Counter Insecticide. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Treatment Number	Counter 15G Rate[1]		Counter Placement
	oz/1000 ft	lbs/acre	
1	0	0	None
2	8	11.9	Narrow band directly over seed, lightly incorporated with press wheel
3	16	23.8	Narrow band directly over seed, lightly incorporated with press wheel
4	8	11.9	Placed with the seed
5	16	23.8	Placed with the seed
6	8	11.9	Wide band directly over seed, lightly incorporated with press wheel
7	16	23.8	Wide band directly over seed, lightly incorporated with press wheel

[1] Counter insecticide is only labeled at the 11.9 lbs/ac rate and should not be applied at above the labeled rate.

Table 2. Effect of Counter rates on plant stand and malformed roots. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Counter 15G Rate[1]	June 4 Stand	July 27 Malformed roots
	%	%
0	45	16.1
11.9 lbs/acre	45	7.5
23.8 lbs/acre	44	9.1
LSD (.05)	NS	5.0

[1] Counter insecticide is only labeled at the 11.9 lbs/ac rate and should not be applied at above the labeled rate.

Table 3. Effect of Counter placement on plant stand and malformed roots. Malheur Experiment Station, Oregon State University, Ontario,Oregon, 1990.

Method of Placement of Counter	June 4 Stand	July 27 Malformed Roots
	%	%
Narrow band directly over seed	37.8	7.6
Placed with seed	49.1	7.1
Wide band directly over seed	47.7	10.3
LSD (.05)	6.7	NS

THE CONTROL OF YELLOW NUTSEDGE WITH FALL APPLIED PREPLOW AND POSTEMERGENCE APPLICATION OF METOLACHLOR (DUAL)

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Purpose

Yellow nutsedge (Cyprus esculentus) is the most troublesome weed to irrigated agriculture in Malheur County of eastern Oregon and southwest Idaho. It infests most agricultural lands in these areas and is most threatening to all cultivated row crops. Once introduced into a field it can spread rapidly by seed, tuber nutlets, and rhizomes to large patchy areas and in some cases infests entire fields. Spreading of plants occurs both by natural growth of the plants and by plant parts being spread by farm equipment during field tillage. Researchers who have contributed life long physiology studies to the control of the plant report that reproductive plant parts will not survive for longer than three years in irrigated soils under normal conditions. If reproduction can be prohibited for three years by controlling plant growth, yellow nutsedge should be eradicated from infested areas. A three-year study was initiated in the fall of 1988 to determine tolerance of six different crops and control of yellow nutsedge by applying Dual (metolachlor) for three consecutive years as a fall preplow application. The trial was conducted in a seven acre field heavily infested with yellow nutsedge. These results are after the second year of evaluation.

Procedure

Metolachlor (Dual) was broadcast applied at rates of 3.0, 4.0, 6.0 and 8.0 pounds active ingredients per acre. The trial area was a seven acre field approximately 1,000 feet long and 305 feet wide. Dual was applied with a field sprayer and incorporated to a depth of 4 inches with a triple-k field cultivator before the field was plowed twelve inches deep with a moldboard plow. Individual herbicide plots were 64 feet wide for the width of the field (305 feet). Each herbicide treatment was replicated three times and placed at random as strips across the field for the entire length of the field. After plowing the field was worked-down with a ground-hog tiller and soil compactor then bedded on 22-inch centers.

Crops planted and evaluated for tolerance to Dual included winter and spring wheat, alfalfa, onions, sugar beets, corn and dry beans. Each crop was planted in strips, eight rows wide across the strips of herbicide treatments for the length (1,000 feet) of the field. Crops were replicated three times and spaced at random across the width (305 feet) of the field.

An additional application of Dual at the rate of 4.0 pounds active ingredient/acre was applied over alfalfa, wheat, onions and sugar beets as a postemergence treatment when these corps and emerging plants of yellow nutsedge were 3 to 4 inches tall. The yellow nutsedge plants were germinating from nutlets in the upper 3-inch depth of soil where the concentrations of Dual, plowed-down, were too low to control nutsedge effectively. Four pounds of Dual was applied and incorporated to a depth of three inches before planting corn and beans.

Herbicides applied as postemergence treatments to control annual broadleaf and grassy weeds emerging with alfalfa , onions, sugar beets and wheat included Buctril, Goal + Buctril, Betamix, and Brominal respectively. Poast herbicide was tank-mixed with each broadleaf herbicide to control annual grasses.

Soils within the field in texture varied from sandy loam, silt loam and clay loam. The field was irrigated by furrow type irrigation. All crops planted in the spring were irrigated for seed germination and plant emergence. Onions, sugar beets, alfalfa, and spring wheat was planted on March 26 and 27. Corn and dry beans were planted on May 10. The crops were cultivated as needed to make corrugates for irrigation.

Dual herbicide treatments were applied on November 5 and incorporated and plowed-down November 6 and 7. Malcolm variety of fall wheat was planted on November 10.

All crops were left growing until August 1 to evaluate for herbicide tolerance as long as possible before the residue of the crops were destroyed to prepare the field for the next fall application of herbicide treatments. The crops were destroyed by shredding the foliage with a flail beater, followed by discing and corrugation. The field was furrow irrigated and herbicide treatments evaluated for emerging nutsedge plants before it was again worked down in preparation for 1990 fall applied treatments.

The effectiveness of Dual treatments for control of yellow nutsedge and tolerance to crops was evaluated on May 10, June 15 and July 28. Evaluation were visual ratings for percent control of yellow nutsedge based on nutsedge populations and growth in untreated check plots, crop tolerance ratings were made by comparing growth of individual crops growing in the treated and untreated strips.

Results

Fall applied Dual incorporated with a moldboard plow gave good control of yellow nutsedge plants. Incorporation with a moldboard plow has also given selectivity to crops grown annually in rotation. A second application of Dual in the spring applied postemergence to onions, sugar beets, alfalfa and wheat and preplant incorporated to corn and beans has improved control of yellow nutsedge. The improved control is the results of control of nutsedge plants germinating from nutlets in the surface three inches of soil where Dual concentrations when plowed under are too low to be effective.

Results of these trials after two years of applications shows that all crops were tolerant to Dual plowed under at rates as high as 8 pounds ai/ac. Some crops were more sensitive than others to 4 pounds of Dual applied as postemergence applications. Sugar beets were very tolerant, wheat and alfalfa showed only slight symptoms. Onions were most sensitive but herbicide symptoms did not persist and were only evident for a short period of time after which onions had normal growth and appearance when compared to onions in the untreated control. Corn and beans were injured when 4 pounds of Dual was applied preplant and incorporated over 6 and 8 pounds of Dual plowed under. Dual injury delayed emergence of these crops and slowed early growth. Reduced rates of Dual incorporated preplant would probably not have affected normal emergence and growth of corn or beans.

Optimum control of yellow nutsedge was obtained with Dual rates above 4 pounds ai/ac when plowed down without spring applied applications. An additional application of Dual applied in the spring gave essentially complete control of yellow nutsedge. The spring applied postemergence application of Dual was activated by cultivation followed by irrigation and by rain which occurred a few days after these treatments were applied.

In September after the field had been tilled and irrigated, dense stands of yellow nutsedge emerged in all untreated check strips. Treated plots remained free of nutsedge plants. Dual is a very effective herbicide for the control of yellow nutsedge and present results indicate that population of nutsedge plants can greatly be reduced if not eradicated, from infested fields with Dual applied for three consecutive years.

Table 1. Percent control of yellow nutsedge and crop injury ratings for Dual applied as fall preplow, preplant and spring applied or postemergence applications. Sparks Farm, Nyssa, Oregon, 1990.

Dual Fall Applied	Control of Yellow Nutsedge (%)			CROP INJURY RATINGS																				
				Winter Wheat[1]			Spring Wheat[1]			Alfalfa[1]			Onions[1]			Sugar Beets[1]			Corn[2]			Dry Beans[2]		
(lbs ai/ac)	5/10	6/15	7/28	5/10	6/15	7/28	5/10	6/15	7/28	5/10	6/15	7/28	5/10	6/15	7/28	5/10	6/15	7/28	5/10	6/15	7/28	5/10	6/15	7/28
3	78	99	100	0	0	0	0	0	0	0	5	0	0	15	5	0	0	0	0	0	0	0	0	0
4	89	100	100	0	0	0	0	0	0	0	5	0	0	15	5	0	0	0	0	0	0	0	5	0
6	99	100	100	10	5	0	0	0	0	0	5	0	0	15	5	0	0	0	0	15	7	0	10	5
8	99	100	100	15	8	5	0	5	0	5	10	5	5	20	10	0	0	0	0	20	9	0	15	10
untreated	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1) Crops that received fall preplow and postemergence applied Dual. Postemergence rate of Dual at 4.0 pounds ai/ac.
2) Crops that received fall preplow and preplant incorporated Dual. Preplant incorporated rate of Dual at 4.0 pounds ai/ac.

Ratings taken on May 10 indicate crop tolerance and percent control of yellow nutsedge before the postemergence treatments were applied.

Ratings taken on June 15 and July 28 indicate additional control of yellow nutsedge and crop injury as a result of Dual applied in the spring as preplant or postemergence.

NITROGEN UPTAKE AND REMOVAL BY SELECTED CROPS

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Objectives

Crop nitrogen use and nitrogen removal at harvest have not been determined for Malheur County crops. Nitrogen fertilizer management trials in 1990 can be used to provide nitrogen uptake and nitrogen removal for five crops.

Procedures

Sugar beets, onions, wheat, and barley were grown on Owyhee silt loam and potatoes were grown on a Nyssa silt loam at the Malheur Experiment Station. Experiments were designed to study crop responses to nitrogen fertilizer, the efficiency of nitrogen uptake, and the movement of nitrate and ammonium in the soil profile.

Crop yield was determined for all crops. Plants were sampled before or at harvest. Plant parts were divided into harvested and non-harvested portions and analyzed for nitrogen content to provide estimates of total nitrogen uptake, nitrogen removed in the harvested portion, and nitrogen in the remainder of the plant. Plants were divided as follows:

Crop	Harvested Portion	Remainder	Not Measured
Wheat	Grain	Stubble	Roots
Sugar Beets	Beet	Leaves and crown	Fine roots
Onions	Bulb	Leaves and neck	Fine roots
Potatoes	Tuber	Leaves and stems	Roots
Barley	Grain	Stubble	Roots

Results and Discussion

Nitrogen needs for plant development were estimated for five crops using the 1990 results at the Malheur Experiment Station (Table 1). Plant nitrogen content per unit yield was averaged over the entire range of nitrogen treatments for each crop. Comprehensive estimates of average nitrogen available from irrigation water and average nitrogen available from organic matter mineralization were not considered.

Nitrogen uptake and removal by these same five crops can be estimated for Malheur County. Lynn Jensen and Ben Simko (Malheur County Cooperative Extension, OSU) have recently surveyed Malheur County fertilization practices, agricultural chemical use, and yields. In addition Gary Schneider (Malheur county Cooperative Extension, OSU) regularly publishes estimated average crop yields and acreage, Combining average nitrogen contents in (Table 1) with average yield from Jensen and Simko provides an estimate of average crop nitrogen uptake (Table 2). Using the acreage estimates of Gary Schneider, relative nitrogen loading can be estimated for four crops (Table 3).

The "estimated nitrogen balance" is a rough approximation for the total of all Malheur County acreage for four crops (Table 3). Onions and potatoes show positive nitrogen balances based on average grower N applications and yield but actual balances vary from field to field. If a particular crop in a given field receives more nitrogen fertilizer than there is crop nitrogen removal, the "extra" nitrogen is not automatically leached to the groundwater. Part of fertilizer nitrogen is lost to the atmosphere, lost in runoff water, or becomes part of the residual soil nitrogen supply. Residual soil nitrogen occurs in many chemical and biological forms. These forms include nitrate, ammonium, and nitrogen in the organic matter. The fate of fertilizer nitrogen is strongly influenced by application timing, placement, fertilizer form, irrigation management, and other factors which vary from field to field and vary among growers. Through a better understanding of all nitrogen movements, nitrogen use efficiency can be increased.

Table 1. Nitrogen uptake and removal by five crops grown in Malheur County Oregon. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990[c].

Crop	Number of Plots Measured for Nitrogen	Available Soil N at Planting	Range of Applied N Fertilizer	Average Yield	Average Total Plant Uptake	Average N in Harvested Crop	Average Pounds of N Per Unit Yield: In Harvested Portion	Average Pounds of N Per Unit Yield: Total Uptake
		- - lbs N/acre - -			- - lbs N/acre - -		- - - - - lbs - - - - -	
Wheat	30	246[a]	0-200	162 bu/ac	266	211	1.28/bu	1.63/bu
Sugar beets	12	57[a]	100-220	43.6 t/ac	331	189	4.33/ton	7.62/ton
Onions	108	67[b]	0-400	506 cwt/ac	102	81	0.16/cwt	0.21/cwt
Potatoes	24	159[b]	40	484 cwt/ac	196	157	0.32/cwt	0.40/cwt
Barley	29	246[a]	0-200	137 bu/ac	177	133	0.96/bu	1.28/bu

[a] based on nitrate and ammonium in the top 3 feet of soil

[b] based on the nitrate and ammonium in the top foot of soil

[c] numbers in the table are not consistent to the last digit because each number is based on the average of the actual field data, not calculated from previous columns

Table 2. Average Malheur County crop yield, N fertilization, estimated crop N uptake, and estimated fertilizer carry over. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Crop	Average Yield	Average N applied	Estimated Average N Uptake			Estimated Fertilizer N Carryover
			Total Plant Uptake	In Harvested Portion	N in Crop Residue after Harvest	
		lbs/acre	-------- lbs/acre -------			lbs/ac
1. Alfalfa hay	4.5 t/ac[b]	0	*	*	*	*
2. Wheat	111 bu/ac[a]	136[a]	181[c]	142[c]	39[c]	-45
3. Sugar beets	31.3 t/ac[a]	205[a]	239[c]	136[c]	103[c]	-34
4. Onions	621 cwt/ac[a]	284[a]	130[c]	99[c]	31[c]	154
5. Potatoes	405 cwt/ac[a]	215[a]	162[c]	130[c]	32[c]	53
6. Alfalfa Seed	542 lbs/ac[b]	0	*	*	*	*
7. Dry Beans	25.4 cwt/ac[a]	74[a]	*	*	*	*
8. Corn (grain)	132 bu/ac[b]	*	*	*	*	*
9. Corn (silage)	21.3 t/ac[b]	*	*	*	*	*
10. Sweet corn	8.02 tons/ac[a]	204[a]	*	*	*	*
11. Barley	82 bu/ac[b]	*	105[c]	79[c]	26[c]	*
12. Mint	75 lb/ac[b]	*	*	*	*	*
13. Others	*	*	*	*	*	*

a) based on the 1991 survey of crop production practices by Lynn Jensen and Ben Simko, OSU extension.

b) based on the 1988-1990 data collected by Gary Schneider, OSU extension.

c) based on 1990 crop research at the Malheur Experiment Station as presented in Table 1 and survey yields by Jensen and Simko.

* data not yet determined

Table 3. Estimated relative nitrogen loading from Malheur County irrigated crops and forages. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Crop	Irrigated Crop And Pasture Area[a]	Balance Of Nitrogen Fertilization And Crop Uptake: Net Nitrogen Remaining In Field After Crop Harvest[b]				
		Per Acre		County Wide		
		Crop Residue N	Mineral N	Crop Residue N	Mineral N	Total N
	acres	lbs/ac		Total lbs of N		
1. Alfalfa hay	53,000	*	*	*	*	*
2. Wheat	32,800	39	-45	1,279,200	-1,476,000	-196,800
3. Sugar beets	16,300	103	-34	1,678,900	-554,200	1,124,700
4. Onions	9,620	31	154	298,220	1,481,480	1,779,700
5. Potatoes	7,300	32	53	233,600	386,900	620,500
6. Alfalfa Seed	7,300	*	*	*	*	*
7. Dry Beans	7,200	*	*	*	*	*
8. Corn (grain)	6,400	*	*	*	*	*
9. Corn (silage)	6,400	*	*	*	*	*
10. Sweet corn	4,125	*	*	*	*	*
11. Barley	4,000	*	*	*	*	*
12. Mint	2,350	*	*	*	*	*
13. Others	113,205	*	*	*	*	*
Total	270,000	Incomplete data to tabulate total loading				

[a] Based on the 1991 survey of crop acreage by Gary Schneider, OSU extension.

[b] Based on 1990 crop research at the Malheur Experiment Station as presented in Table 1 and survey results by Jensen and Simko.

* data not yet determined

MALHEUR COUNTY CROP SURVEY OF NITROGEN AND WATER USE PRACTICES

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In 1989, northeastern Malheur County was declared a groundwater management area because of nitrate contamination in shallow aquifers. Subsequently, meetings were held a citizens committee to recommend ways of cleaning up the aquifer. They realized that there is a lack of knowledge concerning actual grower practices for nitrogen rates and application timing. It was felt that the best way to obtain this information was to conduct a comprehensive survey that encompassed enough growers to make the survey reliable. Because of the logistics of obtaining this kind of survey, the help of local fertilizer fieldmen was enlisted. There was good cooperation between the fieldmen and the growers; resulting in a high percentage of the survey forms returned. A total of 51 surveys were completed and returned resulting in a high percent of the county's row crop acreage covered.

The results of the survey will enable us to pinpoint current grower practices that are beneficial to protecting groundwater as well as those practices which need more research and education (Tables 1 to 10). Items which need to be addressed include soil testing in certain crops, fall applied nitrogen, total nitrogen use, and Dacthal application.

The survey indicates that 38 percent of onion growers, 64.9 percent of sweet corn growers, 71.9 percent of dry bean growers, and 96 percent of wheat growers do not soil sample. Soil testing for these crops would give a more accurate indication of how much nitrogen must be applied for maximum yields. Wheat is a deep rooted crop that could be utilized in recovering excess nitrogen applied to a previous crop, but soil sampling is necessary.

Fall applied nitrogen is applied in significant amounts to onions and sugar beets and to a lesser extent to sweet corn and potatoes. The potential for leaching this fertilizer during the winter months or during the first irrigation is high. During dry years, fertilizer salts are available to add to the salt injury experienced by area growers. The addition of a starter fertilizer could eliminate the need for fall applied nitrogen on these crops.

Table 3 shows Dacthal use on onions. Dacthal use on onions. Dacthal is a pre-emergence herbicide that has shown up in Malheur County groundwater in the di-acid metabolite form. Almost half of onion growers are still broadcasting Dacthal. Banding would cut the application rate by 2/3 and thus the potential for leaching into the groundwater. It is interesting to note that 27 percent of the growers do not use

Dacthal. The fact that part of the growers do not use Dacthal indicates the possibility of eventually eliminating the use of Dacthal.

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Table 1.

1990 MALHEUR COUNTY CROP SURVEY

CROPS	SURVEY ACREAGE	NUMBER OF SURVEY RESPONSE	MALHEUR COUNTY CROP ACREAGE	% SURVEYED
Onions	4,075	45	9,620	42
Sweet Corn	1,475	23	4,125	36
Dry Beans	2,829	17	7,200	39
Wheat	6,755	50	32,800	21
Sugar beets	5,727	37	13,000	44
Potatoes	2,466	31	7,300	34
Mint	1,970	4	2,350	84
Alfalfa Seed	889	9	7,300	12
Field Corn	730	7	6,400	11
Sweet Corn Seed	150	3	?	
Alfalfa Hay	140	2	53,000	.3
Carrot Seed	50	1	?	

Table 2.

ONION SURVEY - 4075 ACRES

			Average	High	Low
Years Grown			25.8	58	2
Yield (cwt)			621.1	1200	450
Acres Grown			92.6	200	11
Soil Test	Yes	28			
	No	17			
Tissue Test	Yes	15			
	No	30			
Nitrogen Use:					
Fall			98.1	160	15
Preplant Spring			1.6	50	0
Starter			3.5	100	0
Number of Sidedress Applications			1.6	2	1
Pounds of N Sidedressed			168.8	300	100
Water Run N			10.9	60	0
Other			1.2	50	0
Total Nitrogen Applied			284.0	400	170
Number Insecticide Sprays (thrips)			3.6	5	2
Number Fungicide Applications			3.6	5	1
Pounds Dacthal		6.7	12	0	
Number of Irrigations			18.9		
Water Set - Hours			19.9		
Water Use - Acre feet			3.7		

Table 3.

DACTHAL USE ON ONIONS

METHOD OF APPLICATION	NUMBER OF GROWERS	%	ACRES	%
BAND DACTHAL	12	27.3	1327	32.6
BROADCAST DACTHAL	20	45.4	2020	49.5
DO NOT USE DACTHAL	12	27.3	728	17.9
	44		4075	

Table 4.

POTATO SURVEY - 2466 ACRES

			Average	High	Low
Yield (cwt)			405.06	450	300
Soil Test	Yes	25			
	No	6			
Tissue Test	Yes	26			
	No	5			
Nitrogen Use					
Fall			47.10	150	0
Spring			34.90	150	0
Starter			11.35	150	0
Number of Sidedress Applications			0.81	2	0
Pounds of N Sidedressed			92.90	190	0
Water Run		27.00	140		
Other			2.00		
Total Nitrogen Applied			215.13	300	116
Number of Irrigations			16.35		
Water Set - Hours			15.78		
Water Use - Acre Feet			3.64		

Table 5.

MINT SURVEY - 1970 ACRES

			Average	High	Low
Yield (lbs.)			86.25	120	70
Soil Test	Yes	3			
	No	1			
Tissue Test	Yes	1			
	No	3			
Nitrogen Use:					
Fall			38.75	80	0
Spring			50.00	200	0
Starter			50.00	100	0
Number of Sidedress Applications			0.50	2	0
Pounds of N Sidedressed			50.00	200	0
Water Run N			26.25	40	0
Other			37.50	150	0
Total Nitrogen Applied			252.50	310	140
Number of Irrigations			14.00		
Water Set - Hours			21.00		
Water Use - Acre Feet			4.25		

Table 6.

SWEET CORN SURVEY - 1475 ACRES

			Average	High	Low
Average Yield (tons)			8.02	9.0	6.5
Soil Test	Yes	8			
	No	14			
Tissue Test	Yes	1			
	No	21			
Nitrogen Use:					
Fall			20.41	165	0
Preplant Spring			46.36		
Starter			27.05		
Number of Sidedress Applications			0.64	1	0
Pounds of N Sidedressed			107.73	200	0
Water Run			2.73		
Other			0.00		
Total Nitrogen Applied			204.27	285	165
Number Irrigations			11.45		
Water Set - Hours			20.73		
Water Use - Acre Feet			2.97		

Table 7.

DRY BEAN SURVEY - 2829 ACRES

			Average	High	Low
Yield (cwt)			25.35	30	20
Soil Test	Yes	5			
	No	12			
Tissue Test	Yes	2			
	No	15			
Nitrogen use:					
Fall			0		
Spring			62.06	150	0
Starter			7.35		
Number of Sidedress Applications			0.06		
Pounds of N Sidedressed			4.71		
Water Run		0.00			
Other			0.00		
Total Nitrogen Applied			74.12	150	45
Number Irrigations			11.53		
Water Set - Hours			17.65		
Water Use - Acre Feet			2.69		

Table 8.

WHEAT SURVEY - 6755 ACRES

			Average	High	Low
Yield (bu.)			111.06	150	75
Soil Test	Yes	2			
	No	48			
Tissue Test	Yes	1			
	No	49			
Nitrogen Use:					
Fall			89.38	160	0
Starter			2.00		
Spring (top dress)		36.92	105	0	
Water Run		1.20			
Other			6.80		
Total Nitrogen Applied			136.30	240	80
Number Irrigations			8.22		
Water Set - Hours			19.63		
Water Use - Acre Feet			2.40		

Table 9.

SUGAR BEET SURVEY - 5727 ACRES

			Average	High	Low
Yield (tons)			31.28	36	22
Soil Test	Yes	28			
	No	9			
Tissue Test	Yes	29			
	No	8			
Nitrogen use:					
Fall			80.03	215	0
Spring			18.38	240	0
Starter			2.35	75	0
Number of Sidedress Applications			0.97	2	0
Pounds of N Sidedressed			97.97	225	0
Water Run		5.14	40	0	
Other			1.08		
Total Nitrogen Applied			204.95	276	100
Number of Irrigations			17.00		
Water Set - Hours			19.33		
Water Use - Acre Feet			3.63		

Table 1. Nitrogen contribution by irrigation water. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990.

Average Nitrate-N plus Ammonium-N	Irrigation Amount				
	1 in	1 ft	2 ft	3 ft	4 ft
ppm	------------- lbs N/ac -------------				
0	0	0	0	0	0
1	.2	2.7	5.4	8.2	10.9
2	.5	5.4	10.9	16.3	21.8
3	.7	8.2	16.3	24.5	32.7
4	.9	10.9	21.8	32.7	43.5
5	1.1	13.6	27.2	40.8	54.4
6	1.4	16.3	32.7	49.0	65.3
7	1.6	19.0	38.1	57.1	76.2
8	1.8	21.8	43.5	65.3	87.1
9	2.0	24.5	49.0	73.5	98.0
10	2.3	27.2	54.4	81.6	108.9
20	4.6	54.4	108.8	163.2	219.8
30	6.9	81.6	163.2	244.8	328.7

The Malheur Experiment Station will seek to make more comprehensive analyses of nitrogen in the irrigation water during 1991.