Special Report 862
June 1990

Malheur Experiment Station
Malheur County Crop Research 1989

Agricultural Experiment Station
Oregon State University

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Oregon State University, Corvallis

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The following report includes information concerning unregistered uses of pesticides. Experimental results should not be interpreted as recommendations for use. Use of unregistered materials or use of any registered pesticides inconsistent with its label is against both Federal Law and State Law.

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Idaho Alfalfa Seed Growers Association
Idaho-Eastern Oregon Onion Committee
Malheur County Alfalfa Seed Growers Association
Malheur County Potato Growers
Nevada Seed Council
Nyssa Nampa Beet Growers Association
Oregon Essential Oil Growers League
Oregon Mint Growers Association
Oregon Potato Commission
Oregon Processed Vegetable Commission

OREGON PUBLIC AGENCIES SUPPORTING RESEARCH

Department of Agriculture
Department of Environmental Quality
Malheur County Regional Economic Development Strategies

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FORAGE ALFALFA VARIETY EVALUATION

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Oregon State University
Ontario, Oregon, 1989

Objective

An alfalfa forage trial was installed to identify high yielding varieties adapted to conditions in the Treasure Valley.

Procedures

The trial was planted in the fall of 1987 and is scheduled to run for five years. Six public and 25 private alfalfa varieties (Table 3) were arranged in a randomized complete block experimental design with four replications. Plots are 5 feet wide by 19 feet long with 2-foot bare soil alleys separating plot ends. Strips 3 feet by 19 feet, centered in each plot, were harvested to determine fresh weight yields in 1988. The harvest area was reduced to 3 feet by 14 feet in 1989. Samples from eight randomly selected plots were dried to determine percent dry matter.

Winter wheat was grown in the trial area in 1987. After grain harvest the field was disked, furrowed, and irrigated to germinate volunteer grain. Following subsequent disking and ripping, 370 pounds of phosphate per acre in the form of super triple phosphate were plowed down and the seedbed was prepared with a "Triple-K" spring-toothed implement, cultipacker, and harrow. The trial was hand planted at the rate of 15.75 pounds per acre on September 8 and 9, 1987, and irrigated on September 10. An infestation of spotted alfalfa aphids in the seedling alfalfa was controlled with a broadcast application of Lorsban at the rate of one pound ai/ac on October 2, 1987.

In early March, 1988, areas with marginal plant stands were reseeded to produce a uniform plant population. On March 4 the alfalfa was sprayed with the herbicides Buctril and Fusilade at the rates of two pounds and one pound ai/ac, respectively, in conjunction with one quart Moract per acre. The alfalfa was furrow irrigated nine times in 1988. The trial was managed as a high input, high yield site with neither irrigation nor fertility limiting production.

Even though the trial is managed on a four cutting schedule, the warm fall allowed a fifth cutting on October 19, 1988. During 1989 the trial was irrigated as in 1988, but was harvested only four times.

Results

First season yields reported at 12 percent moisture ranged from a high of 12.6 tons per acre to 9.6 tons per acre (Table 1). Second season yields ranged from 14.0 to 12.0 tons per acre (Table 2). Favorable growing conditions in early 1989 increased yields. Information on winter hardiness and resistance to diseases and insects is presented in Table 3.

Table 1. First year yield[2] 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 Lahonton	Stand[1] 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	10.6	96	8.0
Perry	NE/USDA	2.6	2.9	2.5	1.9	1.2	11.2	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	11.3	102	8.0
Excalibur	Allied Seed	2.9	3.3	2.5	1.9	1.4	11.9	107	7.9
Fortress	Northrup King	2.9	3.1	2.8	1.9	1.3	12.1	109	8.3
86637	Northrup King	2.6	3.0	2.9	1.9	1.5	11.8	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	11.9	107	7.4
360 II	Greenway	2.6	3.0	2.5	1.9	1.1	11.0	99	7.9
360 S	Greenway	2.9	3.1	3.0	1.9	1.3	12.2	110	7.8
Allstar	W.D. Seed Growers	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	11.7	106	8.1
S-127	W-L Research	2.9	3.3	2.8	1.8	1.3	12.0	108	8.3
WL 317	W-L Research	2.8	3.1	2.9	1.8	1.3	12.0	108	8.3
H-171	Lohse Mill Inc.	2.4	3.1	2.8	1.9	1.5	11.6	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	11.4	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
8660	Agripro	2.7	3.2	3.1	2.0	1.7	12.6	113	8.3
8640	Agripro	2.3	2.9	3.0	1.9	1.5	11.8	106	7.5
8650	Agripro	2.5	2.9	2.9	1.9	1.5	11.6	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	9.6	87	5.5
HE 26	Geertson Seed	2.2	2.9	2.4	1.8	1.1	10.3	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] Average of 4 replications, 1 = no stand to 9 = excellent stand.
[2] Yield at 12% moisture.

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 Sept. 13	1989 Total	% of Lahonton
		tons/ac					%
Lahontan	NV/USDA	3.2	2.7	3.5	3.2	12.6	
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
360 II	Greenway	4.0	2.5	3.4	3.3	13.2	105
360 S	Greenway	4.4	2.8	3.3	3.5	14.0	111
Allstar	W.D. Seed Growers	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
8660	Agripro	3.8	2.7	4.0	3.4	13.9	111
8640	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. Published 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	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
360 II	Greenway												
360 S	Greenway												
Allstar	W.D. Seed Growers	1988	MH	R	HR	R	HR	HR		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 Inc.		MH	R	R	R	HR	HR				R	
WL 317	W-L Research Inc.	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
8660	Agripro		MH	MR/LR	R	R/MR	R	R		R	R	R	R
8640	Agripro		H	R/MR	R	R/MR	R	R		R	R	R	R
8650	Agripro		MH	MR	R	R/MR	R	R		R	R	R	R
Renegade	Geertson Seed	1990	H	R	R	MR	R	LR		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)

WATER STRESS AND ALFALFA SEED YIELDS

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Oregon State University
Ontario, Oregon, 1989

Abstract

An irrigation study was conducted to test the use of a crop water stress index for irrigating an alfalfa seed crop. Plant canopy temperatures, air temperatures, and air relative humidity were measured using a Scheduler® Plant Stress Monitor. The Scheduler calculated an index on a scale of 0 to 10. Crop water stress index values of 1, 3, 5, and 8 were used as irrigation criteria. Seed yields were positively associated with a minimization of irrigation and high crop water stress index. Irrigation scheduled by a crop water stress index of 8 was as effective as irrigation scheduled by soil water for seed production. Irrigation scheduled with an index of 8 used only 17 percent of the irrigation water as areas maintained with continuously low water stress.

Introduction

Alfalfa seed growers recognize that frequent or heavy irrigation stimulates vegetative growth of the alfalfa and reduces seed recovery. A well watered seed crop develops too much growth to desiccate or combine, has poor seed set, and has poor seed recovery. Some extent of water stress is beneficial to alfalfa seed production, but the extent that crop stress is favorable to yields is not known.

An alfalfa management trial conducted during the 1985 through 1987 seasons at the Malheur Experiment Station demonstrated that seed yields were positively associated with decreasing levels of soil water and increasing levels of crop stress, be that stress measured as crop canopy temperature, as a temperature difference between the crop and the air, or as a crop water stress index.

Alfalfa seed growers need a practical field method to quickly evaluate crop water stress to effectively manage irrigation so that water stress needed for maximum seed yields is realized without endangering the crop. Alternatives include monitoring soil water, monitoring plant water potential, or monitoring crop cooling through water transpiration.

Objective

The objective was to determine the relation of alfalfa seed yields to crop water stress index. A crop water stress index based on potential cooling of a well watered crop and potential heating of a stressed crop was tested in the following experiment.

Procedures

Wrangler alfalfa was planted in October 1984 on 30-inch rows on an Owyhee silt loam soil. In June of 1987 the field was divided into plots for irrigation studies. Plot size consisted of four 30-inch rows of alfalfa 100 feet long. Treatments were replicated four times in a randomized complete block design.

Soil water was determined twice a week using a CPN Model 403 neutron probe and plastic access tubes 4 feet long. One tube was placed in each field plot. The neutron probe readings were used for irrigation scheduling by conversion to inches of water per foot of soil. Moisture retention curves related soil water content to soil water potential. Check plots were irrigated when the soil water potential reached -8 bars.

A Scheduler[R] Plant Stress Monitor (Standard Oil Engineered Materials) was used three to four times a week to measure crop canopy temperature and simultaneously measure air temperature and air relative humidity above the crop canopy. The Scheduler calculated a crop water stress index (CWSI) based on the crop temperature and the potential for crop cooling.

Five irrigation treatments were established at the experiment station for the summer of 1988 and 1989. The five treatments consisted of a five irrigation scheduling criteria:
CWSI = 1, CWSI = 3, CWSI = 5, CWSI = 8, and soil moisture = -8 bars, the check treatment.

Alfalfa in each plot was irrigated only when it reached the established irrigation criteria, either crop water stress index or soil water potential. Irrigation water was applied for four hours using only every other furrow to only partially relieve water stress.

The alfalfa received a pre-bloom insect clean up spray of Furadan at 1.0 lbs ai/ac, before leaf cutting bees, Megachile rotundata, were released to pollinate the field. Domiciles for pollination were located at both the east and west end of the field. Decisions for control of lygus bugs, aphids, and weevils were based on IPM recommendations:

Insect	Insects/sweep
Alfalfa weevil	20-25
Lygus (adult + instars 4 & 5)	
early season	2-4
late season	5
Spotted alfalfa aphid	10-15
Pea aphid	80-100

Insects were sampled weekly from the middle of each plot. Sampling consisted of one 90 degree sweep with a standard 15-inch net. Counting was done immediately and data recorded.

When insect counts reached the threshold levels for lygus or pea aphids, Metasystox R plus dibrome was applied. When spotted alfalfa aphid reached threshold levels, Thiodan was applied. Insecticides were applied only during alfalfa bloom from mid-June to mid-August. Two sprays of Metasystox R plus dibrome were required for lygus control and one spray of Thiodan for spotted alfalfa aphid was required in 1988. Metasystox R was applied at 0.5 lb ai/ac. Dibrome was applied at 0.75 pt/ac, and Thiodan at 0.5 lb ai/ac.

All the pesticides were applied using a three-foot copper boom fitted with four 8002E nozzles spaced 12 inches apart. Sprays were made 18 inches above the crop at 40 psi and 30 gallons of water per acre.

The seed crop was desiccated in September with two pints of Diquat and eight ounces of X-88 per acre. Seed was harvested from a swath 50 inches wide and 29 feet long in the middle of each plot using a Wintersteiger Nurserymaster plot combine. Seed from each plot was cleaned individually on a clipper.

Off station plots were established at the Sisson - Strickland farm in Nyssa in 1989. Off-station plots were irrigated when CWSI values reached 1, 3, 5, 8, and 10 respectively, each replicated four times. Plots were 90 feet long and four rows wide in a mature stand of alfalfa.

Insects were controlled by the seed grower in off station plots. Off-station plots were harvested using the Wintersteiger Nurserymaster plot combine.

Results and Discussion

Crop water stress index values increased slowly through June and July. Alfalfa irrigated at CWSI = 1 received 53 hours of irrigation on average or about 13 four hour sets in 1988. Plots irrigated at CWSI = 8 received an average of only nine hours of furrow irrigation for the season (Table 1). The number of irrigations and the duration of each were less in 1989 than in 1988 (Table 3). Irrigation sets were of short duration because plots were short water runs.

Maximum observed CWSI and average observed CWSI of each plot was consistent with the irrigation criteria (Table 2). Seed yields were positively related to higher levels of stress (Table 2).

Alfalfa receiving the least irrigation and with the highest stress produced the greatest yields in 1988. Values of CWSI = 8 and soil water potential of -8 bars in the second foot of soil allow considerable stress short of overstressing the crop.

Patterns of CWSI that ranged from 4 to 8 during bloom and seed set were associated with greater seed yields than patterns of CWSI ranging closer to zero (Figure 1). In 1989 yields were highest when plots were irrigated at CWSI greater or equal to 5 (Tables 3 and 4).

Acknowledgment

The alfalfa seed water stress research has been supported in 1987 through 1989 by the Idaho Alfalfa Seed Commission and The Carborundum Company. Additional support in 1989 was received from the Nevada Seed Council, the Malheur County Seed Growers, and the Malheur County Regional Economic Development Strategy Board.

Table 1. Total hours of irrigation and average season long soil water content resulting from five furrow irrigation criteria for alfalfa seed production. Malheur Experiment station, OSU, Ontario, Oregon, 1988.

Treatment irrigation criteria	Furrow irrigation		June through August Av Soil Moisture	
			1st ft.	2nd ft.
	No.	hrs	- - - - - in/ft - - - - -	
1. CWSI = 1	13	53	2.82	2.92
2. CWSI = 3	10	39	2.44	2.57
3. CWSI = 5	6	24	2.22	2.45
4. CWSI = 8	2	9	1.94	2.36
5. Soil Moisture = -8 bars	6	23	2.19	2.33
Correlation with Av CWSI		-.70**	-.71**	-.68**

** significant at p = .01

Table 2. Average and maximum crop water stress index and alfalfa seed yields resulting from five furrow irrigation criteria. Malheur Experiment Station, OSU, Ontario, Oregon, 1988.

Treatment irrigation Criteria	Crop Water Stress Index June 23 - Aug 15		Clean seed yield
	Av.	Max.	
	- - - CWSI (0-10)- - -		lbs/ac
1. CWSI = 1	0.2	4.1	371
2. CWSI = 3	1.3	5.2	409
3. CWSI = 5	2.0	6.4	532
4. CWSI = 8	3.4	9.3	631
5. Soil Moisture = -8 bars	2.3	7.4	567
Correlation with Max. CWSI	+.84**	-	+.67**

** significant at p = 0.01

Figure 1. Patterns of crop water stress index (CWSI) of selected plots for alfalfa grown for seed and corresponding seed yields. Malheur Experiment Station, OSU, Ontario, Oregon, 1988.

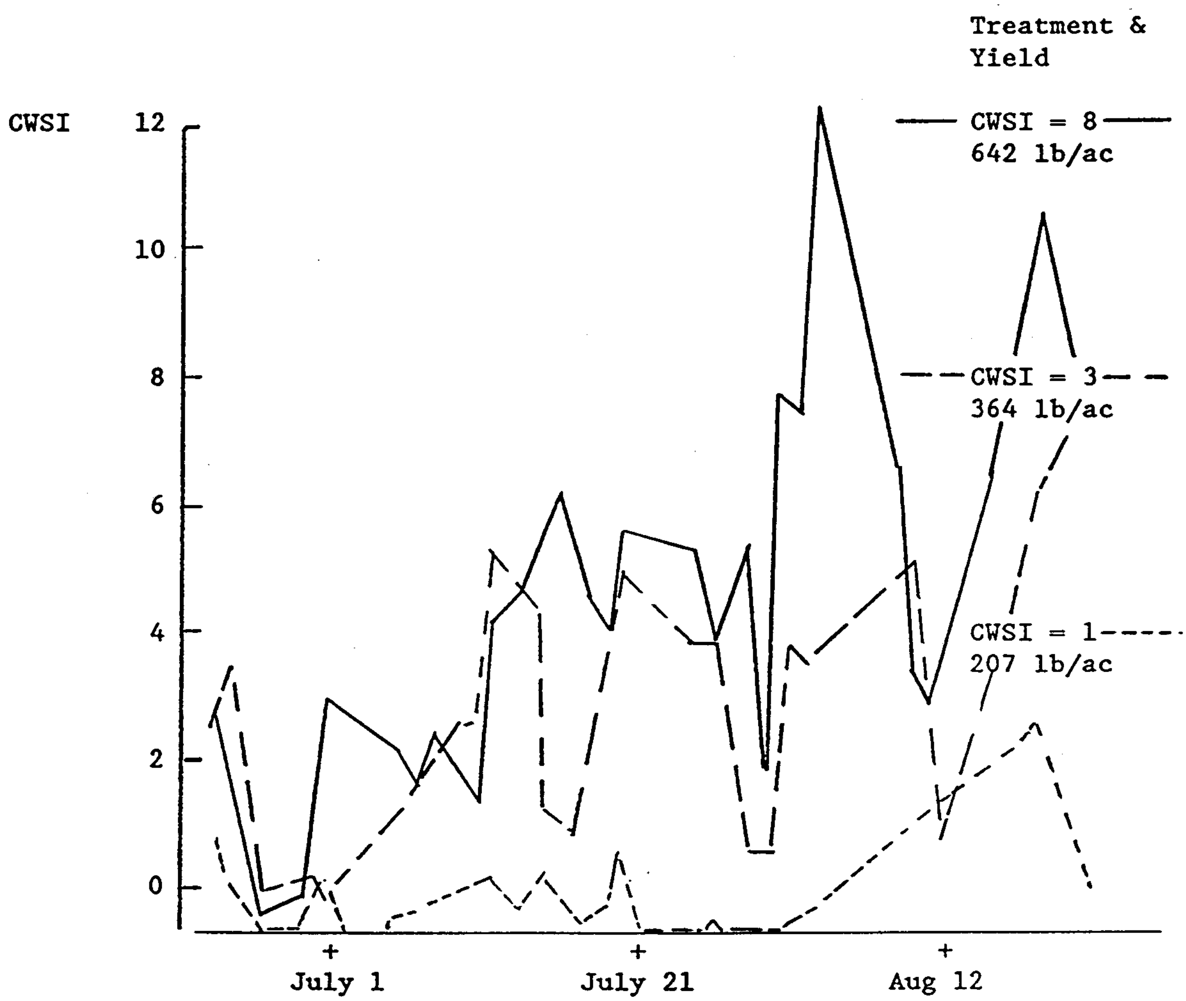

Table 3. Alfalfa seed yields from five furrow irrigation criteria. Malheur Experiment Station, OSU, Ontario, Oregon, 1989.

Treatments, irrigation criteria	Furrow irrigations		Clean seed yields
	No.	hrs	lbs/ac
1. CWSI = 1	11	47	335
2. CWSI = 3	8	31	461
3. CWSI = 5	4	16	634
4. CWSI = 8	1	4	364
5. Soil moisture = -8 bars	3	15	618
LSD (.05)			145

Table 4. Alfalfa clean seed yields from five furrow irrigation criteria at the Sisson-Strickland Farm, Nyssa, Oregon, 1989.

Treatments, irrigation criteria	Furrow irrigations[1]	CWSI		Clean seed yields
		Average	Maximum	
	No.	- - Scale 0 - 10 - -		lbs/ac
1. CWSI = 1	7	1.4	3.9	625
2. CWSI = 3	4	1.7	4.2	781
3. CWSI = 5	3	2.8	5.2	848
4. CWSI = 8	2	4.4	4.8	633
5. CWSI = 10	2	5.0	8.5	520
LSD(.05)				130

[1]Two irrigations were applied before the treatments were imposed.

WEED CONTROL IN SEEDLING ALFALFA AND RED CLOVER WITH HERBICIDES APPLIED AS POSTEMERGENCE TREATMENTS

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Ontario, Oregon, 1989

Purpose

Foliar active herbicides were evaluated for annual grass and broadleaf weed control and for crop tolerance when applied in the spring to seedling alfalfa and red clover.

Procedures

Lahontan variety of alfalfa was seeded in sandy loam soil in the early spring of 1989. The red clover was a contaminant of the weed seed which was broadcast over the trial area and worked into the surface soil as the seedbed was prepared for planting alfalfa. The alfalfa was planted in rows 22 inches apart. After planting, the alfalfa was corrugated and watered by furrow irrigation. The alfalfa received two irrigations before plant emergence and one irrigation after the alfalfa had emerged and before the herbicide treatments were applied. Weed species seeded included barnyardgrass, green foxtail, and witchgrass. Species of broadleaf weeds emerging from natural field infestation included blue mustard, tumbling mustard, shepherdspurse, prickly lettuce, kochia, and pigweed. The emerging broadleaf weeds were removed by handweeding soon after emergence because of their density and competitive effects on seedling alfalfa, red clover, and weedy grass species. The herbicides were evaluated for crop tolerance and grass control when applied as single and tank-mix combinations. The tank-mix combinations included herbicides active on broadleaf weeds but were only included to evaluate for antagonistic effects affecting herbicidal activity of the herbicides applied for grass control.

Individual plot size was four rows wide (88 inches) by 30 feet long. Each treatment was replicated three times and treatments were arranged at random in blocks. The herbicides were applied as early and late applications. The early applications were applied on May 23. The late applications on June 9. On May 23 the alfalfa was three to four inches tall and the clover two to three inches tall with three to four trifoliate leaves. The grasses ranged in size from one leaf to plants with three tillers. On June 9 the grasses were about one foot tall and just topping the alfalfa and red clover plants.

The herbicides were applied as broadcast applications using a bicycle wheel plot sprayer equipped with a 7.5-foot boom and four teejet fan nozzles, size 8002. Nozzles were located on the boom so each individual nozzle would spray directly over a single row. Spray pressure was 42 psi and volume of water applied was 21.5 gallons/ac. Spraying conditions on May 23 were clear skies, wind 2-4 mph, air temperature 62°F, and soil temperature 76°F.

The treatments were evaluated for crop tolerance and grass control at intervals of 7, 14, 21, and 28 days following the application of the herbicide treatments.

Results

The herbicide treatments and ratings for crop tolerance and grassy control are listed in Table 1 for early applied treatments and Table 2 for the late applied treatments. Select effectively controlled all grasses alone and in combination with broadleaf herbicides at rates of 0.094, and 0.125 lbs ai/ac at both early and late time of applications. Fusilade 2000 and Assure were less active than Select for control of green foxtail and barnyardgrass. Poast at 0.2 lbs ai/ac resulted in good control of all grass species but the herbicide is less active than Select. Witchgrass was most sensitive of the grass species and was quite effectively controlled by all herbicide treatments. All grass herbicides were compatible as tank mixes with Buctril, 2,4-DB, and Pursuit. Buctril and 2,4-D caused some initial injury to both alfalfa and red clover, but recovered without showing injury at the 28-day evaluations. Both alfalfa and red clover were tolerant to Select, Fusilde 2000, Assure, and Pursuit. Growth or herbicide symptoms never occurred to alfalfa or red clover with these herbicides.

Table 1. Percent control of grasses and ratings for crop tolerance from herbicides applied to seedling alfalfa and red clover as early postemergence applications. Spark's Farm, Nyssa, Oregon, 1989.

Herbicides	Rate	Crop injury				Barnyardgrass				Green Foxtail				Witchgrass			
		7	14	21	28	7	14	21	28	7	14	21	28	7	14	21	28
	lbs ai/ac	% control															
Select	0.078	0	0	0	0	70	92	100	100	70	99	100	100	80	100	100	100
Select	0.094	0	0	0	0	83	98	100	100	78	100	100	100	85	100	100	100
Select	0.125	0	0	0	0	85	100	100	100	83	100	100	100	90	100	100	100
Poast	0.20	0	0	0	0	72	95	100	100	65	98	99	99	86	100	100	100
Fusilade 200	0.1875	0	0	0	0	68	90	100	100	45	65	50	50	85	100	100	100
Assure	0.094	0	0	0	0	70	90	98	96	63	55	60	55	80	95	98	100
Assure	0.125	0	0	0	0	68	93	100	100	72	68	70	65	86	98	100	100
Select + Buctril	0.094 + 0.5	55	30	0	0	73	98	100	100	72	99	100	100	83	100	100	100
Select + Buctril	0.125 + 0.5	50	25	0	0	83	100	100	100	82	100	100	100	88	100	100	100
Select + 2,4-DB	0.094 + 0.05	18	10	0	0	73	96	100	100	72	99	100	100	83	100	100	100
Select + 2,4-DB	0.125 + 0.5	20	12	0	0	82	98	100	100	83	100	100	100	88	100	100	100
Check		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2. Percent control of grasses and ratings for crop tolerance from herbicides applied to seedling alfalfa and red clover as late postemergence applications. Spark's Farm, Nyssa, Oregon, 1989.

Herbicides	Rate	Crop injury				Barnyardgrass				Green foxtail				Witchgrass			
		7	14	21	28	7	14	21	28	7	14	21	28	7	14	21	28
	lbs ai/ac	% control															
Select	0.078	0	0	0	0	60	85	96	98	65	90	93	95	72	95	97	100
Select	0.094	0	0	0	0	68	96	98	100	72	95	97	100	80	98	99	100
Select	0.125	0	0	0	0	75	96	100	100	78	99	99	100	88	98	100	100
Poast	0.20	0	0	0	0	65	88	93	98	68	86	90	98	75	90	98	100
Select + Pursuit	0.094 + 0.25	0	0	0	0	62	95	99	100	73	93	97	100	85	98	100	100
Select + Pursuit	0.125 + 0.25	0	0	0	0	68	97	99	100	79	96	98	100	92	99	100	100
Check		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Rating: 0 = no herbicide effect
10 = all plants killed

WEED CONTROL RESEARCH IN MINT

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Justification

The production of mint oil is an important part of the agricultural industry in eastern Oregon and southwest Idaho. Weeds have continually infested mint fields resulting in reduced oil yields from plant competition and lowering the quality of mint oil from weed oils as contaminates. Several herbicides are registered to control weeds selectively as soil and post applications. Most herbicides are very effective and have been used with success. As new weed species infest fields because of tolerance to presently used herbicides, or as weeds which were once controlled by registered herbicides develop resistance, there is a need for new herbicides of another chemistry to be tested and, if effective, be registered. Continued research is needed to find new or improved methods to control weeds in mint and integrate these methods into an effective weed management program.

Objectives

1. Obtain residue data necessary for the federal registration of Stinger and Prowl herbicides through the IR-4 program.

2. Evaluate tank mixes of soil and foliar active herbicides for tank compatibility and activity on weeds by species and tolerance of spearmint and peppermint to herbicides at various rates and combinations.

3. Evaluate the tolerance of spearmint and peppermint as new and established plantings to fall plowdown and surface-applied and mechanical-incorporated applications of metolachlor herbicide for control of yellow nutsedge.

4. Evaluate the tolerance of emerging baby mint crops to preplant incorporated and postplant pre-emergence surface applications of Treflan, Sinbar, Sonalan, prodiamine, and Stinger.

5. Evaluate the following herbicides for weed control efficancy and crop tolerance when applied in the fall:

    1. Stinger
    2. Prowl
    3. Goal
    4. Tough
    5. Sinbar
    6. Select
    7. Fusilade
    8. Buctril
    9. MCPB
    10. Pursuit
    11. Prefar
    12. Dual
    13. Treflan
    14. Sonalan
    15. prodiamine

6. Identify the following species of weeds as susceptable or tolerant to the previous by listed herbicide treatments.

1.	Prickly lettuce	7.	tumble mustard	12.	green foxtail
2.	blue mustard	8.	shepherd purse	13.	Canada thistle
3.	salisfy	9.	mallow	14.	yellow nutsedge
4.	kochia	10.	hairy nightshade	15.	quackgrass
5.	lambsquarters	11.	barnyardgrass	17.	downy brome

Procedures Used to Conduct Research Trials

1. Stinger and Prowl herbicides were applied during fall and spring to determine oil yields and residue data from harvested hay.

   a. Trials were located on good stands of peppermint identified for us by Dick Nelson of Todds Oil Company, Nampa, Idaho. Growers were Leland Ernest and Todd Eggars.

   b. Treatments applied included Stinger fall applications at rates of 3/16, 1/4, 3/8, and 3/4 pounds ai/ac. Spring applications were at rates of 3/16 and 3/8 pounds ai/ac. Repeat fall and spring applications included 1/4 + 1/8 and 1/2 + 1/4 pounds ai/ac. Individual plot size was 9 x 30 feet and each treatment was replicated four times using a randomized complete block experimental design. Fall treatments were applied on November 11 and 12, 1988. Spring treatments were applied on June 3, 1989. Sinbar at 1.5 lbs ai/ac was oversprayed the Stinger plots for assistance to Stinger for weed control. Herbicides in these trials and all subsequent trials described in this annual report were applied using a single bicycle wheel plot sprayer. Spray boom was nine feet long using 8002 teejet fan nozzles spaced ten inches apart along the boom. Herbicides were applied as double-overlap broadcast applications using a spray pressure of 35 psi, applying water as the herbicide carrier at the rate of 28 gallons per acre.

   The Stinger trials were harvested on July 24, 1989. The Prowl trials were harvested on July 27, 1989. A single ten-pound hay sample was collected from the harvested area of each plot and air dried before distilled at at Oregon State University. Total area harvested from each plot to obtain hay weights and calculate oil yields was 33.4 sq ft taken from the center strip of each plot. Weeds escaping herbicides were removed by handweeding at frequent intervals.

2. These trials were conducted to evaluate the compatibility of herbicide combinations when applied in the fall and/or spring as tank mixes to established stand of peppermint and spearmint for control of winter and summer annual grasses and broadleaf weeds.

   a. Trials were located on peppermint fields in Oregon and Idaho at C.R. Kesler's, Stuart Batt's, Todd Eggar's, and Owen Frorer's. Trials on spearmint were located at Stuart Batt's, Ontario, Oregon.

   b. The peppermint and spearmint fields were 2- and 3-year-old stands. The crops were in the semi-dormant growth condition when the fall treatments were applied. The mint plants had started growing with buds at the soil surface in the peppermint fields and the spearmint had about one to two inches of new growth when the spring treatments were applied. The fall treatments were applied between November 1 and 17, 1988. The spring treatments were applied during late March and early April, 1989. The herbicides were applied using the same equipment and procedures described previously in section 1, (Stinger and Prowl). Weed species present, but variable in density and species between fields, were prickly lettuce, salisfy, shepherds purse, tumbling mustard, downy brome, and blue mustard. On occasion in some fields early germinating kochia and pigweed plants were emerging when the spring treatments were applied.

3. Fall-applied soil and foliar active herbicides followed by spring-applied foliar active herbicides were evaluated for tolerance to established peppermint stands and for control of winter and summer annual broadleaf and grassy weeds.

   a. The trial was on the Owen and Craig Frorer farm located near Nyssa, Oregon.

   b. The fall-applied herbicides included Prowl, Prodiamine, Goal, and Sinbar. Prowl was applied alone and as tank-mix combinations with Goal and/or Sinbar. These herbicides were applied on November 16, 1988. The peppermint was a one year old planting. The weeds emerged when the fall herbicide treatments were applied included prickly lettuce, salisfy, blue mustard, tumbling mustard, and quackgrass in spots over the trial area. The spring applied postemergence herbicides included Stinger, Tough, Buctril, Fusilade, and Select. Stinger was applied in two-way tank-mixes with Tough, Buctril, Fusilade, and Select and in three-way tank-mixes with Buctril/Fusilade and Tough/Fusilade. A split plot experimental design was used for this trial. All treatments were replicated three times. The spring herbicide treatments were applied on May 19. All fall treated plots were relatively free of spring emerging summer annual weeds. Sinbar + Prowl and Goal + Prowl treated plots were relatively free of all weeds. Quackgrass was severely injured by Sinbar in those plots receiving fall applied Sinbar + Prowl. Weed species in the plots receiving only spring applied herbicide treatments included prickly lettuce, salisfy, blue mustard, tumbling mustard, quackgrass, kochia, downy brome, green foxtail, barnyardgrass, and pigweed. In these plots the quackgrass was 12 to 16 inches tall, barnyardgrass, green foxtail, kochia and pigweed plants were two to four inches tall and the winter broadleaf weeds four to ten inches tall with rosettes three to eight inches across. The herbicides were applied using the same equipment and procedures described previously in Section 1.

4. Several postemergence herbicides applied singly and in tank-mix combinations were evaluated for the control of emerged annual broadleaf weeds when applied in the spring to actively growing peppermint and spearmint.

   a. The experimental sites were located at Stuart Batt's, Oregon Slope near Weiser, Idaho, and the Malheur Experiment Station, Ontario, Oregon. The herbicides were selected to evaluate for the control of mustard weed species which normally escape fall applications of Stinger and Prowl and to determine the tolerance of mint to Pursuit.

   b. The herbicide treatments included single applications of Stinger, Buctril, MCPB, Pursuit and two-way tank-mixes of Buctril + MCPB, Buctril + Stinger, Pursuit + Stinger and a three-way tank-mix of Stinger + Buctril + MCPB. The treatments were applied on March 30 at Stuart Batt's and April 6 to plots at the Malheur Experiment Station. Weeds emerged when treatments were applied at Stuart Batt's included prickly lettuce, blue mustard, salisfy, lambsquarters and kochia. Weed species in plots at the Malheur Experiment Station included prickly lettuce, blue mustard, and kochia. At the time of treatment application the prickly lettuce and blue mustard plants had rosettes from 3 to 5 inches in diameter. The salisfy plants had as many as eight leaves. The kochia and lambsquarters were small seedlings less than two inches tall. The spearmint had four inches of new spring growth and the peppermint was budding, with less than an inch of new growth above the soil surface. Individual plots were 9 x 30 feet and each treatment was replicated three times. The herbicides were applied with the same equipment and procedures as described in section 1.

5. Herbicide treatments with residual soil activity were applied in the fall and spring to evaluate for weed control and crop tolerance to new planting of spearmint.

   a. Trials were located at Bob Friday's, Meridian, Idaho, and on Owen Frorer's farm Nyssa, Oregon.

   b. The herbicides included Prowl and Prodiamine and tank-mix combinations of Prowl + Sinbar, and Prowl + Prefar. The spearmint was planted in bedded land during early November and the fields were corrugated after planting in preparation for next year's furrow irrigation. The herbicides were applied as broadcast treatments and left on the soil surface of the newly planted mint. The herbicides applied as fall treatments were applied soon after planting. The spring treatments were applied at Owen Frorer's on March 30, on April 6, at Bob Friday's. At each location they were applied as soon as the surface of the soil was dry enough to get the spray equipment into the field. At both locations a few mint plants were emerged when the spring treatments were applied. Individual plots were 9 x 30 feet and each treatment was replicated three times.

6. Stinger herbicide applied as single and repeat applications for Canada thistle control in peppermint.

   a. The trial was in a year old peppermint planting. The field was located near Fruitland, Idaho.

   b. The herbicide treatments included Stinger applied as single and repeat applications at several rates. A surfactant was added to all Stinger treatments at a rate of 0.25 percent v/v. The single treatments were fall and spring applications. The repeat applications were applied in the late fall and spring. The fall applications were applied on October 29 and the spring treatments applied on May 12. The fall treatments were applied after the Canada thistle had been frosted with several light frosts. The plants were still green and plant populations were uniform over the trial area. Individual plants ranged in size from small recently emerged plants to plants with shoots 10 to 16 inches tall. The field had been irrigated late thus the plants had not been subjected to stress. On May 12, when the spring treatments were applied most of the Canada thistle plants in the plots previously treated on October 29, were necrotic and appeared dead. Some new plants had emerged in these plots since the fall treatments were applied. Many of these plants were chlorotic and weakened by the fall applied Stinger. The Canada thistle plants in the non-treated plots had made rapid growth during the fall and spring and plant populations were dense. Some plants were budding but 90 percent were in the prebud stage when the spring Stinger treatments were applied. Peppermint plants were sparse in the trial area because of competition from the growth of the Canada thistle. Individual plots were 9 x 25 feet and each treatment was replicated three times. Individual replications were separated and placed in close proximity to one another but where Canada thistle stands were dense and most uniform. The herbicides were applied as broadcast applications with the same equipment and procedures described in section 1.

7. An experiment was conducted to evaluate Dual herbicide for the control of yellow nutsedge when applied in the fall and incorporated to a depth of 12 inches as the plots were moldboard plowed. Previous results using this technique has shown good control of nutsedge and adequate crop tolerance to crops sensitive to Dual incorporated in the top few inches of soil before planting.

   a. The trial was conducted in part of a seven acre field, heavily infested with yellow nutsedge. The field was rented from Guy Sparks for research to conduct trials for selective nutsedge control in several crops.

   b. Dual (metalachlor) was applied at three, four, six, and eight pounds ai/ac in strips 64 feet wide across the seven acre field. The width of the field and length of the strips was approximately 400 feet. The Dual was applied as broadcast treatments to the soil surface and incorporated to a depth of three to four inches with a double discing using a 12 foot tandem disc. After discing, the field was plowed to a depth of 12 inches with a 16-inch moldboard plow. The field was left plowed over winter. In the spring the field was tilled to prepare seedbed and peppermint planted in strips 20 feet wide at random lengthwise to the field and across the Dual incorporated strips. Each herbicide rate and planted strip was replicated three times and placed at random within the trial area. Sinbar at 1.5 pounds per acre applied as a postplant treatment was a supplemental treatment to some of the Dual plowdown applications. The Sinbar was incorporated in the upper two inches of soil by using a rotary harrow. The harrow was operated twice over the plots in a direction parallel to the planted rows at a tractor speed of seven mph. The herbicides were applied as a double overlap application using a field sprayer equipped with a 24 foot boom. Teejet fan nozzles size 8002 were spaced along the boom at ten inch spacings. Spray pressure was 35 psi and water as the carrier was applied at a volume of 28 gallons per acre. The crops were destroyed after the treatments were evaluated in mid-July in preparation for continuation of the study during 1990 and 1991. The three year study was designed to determine if yellow nutsedge can be eradicated if nutlets produced from growing yellow nutsedge plants can be inhibited from growing for three consecutive years.

<u>Results and Conclusions</u>

1. <u>Treatments are listed in Table 1.</u> Stinger did not cause herbicide symptoms on peppermint plants when applied in the fall at rates of 3/16, 1/4, and 3/8 pounds ai/ac. Herbicide symptoms on terminal leaves did persist until harvest from Stinger applied in the fall at 3/4 pounds ai/ac and when applied in the spring at 3/16 and 3/8 pounds ai/ac. Repeat applications of Stinger (fall and spring) were no more severe on peppermint than spring applied Stinger alone.

Hay and oil yields were not different from Stinger treatments of 1/4 + 1/8 and 1/2 + 1/4 applied in fall and spring than those yields harvested from the untreated check plots. Peppermint was tolerant to Prowl applied in the spring at rates of 1, 2, 3, and 4 pounds ai/ac. Yields of harvested hay and oil yields compared to hay and oil yields from untreated check plots. Residue data from green hay and oil samples for Stinger and Prowl will be available to support the registration of these herbicides for use in mint.

2. Treatments listed in Table 2. Stinger was compatible when tank-mixed with Prowl, Goal, Sinbar, and Tough in two and three-way mixes. Stinger very effectively controlled prickly lettuce and salisfy. It did not have activity on blue mustard, tumbling mustard, or the summer annual broadleaf and grassy weeds. Prowl persisted from fall applications to control the summer weeds which are not controlled by Stinger. Stinger in combination with Goal was also compatible. Goal did give partial control of the mustard weed species. Tough tank-mixed with Stinger applied in the spring controlled kochia and pigweed. Tough was much less active on the mustards, prickly lettuce and salisfy and had essentially no activity on the grasses. Sinbar applied in tank-mix combinations with other herbicides seems to enhance the activity of other herbicides to improve weed control, but does not effectively control all weed species by itself. Generally weed control and crop safety was better from all herbicides applied in the fall compared to spring applied treatments. Quite often early germinating winter weeds grew through the winter and were too large to be effectively controlled with economical rates of spring applied Stinger herbicide. This was most apt to happen when applications were delayed in the spring by rain.

3. Treatments are listed in Table 3. Most of the herbicide treatments resulted in excellent weed control for a broad spectrum of weed species without the herbicides causing injury to mint. Sinbar, Prowl, and Goal were applied in the fall to control some emerged weeds (Sinbar and Goal) but primarily to be activated by late fall and winter moisture. The postemergence spring applied herbicides included Stinger, Tough and Buctril for control of emerged broadleaf weeds. Fusilade and Select was tank-mixed with Stinger, Tough and Buctril for postemergence activity on annual and perennial grasses. All materials were compatible when tank-mixed. Prowl applied in the fall with Sinbar and Goal was activated by winter moisture. Prowl combination treatments resulted in good control of the summer annual broadleaf and grassy weeds. Sinbar had partial activity on prickly lettuce and tumbling mustard. Prowl had no activity on prickly lettuce, salisfy, tumbling mustard, or blue mustard. Sinbar did not control blue mustard or salisfy. Goal applied with Prowl gave partial control of blue mustard, prickly lettuce, tumbling mustard but was much less active on salisfy than Stinger. Stinger spring applied to plots previously receiving fall applied Prowl and Sinbar or Prowl + Goal controlled escaping prickly lettuce and salisfy. Stinger did not control the mustard species. Buctril tank-mixed with Stinger resulted in excellent control of all broadleaf weed species escaping the fall applied treatments. Fusilade and Select were very active on all annual grasses including downy brome, barnyardgrass and green foxtail. Select was not active on quackgrass. Fusilade gave partial quackgrass control but quackgrass control was more effective when Fusilade treatments were applied following fall applications of Sinbar. Peppermint was very tolerant of Tough. Tough was very active on the emerged summer annual broadleaf weeds but did not control prickly lettuce, salisfy or blue mustard.

4. Treatments are listed in Table 4. In silt and clay loam soils spring applied Prowl was activated under sprinkler irrigation and persisted to control summer annual broadleaf weeds through the growing season and continued to keep annual weeds from emerging in the postharvested spearmint and peppermint plots. Foliar and soil activity of Stinger controlled prickly lettuce and salisfy under sprinkler irrigation from spring applications. Buctril and Stinger tank-mix combinations controlled all emerged broadleaf weeds including prickly lettuce, blue mustard, salisfy and the emerged summer annuals including kochia, lambsquarters, and pigweed. MCPB was less active on broadleaf weeds than Stinger or Buctril and both peppermint and spearmint was less tolerant of MCPB than either Stinger or Buctril. Pursuit eliminated mint stands at rates used in this study. Pursuit is very active on mustard species and would be an excellent candidate for a tank-mix combination with Stinger if mint is found tolerant to Pursuit at lower rates.

5. Treatments are listed in Table 5. New fall plantings of spearmint were tolerant to both fall and spring applications of Prowl, Prodiamine, and Prowl as tank-mix combinations with Sinbar and Prefar when rates of Prowl did not exceed 1.5 pounds ai/ac. Fall treatments resulted in better weed control and mint tolerance was greater than with spring applications. Prowl plus Sinbar and Prowl plus Prefar were superior to Prowl applied singly. Prodiamine at 1.0 pound ai/ac resulted in better weed control than Prowl at rates with mint tolerance. Spring applications of Prowl needs mechanical tillage for incorporation to fully activate the chemical to result in adequate weed control. Germinating mallow plants were quite effectively controlled by Sinbar and Prowl when applied in the fall.

6. Treatments are listed in Table 6. Fall applied treatments of Stinger at several rates were compared to spring applied treatments and repeat treatments applied in the fall and spring were compared to single applications for the control of Canada thistle at various rates of Stinger herbicide in peppermint. The percent crop injury and Canada thistle control was rated on June 2 and July 20. Repeat applications (fall and spring) resulted in much better control of Canada thistle than did the single applied fall or spring applications. Fall applied applications were also better giving about 12 percent more control compared to the spring applied treatments. The percent control of Canada thistle at the intermediate rates applied in the fall, spring and repeat applications was 72%, 60%, and 89% respectively. Stinger applied in the fall and again in the spring were significantly better for Canada thistle than were the single applications applied either in the spring or fall.

7. Treatments are listed in Table 7. Peppermint showed good tolerance to Dual applied in the fall and plowed under with a moldboard plow. Crop injury and percent weed control ratings were taken on May 5 and July 24. The mint did not show injury from the herbicide treatments at any time during the growing season. The percent control of yellow nutsedge improved from 42%, 57%, 63%, and 73% respectively as the rate of Dual was increased from 3, 4, 6, and 8 pounds ai/ac. An additional increase in the percent nutsedge control was obtained with Sinbar applied as a postplant preemergence application at the rate of 1.5 pounds ai/ac. The percent control of yellow nutsedge with the Dual/Sinbar combination treatments were 88, 95, 98, and 99 percent as the rate of Dual increased from 3, 4, 6, and 8 pounds ai/ac. The combination treatments were superior to the single application of Dual. The Sinbar improved the control of yellow nutsedge by controlling the nutsedge plants

germinating from shallow nutlets near the soil surface where Dual concentrations were less than adequate to be phytotoxitic.

Table 1. Crop injury ratings and harvested hay and oil yields from peppermint treated with Stinger and Prowl herbicides. Eggar's Farm and Malheur Experiment Station, 1989.

Herbicides	Rates	Time applied	Crop injury R_1	Crop injury R_2	Crop injury R_3	Crop injury R_4	Avg	Green Hay Yields R_1	Green Hay Yields R_2	Green Hay Yields R_3	Green Hay Yields R_4	Avg	Oil yields R_1	Oil yields R_2	Oil yields R_3	Oil yields R_4	Avg
	lbs ai/ac		%					lbs/33.4 sq ft					ml/10 lbs hay				
Stinger	3/16	fall	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-
Stinger	1/4	fall	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-
Stinger	3/8	fall	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-
Stinger	1/4 + 1/8	fall & spring	0	0	0	0	0	30.3	32.5	43.1	35.3	35.3	18.5	23.5	21.5	23.0	21.6
Stinger	3/16	spring	5	10	10	5	8	-	-	-	-	-	-	-	-	-	-
Stinger	3/8	spring	15	20	20	20	18	-	-	-	-	-	-	-	-	-	-
Stinger	3/4	fall	10	5	5	5	6	-	-	-	-	-	-	-	-	-	-
Stinger	1/2 + 1/4	fall & spring	10	15	15	15	12	34.1	39.4	40.6	38.0	38.0	20.0	21.0	22.5	22.6	21.5
Check	-	-	0	0	0	0	0	31.6	37.8	43.8	37.7	37.7	24.0	22.5	23.5	23.0	23.2
Prowl	1.0	spring	0	0	0	0	0	43.0	50.8	45.6	55.5	48.7	17.5	16.0	16.5	15.5	16.4
Prowl	2.0	spring	0	0	0	0	0	51.8	51.9	45.9	51.6	50.3	10.5	17.0	16.5	19.5	15.9
Prowl	3.0	spring	0	0	0	0	0	55.0	55.4	44.6	45.4	50.1	15.5	14.0	16.0	15.0	15.1
Prowl	4.0	spring	0	0	0	0	0	47.6	51.2	44.4	50.2	48.3	14.5	16.0	16.0	15.5	15.5
Check	-	spring	0	0	0	0	0	52.7	40.1	49.0	49.3	47.7	15.5	15.0	14.5	17.5	15.6

Visual evaluations taken and plots harvested on July 24 and 25, 1989.
Ratings 0 to 100: 0 = no plant injury, 100 = all plants killed.

Table 2. Percent weed control and crop injury ratings from herbicides applied to peppermint in the fall of 1988. Kesler Farms, Nyssa, Oregon, 1989.

Herbicides	Rates	Time applied	Crop injury	Prickly Lettuce	Salisfy	Blue Mustard	Tumbling Mustard	Kochia	Pigweed	Barnyard grass	Green Foxtail
				Weed Control							
	lbs ai/ac		%	%							
Stinger + Prowl	0.125 + 2	fall	0	100	100	20	30	99	99	99	99
Stinger + Prowl	0.188 + 2	fall	0	100	100	25	30	100	99	99	99
Stinger + Prowl	0.25 + 2	fall	0	100	100	20	35	100	99	99	99
Stinger + Goal + Prowl	0.125 + 0.5 + 2	fall	8	100	100	93	86	100	99	99	99
Stinger + Goal + Prowl	0.125 + 0.75 + 2	fall	12	100	100	96	89	99	99	99	99
Goal + Prowl	0.75 + 2	fall	8	82	70	95	85	99	99	99	99
Goal + Prowl	1.0 + 2.0	fall	15	88	75	98	92	99	99	99	99
Stinger	0.125	fall	0	100	100	0	0	10	15	0	0
Goal	1.0	fall	15	85	75	98	88	78	83	35	40
Goal + Prowl + Sinbar	0.75 + 2 + 1	fall	12	91	70	98	88	100	99	99	99
Stinger + Prowl + Sinbar	0.125 + 2 + 1	fall	0	100	100	10	68	100	99	99	99
Tough + Prowl	1 + 2	fall	0	40	30	10	30	98	100	98	96
Tough + Prowl	2 + 2	fall	0	52	35	10	40	99	100	99	98
Stinger + Prowl	0.125 + 2	spring	0	100	92	5	20	93	90	92	94
Stinger + Prowl	0.188 + 2	spring	0	100	98	10	25	90	88	90	82
Stinger + Goal + Prowl	0.125 + 0.5 + 2	spring	15	100	95	85	88	95	92	90	90
Goal + Prowl	1.0 + 2.0	spring	25	82	70	88	92	95	95	88	87
Stinger + Tough	0.125 + 1.0	spring	0	100	96	0	0	88	92	0	0
Goal + Stinger	1.0 + 0.125	spring	20	100	98	88	92	76	85	30	30
Stinger + Prowl + Tough	0.125 + 2 + 1	spring	0	100	96	15	22	99	92	88	90
Goal + Prowl + Tough	0.75 + 2 + 1	spring	15	78	78	82	88	99	94	88	90
Tough + Prowl	1 + 2	spring	0	45	30	0	25	100	99	90	88
Tough + Prowl	2 + 2	spring	0	48	35	0	35	100	100	90	90
Check	-	-	0	0	0	0	0	0	0	0	0

Ratings are average of six replications. Three replications at two experimental sites.
Ratings are from 0 to 100. Zero equals no herbicide effect, 100 equals all plants killed.

Table 3. Percent weed control and crop injury ratings from soil and foliar active herbicides applied as fall and spring applications. Frorer Farm, Nyssa, Oregon, 1989.

Herbicides Applied Fall	Herbicides Applied Spring	Rates Fall	Rates Spring	Crop injury	Pl	Bln	Tm	Sal	Kochia	Pg	Qg	Db	Bry	G Fox
				%	%									
Sinbar + Prowl	-	1.5 + 2	-	0	65	15	78	10	99	100	80	80	99	99
Sinbar + Prowl	Stinger + Fusilade	1.5 + 2	0.125 + 0.1875	8	100	0	0	99	100	100	95	100	100	100
Sinbar + Prowl	Tough	1.5 + 2	0.0	0	60	45	40	65	98	99	78	83	99	99
Sinbar + Prowl	Stinger + Tough	1.5 + 2	0.125 + 0.9	5	100	45	45	100	100	100	75	78	100	99
Sinbar + Prowl	Stinger + Buctril	1.5 + 2	0.125 + 0.5	15	100	98	98	100	100	100	80	85	99	99
Sinbar + Prowl	Tough + Fusilade	1.5 + 2	0.9 + 0.1875	0	65	40	35	55	100	100	98	100	100	100
Sinbar + Prowl	Tough + Select	1.5 + 2	0.9 + 0.125	0	65	35	35	60	100	100	78	98	99	100
Sinbar + Prowl	Buctril + Stinger + Fusilade	1.5 + 2	0.5 + 0.125 + 0.1875	18	100	99	99	100	100	100	94	99	99	99
Sinbar + Prowl	Tough + Stinger + Fusilade	1.5 + 2	0.9 + 0.125 + 0.1875	5	100	30	35	100	100	100	97	100	100	100
Sinbar + Prowl	Select + Stinger + Tough	1.5 + 2	0.9 + 0.125 +	8	100	35	35	100	100	100	95	100	100	100
									98	99	78	83	98	99
Goal + Prowl	-	1 + 2	-	0	72	82	88	68	98	83	25	76	78	82
Goal + Prowl	Stinger + Fusilade	1 + 2	0.125 + 0.1875	10	100	80	85	100	99	99	98	98	99	94
Goal + Prowl	Tough	1 + 2	0.9	0	55	83	85	70	100	99	32	47	99	96
Goal + Prowl	Stinger + Tough	1 + 2	0.125 + 0.9	8	100	85	85	100	100	99	34	45	96	98
Goal + Prowl	Stinger + Buctril	1 + 2	0.125 + 0.5	15	100	100	99	100	100	100	40	49	98	99
Goal + Prowl	Tough + Fusilade	1 + 2	0.9 + 0.1875	0	65	35	30	68	100	99	86	99	99	99
Goal + Prowl	Tough + Select	1 + 2	0.9 + 0.125	0	60	30	30	70	100	100	25	100	100	100
Goal + Prowl	Buctril + Stinger + Fusilade	1 + 2	0.5 + 0.125 + 0.1875	15	100	100	98	100	99	100	85	100	100	100
Goal + Prowl	Tough + Stinger + Fusilade	1 + 2	0.9 + 0.125 + 0.1875	5	100	35	35	100	100	100	85	99	100	100
Goal + Prowl	Select + Stinger + Tough	1 + 2	0.9 + 0.125 + 0.125	5	100	35	35	100	100	100	45	99	99	100
Prowl	-	2	-	0	15	15	20	15	96	98	5	72	98	99
Prowl	Stinger + Fusilade	2	0.125 + 0.1875	5	100	10	20	100	100	100	83	99	99	99
Prowl	Tough	2	0.9	0	60	30	30	65	99	99	0	83	98	99
Prowl	Stinger + Tough	2	0.125 + 0.9	8	100	35	35	100	100	100	5	80	99	99
Prowl	Stinger + Buctril	2	0.125 + 0.5	15	100	100	99	100	100	100	5	75	99	99
Prowl	Tough + Fusilade	2	0.9 + 0.1875	0	65	30	35	60	100	100	83	99	99	99
Prowl	Tough + Select	2	0.9 + 0.125	0	60	30	30	63	100	100	15	100	100	100
Prowl	Buctril + Stinger + Fusilade	2	0.5 + 0.125 + 0.1875	15	100	100	99	100	100	100	85	100	100	98
Prowl	Tough + Stinger + Fusilade	2	0.9 + 0.125 + 0.1875	8	100	40	45	99	100	100	82	100	100	98
Prowl	Select + Stinger + Tough	2	0.9 + 0.125 + 0.125	5	100	35	35	99	100	100	15	100	100	100
Check	Check	-	-	0	0	0	0	0	0	0	0	0	0	0

Ratings: 0 = no herbicide effect, 100 = all plants killed

Key for weed species:

a - Pl = prickly lettuce
b - Blm = blue mustard
c - Tm = tumbling mustard
d - Sal = Salisfy
e - kochia
f - Pg = pigweed
g - Qg = quackgrass
h - Db = downy brome
i - = Bry = barnyardgrass
j - GFox = green foxtail

Table 4. Percent weed control and crop injury ratings from Prowl tank-mixed with postemergence herbicides and postemergence herbicides applied singly as spring time applications. Stuart Batt and Malheur Experiment Station. Weiser, Idaho and Ontario, Oregon, 1989.

Herbicides	Rate	Crop injury	Weed Control Pl	Bm	Sal	Koc	Lqs	Pg	Bry	G Fox
	lbs ai/ac	%	%							
Prowl + Stinger	1.0 + 0.125	0	100	10	98	99	98	99	99	99
Prowl + Stinger	2.0 + 0.125	0	100	10	99	99	99	99	99	99
Prowl + Stinger	3.0 + 0.125	0	100	10	98	98	98	99	99	98
Prowl + Buctril + Stinger	2.0 + 0.5 + 0.125	0	100	92	100	100	100	100	99	99
Prowl + Buctril + Stinger	2.0 + 0.75 + 0.125	0	100	98	100	100	100	100	99	99
Prowl + Buctril + Stinger	2.0 + 1.0 + 0.125	10	100	100	100	100	100	100	99	99
Prowl + Buctril	2 + 0.5	0	70	93	25	100	100	100	98	99
Prowl + Buctril	2 + 0.75	0	85	98	30	100	100	100	99	99
Prowl + Buctril	2 + 1.0	10	95	100	30	100	100	100	99	79
Prowl + Goal + Sinbar	2.0 + 0.75 + 1.5	15	97	0	58	100	100	100	99	99
Stinger	0.125	0	100	0	99	0	20	20	0	0
Buctril	0.5	0	78	89	30	98	97	80	0	0
Buctril	0.75	0	85	93	32	99	99	83	0	0
Buctril	1.0	15	95	98	38	99	99	85	0	0
MCPB	0.5	15	65	68	28	85	80	23	0	0
MCPB	0.75	25	72	74	32	85	83	83	0	0
MCPB	1.0	40	78	75	40	88	85	85	0	0
Buctril + MCPB	0.25 + 0.25	5	83	92	65	100	100	100	0	0
Buctril + MCPB	0.25 + 0.50	12	85	93	50	100	100	100	0	0
Buctril + MCPB	0.25 + 0.75	25	89	92	60	100	100	100	0	0
Buctril + MCPB	0.50 + 0.25	40	96	98	55	100	100	100	0	0
Buctril + MCPB	0.50 + 0.50	50	100	99	55	100	100	100	0	0
Buctril + MCPB	0.50 + 0.75	50	100	99	65	100	100	100	0	0
Stinger + Buctril + MCPB	0.125 + 0.25 + 0.25	10	100	83	100	100	100	100	0	0
Pursuit	0.33	100	20	100	100	100	100	100	10	15
Pursuit	0.66	100	25	100	100	100	100	100	10	10
Pursuit	0.99	100	30	100	100	100	100	100	10	15
Pursuit + Stinger	0.33 + 0.125	100	100	100	100	100	100	100	15	15
Check	-	0	0	0	0	0	0	0	0	0

Ratings: 0 = No herbicide effect, 100 = plants killed

Weed species key:

1 - Pl = prickly lettuce
2 - Bm = blue mustard
3 - Sal = salisfy
4 - Koc = kochia
5 - Lqs = lambsquarters
6 - Pg = pigweed
7 - Bry = barnyardgrass
8 - G Fox = green foxtail

Table 5. Percent weed control and corp tolerance to new fall plantings of spearmint from soil active herbicides applied postplant as fall and spring applications. Bob Friday, Meridian, Idaho and Owen Frorer, Nyssa, Oregon, 1989.

			Crop Injury				Percent Weed Control: Barnyardgrass				Percent Weed Control: Hairynightshade			
Herbicides	Rate	Time applied	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
	lbs ai/ac		%											
Prowl	1.0	fall	0	0	0	0	60	65	60	62	35	45	50	43
Prowl	1.5	fall	0	0	0	0	85	80	85	83	70	85	85	81
Prowl	2.0	fall	10	15	10	12	100	99	98	99	95	98	98	97
Prowl + Sinbar	1.0 + 1.5	fall	0	0	0	0	75	85	85	82	99	99	99	99
Prowl + Sinbar	1.5 + 1.5	fall	0	0	0	0	90	98	95	94	100	100	100	100
Prodiamine	1.0	fall	0	0	0	0	99	100	99	99	99	99	99	99
Sinbar + Prefar	1.5 + 4.0	fall	0	0	0	0	100	100	100	100	100	100	100	100
Prowl	1.0	spring	10	15	10	12	40	35	40	38	25	20	20	22
Prowl	1.5	spring	20	20	15	18	45	50	55	50	30	35	30	32
Prowl	2.0	spring	25	30	25	26	65	60	65	62	50	60	55	55
Prowl + Sinbar	1.5 + 1.5	spring	10	15	10	12	70	65	70	68	90	80	85	85
Check	-	-	0	0	0	0	0	0	0	0	0	0	0	0

Ratings: 0 = no herbicide effect, 100 = plants killed
Evaluated May 25, 1989

			Weed Control: Pigweed				Weed Control: Lambsquarters				Weed Control: Mallow			
Herbicides	Rate	Time applied	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
	lbs ai/ac		%											
Prowl	1.0	fall	70	80	70	73	65	70	60	65	20	25	30	25
Prowl	1.5	fall	95	98	95	96	70	75	80	75	35	40	45	40
Prowl	2.0	fall	100	100	100	100	95	98	95	96	50	60	60	57
Prowl + Sinbar	1.0 + 1.5	fall	100	100	100	100	98	99	99	98	80	85	85	83
Prowl + Sinbar	1.5 + 1.5	fall	100	100	100	100	100	100	100	100	90	85	90	88
Prodiamine	1.0	fall	100	100	100	100	100	100	100	100	45	50	50	48
Sinbar + Prefar	1.5 + 4.0	fall	100	100	100	100	100	100	100	100	85	90	85	96
Prowl	1.0	spring	65	75	70	70	35	40	45	40	10	15	15	13
Prowl	1.5	spring	80	70	75	75	50	70	55	58	20	15	20	22
Prowl	2.0	spring	85	80	85	83	80	70	70	73	25	20	20	22
Prowl + Sinbar	1.5 + 1.5	spring	90	90	90	90	85	85	85	85	70	75	70	72
Check	-	-	0	0	0	0	0	0	0	0	0	0	0	0

Ratings: 0 = no herbicide effect, 100 = plants killed
Evaluated May 25, 1989

Table 6. Canada thistle control in peppermint with foliar applications of Stinger herbicide. Fruitland, Idaho, 1989.

			Crop Injury: June 2				Crop Injury: July 20				Control of Canada Thistle: June 2				Control of Canada Thistle: July 20			
Herbicide	Rate	Time applied	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
lbs ai/ac			%															
Stinger	0.125	fall	0	0	0	0	0	0	0	0	75	70	70	72	65	65	60	63
Stinger	0.188	fall	0	0	0	0	0	0	0	0	80	75	75	76	70	75	75	72
Stinger	0.25	fall	0	0	0	0	0	0	0	0	85	90	85	86	80	83	80	81
Stinger	0.125	spring	0	0	0	0	0	0	0	0	60	60	65	62	50	50	50	50
Stinger	0.188	spring	10	8	12	10	0	0	0	0	65	70	65	66	55	65	60	60
Stinger	0.25	spring	20	25	20	22	0	0	0	0	70	70	75	72	60	70	70	67
Stinger	0.125 + 0.125	fall & spring	0	0	0	0	0	0	0	0	85	90	90	88	90	85	85	87
Stinger	0.188 + 0.125	fall & spring	0	0	0	0	0	0	0	0	95	90	93	93	90	90	88	89
Stinger	0.25 + 0.125	fall & spring	0	0	0	0	0	0	0	0	98	95	98	97	90	95	95	93
Check	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Ratings: Indicates percent reduction in plant population and plant growth compared to plant numbers and growth in untreated check plots.

Table 7. Percent control of yellow nutsedge (Cyprus esculentus) and tolerance of new peppermint plantings to preplant plow-down applications of Dual (metolachlor) and postplant incorporated Sinbar (terbacil). Nyssa, Oregon, 1989.

		Crop Injury								Control of Yellow Nutsedge							
		May 5				July 24				May 5				July 24			
Herbicide	Rate	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
	lbs ai/ac	%															
Dual	3.0	0	0	0	0	0	0	0	0	70	60	65	65	45	40	40	42
Dual	4.0	0	0	0	0	0	0	0	0	65	75	70	70	50	65	60	57
Dual	6.0	0	0	0	0	0	0	0	0	90	85	95	90	70	60	60	63
Dual	8.0	0	0	0	0	0	0	0	0	98	95	98	96	70	75	75	73
Dual + Sinbar	3.0 + 1.5	0	0	0	0	0	0	0	0	90	95	95	93	85	90	90	88
Dual + Sinbar	4.0 + 1.5	0	0	0	0	0	0	0	0	98	95	98	96	95	95	95	95
Dual + Sinbar	6.0 + 1.5	0	0	0	0	0	0	0	0	100	100	100	100	99	98	98	98
Dual + Sinbar	8.0 + 1.5	0	0	0	0	0	0	0	0	100	100	100	100	100	99	99	99
Check	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Ratings: Indicates reduction in plant population and plant growth compared to plant population and growth in untreated check plots.

ONION VARIETY TRIALS

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Malheur Experiment Station
Oregon State University
Ontario, Oregon, 1989

Purpose

Commercial and semi-commercial varieties of yellow, white, and red onions were compared for maturity date, bulb yields, bulb size, bulb shape, and storage quality.

Procedures

The onions were planted on April 26 in silt loam soil with 1.3 percent organic matter and a pH of 7.3. Wheat and sugar beets had been grown in the field in 1988 and 1987 respectively. The wheat stubble was shredded and the field was deep-chiseled, disked, irrigated, and moldboard-plowed in the fall. One-hundred pounds per acre of P_2O_5 and 60 pounds N per acre was broadcast before plowing. The field was not tilled in the fall after plowing.

Fifty-six varieties were planted in plots four rows wide and 25 feet long. Each variety was planted in five replications. Seed for each row was prepackaged using enough seed for a planting rate of 12 viable seeds per foot of row. Onions were planted with 12-inch cone-seeders mounted on a John Deere Model 71 flexi-planter unit equipped with disc openers.

The onions were watered by furrow irrigation immediately after planting to assure adequate soil moisture for uniform seed germination and seedling growth.

On May 29, 40 pounds N per acre as Uran solution 32 was applied in the water during furrow irrigation. The onions were hand-thinned on June 8 and 9 to a population of four plants per linear foot of row. Two hundred pounds of N per acre (ammonium sulfate) was sidedressed on June 15 by shanking on each side of all rows planted on single-row beds.

Ammo insecticide for thrip control was applied at the rate of four ounces per acre during each aerial application on June 19, July 15, July 27, August 8, and August 19.

Maturity ratings were recorded on August 7, 14, 21, 28, and September 12. Numerical ratings given were based on percent of bulbs with tops fallen over.

The onions were lifted on September 23, topped, and bagged on October 3, 4, and 5, and put in storage on October 6 and 7. One-half the onions were graded on January 12 and 13. The remaining half of the onions will stay in storage until mid-March and graded at that time to obtain better ratings for onion varietal storage quality. The onion bulbs were graded according to diameter of bulbs. Sizes were 2 1/4 to 3 inch (medium), 3 to 4 inch (jumbo), and larger than 4-inch (colossal). Split bulbs were classed as Number Two's.

The bulbs infected by <u>Botrytis</u> were weighed to determine percent storage rot and then graded for size. The storage rot data are reported as average neck rot and potential neck rot. The average neck rot data is the mean of observed neck rot from five replications. Potential neck rot is the percent rot from a single replication where the greatest amount of neck rot occurred.

Results

Each variety is listed by company furnishing the seed and listed in descending order according to total yield. Bulb yields were good this year and size was normal. Planting date and harvest was about ten days later than normal, but most varieties matured well. The onions stored well with low incidence of neck rot among all varieties.

Average bulb yields were 674 cwt/ac with 40 percent colossal-sized bulbs and 48 percent jumbos. Overall percent Number Two's was less than 1 percent and the average neck rot for all varieties was 1.35 percent.

Early maturing varieties included Maya, XPH 3373, XPH 86N41, Red Baron, Hustler, RCSX 1463, Rio Gusto, RCSX 1462, and Golden Cascade. One half of the varieties had their tops down on August 14. Very few onions bolted in 1989.

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

Table 1. Yield and quality of onions in the 1989 variety trial. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Company	Variety	Yield Rank	Yield total	Average Neckrot	Potential Neckrot	Yield by Market Grade: + 4 inch		3-4 inch		2 1/4 - 3 inch		1 1/2-2 1/4 inch		2's	Maturity Reading: 8/7	8/14	8/21	8/28	9/12
			cwt/ac	%	%	cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac					
Amer. Takii	6403	1	876	1.83	6.41	636	73	205	23	9	1	0	0	9	0	0	0	5	10
	6404	12	771	2.56	2.56	444	58	289	38	18	3	0	0	0	0	3	20	45	70
	6210	17	745	0	0	405	54	289	39	10	1	1	1	41	0	0	2	15	60
	6212	44	602	0	0	96	16	458	76	36	6	0	0	11	10	20	70	92	95
Asgrow	XPH3326	21	709	0.97	4.85	322	45	347	49	22	3	0	0	11	20	30	85	95	95
	Armada	22	707	1.20	1.93	382	54	284	40	26	4	0	0	6	0	5	35	35	80
	Vega	25	685	1.04	3.08	351	51	283	41	39	6	1	1	4	0	1	3	20	50
	Maya	28	677	3.62	11.28	217	32	381	57	33	5	0	0	18	10	60	88	93	93
	XPH3373	34	647	0.48	0.75	200	30	374	58	55	9	0	0	15	20	80	97	98	98
	Fortress	55	477	0	0	18	4	342	72	116	24	0.6	0.12	0	0	9	90	93	93
Crookham	Dai Maru	3	823	4.73	17.47	498	61	233	29	29	3	0	0	20	0	2	5	25	65
	Sweet Amber	6	794	2.63	8.98	368	46	364	46	20	3	0	0	20	0	20	55	70	80
	XPH 85N52	7	788	1.38	3.55	505	64	238	30	20	3	1	1	12	0	3	3	23	60
	Celebrity	11	722	0.96	3.55	468	60	256	33	24	3	2	1	15	0	0	2	20	65
	Sweet Perfection	16	755	1.60	5.21	415	55	307	41	15	2	6	1	4	0	10	45	52	80
	Ringmaker	18	734	1.32	2.53	358	49	302	41	34	5	0	0	30	0	4	45	40	85
	XPH 86N41	35	644	1.40	6.15	191	30	389	60	36	6	0	0	18	20	60	90	90	90
	White Keeper	37	641	0.37	0.88	226	35	349	55	45	7	0	0	18	10	10	55	60	80
	White Delight	40	619	0.53	1.66	198	32	343	55	50	8	1	1	23	10	2	12	35	80
	Red Baron	51	526	0.20	0.51	80	15	355	67	87	17	0	0	22	20	50	50	60	80
Ferry Morse	Oro Grande	9	784	3.54	13.00	438	56	292	37	21	3	0	0	3	0	4	8	10	50
	Redman	42	618	2.68	12.93	158	25	360	58	63	10	0	0	20	0	2	30	40	83
	Class Pak	46	594	0.29	1.44	156	26	358	60	70	12	0	0	7	5	10	20	50	80
	Bullseye	47	577	0.31	0.91	157	27	358	62	60	10	0.5	0.1	0	0	0	3	10	50
Harris Moran	HXP 9087	5	809	1.44	3.70	559	69	210	26	17	2	0	0	11	0	0	3	18	65
	Target	14	762	1.77	2.62	470	62	248	33	21	3	0	0	10	0	0	0	0	15
	NCX 1008	41	619	0.61	1.15	150	24	384	62	63	10	1	0.2	16	0	3	17	60	80
	HXP 2616	45	597	0.67	1.69	176	29	305	51	71	12	0	0	41	0	0	5	48	75
	Hustler	53	484	0	0	116	23	256	53	108	22	3	0.7	7	70	95	99	99	99
Petoseed	70287	8	786	1.24	1.91	451	57	301	39	21	3	0	0	3	0	10	60	83	85
	72588	15	758	0.88	2.19	440	58	286	38	26	3	0	0	0	0	0	3	20	65
	62588	23	691	0.36	1.23	293	42	342	50	33	5	2	1	19	0	10	45	75	85
	62388	33	631	0	0	214	34	374	59	41	6	0	0	2	10	10	55	85	90
	81188	50	545	0.16	0.78	128	23	340	62	72	13	3.2	0.6	0.8	10	10	25	60	80
Rio Colorado	Rio Brillo	24	685	0.13	0.65	370	54	262	38	39	6	1	1	13	0	3	55	65	85
	1449	29	671	1.58	2.89	218	32	364	54	46	7	1	1	32	0	3	30	65	88
	1455	32	649	0.49	1.64	245	37	339	52	58	9	0	0	4	0	5	60	75	90
	Rio Nuevo	33	647	0.82	3.02	210	32	361	56	49	8	1	1	22	0	3	55	85	95
	Rio Perfecto	36	642	1.88	8.22	124	19	357	56	74	12	3	0.6	71	0	1	7	65	90
	Rio Rico	43	604	5.44	16.79	149	25	304	51	70	11	0	0	45	0	2	20	40	70
	Rio Oso	48	564	0.47	1.00	58	10	310	55	117	21	3	0.5	73	10	3	25	60	90
	1463	52	524	0.96	1.93	56	11	307	59	118	23	5	1	32	60	75	99	99	99
	Rio Gusto	54	484	1.44	3.12	23	5	255	52	157	33	9	2	34	90	95	99	99	99
	1462	56	470	2.62	10.79	22	5	239	51	165	36	15	3	16	60	65	90	96	98
Scott Seed	Great Scott	10	779	1.89	7.39	453	58	276	36	23	3	0	0	11	0	2	15	50	70

TABLE 1 CONTINUED ON THE NEXT PAGE

TABLE 1 CONTINUED

Company	Variety	Yield Rank	Yield total	Average Neckrot	Potential Neckrot	Yield by Market Grade: + 4 inch		3-4 inch		2 1/4 - 3 inch		1 1/2-2 1/4 inch		2's	Maturity Reading: 8/7	8/14	8/21	8/28	9/12
			cwt/ac	%	%	cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac					
Sunseeds	Valdez	2	857	2.14	4.75	595	69	220	26	16	2	0	0	5	0	0	10	25	70
	Avalanche	4	821	3.61	6.60	541	66	216	26	13	2	0	0	22	0	0	5	5	40
	Bravado	13	767	1.13	2.65	485	63	248	33	22	3	1	1	2	0	0	4	12	70
	Winner	19	729	1.61	5.65	400	55	281	39	28	4	1	1	6	0	2	15	55	80
	Cima	20	710	1.36	5.13	340	48	289	41	47	7	0	0	24	0	10	20	60	70
	Golden Cascade	26	685	0.41	1.33	323	47	332	48	27	4	1	1	0	0	80	90	90	90
	Blanco Duro	27	680	2.19	9.13	300	44	319	47	40	6	1	1	6	0	0	3	15	65
	Magnum	30	655	0.17	0.85	236	36	349	53	56	9	0.4	0.1	11	10	15	50	75	85
	Bullring	31	653	0.15	0.75	228	35	364	56	57	9	0	0	4	10	30	80	85	90
	Valient	39	631	0.51	0.93	256	40	319	51	53	8	0	0	1	0	2	50	80	90
	Tango	21	559	3.64	14.18	104	18	342	61	88	16	1.6	0.3	2.1	10	20	50	65	80
	Mean		674	1.35		286	40	312	48	49	8	1	0.19	15					
	LSD(.05)		53	3.17		63	8	44	7	25	5	3	0.60	15					
	CV(%)		3	84		8	7	5	5	18	20	107	109	36					
	P-value		.000	0.198		.000	.000	.000	.000	.000	.000	.000	.000	.000					

AN EVALUATION OF HERBICIDE TREATMENTS FOR ONION TOLERANCE AND WEED CONTROL

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Ontario, Oregon, 1989

Introduction

Herbicides were evaluated for weed control and crop tolerance in three separate trials. The objectives were: 1) determine the tolerance of onions, sugar beets, alfalfa, spring wheat, and sweet corn to plowdown applications of Dual (metolachlor) for control of yellow nutsedge (Cyprus esulentus) and 2) obtain efficacy data from herbicides applied as preplant, postplant-preemergence, and postemergence treatments. Preplant soil active herbicides were evaluated as fall and spring applications. Soil active treatments were compared to results obtained from Dacthal in an effort to find new herbicides to replace Dacthal if this material is restricted from further use because of potential ground water contamination.

Postemergence treatments were evaluated as sequential applications of Goal, Buctril, and Fusilade 2000 applied as single and tank-mix combinations. Rates of herbicides were lowered and the earliest applications were begun when the onion growth was at full flag. Our interest is to evaluate onion tolerance when herbicides are applied as sequential treatments to small weeds, soon after emergence, when they are most sensitive to herbicides as postemergence applications. Goal, Buctril, and Fusilade 2000 are presently labeled for application to seedling onions in the two true-leaf stage. Weeds emerging with onions are too large for effective control with Goal and Buctril when applications are delayed until onions have developed two true-leaves. Previous research results have shown improved weed control and adequate crop tolerance from tank-mix combination treatments applied to one true-leaf onions. Experimental herbicides evaluated but not registered for use in onions included Dual, Stinger, Select, Tough, and Nortron.

Procedures

Dual Plowdown: Dual (metolachlor) was applied in the fall at four rates (3, 4, 6, and 8 lbs ai/ac) to sandy loam textured soil with 0.97 percent organic matter and a pH of 6.7. The trial was selected as an experimental site because of uniform infestations of yellow nutsedge. The herbicides were applied to the soil surface as replicated strips, sixty-four feet wide, across the width of the field. The herbicide was applied with a field sprayer equipped with 8002 fan teejet nozzles as broadcast double overlap applications. Spray pressure was 35 psi and water as the herbicide carrier was applied at 23 gallons per acre. The field was disced twice to incorporate the herbicide before plowing with a moldboard plow to a depth of 12 inches.

In the spring (1989) the field was bedded and planted to the following crops: sweet spanish onions (Golden Cascade), sugar beets (WS-88), spring wheat (Bliss), alfalfa (Wrangler), and sweet corn (Jubilee). Individual crops were planted in strips, 8 rows wide, in a direction lengthwise to the field and across the herbicide strips. Both the herbicide strips and crops were each placed at random within the field and each were replicated three times.

Annual weeds emerging in the crops were controlled with herbicides registered for use in each crop applied as postemergence applications. Herbicides included Betamix + Poast for sugar beets, Goal + Buctril + Fusilade for onions, Buctril + Poast for alfalfa, Buctril + MCPA for wheat and Buctril + Atrazine for corn.

The effectiveness of the Dual treatments for control of yellow nutsedge and the tolerance of the crops to Dual were evaluated by visual ratings taken over a period of time from crop emergence to July 28. On July 28 the crops were roto-tilled to kill the plants and dispose of the crop residues to prepare the field for a repeat study in 1989-1990. Studies will continue for three consecutive years to evaluate the effectiveness of Dual in reducing field populations of yellow nutsedge under continuous use during normal crop rotation.

<u>Preplant Incorporated:</u> Herbicides applied as preplant incorporated treatments were applied in the fall during bedding and in the spring when beds were harrowed in preparation for planting. Fall herbicide treatments included Nortron and Nortron tank-mixed and applied with Pyramin and Hoelon. Dacthal was included as a check. These herbicides were applied in bands 11 inches wide and incorporated by placing the herbicide in a layer at the base of the bed. Commonly used bed harrows were used in the spring to remove the bed tops and the herbicides were incorporated by the teeth of the harrow as the beds were mulched and the seed bed prepared for planting.

Herbicides applied in the spring included Nortron, Ramrod, and Dacthal and Nortron applied in tank-mix combinations with Prefar, Ramrod, and Dacthal. Several rates were used with each combinations. Spring applied herbicides were applied on 11 inch bands to the surface of the soil after the beds had been harrowed nearly flat. The beds were harrowed a second time to incorporate the herbicides. A bed-harrow with angle-irons mounted under the harrow to maintain the furrows was used to incorporate the herbicides. The angle-iron runners firmed the soil on the shoulders of the beds thus preventing the treated soil on top of the beds from being dragged into the furrows during incorporation.

Both fall and spring herbicide treatments were applied using a single wheel bicycle plot sprayer. Four 8002E teejet fan nozzles were spaced 22 inches apart on the spray boom thus centered over each row. Spray pressure was 35 psi and water was applied at the rate of 28 gallons/ac. Individual plots were 25 feet long and four rows wide. Each treatment was replicated three times.

<u>Post-plant Preemergence:</u> Herbicide activity and resulting crop tolerance and weed control were compared between preplant incorporated and postplant soil surface shallow incorporated applications. Herbicide treatments applied as postplant applications were the same as those listed in the previous preplant section. The post plant applications were also applied as banded treatments soon after planting and incorporated in the surface soil by dragging a nailboard. Golden Cascade variety of sweet spanish onions were planted in all herbicide trials and trials were irrigated by furrow irrigation as soon as all treatments were applied. Soils in both trials were silt loam texture with a 7.3 pH and 1.2 percent organic matter.

Postemergence Trials: Herbicides applied as postemergence applications were evaluated in three separate trials. 1)Single and tank-mix combinations of Goal, Buctril and Fusilade 2000 applied as sequential applications at weekly intervals following the initial application which began at either the full flag, one true-leaf, or two true-leaf stage of onion growth, 2) comparing three grass herbicides (Select, Fusilade 2000, and Assure) alone and in tank-mix combinations with Goal and/or Buctril for control of green foxtail and barnyardgrass, and 3) evaluating Stinger, Prowl and pyridate (Tough) for onion tolerance and weed control.

Weed seeds of grass and legume species were broadcast seeded over the trial area and harrowed into the upper two inches of soil. Weed species that occurred from normal weed seed infestations included pigweed, lambsquarters, kochia, shepherdspurse, and hairy nightshade. After the weed seeds were broadcast and harrowed in, the field was bedded, planted, and furrow irrigated. Herbicides other than the postemergence treatments were not applied in these trials.

Herbicide treatments in Trial 1 included Goal, Buctril, and Goal + Buctril. Each herbicide and herbicide combination was applied at two rates. Applications of these herbicides were begun at different stages of onion growth to evaluate onion tolerance when treatments were initially applied at the flag, one true-leaf, and two true-leaf stages of onion growth. Refer to Table 4 for complete list of herbicides and rates.

All plots continued to receive application of herbicide treatments at weekly intervals after the initial application to evaluate crop for tolerance to sequential applications and to control weeds soon after emergence. Dates for applying the initial applications to onions in the flag, one true-leaf, and two true-leaf were May 19, May 31, and June 4 respectively. Total number of treatments applied to onions treated in the flag, one true-leaf, and two true-leaf were six, four, and three respectively. Size of weed species when treatments were initially applied to onions in the flag, one true-leaf and two true-leaf were colytedon-2 true-leaves, cotyledon to four true-leaf and cotyledon to eight leaves respectively. Fusilade 2000 was tank-mixed with all treatments at a rate of 12 fl oz/ac as needed in plots to control grass weed species.

Herbicides in Trial 2 included Select, Fusilade 2000, Assure, Goal, Buctril and Select, Fusilade 2000 and Assure in tank-mix combination with Goal and Buctril. These treatments were applied on May 31 to onions in the one true-leaf growth stage. Grass plants ranged in size from one leaf to two tillers with 2-3 inches of growth. MorAct oil was added when grass herbicides were applied alone at a rate of one qu/ac. Goal and Buctril were applied again on June 12 to plots previously treated with these two herbicides. Herbicides and rates are listed in Table 5.

Herbicides in Trial 3 included Tough ec, Stinger, Prowl, and Fusilade 2000. Goal and Buctril were applied in combination with Stinger and Prowl. Treatments were applied on June 4 when onion growth was two true-leaves. Weeds were dense and varied in size from cotyledon to eight leaves with as much as six inches of growth on the larger broadleaf species of weeds.

Results

Preplant Incorporated: Onion tolerance and weed control was good with herbicides applied in the fall and spring and incorporated before planting. Nortron alone and in tank-mix combination with either Pyramin, Dacthal, Ramrod, or Prefar resulted in 95 percent control of pigweed, kochia and lambsquarters. Barnyardgrass control was good with all combinations with the exception of Pyramin. Hoelon improved grass control when tank-mixed with Nortron and Pyramin. Spring applications incorporated preplant on beds as described in the procedure section resulted in weed control equal to fall applications. Onion tolerance was good with all combination treatments. Lowering the rate of Nortron to 1.5 lbs ai/ac in combination treatments has increased the margin of onion tolerance with Nortron and weed control has been good with the addition of the combinant herbicide. Weed control was significantly superior from preplant incorporated treatments compared to the postplant surface applied and nail-boarded herbicide applications. Percent weed control was about 30 percent less in the postplant applied herbicide treatments. The reduction in weed control was noted with all herbicides. Nortron is quite active on hairy nightshade, resulting in continued control by soil residual, and offers the best results for the control of this troublesome and hard to control weed.

Postemergence Treatments: The postemergence applications of Goal + Buctril resulted in excellent weed control and onion tolerance when tank-mix combinations were applied when the weeds were small and most sensitive to herbicides. The effectiveness of the herbicides was reduced when the applications of the treatments were delayed until the onions were in the two true-leaf stage of growth. Continued application of herbicides at weekly intervals or after emergence of new weeds continued to control weeds without injuring the onions and kept these plots free of weeds until layby soil active herbicides were applied and activated.

Results from trials conducted for two consecutive years show that excellent weed control with good onion tolerance can be obtained with tank-mix combinations of Goal + Buctril at rates of 0.05 and 0.15 lbs ai/ac respectively. Application of these herbicides should be started at one leaf stage of onion growth and continue at regular intervals as new weeds emerge until weeds are controlled by herbicides applied as layby treatments.

Select herbicide was very active on both green foxtail, barnyardgrass and fall panicum (witchgrass). It combined well in tank-mix combinations with Goal and Buctril. Compared to Fusilade 2000, Select was more active on green foxtail and equal to Fusilade for control of barnyardgrass and fall panicum.

Tough (pyridate) formulated as an emulsifiable concentrate did not have selectively to seedling onions. Tough tank-mixed with Fusilade 2000 was antagonistic to the activity of Fusilade 2000 resulting in reduced grass control.

Onions were tolerant to Stinger at 0.1 and 0.2 lbs ai/ac and Stinger very effectively controlled red clover and is very active in controlling all weed species in the legume and compositae family. Stinger was compatible as a tank-mix combinant with Goal, Buctril, Prowl, and Fusilade.

Seedling onions were tolerant to all tank-mixes when Prowl was added as a combinant in the tank-mixes and applied to onions with two true-leaves.

Prowl will continue to be evaluated in tank-mix combinations applied to one leaf onions in 1990.

Onions were tolerant to all rates (3, 4, 6, and 8 lbs ai/ac) of Dual applied to the soil surface as broadcast applications and plowed 12 inches deep with a moldboard plow. Compared to the population of yellow nutsedge plants in the replicated control strips to the populations in the treated strips on July 25, Dual at four lbs ai/ac had controlled about 75 percent of the nutsedge plants. The strips treated with Dual at six and eight lbs ai/ac were essentially free of yellow nutsedge plants on July 25 when the field was roto-tilled to prepare the soil for fall application of treatments.

Table 1. Percent weed control and crop injury ratings from herbicides applied in the fall during bedding for weed control in spring seeded onions. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Herbicides	Rate	Crop Injury				Weed Control: Pigweed				Kochia				Lambsquarters				Barnyardgrass			
		1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
	lbs ai/ac	%																			
Nortron	1.0	10	0	0	4	95	85	65	82	92	80	60	77	98	85	65	83	85	75	60	73
Nortron	1.5	15	0	0	5	98	98	99	98	98	98	99	98	98	98	99	98	92	90	96	93
Nortron	2.0	15	0	0	5	99	90	100	96	100	95	100	98	100	95	100	98	95	85	92	91
Nortron + Pyramin	1 + 1.5	5	0	0	2	60	85	85	77	75	90	90	85	65	85	85	78	60	80	80	73
Nortron + Pyramin	1 + 2	0	0	0	0	75	55	80	70	85	65	85	78	78	55	85	73	55	50	60	55
Nortron + Pyramin	1 + 3	3	0	0	1	85	65	60	70	92	80	70	81	88	70	60	73	63	65	55	61
Nortron + Pyramin	1.5 + 1.5	0	0	0	0	85	98	100	94	80	98	100	93	85	98	100	94	40	78	75	64
Nortron + Pyramin	1.5 + 2	0	0	0	0	85	98	98	94	85	98	98	94	85	98	98	94	40	88	95	74
Nortron + Pyramin	1.5 + 3	0	0	0	0	98	99	93	97	95	99	95	96	95	99	95	96	65	85	78	76
Nortron + Hoelon	1.5 + 1.5	0	0	0	0	78	92	90	87	85	95	93	91	85	98	97	93	100	100	100	100
Nortron + Pyramin + Hoelon	1.5 + 1.5 + 1.5	0	0	0	0	78	99	96	91	85	98	95	93	85	99	98	93	100	100	100	100
Dacthal	9	0	0	0	0	50	35	55	47	45	35	60	47	50	40	60	50	35	40	60	45
Dacthal	12	0	0	0	0	40	50	85	58	35	40	85	53	60	55	85	67	45	50	85	60
Check	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Ratings: 0 = no herbicide effect, 100 = all plants killed
Herbicide applied on November 2, 1988.

Table 2. Percent weed control and crop injury ratings from herbicides applied in the spring and incorporated with a bed-harrow before planting. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Herbicides	Rate	Crop Injury				Weed Control: Pigweed				Kochia				Lambsquarters				Barnyardgrass			
		1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
	lbs ai/ac	%																			
Nortron	1.5	10	0	0	4	95	90	95	93	92	90	92	91	98	92	92	95	96	90	92	93
Nortron	2.0	10	5	0	5	98	98	100	98	99	98	99	98	99	98	99	98	98	96	99	97
Nortron + Prefar	1 + 2	0	0	0	0	100	75	90	88	100	85	80	88	100	80	85	88	100	85	80	88
Nortron + Prefar	1 + 3	0	5	0	2	99	99	99	99	100	98	98	98	99	99	99	99	100	99	99	99
Nortron + Prefar	1 + 4	0	0	0	0	95	98	100	97	95	98	100	97	98	98	100	98	100	100	100	100
Nortron + Dacthal	1 + 2	0	0	0	0	99	80	85	88	99	85	85	90	98	85	88	90	99	93	89	94
Nortron + Dacthal	1 + 4	0	0	0	0	93	99	98	95	92	98	99	95	95	98	99	97	96	98	99	97
Nortron + Ramrod	1 + 2	0	0	0	0	85	98	96	93	80	98	98	92	85	98	98	94	95	98	98	96
Nortron + Ramrod	1 + 4	0	0	0	0	98	98	99	98	99	99	99	99	99	99	99	99	99	99	99	99
Nortron + Ramrod	4	0	0	0	0	98	92	95	95	96	90	90	92	98	95	95	96	99	95	95	96
Nortron + Ramrod	4 + 4	0	0	0	0	95	95	98	96	98	96	99	97	96	98	98	97	95	98	99	97
Check	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Ratings: 0 = no herbicide effect, 100 = all plants killed
Herbicides applied on April 18, 1989.

Table 3. Percent weed control and crop tolerance ratings from herbicides applied as postplant preemergence applications and incorporated in the surface soil by nailboard. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Herbicides	Rate	Crop Injury				Weed Control: Pigweed				Kochia				Lambsquarters				Barnyardgrass			
		1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
	lbs ai/ac	%																			
Nortron	2.0	0	0	0	0	70	60	65	65	65	60	60	62	60	55	60	58	50	60	50	53
Nortron + Prefar	1 + 4	0	0	0	0	95	85	80	86	85	75	70	77	90	85	80	85	98	85	90	91
Nortron + Dacthal	1 + 4	0	0	0	0	25	65	45	45	30	70	45	48	25	60	55	47	20	30	35	28
Nortron + Ramrod	1 + 4	0	0	0	0	75	60	60	65	65	55	60	60	60	50	50	53	60	50	50	53
Ramrod	4	0	0	0	0	50	60	50	53	40	50	45	45	35	40	45	40	45	50	60	52
Ramrod + Dacthal	4 + 4	0	0	0	0	40	45	40	42	50	60	65	58	40	45	40	42	40	45	50	45
Check	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Ratings: 0 = no herbicide effect, 100 = all plants killed.
Herbicides applied on April 20, 1989.

Table 4. Percent weed control and crop tolerance to sequential applications of postemergence applied herbicides when the sequential treatments followed the initial application applied when the seedling onions were in the flag, one, or two true-leaves. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Herbicides	Rate	Crop Injury	Initial Application	Weed Control PW	LQ	KO	HN	RC	SP	Bry	GF
	lbs ai/ac	%		%							
Goal	2(0.05)	0	Flag	100	97	62	99	66	99	100	88
Buctril	2(0.15)	0	Flag	100	100	98	100	75	100	100	78
Goal + Buctril	2(0.05 + 0.15)	0	Flag	100	100	100	100	96	100	100	90
Goal	0.1	0	Flag	100	96	72	100	85	98	100	93
Buctril	0.3	3	Flag	99	100	100	100	43	100	100	78
Goal + Buctril	0.1 + 0.3	0	Flag	100	100	100	100	98	100	100	92
Check	-	0	-	0	0	0	0	0	0	0	0
Goal	2(0.05)	0	1 leaf	99	86	58	85	45	60	96	85
Buctril	2(0.15)	0	1 leaf	93	100	100	98	60	100	92	69
Goal + Buctril	2(0.05 + 0.15)	3	1 leaf	97	100	100	100	73	100	99	88
Goal	0.1	0	1 leaf	100	87	78	91	78	99	98	92
Buctril	0.3	0	1 leaf	91	100	100	99	63	100	90	72
Goal + Buctril	0.1 + 0.3	5	1 leaf	99	99	99	99	97	100	99	93
Check	-	0	-	0	0	0	0	0	0	0	0
Goal	2(0.05)	0	2 leaf	88	73	53	72	45	58	92	82
Buctril	2(0.15)	3	2 leaf	100	100	100	98	58	100	83	64
Goal + Buctril	2(0.05 + 0.15)	0	2 leaf	100	100	100	99	93	100	93	85
Goal	0.1	0	2 leaf	88	78	58	83	60	68	95	86
Buctril	0.3	0	2 leaf	90	93	92	100	65	86	85	66
Goal + Buctril	0.1 + 0.3	0	2 leaf	93	100	97	100	82	98	96	88
Check	-	0	-	0	0	0	0	0	0	0	0

Ratings: 0 = no herbicide effect, 100 = all weeds controlled
Evaluated on June 28, 1989
Key weed species: PW pigweed, LQ lambsquarters, KO kochia, HN hairy nightshade, RC red clover, SP sheperdspurse, Bry barnyardgrass, GF green foxtail

Table 5. Percent weed control and crop tolerance from herbicides applied as postemergence treatments for grass control. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Herbicides	Rates	Applied	Crop Injury	Weed Control PW	LQ	HN	KO	RC	SP	Bry	GF	WG
	lbs ai/ac		%	%								
Select	0.094	1 leaf	0	0	0	0	0	0	0	100	99	99
Select	0.125	1 leaf	0	0	0	0	0	0	0	100	100	100
Select + Goal + Buctril	0.094 + 0.05 + 0.15	1 leaf	5	100	98	96	95	75	99	100	100	100
Select + Goal + Buctril	0.125 + 0.05 + 0.15	1 leaf	5	100	99	95	97	73	99	100	100	100
Select + Goal	0.094 + 0.10	1 leaf	5	99	81	93	63	68	86	100	100	100
Select + Buctril	0.094 + 0.30	1 leaf	5	83	99	99	98	25	97	100	100	100
Goal	0.10	1 leaf	5	97	76	94	63	74	83	35	43	53
Buctril	0.30	1 leaf	5	70	99	99	99	18	97	0	0	0
Fusilade 2000	0.1875	1 leaf	0	0	0	0	0	0	0	96	62	100
Fusilade + Goal + Buctril	0.1875 + 0.05 + 0.15	1 leaf	5	99	98	98	93	70	97	98	63	100
Assure + Goal + Buctril	0.09 + 0.05 + 0.15	1 leaf	5	99	97	99	96	68	98	100	68	100
Check	-	-	0	0	0	0	0	0	0	0	0	0

Ratings: 0 = no herbicide effect, 100 = all plants killed.
Evaluated June 14, 1989.
Key weed species: PW pigweed, LQ lambsquarters, HN hairy nightshade, KO kochia, RC red clover, SP shephderdspurse, Bry barnyardgrass, GF green foxtail, WG witchgrass

Table 6. Percent weed control and crop tolerance of herbicides applied postemergence for weed control in onions. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Herbicides	Rate	Crop Injury	Weed Control PW	LQ	HN	KO	RC	SP	Bry	GF
	lbs ai/ac	%	%							
Tough	0.45	32	88	92	94	93	10	15	0	0
Tough	0.67	48	93	98	99	99	12	20	0	0
Tough	0.90	63	99	100	100	100	15	25	0	0
Tough + Fusilade	0.45 + 0.1875	8	46	62	60	63	0	5	63	40
Tough + Fusilade	0.67 + 0.1875	12	58	68	67	69	0	7	55	30
Tough + Fusilade	0.90 + 0.1875	16	65	75	74	76	3	10	48	20
Stinger	0.1	0	25	15	20	10	100	10	0	0
Stinger	0.2	0	33	22	28	13	100	13	0	0
Stinger + Fusilade	0.1 + 0.1875	0	25	16	18	12	100	10	99	83
Stinger + Fusilade	0.2 + 0.1875	0	34	23	29	18	100	15	99	85
Goal + Buctril + Prowl	0.05 + 0.15 + 1.5	3	92	98	99	99	80	99	78	82
Stinger + Goal + Buctril + Prowl	0.1 + 0.05 + 0.15 + 1.5	3	95	99	99	99	82	99	79	80
Check	-	0	0	0	0	0	0	0	0	0

Ratings: 0 = no herbicide effect, 100 = all plants killed.
Evaluated June 21, 1989

Key weed species:

PW	pigweed	RC	red clover
LQ	lambsquarters	SP	sheperdspurse
HN	hairy nightshade	Bry	barnyardgrass
KO	kochia	GF	green foxtail

THE EFFECT OF ONION THRIPS (Thrips tabaci-Lindeman) ON SWEET SPANISH ONIONS - 1989

Lynn Jensen
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Oregon State University
Malheur Experiment Station
Ontario, Oregon, 1989

Introduction

Research on onion thrips has given variable results. Some work with onion thrips has suggested that they do not affect yield. Other research has shown significant yield reductions from thrips. A literature search suggested more thrips resistance from onion lines with a Spanish onion heredity.

Objective

Determine the effect of onion thrips on eight different varieties, four with a Spanish heredity and the typical light green foliage and four with the gray green foliage of those varieties without as much Spanish heredity. Determine a thrips action threshold if damage does occur in some varieties.

Materials and Methods

The eight varieties selected for the trial were:

Gray Green Foliage	Light Green Foliage
Cima	Armada
Valient	Vega
Magnum	Valdez
Golden Cascade	Winner

The onions were planted on April 22 in a split plot, randomized block design at the Malheur Experiment Station. The split plots were eight rows wide by 20 feet in length. Four rows of each plot were kept as nearly thrips free as possible through regular spraying and four rows were unsprayed. The trials were harvested on September 18 and graded and evaluated on October 12.

In addition, five plots were set up in a latin square design to determine threshold levels for control. The variety planted was Golden Cascade. Thrips numbers were counted on 20 plants per plot every week for five weeks and plots sprayed at varying weekly time intervals.

Unsprayed checks reached populations of 100+ thrips per plant.

Results and Discussions

Onion Thrips Effect on Varieties

Visual thrips damage in the untreated plots was observable by the second week of July. Total yield, colossal + jumbo yield, and colossal yield were all reduced by onion thrips injury on all varieties (Table 1). Colossal yields were the most severely impacted. Yields of mediums and jumbos increased slightly due to a decrease in colossal yields. There was a differential response on yield by variety. Armada was least affected by thrips damage with a 3.6% total yield reduction but colossals were reduced by 28.2% and colossals + jumbos by 6.1%. Golden Cascade, Valient and Magnum, all of the grey green foliage type, were severely affected by thrips.

The three light green foliage types, Armada, Vega and Valdez all had less injury than the grey green varieties. Winner (a light green variety) and Cima (a grey green variety) did not respond according to their foliage color. Cima had much less damage than the other grey green varieties and Winner had much more damage than the other light green varieties. Generally, the grey green varieties were more susceptible to thrips injury.

Economically, a grower would have been justified in controlling onion thrips in each variety.

Onion Threshold Trial

Graph 1 shows the average thrips population for each treatment. The onion variety evaluated was Golden Cascade, one of the most sensitive varieties tested in the variety trial. Treatment 1 was kept as clean as possible; treatment 2 was allowed to build to an average of 96 thrips per plant, then the population lowered to that of treatment 1; treatment 3 was the same as 2 except the population was lowered to 13 thrips per plot and kept near there; treatment 4 was treated 13 days after treatments 2 and 3 (July 27) and brought down to 11 thrips per plant; treatment 5 was the untreated check. The results are in Table 3.

The best treatment was treatment 2, which had three sprayings for thrips rather than the five for treatment 1. However, the differences were not significantly different. Treatment 3, with only partial thrip control, had significantly fewer colossals than treatment 2. Total yields were also lower, although not significantly. The yield of the untreated check was significantly lower than any of the treated plots except for the late (July 27) sprayed plot, which was equal to the check.

Small numbers of thrips (13 average per plant) can reduce the percent of colossals. Where a premium is paid for colossals, the reduction in yield makes it economical to treat. The trend was for lower colossals and jumbo yields at that infestation level; however, it was not statistically different. Realistically, the cost of controlling thrips is minor compared to the potential yield and profit advantages, even when yield is not significantly different; because of the downward trend in yield from thrips injury. Letting the thrips population build up early in the season was not detrimental to yields. However, the infestation levels must be reduced to a 4 per plant average to insure no yield reduction. Practically, that is extremely difficult once the population is high because of the inefficiency of the available insecticides and the methods of application. The best recommendation is to keep the thrips populations low. Graph 2 shows the population explosion that occurs with thrips. The best level to control thrips is when the population is 2 thrips per plant or less. After the 2 per plant level, the population build up increases rapidly. After the population reaches 10, the increase is extremely rapid. Trying to control thrips after this point is very difficult.

Conclusions

1. Some varieties are injured more by onion thrips than other varieties. Generally, the grey green foliage color types are more sensitive to damage.

2. Yield of colossals was always reduced, though total yield was not always significantly reduced.

3. The varieties Golden Cascade, Magnum and Winner were highly susceptible to injury.

4. The varieties Armada and Vega were fairly resistant.

5. Onions can withstand high thrips populations early in the season if brought under control but colossal yield will be reduced. Omitting control is not a practical management alternative.

6. A thrips population of 13 thrips per plant throughout the season reduced yields.

7. Thrips are controlled easier when control is initiated at an average of 2 thrips per plant.

Acknowledgement

A special thanks to Hasebe Farms, Uriu Farms, the Idaho-Oregon Onion Research Committee, and the Malheur Experiment Station for helping support these studies.

Table 1. Effects of onion thrips on onion varieties. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Variety	Foliage color	Yield reduction without thrips control: Total yield	Colossal + Jumbo	Colossal
		- - - - - - - - % - - - - - - - -		
Armada	LG	3.6	6.1	28.2
Vega	LG	4.9	10.4	35.0
Valdez	LG	10.4	16.2	39.1
Winner	LG	21.8	25.5	50.4
Cima	GG	12.0	18.2	55.2
Golden Cascade	GG	26.7	35.2	69.9
Magnum	GG	25.1	36.0	70.2
Valient	GG	18.0	29.9	72.9

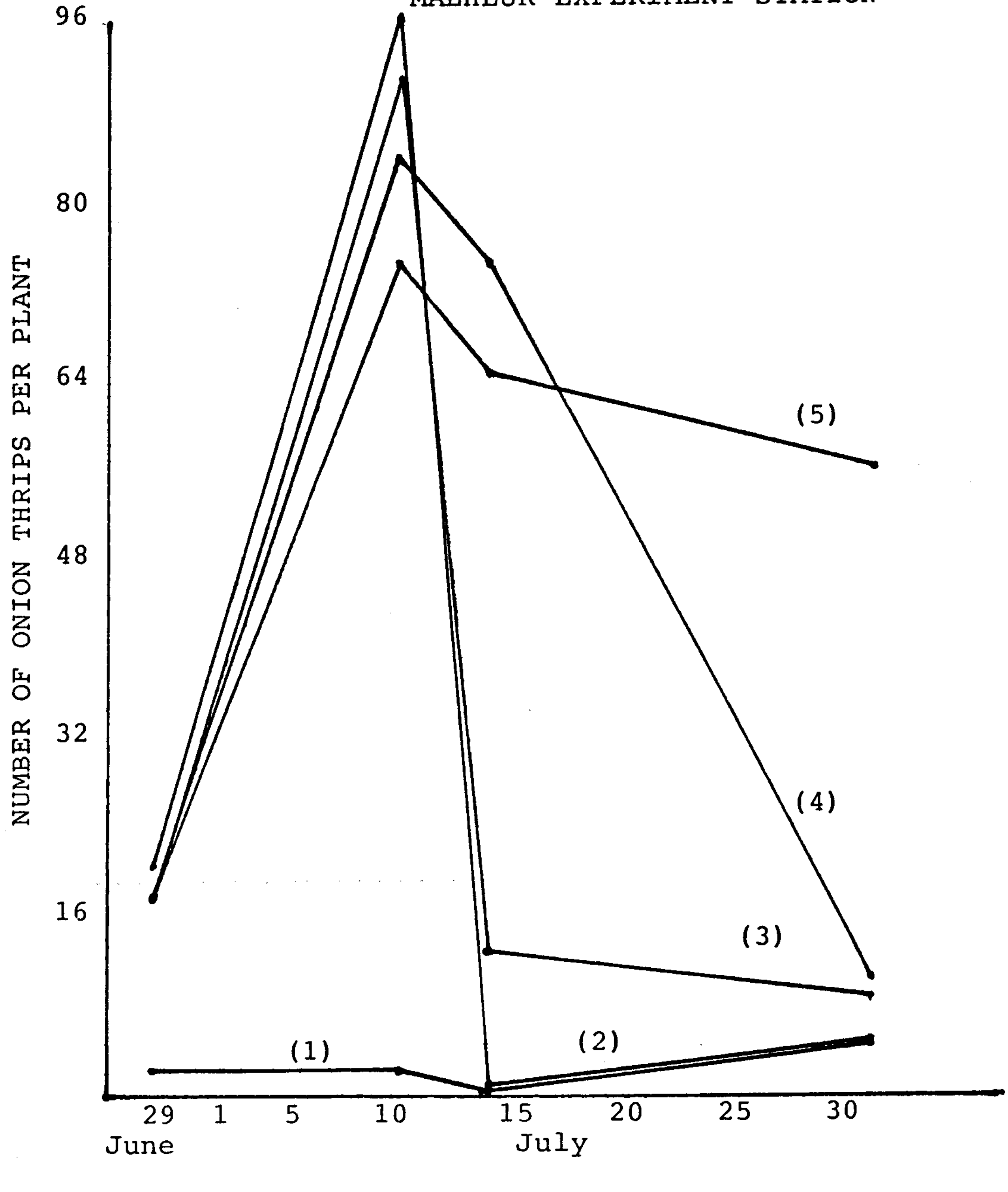
Table 2. Effects of onion thrips injury on eight onion varieties. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Variety		Yield: Total	Colossal	Colossal + Jumbo	Mediums
		- - - - - - - - cwt/ac - - - - - - - -			
Armada	Controlled	620.1	369.1	579.2	40.9
	Uncontrolled	598.0	265.1	543.7	54.3
Vega	Controlled	577.4	300.0	528.7	48.7
	Uncontrolled	548.7	195.0	473.9	74.8
Cima	Controlled	514.8	245.4	450.2	64.6
	Uncontrolled	453.3	109.8	368.3	85.0
Valdez	Controlled	554.3	311.0	518.1	36.2
	Uncontrolled	496.7	223.0	434.2	62.5
Valient	Controlled	456.3	202.9	397.4	58.9
	Uncontrolled	374.1	55.0	278.6	95.5
Magnum	Controlled	416.5	184.8	358.5	58.0
	Uncontrolled	312.1	55.1	229.4	82.7
Golden Cascade	Controlled	583.9	319.3	529.5	54.4
	Uncontrolled	428.0	96.0	342.9	85.1
Winner	Controlled	629.9	398.1	595.9	34.0
	Uncontrolled	492.7	197.6	443.7	49.0

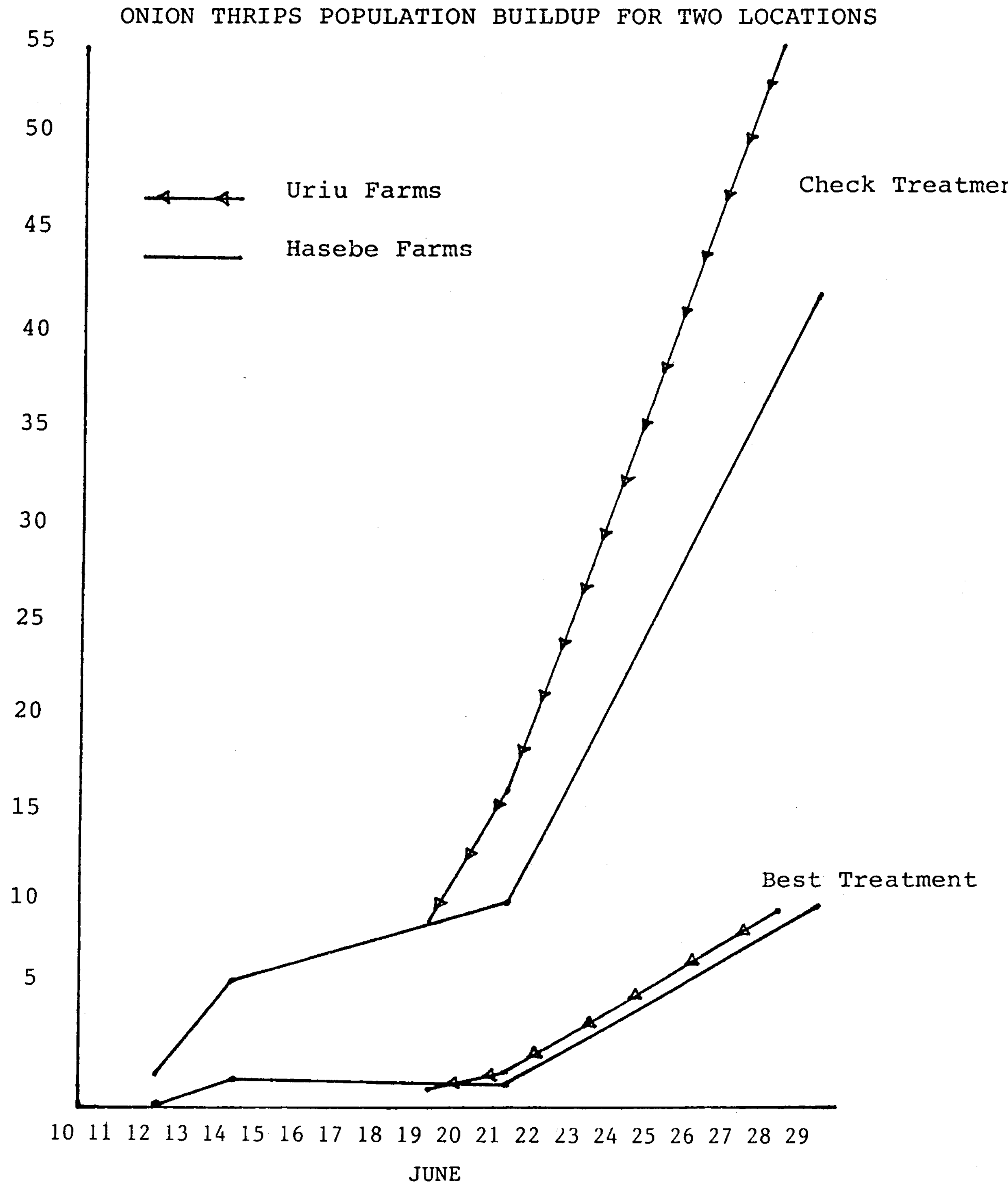
Table 3. The effect of onion thrips on the yellow sweet spanish onion variety Golden Cascade. Malheur Experiment Station, Oregon State University. Ontario, Oregon, 1989.

Treatment	Yield	Colossal		Jumbo		Colossal + Jumbo		Medium	
	cwt/ac	cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac	%
1	577.6	244.5	42.3	282.1	48.8	526.6	91.1	51.0	8.9
2	606.8	269.9	44.5	283.4	46.7	553.3	91.2	53.5	8.8
3	566.9	179.5	31.7	328.0	57.9	507.5	89.6	59.4	10.4
4	469.1	95.4	20.3	293.6	62.6	389.0	82.9	80.1	17.1
5	468.0	85.7	18.3	302.0	64.5	387.7	82.8	80.3	17.2
LSD(.05)		74.3				66.1			

GRAPH 1. ONION THRIPS THRESHOLD EXPERIMENT
MALHEUR EXPERIMENT STATION



GRAPH 2.


ONION THRIPS POPULATION BUILDUP FOR TWO LOCATIONS
55
50
45
40
35
30
25
20
15
10
5
Uriu Farms
Hasebe Farms
Check Treatmen
Best Treatment
10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
JUNE

SUSCEPTIBILITY OF EIGHT SWEET SPANISH ONION VARIETIES TO FUSARIUM PLATE ROT - 1989

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Ontario, Oregon, 1989

Introduction

During the 1989 growing season, an experiment was begun at the Malheur Experiment Station to determine the effect of onion thrips on eight onion varieties. Early in the season, some of the plants showed signs of plate rot infection. Since comparisons of variety resistance to plate rot are not known, it was decided that these onions should be rated for incidence of plate rot.

Materials and Methods

The onions were planted on April 22 in a randomized complete block design with five replications. Standard cultural practices were used to grow the crop. The plots were 4 rows wide by 20 feet in length. The center two rows were harvested and evaluated. All onions within the harvested area were examined and rated as being infected or free of infection.

Results

Of the eight varieties evaluated, Golden Cascade was the most resistant, also the most consistent across replications in its resistance. Some varieties such as Armada and Winner showed low infections in some plots and very high numbers in others. The potential for problems is high with these varieties. Valdez and Winner were very susceptible to fusarium and should not be planted where fusarium is a problem.

Table 1. The effect of fusarium plate rot on eight varieties of yellow sweet spanish onions, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Variety	Highest onion infection rate	Lowest onion infection rate	Average infection
	%		
Golden Cascade	9.2	1.7	6.8
Cima	14.6	6.0	8.7
Valient	13.1	6.3	8.9
Vega	14.4	7.3	10.1
Armada	21.1	3.1	11.1
Magnum	13.0	8.9	11.2
Winner	23.9	4.2	15.4
Valdez	22.8	13.2	17.8
LSD(.05)			5.2

SWEET SPANISH ONIONS FOR EXPORT

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Oregon State University
Ontario and Corvallis, Oregon, 1989

Introduction

Onion production in Malheur County and Western Idaho has increased substantially in the past five years. When the jobs generated by the packing and processing industries are coupled with the gross agricultural income, the benefits to the Treasure Valley are enormous. Current production can readily exceed the American market consumption. The export potential for sweet spanish onions is just beginning to be investigated, but inconsistent quality of onions upon arrival in the Far East after 14-21 days on board ship has plagued the industry. Being able to ship quality onions and have them arrive in excellent condition would greatly enhance the possibility of exporting onions.

Black mold develops when onions are stored or shipped at high temperatures and high relative humidity, conditions that can easily occur during export. Black mold on onions is caused by the fungus *Aspergillus niger*. Black mold lives on all types of decaying organic matter in or on the soil. The fungus produces quantities of airborne spores. Air movement carries these spores everywhere including beneath the outer onion scales. Spores are available to enter any damaged site.

Black mold may start in nicks or scratches caused by injury at harvest or injury at packout. But black mold doesn't need a site of injury to get started since it will penetrate healthy onions directly in conditions of high humidity and high temperatures. The disease is usually first noted as small black specks of spores between the onion skins. The black dots tend to be lined up vertically along the veins between the skins. These dots are colonies of the fungus which grow slowly, invading the flesh of the onion underneath, and even in the absence of other disease organisms can eventually lead to conditions similar to the bacterial disease slippery skin.

No fungicide has proven effective for black mold control in the PNW. The best control has been rapid curing of onions in the field, maintaining good dry air ventilation in storage, and slowly reducing air temperature in onion storages according to normal recommendations. Black mold infections are aggravated by high temperatures and high relative humidity in storage. Dry air and cold temperatures above freezing retard disease development. Since spores are present everywhere, storage or shipping environments conducive to the disease lead to rapid disease progression.

During the 1988 and 1989 storage and export seasons the Idaho-Eastern Oregon Onion Committee supported research at the Malheur Experiment Station examining the export of sweet spanish onions. Cima and Golden Treasure onions were grown, field cured and harvested. These onions were packed out from storage and subjected to simulated export.

Specks of black mold were evident on some of the onions. Neck rot (Botrytis allii) and black mold infections (Aspergillus niger) had also developed in almost all nicks or other spots of physical damage. Further storage in warm humid conditions beyond the initial three week period fostered the rapid development of black mold.

Better black mold control might be possible through resistant or tolerant varieties, fungicide sprays, or better storage or shipping conditions. The best solution for the future is not known. For the present the best management strategy is careful attention to field curing and control of storage humidity and temperature.

Objectives

A. Determine shipping conditions that would reduce onion loss to fungal and bacterial rot.

B. Investigate controlled atmosphere conditions that could prolong and improve storage of sweet spanish onions.

C. Determine whether fungicides used during the growing season can reduce the incidence of black mold during shipping and marketing.

Experiment 1: Simulated Export

Procedures

Cima and Golden Treasure onions were planted April 22, 1989. Onions received a total of 225 lbs N per acre in the form of ammonium nitrate. Weeds were controlled with Dacthal herbicide, cultivation, and manual weeding. Thrips were controlled with two applications of Ammo. No fungicides were applied to the crop. Onions were lifted September 15, topped September 22, placed in storage and packed out on November 30.

Simulated shipping treatments were the following:

1. Onions were placed in an enclosure without ventilation or desiccant, simulating export conditions.

2. Onions were placed in an enclosure without ventilation. Sacks of dehydrated lime were added to absorb water from the atmosphere.

3. Onions were placed in an enclosure with internal recirculating air.

All three enclosures were in a room heated to 75° F. The room was humidified to 65 percent relative humidity to provide conditions favorable to onion loss. Both Cima and Golden Treasure onions were stored in the three environments for three, six, or nine weeks starting November 30, 1989. The 18 treatment combinations were replicated five times. After three, six, or nine weeks onions were removed from storage and evaluated for the occurrence and development of fungal and bacterial decay.

Results and Discussion

The enclosures averaged 75° F and 65 percent relative humidity for the first three weeks and 78° F and 65 percent relative humidity for the second three weeks. By six weeks onion loss averaged near 40 percent. The experiment was terminated prior to the nine week evaluation.

Onions stored in the recirculating air compartment developed significantly less black mold and bacterial decay symptoms (Table 1). There was no significant difference between Cima and Golden Treasure onions in disease development, so the two varieties are considered together. The incidence of neckrot averaged 0.4 percent. Simulated shipping treatments had no significant effect on neckrot. Air circulation decreased onion losses from all causes by 41 percent compared to similar storage conditions without air circulation.

Onions with mechanical damage rotted first. Reduction of mechanical damage during packout should reduce loss by decreasing disease infection sites.

Experiment 2: Controlled atmosphere storage.

Procedures

Long-term storage of onions may be promoted by controlled atmosphere conditions. Sweet spanish onions are being stored at three temperatures (32, 41 and 50° F)and five carbon dioxide concentrations (ambient, 5, 10, 15, and 20 percent CO_2). Each treatment was replicated ten times. Onions will be removed from storage at the end of April 1990, and evaluated for weight loss and disease incidence.

Experiment 3: Fungicide use to reduce loss during export.

Procedures

Cima onions were planted, grown and harvested as in Experiment 1 above. Onions were sprayed with fungicides every two weeks (June 23, July 7, July 20, August 3, August 14, and August 28) to test their ability to reduce black mold infection during storage.

Treatments were as follows:

1. Check
2. Rovral 1.5 lb/ac
3. Ronilan 2.0 lb/ac
4. Bravo 500 3 pt/ac
5. Ridomil 2.0 lb/ac

Onions were stored six weeks in simulated export conditions without ventilation. The temperature averaged 75° F during the first three weeks and 78° F during the second three weeks. Relative humidity averaged 65 percent.

Results and Discussion

After six weeks 38 percent of the untreated onions had disease symptoms (Table 4). Six weeks provided an adequate duration for clear treatment differences in 1988-1989. Fungicides could have important economic benefits if they slowed disease progression for two or three weeks. In 1989 - 1990 treatments were evaluated after six weeks and black mold progression was so rapid that beneficial fungicide treatment effects may have been obscured. Rovral and

Bravo 500 have promise for further testing (Table 4). As in Experiment 1 above, neckrot was a minor source of loss.

Table 1. Incidence of black mold, bacterial soft rot, slip skin, and infected mechanical injuries on sweet spanish onions stored for three weeks at 75° F and 65 percent relative humidity. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Treatment in export	Predominate Symptoms Black mold	Slip* skin	Soft rot	Sub-Total	Infected mechanical injuries	Total
	- - - - -	- - - - -	- - - - -	%	- - - - -	- - - - -
Check	6.86	0.82	1.26	8.94	5.76	14.70
Lime	6.04	2.37	1.32	9.73	4.68	14.42
Ventilation	3.60	1.44	0	5.04	3.55	8.59
LSD(.05)				2.42		3.34

*Slip skin can result from an advanced infection of black mold and from bacterial soft rot between onion scales.

Table 2. Loss of sweet spanish onions to neckrot and other fungi and bacteria during three weeks storage at 75° F and 65 percent relative humidity. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Treatment in export container	External mold and soft rot	Neckrot	Total loss
	- - - - -	%	- - - - -
Check	14.70	0.43	15.12
Lime	14.42	0.58	15.00
Ventilation	8.59	0.26	8.85
LSD(.05)	3.34	ns	2.42

Table 3. Controlled atmosphere for long-term storage of Cima and Golden Treasure sweet spanish onions, 1989-1990. Storage is still in progress at the Department of Horticulture, Oregon State University, Corvallis, Oregon.

Treatment number	Onion Storage Conditions	
	Temperature	Carbon dioxide
	°F	%
1.	32	ambient
2.	32	5
3.	32	10
4.	32	15
5.	32	20
6.	41	ambient
7.	41	5
8.	41	10
9.	41	15
10.	41	20
11.	52	ambient
12.	52	5
13.	52	10
14.	52	15
15.	52	20

Table 4. Loss of sweet spanish onions after six weeks at 76° F and 65 percent relative humidity following four field fungicide treatments, 1989-1990. Malheur Experiment Station, Oregon State University, Ontario, Oregon.

		Type of Loss					
Fungicide Treatments[1]	Rate	Black Mold	Slip skin	Soft rot	Infected mechanical injuries	Neckrot	Total
		%					
Check	-	29.8	4.2	2.9	1.0	0	37.9
Rovral	1.5 lb/ac	23.2	0	2.7	2.7	0.3	28.9
Ronilan	2 lb/ac	29.3	4.5	4.2	1.4	0	39.4
Bravo 500	3 pt/ac	22.8	4.0	3.4	0	0.4	30.6
Ridomil	2 lb/ac	25.8	2.9	7.5	2.1	0.6	38.9
LSD(.05)		ns	ns	ns	ns	ns	ns

[1] Fungicides were applied six times.

CONDITIONING ONION BULBS TO IMPROVE STORAGE QUALITY BY APPLYING ARTIFICIAL HEAT

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Ontario, Oregon, 1989

Purpose

Determine if bulb losses during onion storage caused by Botrytis neckrot could be reduced if onions are conditioned by heat before they are placed in permanent storage.

Summary

Avalanche, Valdez, Dai Maru, and Viva varieties of onions were subjected to heat treatments at three temperatures and durations of time to evaluate the affect of heat on improving storage quality of late maturing, high yielding bulbs. Onion bulbs were harvested on September 20 and October 12. Bulbs from both harvest dates were treated and placed in storage immediately following heat treatments. The effects of the heat treatments on storage quality will be evaluated on January 11 and March 6, when bulbs are removed from storage.

Heat treatments were 125° F for 20, 40, 80 minutes, 150° F for 20, 30, 40 minutes, and 180° F for 10, 15, and 20 minutes. Approximately 75 pounds of onions were treated in each of seven replications. All heat treatments for each onion variety significantly reduced the percent neckrot when compared to the amount of neckrot in untreated controls. The percent neckrot occurring in the untreated checks varieties of Viva, Dai Maru, Avalanche, and Valdez was 27, 34, 46, and 51 percent respectively. Averaging the amount of neckrot from heated onions for each variety listed above reduced the percent neckrot to 10.9, 5.4, 10.5, and 5.6. The most attractive and effective treatments from a commercial use standpoint because of quantity of onions to condition in the shortest time period would be 180° F from 10-15 minutes. These were effective heat treatments for each variety tested.

Introduction

Multi-years data showed that bulb yields increased significantly from bulb enlargement when growth was allowed through September. The greatest yield increases were noted with late maturing varieties such as Avalanche, Valdez, Dai Maru, and Durango. Yield increases were also significant but less dramatic with early maturing varieties, Golden Cascade, and White Keeper. Bulbs continue to grow and increase in size even though tops have fallen over as long as the tops remain green.

Data obtained from four years of study showed that onion bulbs dried by artificial heat store with less neckrot at the end of storage than non-conditioned bulbs. Preliminary data from 1987 and 1988 studies indicated that improved storage quality is related to temperatures generated in the neck tissue during drying rather than moisture losses from bulbs.

Conditioning onion bulbs with heat in trials during 1984, 1985, and 1987 resulted in a significant reduction in neckrot during storage and in a increased yield of marketable onions. Drying time and drying temperatures were not varied during trials conducted in 1984 and 1985. Trials in 1986 and 1987 sought to identify optimum drying temperatures and drying time to improve the storing quality of onion bulbs. Trials in 1988 sought to repeat timed temperature treatments of 1987 with additional treatments and equipment changes added. In 1988, although the incidence of neckrot infection in unheated check lots of bulbs was too low to evaluate their effectiveness for controlling neckrot during storage, temperatures safe for conditioning onions were identified. Onion bulbs were sensitive and damage occurred if bulbs were subjected to a temperature of 150° F for more than 30 minutes and for over 20 minutes at 180° F. It was also noted that yellow onion bulbs are less sensitive to injury by heat than bulbs of white varieties.

Materials and Methods

Avalanche, Valdez, Viva, and Dai Maru varieties of onions were planted on April 26 in replicated strips. Each strip was four rows wide and averaged approximately 400 feet long. The area produced enough onions to accommodate all heat treatments to be stored for two time intervals, January 11 and March 6. The onions were planted at a seeding rate of twelve seeds per foot and hand-thinned to a growing stand of four plants per foot of row.

On May 29, 40 pounds N per acre of Uran solution 32 was applied in the water during furrow irrigation. The onions were hand-thinned on June 10 and 11 to a population of four plants per linear foot of row. An additional 200 pounds of N per acre was sidedressed on June 15. Thrips were controlled with four applications of Ammo at a rate of four ounces of material per application.

The early harvested bulbs were lifted on September 20. The late harvested bulbs were lifted on October 11. The onion tops were green for all varieties when lifted on both harvest dates. At each harvest date the onions were topped immediately after lifting using special care not to bruise the onion bulbs. Individual bulbs were hand-wiped to remove soil from the roots as they were placed in wood-framed boxes. Wire screens in the bottom of the boxes allowed for air movement around individual bulbs during drying. Bulbs were placed in the boxes so the directed air from the dryer fans would blow directly onto the necks. After drying the onions were removed from the drying boxes and placed in wooden crates or burlap bags for storage. Approximately 75 pounds of onions were dried in each treatment and each treatment was replicated seven times. Drying treatments were started immediately after topping without any time for field curing. There were a total of ten drying treatments. Drying temperatures and drying times for each temperature were 125° F for 20, 40, and 80 minutes; 150° F for 20, 30, and 40 minutes, and 180° F for 10, 15, and 20 minutes. The onions were put in storage immediately after drying. Air was not blown over onions during the storage period, with the intent of developing conditions to stimulate growth of the *Botrytis* neckrot organism.

The infected bulbs were weighed and sound bulbs at the end of the storage period and the percent of onion bulbs infected with neckrot calculated.

Results

Early Harvested Bulbs: The percent neckrot occurring in the non-heated control treatments was to low to measure the effect of any heat treatments on storage quality (Table 1). Although there was less occurrence of neckrot to bulbs in some treatments the differences when compared to the control treatments were not large enough to be significant at the five percent level. The lack of neckrot infection was contributed to storage of onions in small wooden crates with adequate aeration to prevent the development of Botrytis fungus. The results do show, however, that onion bulbs will tolerate the more practical conditioning temperature at 180° F for 10 to 15 minutes.

Late Harvested Bulbs: The onion bulbs harvested on October 11 were stored in burlap bags after receiving the various heat treatments. Approximately 75 pounds of onion bulbs was contained in each bag (one replication). The bagged onions were put in large wooden crates (6 x 4 x 4 ft) and placed in a ventilated onion storage shed. A significant amount of neckrot infection occurred in the non-heated onions and the effectiveness of the heat treatments for improving storage quality was evaluated.

The results are reported in Table 2. The amount of Botrytis neckrot in the non-heated control treatments varied between onion varieties (Table 2). The highest percent neckrot occurred in Avalanche (46 percent) and Valdez (51 percent). Dai Maru was intermediate (34 percent) and the least amount of neckrot occurred in Viva (27 percent). All heat treatments significantly improved storage quality by reducing storage rot when compared to the average rot in the non-heated controls. As shown by the CV values, quite large differences in the amount of rot did occur between replications within the same treatments. Under commercial use, responses from heat treatments could vary between varieties, individual growers, and years that onions are conditioned by heat. Even with the variation that occurred between replications within a single heat treatment the amount of neckrot was always highest in the non-heated control treatments (Table 3). This offers confidence and reliability to the effectiveness of the heat treatments for improved storage quality. The least amount of variability in percent neckrot between replications, occurred in the onions treated at 180° for 10 or 15 minutes. The greatest amount of variability occurred in the treatments at 125° F for 80 minutes and 150° F for 40 minutes. Individual onion bulbs may have been injured by heat at these temperatures and long exposure time, thus causing them to rot in storage.

Results of this trial and also from previous research studies, indicates that heat treatments can improve storage quality by reducing losses in storage due to neckrot. Specific types of equipment to accommodate commercial drying and costs involved in the drying process needs to be investigated. It appears that benefits from conditioning onions may only be advantageous when losses from neckrot in storage is expected to exceed eight to ten percent. Heat treatments may only be beneficial for specific varieties such as white bulbs or late maturing, high yielding yellow lines where relative long-term storage is planned.

Table 1. Percent storage rot from onion bulbs harvested on September 20 and conditioned for storage by heat treatments applied at three different temperatures for varying lengths of time. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Heat Treatments		Varieties				Avg over Varieties
Temp(°F)	Time (min)	Avalanche	Valdez	Viva	Dai Maru	
		% Neckrot				
120	20	3.22	1.79	6.76	3.70	3.87
	40	1.39	1.46	4.57	3.73	2.79
	80	4.84	2.11	2.74	4.46	4.39
150	20	1.77	1.21	7.28	3.13	3.35
	30	1.31	1.72	6.42	3.06	3.13
	40	2.41	2.38	5.36	3.44	3.40
180	10	2.16	1.71	5.74	4.53	3.54
	15	2.75	3.14	3.71	3.34	3.24
	20	3.95	3.68	3.45	4.04	3.78
Check	-	3.62	2.34	8.52	6.89	5.34
	Mean	2.64	2.65	5.39	3.83	-
	LSD(.05)	2.85	2.28	5.96	3.73	-
	CV (%)	38	36	19	32	-

Average of 7 replications
Harvested on September 20 and removed from storage on January 11.

Table 2. Percent storage rot from onion bulbs harvested on October 11 and conditioned for storage by heat treatments applied at three different temperatures for varying lengths of time. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Heat Treatments		Varieties				Avg over Varieties
Temp(°F)	Time (min)	Avalanche	Valdez	Viva	Dai Maru	
		% Neckrot				
125	20	11.10	5.46	10.88	4.73	8.04
	40	13.60	4.47	13.85	10.51	10.61
	80	16.65	8.73	13.80	4.67	10.96
150	20	8.21	9.02	13.53	7.30	9.52
	30	14.55	8.41	8.80	4.74	9.12
	40	15.52	2.60	12.63	3.16	8.48
180	10	5.16	10.43	11.14	3.61	7.58
	15	5.94	7.86	12.16	7.20	8.29
	20	7.63	7.60	11.40	5.81	8.11
Check	-	45.67	50.67	26.68	33.70	39.18
	Mean	14.40	11.52	13.49	8.54	-
	LSD(.05)	8.02	9.79	6.43	8.07	-
	CV(%)	19.55	24.90	17.96	34.1	

Average of 7 replications
Harvested on October 11 and removed from storage on January 11.

Table 3. Amount of Botrytis neckrot occurring in individual replication from onion bulbs treated with heat. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Heat Treatments			Percent Neckrot							
Temp(°F)	Time (min)	Variety	R_1	R_2	R_3	R_4	R_5	R_6	R_7	Avg
125	20	Avalanche	6.94	7.28	20.05	13.34	12.22	5.81	12.10	11.10
		Valdez	12.2	8.97	3.26	3.59	4.75	5.13	4.45	6.15
		Viva	14.60	17.47	13.76	4724	1.32	9.48	11.20	10.88
		Dai Maru	4.87	2.63	8.46	4.60	3.10	3.53	5.52	4.73
	40	Avalanche	19.84	7.39	21.26	15.57	10.86	7.68	12.21	13.60
		Valdez	8.11	5.19	8.32	2.54	2.67	2.10	4.06	4.47
		Viva	10.11	20.18	11.07	18.53	9.37	12.25	14.99	13.85
		Dai Maru	10.57	14.30	14.57	6.12	6.97	8.25	12.75	10.51
	80	Avalanche	9.67	22.57	26.23	20.22	13.99	9.21	14.62	16.65
		Valdez	6.50	10.99	7.25	9.92	8.51	9.25	8.31	8.73
		Viva	11.20	13.05	13.64	17.38	17.97	8.45	13.92	13.80
		Dai Maru	0	2.08	8.39	9.94	2.94	6.51	2.42	4.67
150	20	Avalanche	2.46	10.48	17.97	1.17	4.41	10.79	10.23	8.21
		Valdez	3.33	10.04	15.20	8.93	6.76	7.98	11.07	9.02
		Viva	12.21	10.08	13.04	17.68	14.65	15.23	11.67	13.53
		Dai Maru	12.69	15.93	2.43	2.80	2.65	9.27	5.33	7.30
	30	Avalanche	11.91	28.06	18.58	2.16	9.11	13.49	18.51	14.55
		Valdez	0	11.71	3.89	20.67	3.18	6.99	12.43	8.41
		Viva	7.56	6.03	8.68	10.62	11.12	10.43	6.99	8.80
		Dai Maru	3.96	2.96	2.52	6.25	2.98	5.28	6.92	4.74
	40	Avalanche	15.9	11.29	21.61	20.75	20.03	15.86	17.47	15.52
		Valdez	0	0	4.43	1.22	4.46	4.42	3.67	2.60
		Viva	14.78	9.19	16.47	13.85	8.88	10.33	14.92	12.63
		Dai Maru	4.91	6.78	1.31	2.82	0	5.16	1.72	3.16
180	10	Avalanche	17.60	3.66	4.68	2.02	2.98	1.06	4.19	5.16
		Valdez	3.92	7.52	0	17.37	14.08	17.66	12.41	10.43
		Viva	16.59	8.06	3.50	14.63	12.92	12.34	8.98	11.14
		Dai Maru	7.96	6.29	1.97	0.15	1.70	4.31	2.92	3.61
	15	Avalanche	2.80	1.17	4.04	7.00	3.00	15.63	7.89	5.94
		Valdez	6.77	7.68	5.14	8.28	9.76	9.21	5.36	7.86
		Viva	15.40	11.93	11.90	11.97	9.59	10.26	14.07	12.16
		Dai Maru	11.13	4.11	8.48	3.89	8.41	9.40	5.01	7.20
	20	Avalanche	2.32	9.08	4.71	5.42	5.18	16.86	8.67	7.63
		Valdez	9.82	6.03	5.08	8.84	4.71	8.92	9.76	7.60
		Viva	13.13	16.96	18.40	8.50	0	7.32	15.67	11.40
		Dai Maru	7.80	9.89	6.11	3.54	1.70	6.78	4.89	5.81
	Check	Avalanche	42.0	47.0	41.0	40.0	51.0	46.0	51.83	45.67
		Valdez	31.8	50.5	53.0	76.34	77.0	47.0	60.84	50.67
		Viva	16.92	23.70	36.25	32.21	24.30	22.42	30.52	26.68
		Dai Maru	15.00	60.59	41.03	23.56	28.08	28.50	38.92	33.70

ONION PLANT DENSITY, ROW SPACING, AND MATURITY GROUP EFFECTS ON BULB YIELD AND MARKET GRADE

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Abstract

Four varieties of long-day yellow sweet spanish onions of varying maturity were planted in 1985, 1986, and 1987 at three row spacings. Onions were thinned to plant populations of 26,000 to 208,000 plants per acre. Maximum yields of jumbo onions occurred with plant populations from 104,000 to 156,000 plants per acre, depending on the year and the variety. Maximum economic returns occurred at higher plant populations. Later maturing varieties had higher yields and higher optimum populations than early maturing varieties. Row widths had no statistically significant effects on yield or market grade. High incidence of double onions was closely related to low onion plant populations.

Introduction

Spotty onion stands lead to a high proportion of colossal onions (onions with diameters greater than four inches), many split double onions, and reduced yields. Conversely, when onion stands are excessive, the average size of onions is relatively small and economic returns are reduced.

The economic value of onion production in the Treasure Valley is in the "jumbo" market class (onions greater than three inches in diameter). Smaller sizes of onions are produced competitively at locations nearer major onion markets in the east, south, and west.

A number of studies have been conducted in other production areas of the United States on the effects of onion plant density and spacing between rows on marketable yields of onions. Previous work has not been designed to maximize the yields of jumbo onions but to maximize yields of onions 2 1/4 inches and larger. Those studies were conducted in environments not directly applicable to the Treasure Valley. The productive potential of Malheur County, Oregon and south western Idaho is greater than many regions because high solar intensity coincides with the months of the growing season.

In the absence of experimental results to optimize jumbo onion production in the Treasure Valley, growers have made progress in technology for direct-seeding onions. Planting rates are often 1 1/4 to 1 1/2 pounds of pure seed per acre assuming seedling emergence and establishment of 70 percent. Onions are planted in two single rows or two double rows on top of beds. Beds are approximately 40 to 44 inches between the bottoms of the water furrows. Various specialized planters (for example Graymor, Beck, and Monosem planters) are used to spread a small amount of seed uniformly down the length of the bed.

Objective

The objective of this research was to determine the plant populations and row spacings that result in the best marketable yields and gross crop value per acre.

Materials and Methods

Four varieties of yellow sweet spanish onions were planted in April of 1985, 1986, and 1987. Onions were planted at three row spacings, four to eight plant populations, and three to four replicates per year. Missing plots occurred each year and ANOVA methods were adopted that tolerated missing plots. Onion varieties were selected expressing a range of maturity groups from early to late; Golden Cascade, Vega, Dai Maru, and Valdez. Onions were planted in 40-inch beds at rates in excess of the desired plant populations. Beds at each population density were planted with three row spacings using conventional Mel Beck Precision Planters (Figure 1):

1. Two single rows 18 inches apart down the length of the bed.

2. Two double rows with the outside of the double rows 18 inches apart and the inside rows 13 inches apart (2 1/2 inches between the double rows).

3. Two double rows with the outside of the double rows 18 inches apart and the inside rows 8 inches apart (5 inches between the double rows).

On June 5 and 6 the plant stands were hand thinned to 2, 4, 6, 8, 10, 12, 14, or 16 plants per foot of 40-inch bed, corresponding to 26,000, 52,000, 78,000, 104,000, 130,000, 156,000, 183,000, and 208,000 plants per acre. The number of plants in each plot was counted to confirm the plant stand. Plants were thinned in each row spacing and plant density to provide as much room as possible around each plant (Figure 1).

Onions followed in the crop rotation after winter wheat all three years. Wheat stubble received 100 lbs N per acre and 100 lbs phosphate in the fall preceding onions. The onions were sidedressed in late May with 100 pounds per acre of nitrogen in the form of ammonium nitrate. An additional 50 to 100 pounds per acre of nitrogen as ammonium nitrate were applied in late June and July. Total nitrogen fertilization was approximately 250 lbs N/ac each of the three years.

Onion maturity ratings were made approximately every 14 days during August and early September. Maturity ratings were 0 to 100 percent depending on plant top fall and top drying. Onions were lifted in mid-September and topped and bagged at the end of September. The bagged onions were placed in crates for storage and then stored with continuous forced fan ventilation.

The onions were taken out of storage in early January, graded, and weighed. The onions were graded by diameter: less than 2 1/4 inches, from 2 1/4 to 3 inches, from 3 to 4 inches, and greater than 4 inches. Split double onions were considered number twos. Number twos and rotten onions were weighed separately.

Total yield, total jumbos (> 3-inch diameter), percent jumbos, percent rot, and percent loss were calculated for each variety, row spacing, and plant density treatment. Percent loss included all sources of loss from harvest through grading. Losses included loss of moisture, dirt, and rot before and during storage.

Gross economic returns were calculated by crediting medium packout with $4 per hundredweight and jumbo packout with $8 per hundredweight. No credit was calculated for small onions, double onions, or rotten onions.

Results and Discussion

Effects of Varieties

By early August the tops of Golden Cascade started to fall over. Vega, Dai Maru, and Valdez followed (Table 1). By harvest all varieties were mature if not completely dry.

The varieties differed greatly in total yield, in total jumbo yield, in their tendency to produce doubles, and other factors (Table 2). Golden Cascade was the least productive of the four varieties, averaging 711 cwt/acre over three years while Dai Maru was the most productive variety, averaging 826 cwt/acre. Dai Maru had the greatest production of doubles. Variety lateness appeared to be related to yield.

Effects of Plant Density

The number of onions per foot of bed directly affected onion maturity, yield, bulb size distribution, and quality (Figure 2). As the density increased from 2 to 16 plants per foot of bed, the onion necks were considerably thinner and the tops fell over sooner and dried earlier.

Average total yields increased from 377 to 826 cwt/acre as plants per foot increased from 2 to 16 bulbs per foot (Table 3). Onions at 2 bulbs per foot of bed produced 2 percent small and medium onions and 98 percent jumbo onions (Figure 3). However, 12.7 percent of the total yield at 2 bulbs per foot were doubles. In contrast, at 16 bulbs per foot, onions averaged 69 percent jumbos and only 0.4 percent doubles. Doubles clearly decreased with increased plant density (Table 4).

Interaction of Variety With Plant Density

Varieties and plant density showed strong interaction effects on total yield (Figure 4), market class distribution, doubles, and rot. Valdez and Dai Maru showed the greatest yield and jumbo yield enhancements with increased plant density (Figure 4). Varieties differ in their tendency to produce double onions at low plant populations (Figure 5).

All varieties had increased proportions of small and medium onions and decreased proportions of colossal onions with increased plant density. These four varieties had consistent plant populations for maximal yields of jumbo onions all three years. The highest yields of jumbo Golden Cascade onions, 652 cwt/acre, occurred at 8 plants per foot of bed. Vega had its highest yields, 787 cwt/acre, at 12 plants per foot of bed, but had maximum yields of jumbo onions, 621 cwt/acre, at 10 plants per foot of bed. In contrast, Dai Maru and Valdez produced the greatest yield of jumbo onions (804 and 752 cwt/acre respectively) at 12 plants per foot of bed.

Effects of Row Spacings with Variety

Row spacings had no consistent effects on onion yield.

Effects of Years

The trials were not designed to compare the effects of years. Yields were comparable all three years. Onions grown in 1986 suffered a greater incidence of fusarium wilt. Valdez bulbs were most visibly affected by fusarium in 1986, but Vega yields were also depressed.

Gross Return Per Acre

Gross dollar return per acre is influenced by plant population and the relative price of jumbo and medium onions. Economic penalties for low plant populations were severe. Gross return was best for our arbitrary prices at plant populations slightly above those that produced the greatest yields of jumbo onions (Figure 6).

Conclusions

1. Maximum yields of jumbo onions occurred at 105,000 bulbs per acre for Golden Cascade, at 131,000 bulbs per acre for Vega and at 157,000 bulbs per acre for Valdez and Dai Maru. Highest yields of jumbo onions were obtained at lower populations for varieties which mature earlier.

2. Double onions were very common at low onion populations and were reduced at higher populations. Varieties varied significantly in their tendency to produce double onions.

3. Two double rows on a 40-inch bed showed little difference from two single rows on the same bed.

4. If jumbo onions are twice as valuable as medium onions, best gross returns were obtained with 131,000 to 157,000 bulbs per acre for Golden Cascade and Vega and with 183,000 to 209,000 onions per acre for Valdez and Dai Maru.

Grower choices of variety, seeding rate, seed placement and row spacing are of relatively low cost per acre - yet these decisions can have large impacts on onion yield, market class, quality, and economic returns. The large economic responses to changes in plant population observed in these studies justifies careful seed bed preparation, planting, and seedling emergence. Any advances toward precision planting will save seed and also result in greater profits to the growers that implement the improvements.

Acknowledgements

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Table 1. Average maturation and yield of jumbo onions over four onion varieties. The data were averaged over four plant densities: 6, 8, 10, and 12 onions per foot of 40-inch bed[1]. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1985, 1986, 1987.

Variety	Average Maturity Rating, 0 - 100 %			Yield Jumbo Onions		
	1985	1986	1987	1985	1986	1987
	- - - -	%	- - - -	- - -	cwt/ac	- - -
Golden Cascade	61	53	55	631	615	651
Vega	51	50	29	707	588	741
Dai Maru	47	37	19	818	741	877
Valdez	39	40	10	849	701	742
LSD(.05) variety	3	4	3	73	73	55

[1] 1987 data excludes 12 onions per foot of bed.

Table 2. Performance of four Yellow Sweet Spanish onion varieties averaged over four densities and three row spacings. The onion densities were 6, 8, 10, and 12 onions per foot of 40-inch bed.[1] Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1985, 1986, 1987.

Variety	Total Yield	Total Jumbo	Colossal	Doubles
	- - - - - - - - - - -	cwt/ac	- - - - - - - - - -	
1985				
Golden Cascade	711	631	70	4
Vega	781	707	111	11
Dai Maru	861	818	218	38
Valdez	892	849	227	17
LSD(.05)	59	73	50	11
1986				
Golden Cascade	701	615	137	10
Vega	681	588	157	11
Dai Maru	792	741	282	25
Valdez	762	701	277	17
LSD(.05)	71	81	41	9
1987[1]				
Golden Cascade	721	651	172	2
Vega	798	741	295	2
Dai Maru	850	877	410	16
Valdez	824	742	419	8
LSD(.05)	54	55	57	8
Three Year Averages				
Golden Cascade	711	632	127	5
Vega	753	679	188	8
Dai Maru	834	812	303	26
Valdez	826	764	308	14

[1] 1987 data excludes 12 onions per foot of bed.

Table 3. Average total yield of Yellow Sweet Spanish onions with increasing plant populations. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1986.

Plant Population		Variety					Average maturity rating 0-100%
Onions per foot of 40-inch bed	Plants per acre	Golden Cascade	Vega	Dai Maru	Valdez	Average	
		cwt/ac					%
2	26,000	394	362	403	362	377	13
4	52,000	429	537	598	565	534	25
6	78,000	587	572	705	649	615	39
8	104,000	710	645	801	755	725	42
10	130,000	735	719	761	781	752	48
12	156,000	775	787	900	863	833	52
14	182,000	742	627	930	870	807	57
16	208,000	763	624	939	910	826	60
Average		641	309	755	719	684	40

Table 4. The effects of plant density on the yield, size distribution, and loss averaged over four Yellow Sweet Spanish onion varieties. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1986.

Plant Densities		Onion Yields by Market Class						Jumbo Distribution	
Plants per foot of 40-inch bed	Plants per acre	Small < 2.25"	Medium	Jumbo	Total	Crop Loss	Doubles	Jumbo 3-4"	Colossal > 4"
		cwt/ac				%	cwt/ac	cwt/ac	
2	26,000	1	7	369	377	15	48	57	312
4	52,000	1	8	525	534	13	38	142	383
7	78,000	3	24	589	616	14	13	310	279
8	104,000	4	42	679	725	11	14	411	268
10	140,000	5	77	670	752	10	10	493	177
12	156,000	7	130	696	833	13	8	569	127
14	182,000	12	169	626	807	9	5	543	83
16	208,000	18	237	571	826	10	3	504	67
Average		6	87	591	685	12	17	379	212

Figure 1. ROW SPACINGS USED IN ONION PLANT DENSITY RESEARCH
Malheur Experiment Station, O.S.U., Ontario, Oregon - 1985-1987

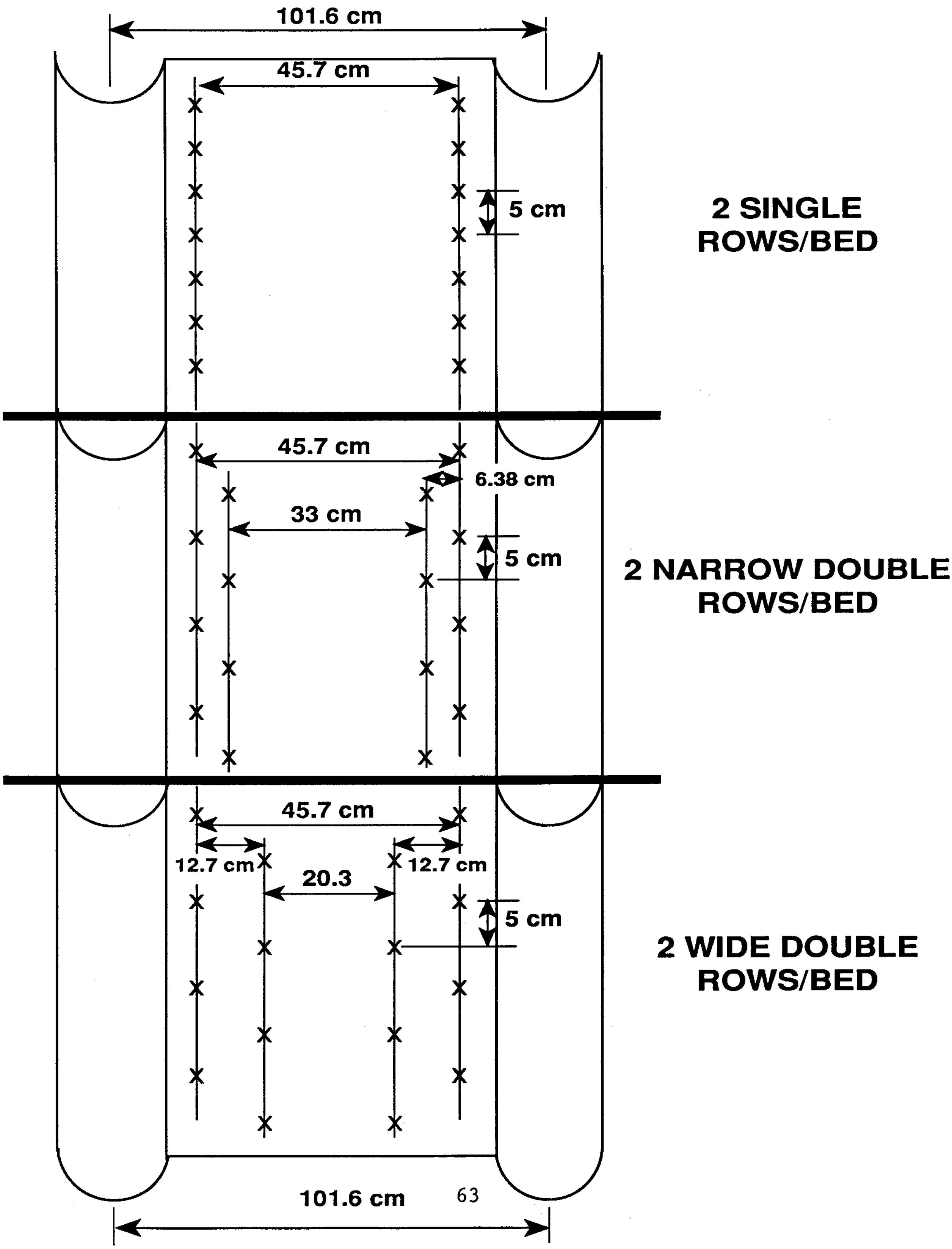


Figure 2. YIELD OF SWEET SPANISH ONIONS AS INFLUENCED BY PLANT POPULATION

Malheur Experiment Station, OSU, Ontario, Oregon

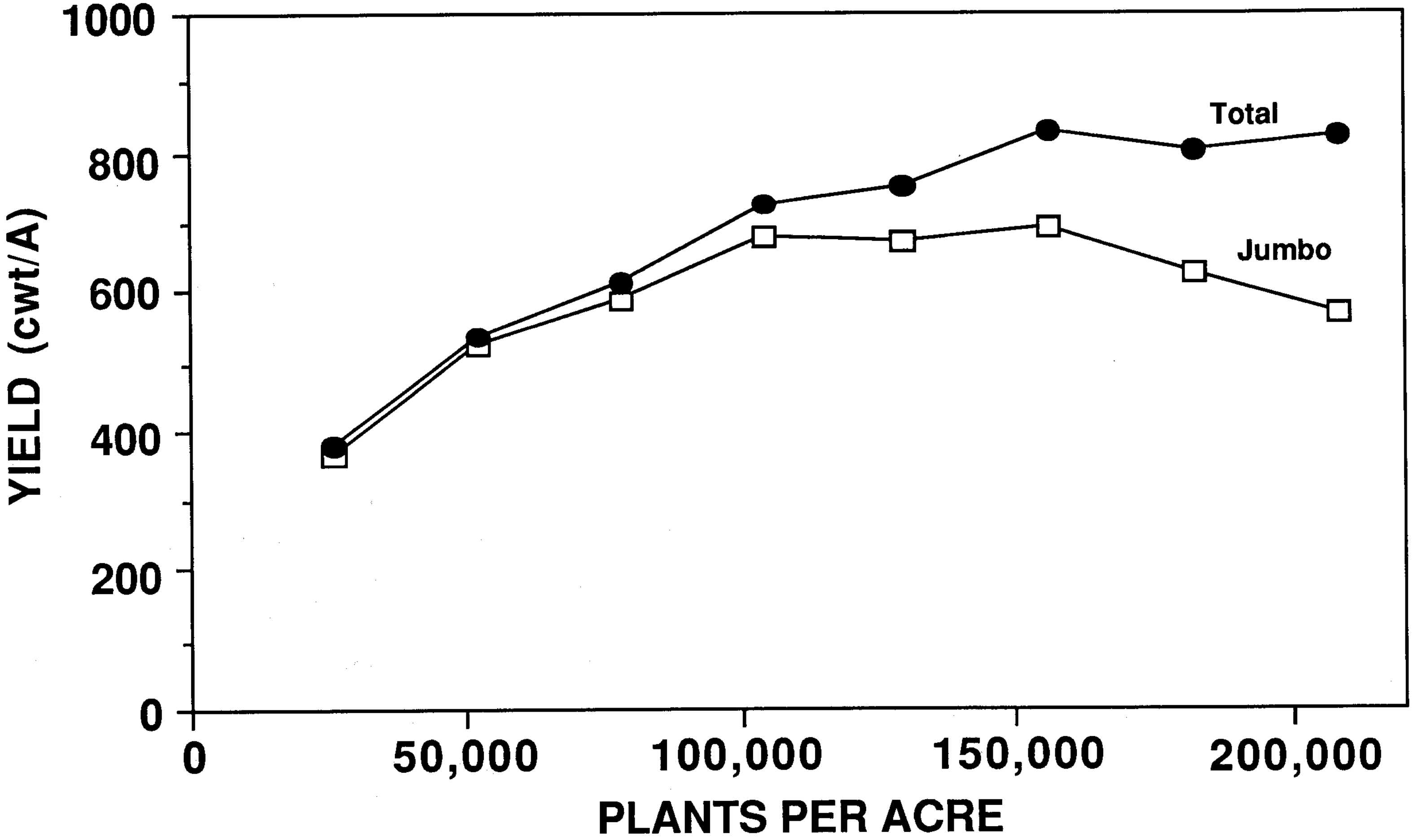


Figure 3. MARKET CLASS DISTRIBUTION OF DAI MARU ONIONS AS INFLUENCED BY PLANT POPULATION.

Malheur Experiment Station, OSU, Ontario, Oregon

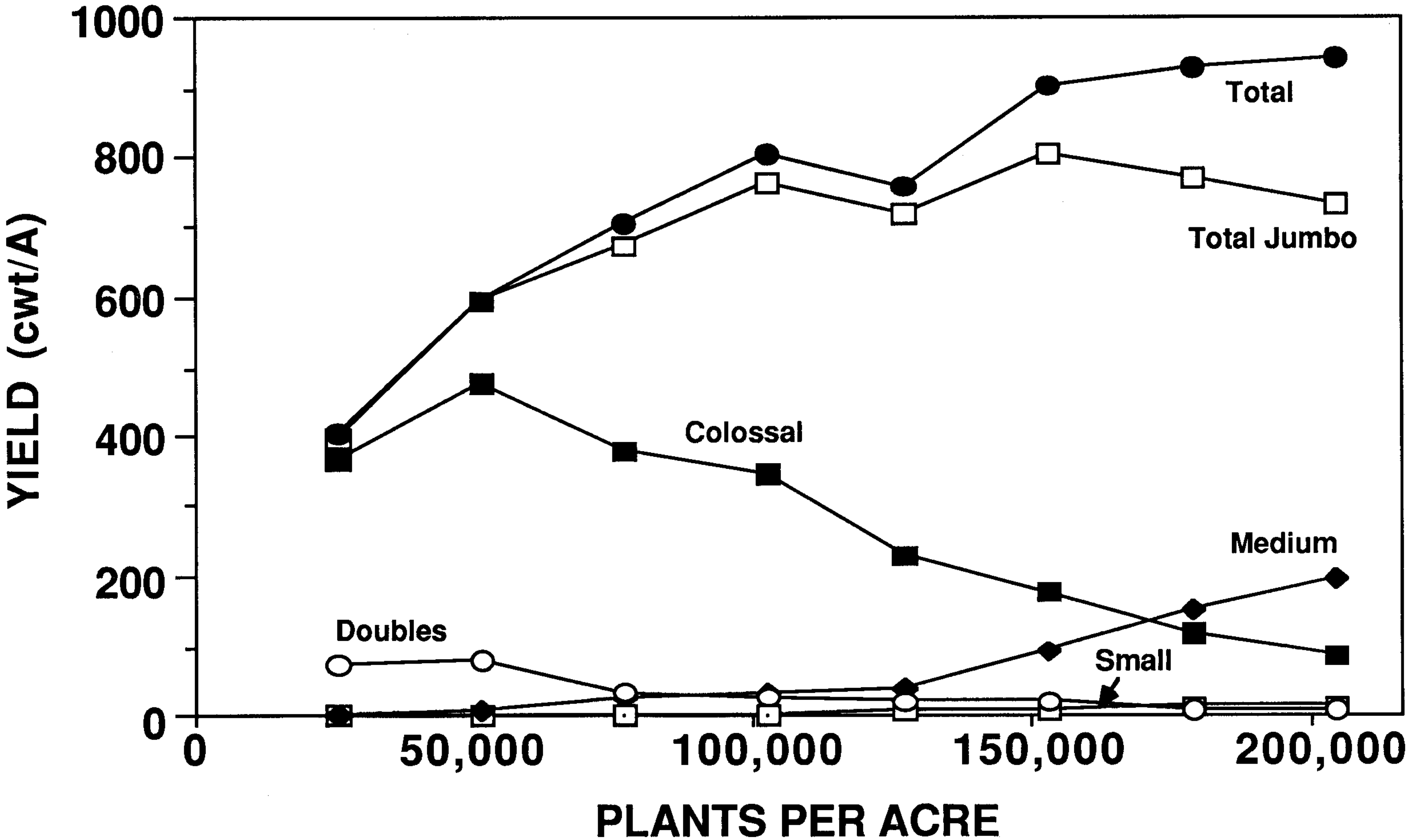


Figure 4. YIELD OF FOUR SWEET SPANISH ONION VARIETIES AS INFLUENCED BY PLANT POPULATION

Malheur Experiment Station, OSU, Ontario, Oregon

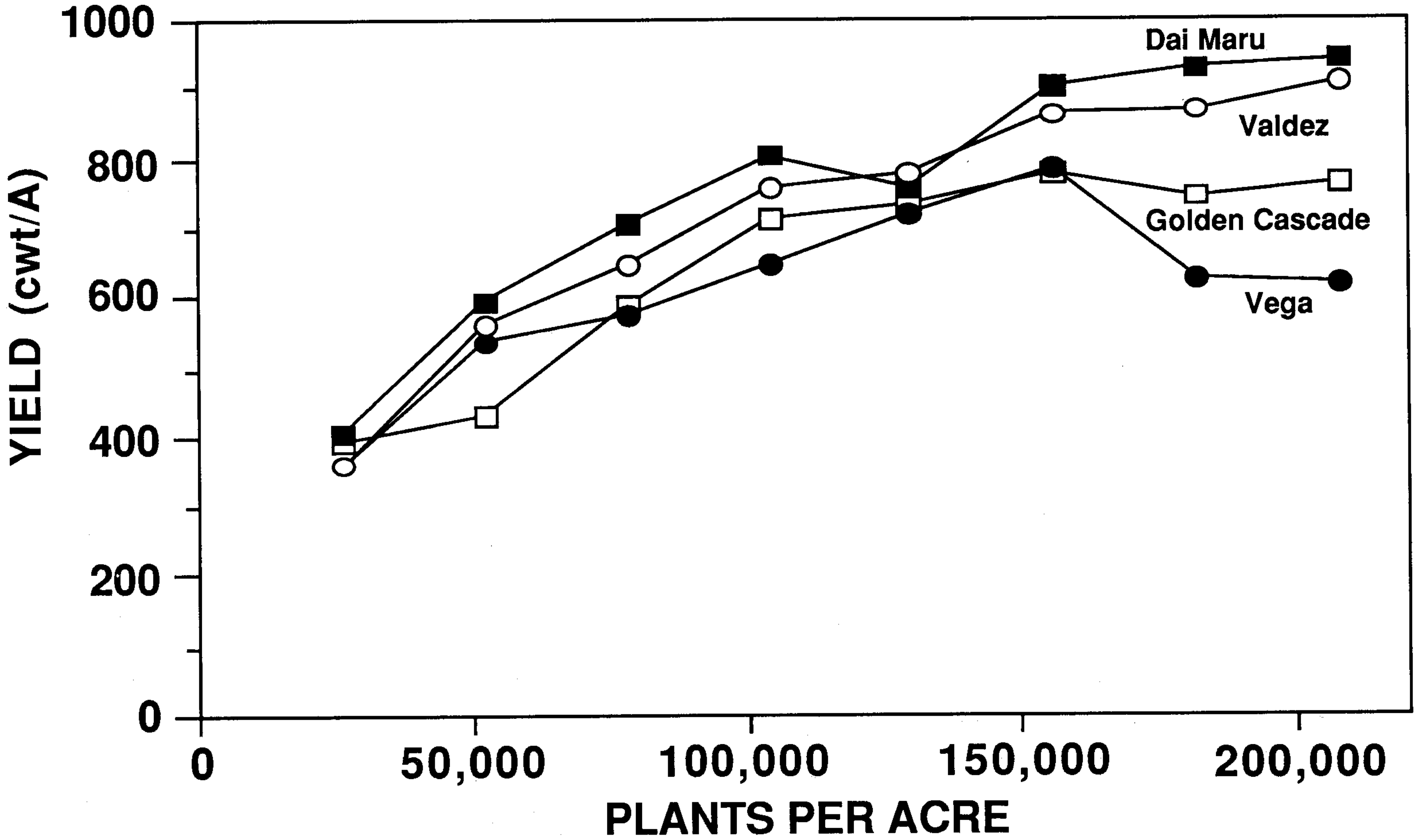


Figure 5. THE EFFECT OF PLANT POPULATION ON THE YIELD OF DOUBLE (Cull) ONIONS.

Malheur Experiment Station, OSU, Ontario, Oregon

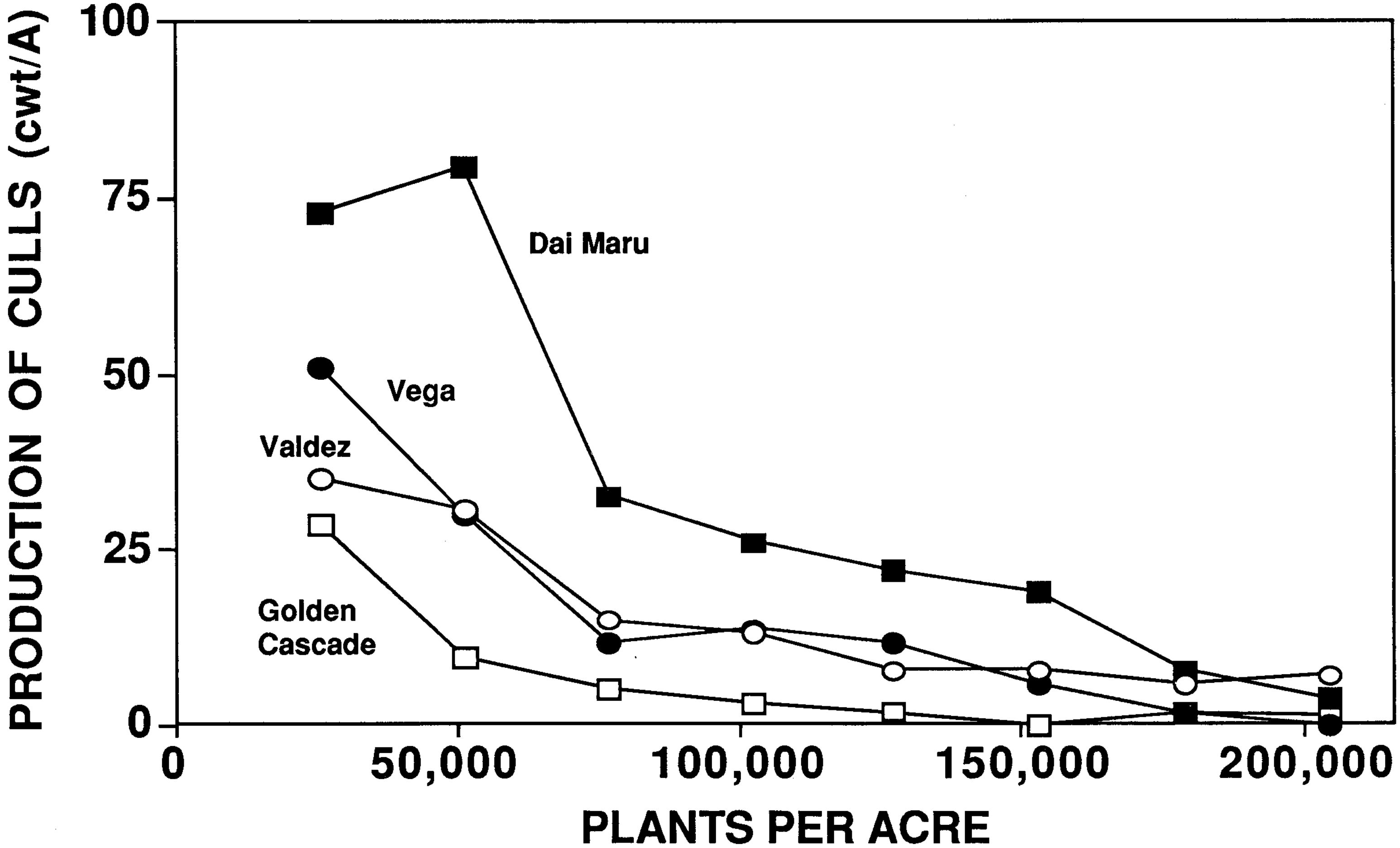
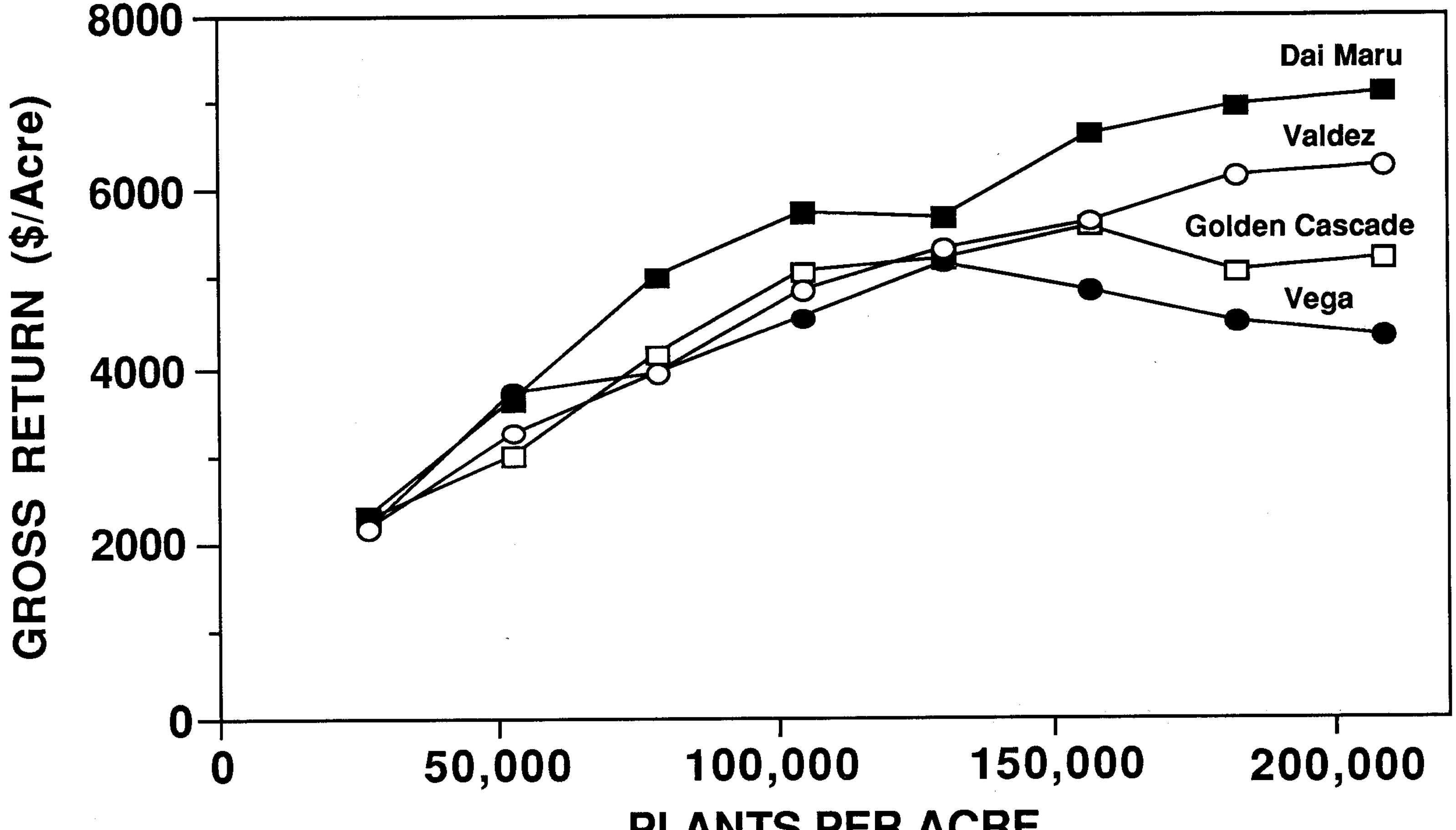


Figure 6. GROSS RETURN FOR FOUR SWEET SPANISH ONION VARIETIES AS INFLUENCED BY PLANT POPULATION

Malheur Experiment Station, OSU, Ontario, Oregon



THE TEST OF THE FEASIBILITY OF FIELD-PLOT INCREASES OF PISUM GERMPLASM NUCLEAR SEED SOURCES, MAINTAINING FREEDOM FROM SEED-BORNE PATHOGENS

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Purpose

A team of USDA ARS scientists, including the senior author, derived pathogen-free nuclear-seed sources of U.S. Pisum sativum (peas) germplasm collection, comprising 2,700 accessions. The alternatives for increasing seeds of these greenhouse-produced nuclear-seed sources were (a) second-generation greenhouse-produced mother plants, involving very high costs and yielding relatively small quantities of seed, and (b) field-plot grown mother plants, with precautions against seed-borne pathogens, yielding larger quantities of economically produced seeds. The feasibility of field-plot seed increases of 200 Pisum nuclear-seed sources was evaluated at the Malheur Experiment Station in 1989.

Procedures

Home gardeners inside a 3.2 km radius around the plots were provided pea seed assured of being free of seed-borne pathogens. Field plots consisted of non-replicated, 3-meter-long rows (50 seeds per plot), with 2.23 m between rows and 3-m alleys between plots, to prevent between-row plant mixing, to cleanly separate plots, and to assure seed clean-outs (zero seed mixing between plots) during the harvest of seeds from plots. Systemic insecticides were applied as needed to minimize aphids and other insect pests in the plots. Plots were regularly examined for disease incidence, particularly for diseases caused by seed-borne pathogens. A special record was made of viral diseases, with identification of causal viruses.

Results

Some plots were flooded during irrigation, causing loss of plants and seed production. Some peas were moderately damaged by residual herbicides. However, most peas escaped flooding and herbicide injury and were very productive, yielding up to 2.8 kg (10,000 to 12,000 seeds). Natural incidence of viruses was confined to bean leaf roll luteovirus (< 50 plants in 8 accessions) and pea enation mosaic virus (< 20 plants, in 3 accessions). There was zero incidence of pea seedborne mosaic virus, a pathogen removed from these Pisum accessions, in deriving the nuclear-seed sources.

Excellent yields of high-quality, pathogen-free seeds suggested, at least under conditions of the 1989 season, that appropriately cautious field-plot increases of these Pisum nuclear-seed sources were feasible.

AN EVALUATION OF <u>SPOTLESS</u> FUNGICIDE FOR CONTROL OF POWDERY MILDEW IN RUSSET BURBANK POTATOES AND ITS EFFECT ON TUBER YIELD, SIZE, AND QUALITY

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Introduction

Powdery mildew (*Erisyphe cichoracearum*) is known to occur on potatoes in the Snake River Valley, the Columbia Basin, and in Utah. Previously control measures have only been required in furrow-irrigated fields in some Columbia Basin areas. Recently with an increase of disease pressures in the Snake River Valley, powdery mildew has been reported by potato industry representatives to be an economic factor affecting both tuber yield and quality requiring control efforts.

Powdery mildew first appears as very small, elongated, light brown stipples on potato stems and petioles. These coalesce as they develop to form dark, water soaked lesions; symptoms spread to leaves. Sometimes the sporeforming structures of the fungus develop in leaf lesions, giving leaves a powdery, dusty brown or gray color that looks like soil or spray residue. As the disease progresses, lower leaves turn yellow and fall. The plant stays erect but becomes covered with mycelium of powdery mildew.

Sulfur is reported to an effective control measure for powdery mildew if it is applied before infections are established. Symptoms appear after infections are established; sulfur applications made after this time are ineffective. In Columbia Basin furrow irrigated fields where the disease is expected, initial sulfur applications are made in mid to late July and repeated every two weeks. Norgold Russet and Norkoda varieties are highly susceptible to powdery mildew and require more careful control when grown in fields where powdery mildew occurs. Near Nyssa, Oregon in 1989 a field of Norkoda variety of potatoes was severely infected with powdery mildew. Infection covered all the foliage including leaves which resulted in early vine senescence stopping tuber growth resulting in significant reduction in tuber size and yield.

Materials and Methods

Spotless (0.125 lbs ai/ac) was tank-mixed with X-77 at two rates (4 and 8 fl oz/ac) and with a crop oil concentrate (COC) tank mixed at a rate of 0.5 percent v/v rate. The trade name for the COC material used in this study was MorAct.

The trial site was located near Adrian, Oregon. Russet Burbank was the potato variety. The soils were a sandy loam texture with a pH of 6.8 and an organic content of 0.92 percent. The potatoes were planted in rows spaced 36 inches apart and watered by furrow irrigation.

The fungicide was applied twice over the top of the potato foliage. The first application was applied on June 20 at the time of row closure. The second application was made on July 5. The fungicide was applied with a hand-held boom CO_2 backpack plot sprayer. The boom was six feet long and the spray covered the foliage in the two center rows with one pass. The four teejet nozzles were size 8002 and spaced 20 inches apart along the boom. Spray pressure was 35 psi and spray volume was 15 gallons per acre. Each treatment was replicated six (6) times. Individual treatments were arranged at random within blocks. Each block was a replication. Each plot size per treatment was four rows wide and 30 feet long.

Potato tubers were harvested on September 9 and graded for size and quality on September 11 and 12. Size categories for number ones and number two tubers were 12 oz and larger, 6-12 oz and 4-6 oz. Cull size tubers were less than 4 oz (eliminators) and larger than 4 oz but to rough to be classified as number two's. Samples of number one tubers (20 tubers per sample) from each replicated treatment was evaluated for hollow heart, internal brown spot, brown centers, specific gravity, fry color and percent dark=end tubers. Specific gravity was determined by the floatation method. Fry colors were determined using a light reflectance meter and percent dark-ends calculated by recording number of tubers with reflectance readings of 28 and less at the stem-end.

Results

The potatoes were never infected with powdery mildew only a few lesions on plant stems were observed. Adjacent potato fields of Norkota and Norgold varieties were heavily infested with mildew.

On July 18, the potato vines in the treated rows were dark green in color and showed significantly less number of plants with symptoms of early-dying than potato vines in the untreated rows.

The foliage of the treated potatoes remained green until August 9. The potato foliage was lighter green and many plants had symptoms of vertillicum. After August 9 all the vines started dying and were completely senested by August 25. Foliage of potatoes grown by sprinkler irrigation remained green until harvested as late as mid-October.

The Spotless fungicide did not have a positive or negative effect on tuber yield, size, or quality. Yield trends were noted which indicated slight increases in tuber size between treatments but differences were not statistically different. Tuber size and yield were higher when Spotless was activated by the higher rate of X-77 and with COC. The incidence of internal defects was very low in tubers from treated plants thus differences between treatments could not be evaluated. This was probably because of severe infection by Verticillum wilt which caused early dying of foliage resulting in a reduced size of all tubers. Specific gravity readings were about average for potatoes and fry quality was generally good in all treated potatoes from all treatments, resulting in a rather low percent of tubers with dark-ends.

Table 1. Potato tuber yields and size of US No. Ones. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Fungicide	Rate	US No. 1's > 12 oz		6 - 12 oz		4 - 6 oz		Total	
	lbs ai/ac	cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac	%
Spotless	0.125	18.88	3.72	175.9	35.46	99.35	20.19	294.2	59.37
Spotless + X-77	0.125 + 4 fl oz	19.85	4.34	150.1	32.57	88.22	19.24	258.2	56.26
Spotless + X-77	0.125 + 8 fl oz	25.39	5.35	160.9	33.80	88.55	18.93	274.2	56.26
Spotless + MorAct	01.25 + 0.5 %	22.39	4.56	172.4	35.39	89.27	18.66	284.1	58.61
Check	-	18.73	4.04	166.0	36.16	88.92	19.68	273.7	59.88
LSD(.05)		11.08	2.14	47.16	7.03	16.95	3.62	56.43	6.82
Mean		21.05	4.40	165.1	34.68	90.86	19.36	277.0	58.44
CV(%)		17.84	16.45	9.68	6.87	6.32	6.33	6.90	3.95

Table 2. Potato tuber yields and size of US No. Twos. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Fungicide	Rate	US No. 2's > 12 oz		6 - 12 oz		4 - 6 oz		Total	
	lbs ai/ac	cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac	%
Spotless	0.125	17.73	3.59	62.67	12.69	30.15	6.12	110.5	22.33
Spotless + X-77	0.125 + 4 fl oz	13.83	3.10	60.19	13.20	28.50	6.27	102.5	22.42
Spotless + X-77	0.125 + 8 fl oz	12.31	2.53	58.34	12.37	32.36	6.97	103.0	21.88
Spotless + MorAct	01.25 + 0.5 %	12.98	2.67	56.87	11.75	25.23	5.20	95.08	19.72
Check	-	8.80	1.98	54.80	12.14	24.94	5.60	88.55	19.55
LSD(.05)		8.03	1.72	12.29	2.42	7.77	1.82	16.99	3.63
Mean		13.13	2.77	58.57	12.43	28.24	6.03	99.94	21.25
CV(%)		29,74	21.08	7.11	6.59	9.33	10.23	5.76	5.79

Table 3. Potato yields and size of culls. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Fungicide	Rate	Culls & Total Tuber Yields Larger 4oz		Less 4 oz		Total Culls		Total yield all tubers
	lbs ai/ac	cwt/ac	%	cwt/ac	%	cwt/ac	%	cwt/ac
Spotless	0.125	22.81	4.57	97.39	19.77	120.2	24.34	494.8
Spotless + X-77	0.124 + 4 fl oz	33.66	7.47	91.21	19.97	124.9	27.44	457.1
Spotless + X-77	0.125 + 8 fl oz	24.74	5.38	100.6	21.63	125.3	27.01	470.8
Spotless + MorAct	0.125 + 0.5 %	29.74	6.26	98.57	20.70	128.3	26.97	482.2
Check	-	18.87	4.29	96.77	21.69	115.6	25.99	452.9
LSD (.05)		12.99	3.04	16.59	4.18	22.68	6.02	53.9
Mean		25.96	5.59	96.90	20.75	122.9	26.35	471.6
CV(%)		16.96	18.46	5.80	6.84	6.25	7.75	3.81

Table 4. Evaluation for internal quality of potato tubers. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Fungicide	Rate	Hollow[1] heart	Internal[1] brown spot	Brown center[1]	Specific gravity[2]	Fry color reflectance[2]	Dark-end tubers[2]
	lbs ai/ac	%	%	%		Avg.	%
Spotless	0.125	0.56	0	0	1.073	40.78	12.6
Spotless + X-77	0.125 + 4 fl oz	0.57	0	0	1.077	36.73	14.9
Spotless + X-77	0.125 + 8 fl oz	0.61	0	0	1.076	41.61	10.8
Spotless + MorAct	0.125 + 0.5%	0.54	0	0	1.078	39.65	15.7
Check	-	0.58	0	0	1.074	37.84	13.3
LSD(.05)		0.09	-	-	0.0064	8.39	6.92
Mean		0.57	-	-	1.0756	39.32	13.46
CV(%)		5.24	-	-	6.42	13.96	8.21

[1] Ten tubers twelve ounce and larger were cut from each replication to determine the amount of hallow heart, internal brown spot and brown centers.
[2] Twenty tubers were selected from tubers within the 6-12 ounce size to determine specific gravity, fry color, and dark-end tubers. One sample of twenty tubers were sampled from each replication.

EVALUATION OF SPRING CEREALS FOR THE TREASURE VALLEY

Mathias F. Kolding
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Ontario, Oregon, 1989

Purpose

Spring cereal selections introduced, or selected from new crosses at the Hermiston Agricultural Research and Extension Center and the Crop Science Department are evaluated for adaptation to the Treasure Valley.

Procedures

The trials were planted April 18, 1989 with a four-row double-disc opener research drill mounted on a small tractor. Individual plots are 4 by 15 feet. They were 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. Nitrogen was not applied since the soil-test results revealed an average of 53 pounds per acre foot of residual nitrogen. Plots were trimmed to 11 feet and were harvested with a plot combine on August 1, 1989, except that the spring oats was harvested August 8.

Results and Discussions

Spring barley and the spring wheat grain yields were probably very low in 1989 due to lack of available nitrogen for seedlings, watering was not as precise as in previous years, and the third week in April planting date is several weeks past the ideal planting day.

The low yields and very low test weights of some of the barleys are due to stem rust, (Puccinia graminis tritici) especially when this disease completely girdles the stem.

Several spring oats, on the other hand, had some promising yields of over 200 bushels per acre. They matured nearly ten days later than the wheats.

Table 1. Western Regional Spring Wheat Trial: a five year grain yield summary, test weights, and plant height of spring wheats tested in a 1989 yield trial. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Entry	Name	Yield 1985	1986	1987	1988	1989	Average	Test weight	Plant height
		bu/ac						lbs/bu	inches
1	McKay	89	98	119	115	51	94.4	60.7	30
2	Federation	70	96	95	92	56	81.8	55.9	34
3	Owens	87	106	123	131	62	101.8	61.9	30
4	Penawawa	104	103	124	131	61	104.6	61.5	27
5	Spillman	103	96	111	115	58	96.6	59.0	31
6	Wakanz	71	91	119	113	64	91.6	54.0	28
7	WA 7326		92	104	109	51	89.0	60.2	29
8	WA 7176		99	117	116	66	99.5	59.3	30
9	ORS 8510			103	100	54	85.7	61.8	31
10	WA 7496			107	116	62	95.0	55.6	27
11	ID 341			109	113	55	92.3	59.7	22
12	ID 366			109	111	66	95.3	63.6	30
13	UT 743				117	56	86.5	54.9	18
14	UT 817				126	69	97.5	58.1	30
15	UT 884				118	65	91.5	57.0	29
16	WA 7493				123	50	86.5	61.2	28
17	OR 487503				98	64	81.0	56.6	25
18	OR 487570				101	62	81.5	55.9	28
19	OR 487316				108	55	81.5	56.9	27
20	ID 367				124	52	88.0	59.4	26
21	ID 369				119	55	87.0	57.4	27
22	ID 379				127	61	94.0	61.2	28
23	ID 415					67	67.0	60.8	28
24	ID 416					68	68.0	55.0	26
25	ID 417					59	59.0	59.3	26
26	ID 419					61	51.0	59.2	26
27	ID 420					58	58.0	58.8	26
28	UT 58646					62	62.0	58.8	26
29	UT 613960					60	60.0	59.2	27
30	UT 002464					59	59.0	60.1	34
31	OR 487355					52	52.0	59.8	28
32	OR 487456					48	48.0	60.0	23
33	OR 487475					42	42.0	58.3	19
34	OR 487400					58	58.0	59.1	27
35	Klasic					34	34.0	57.4	20
36	Serra					56	56.0	58.6	25

Table 2. Western Regional Spring Barley Nursery: a five year yield summary, test weight, date 50% headed, and stem rust (Puccinia graminis tritici) reaction of spring planted barleys tested. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Entry	Name	Yield 1985	Yield 1986	Yield 1987	Yield 1988	Yield 1989	Yield Average	Test weight	Date* headed	Stem rust
		lbs/ac						lbs/bu		**
1	Trebi	3696	5760	5376	6816	4184	5166	46.7	155	S-70
2	Steptoe	4848	6720	5136	8688	4537	5986	48.3	152	S-70
3	Klages	4512	6432	5280	6288	4154	5333	49.2	157	MS-40
4	Morex	4032	5712	5952	7248	4146	5418	47.0	153	S-80
5	WA 102178			4704	7104	3869	5226	46.7	156	S-70
6	BA 4039				6960	4386	5673	47.2	156	MS-20
7	BA 8529				6384	4406	5395	50.8	157	VS-90
8	ID 82519				7397	3847	5622	46.9	151	VS-90
9	ID 71966				7680	4059	5869	48.2	151	VS-90
10	MT 83533				6480	4698	5589	48.9	156	S-60
11	MT 140523				6384	4420	5402	49.2	155	MR-40
12	ND 9147				6672	4372	5522	47.4	157	MR-30
13	OR 842008				6672	4488	5580	48.3	157	VS-90
14	OR 842011				5952	4160	5056	47.5	159	S-60
15	UT 1075				8400	4350	6375	44.9	157	S-90
16	UT 2507				8064	4022	6043	46.6	152	VS-99
17	WA 9448-83				6528	4455	5491	47.6	157	MR-30
18	BA 2601					3701	3701	47.0	155	S-99
19	ID 8540					3494	3494	43.0	152	VS-80
20	MN 52					4456	4456	48.6	153	MR-50
21	MT 83435					3780	3780	48.6	155	MR-80
22	MT 851032					4449	4449	46.1	155	MR-10
23	ND 9866					3934	3934	50.3	154	MS-60
24	OR 1					3818	3818	46.5	157	MR-30
25	OR8623					3534	3534	46.6	152	MS-10
26	PB 107					3540	3540	45.3	158	MR-60
27	UT 502358					3644	3644	40.6	156	S-90
28	WA 9029					4016	4016	41.2	157	S-90
29	WA 12629					2730	2730	48.1	158	VS-99
30	WP 584118					3938	3938	43.1	155	VS-99

* Date headed is when 50% of spikes are emerged from the sheath starting from January 1 (May 1 = 121).

** Stem rust reaction is the pustule type and an estimated percent of the stem circumference area infected (VS = Very Susceptible, S = Susceptible MR = Moderate Resistance).

Table 3. Western Regional Spring Oats: Grain yield,and test weights of spring oats. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Entry	Name	Grain yield		Percent of one	Test weight
		lbs/ac	bu/ac		lbs/bu
1	Park	5462	171	100	33.0
2	Cayuse	5968	186	109	32.0
3	Otana	6225	195	114	40.2
4	Appaloosa	6814	213	125	38.1
5	Border	6737	211	123	38.4
6	64 AB 2608	7203	225	132	38.4
7	Monida	6857	214	126	38.9
8	Ogle	5166	161	95	39.1
9	75AB 861	6230	195	114	40.3
10	Calibre	6612	207	121	39.5
11	Dumont	6715	210	123	37.0
12	80AB 4725	5696	178	104	38.0
13	81AB 5792	6387	200	117	37.3
14	Riel	6500	203	119	39.5
15	80AB 988	5137	161	94	36.2
16	80AB 5807	6185	193	113	37.2
17	Valley	5688	178	104	40.8
18	80AB 5322	5916	185	108	39.2
19	82AB 248	6512	204	119	34.0
20	82AB 1178	5732	179	105	32.0
21	82AB 1142	5300	166	97	32.0
22	Robert	5594	175	102	33.0
23	Trucker	5530	173	101	41.2
24	NPB 86575	5043	158	92	34.4
25	NPB 86586	3952	124	72	32.8
26	NPB 86801	5062	158	93	34.1
27	NPB 871742	4802	150	88	34.1
28	83AB 3119	6386	200	117	35.7
29	83AB 3250	7490	234	137	37.4
30	83AB 3725	5320	166	97	38.5

Table 4. Eastern Oregon Irrigated Spring Barley: a six-year grain yield summary of spring barleys evaluated in yield trials. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

		Yield						
Entry	Name	1984	1985	1986	1987	1988	1989	Average
		lbs/ac						
1	Karla	5280	6432	6524	6240	7461	4012	5991
2	Lindy	6960	5616	7104	5904	7980	4082	6268
3	Micah	5568	5808	5280	6576	5847	3625	5451
4	FB78444-006	7968	7200	6816	6240	7647	3602	6578
5	Andre			6816	6000	7880	3368	6016
6	Trebi						3727	3727
7	Diamant						4149	4159
8	Robust						3548	3548
9	Lewis						4001	4001
10	Gus						4336	4336
11	Columbia						3846	3846
12	Moravian III						3982	3982
13	B 2601						3948	3948
14	2B 82-8529						3625	3625
15	CBR 171 BR6001						3683	3683
16	Hazen						3734	3734
17	Klages						3683	3683

EVALUATION OF WINTER CEREALS FOR THE TREASURE VALLEY

Mathias F. Kolding
Malheur Experiment Station
Oregon State University
Ontario, Oregon, 1989

Purpose

Winter cereal selections derived and selected from new crosses at the Hermiston Agricultural Research and Extension Center and the Crop Science Department are evaluated for adaptation to the Treasure Valley.

Procedures

The trials were planted October 20, 1988 with a four-row double-disc opener research drill mounted on a small tractor. Individual plots are 4 by 15 feet. They were 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. No nitrogen was applied since the soil-test results revealed an average of 53 pounds per acre foot of residual nitrate nitrogen. Plots were trimmed to 11 feet and were harvested with a plot combine on July 31, 1989.

Results and Discussions

Observations concerning advanced winter barley selections are summarized in Tables 1 and 2. Entry number 4, AB 812, is the most recent winter barley released for the Pacific Northwest. Though it is not the top producer across all trials in Table 1, its yields are better than the checks, and it was the highest producer at the Malheur Experiment Station in 1989. AB 812 is usually two to four inches shorter than either Hesk or Mal. It is an improvement in straw strength, test weights may average a little low, but kernel size is usually very good for a winter six-row type.

Entry number 3, FB77796 H6001, is an early maturing six-row that has good winter-hardiness. It is being increased in a breeders seed plot at the Hermiston Research Center. Those growers with shallow soils, or in the lower rainfall areas may have an interest in FB77796 H6001.

The FB81019 series continue to give outstanding yields. They are hardy types that derive their hardiness from a mutant line out of the very cold hardy line, 'Tokat'.

Most of the barley entries have a high level of tolerance to Barley Yellow Dwarf Virus. These lines have been exposed to very high levels aphid populations at the Hermiston Agricultural Research and Extension Center where winter barleys are planted during the last week of August so that plants are emerging when aphids are migrating from drying and dying cereals and grasses. Usually the aphids counts are higher than 400 aphids per foot of row by the time plants are four to ten inches tall.

Table 1. Eastern Oregon Irrigated Winter Barley: a three-year grain yield summary of winter barleys evaluated in yield trials grown near Boardman, Hermiston, and Ontario, Oregon.

Entry	Name	Yield* 1987	1988	1989	Average
		lbs/ac			
1	Check**	5419	5631	5153	5380
2	FB81019-04030	5477	6105	5885	5797
3	FB81019-4032	5887	6858	5588	6043
4	AB 812	5678	6477	4684	5534
5	FB763167H6001	5689	5846	5256	5574
6	FB77796 H6001			5248	5248
7	FB84231 H7001			4842	4842
8	FB84231 H7004			4495	4495
9	FB84231 H7016			4548	4548
10	FB84231 H7019			4721	4621
11	FB84243 H7109			5266	5266
12	FB84243 H7114			5964	5964
13	FB84378 H7011			6043	6043
14	FB84378 H7103			5656	5656
15	FB84378 H7104			5755	5755
16	FB84378 H7106			5351	5351
17	FB81019-BR008			6180	6180
18	FB81161-BR012			5224	5224

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

** Hesk was the check for 1987 and 1989: Mal was the check for 1988.

The winter of 1988-1989 started with warm fall temperatures which lasted until the first week of February when temperatures dropped to minus 10 degrees below zero Fahrenheit and stayed below freezing for over a week. In addition, there was no snow cover preceding the cold temperatures. Consequently, those winter barleys not requiring a long vernalization period, or those which were seeded in November suffered severe cold damage. In the early planted winter barley trial at Hermiston, all the barleys died except FB77796 H6001. Wheats and barleys planted the third of November were at the very tender three to four leaf stage when the February cold temperatures occurred. All the barleys were damaged severely enough to require reseeding if they were in a commercial field. The mean survival of 24 plots of 'Showin', 'AB 812', 'Mal', 'Scio', 'Hesk',and FB77796 H6001 was 9, 10, 18, 22, and 24 percent respectively. 'Stephens' winter wheat survived at 54 percent.

Table 2. Eastern Oregon Irrigated Winter Barley: grain yield, date 50% headed, test weight, percent lodging, percent plump and thin (pan) kernels of winter barleys evaluated. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Entry	Name	Percent yield	of one	Rank	Date*	Test Weight	Lodging	Percent plump**	Percent pan
		lbs/ac				lbs	%		
1	Hesk	7427	100	5	143	46	0	84	16
2	79AB 812	7574	102	1	144	46	0	90	10
3	FB77796 H6001	6431	87	18	140	48	0	88	12
4	FB763167H6001	7324	99	6	143	46	0	86	14
5	FB81019-04030	6831	92	15	147	41	0	88	12
6	FB81019-4032	6880	93	12	149	43	0	71	29
7	FB84231 H7001	7437	100	4	142	45	0	90	10
8	FB84231 H7004	6872	98	13	143	44	0	85	15
9	FB84231 H7016	7555	102	3	143	44	0	91	09
10	FB84231 H7019	7058	95	9	144	44	0	78	22
11	FB84243 H7109	6660	90	17	149	46	0	91	09
12	FB84243 H7114	6742	91	16	149	45	0	78	22
13	FB84378 H7011	6855	92	14	149	42	0	90	10
14	FB84378 H7103	7095	96	8	151	44	0	90	10
15	FB84378 H7104	7185	97	7	149	43	0	82	18
16	FB84378 H7106	6955	94	11	149	42	0	90	10
17	FB81019 BR008	7558	102	2	144	41	0	99	01
18	FB81161-BR012	7034	95	10	144	47	0	84	16

* Date is number of days started at January 1 (May 1 = day 121)

** Percent plump is the percent of 200 grams of barley remaining on a 6/64 by 1/2 inch slotted screen after a specified number of shakes while percent pan is the percent which passed through the slots.

Figure 1. Average grain yields of five soft white winter wheats tested from 1986 through 1989 at the Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Variety	Bushels per acre
Stephens	142
Hill	135
Malcolm	140
Dusty	141
FW75336-103	139

Grain yield averages in Figure 1 are very close. However, if FW75336-103 becomes a new variety growers will have five diverse genetic sources from which to chose for disease resistance and reaction to adverse weather, therefore presenting a better probability for long term stable yields.

Table 3. Eastern Oregon Irrigated White Winter Wheat: a four-year grain yield summary of white winter wheats evaluated in yield trials grown near Boardman, Hermiston, and Ontario, Oregon.

Entry	Name	1986	1987	1988	1989	Average	Years**
		- - - - - - - - - Yield* - - - - - - - - -					
		- - - - - - - - - - bu/ac - - - - - - - - -					
1	Stephens	129	126	131	81	112	14
2	Hill	131	121	130	80	110	14
3	Malcolm	126	131	137	76	112	14
4	FW75336-103	126	132	135	83	114	14
5	FW771697 G19	133	124	126	75	109	14
6	FW81463-307	129	129	138	76	112	14
7	FW81454-301 "FW-301"	119	131	140	76	111	14
8	FW82178-B5018	122	129	139	75	110	14
9	Dusty	130	128	137	76	112	14
10	Lewjain		129	139	72	106	11
11	FW82169-318		130	138	75	107	11
12	FW81464-333 "FW-333"		133	133	75	106	11
13	FW82202-324		117	124	88	106	11
14	FW 205-19B			112	76	90	8
15	FW83117 D5015				84	84	5
16	FW83117 D5039				85	85	5
17	FW83115 D5068				76	76	5
18	FW83115				77	77	5

* Yield is the average bushels per acre for three locations in 1986, 1987, 1988, and for five locations in 1989.

** Years are number of years used to calculate the final average. Stephens 11 and 8 year average is 106 and 100 bushels per acre respectively.

Figure 2. Winter survival of winter wheats sown the third week of November 1988 and exposed to sub-zero temperatures when at the three to four leaf stage at the Hermiston Agricultural Research and Extension Center, Oregon State University, Hermiston, Oregon.

Variety	Percent survival	Bushels per acre
Hill	77	78
Madsen	75	72
Dusty	70	71
Tres	69	70
Andrew	67	52
Hyak	66	55
Ute	65	61
Batum	64	66
FW75336	63	70
Malcolm	62	71
Lewjain	57	56
Stephens	55	61
Hesk (barley)	24	30

Table 4. Eastern Oregon Irrigated White Winter Wheat: grain yield, date 50% headed, test weight, percent lodging, and stem rust reaction of soft white winter wheats. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Entry	Name	Yield	Percent of One	Rank	Date*	Plant Height	Test Weight	Lodging	Stem** Rust
		bu/ac				inches	lbs	%	
1	Stephens	109	100	16	137	36	59.8	0	VS-30
2	Hill	116	106	8	139	40	60.3	0	MR-TR
3	Malcolm	125	115	1	139	36	59.3	0	VS-20
4	FW75336	114	105	12	139	36	58.0	0	VS-80
5	FW771697 G19	123	113	2	140	35	59.0	0	VS-30
6	FW81463-307	120	110	4	139	35	57.6	0	MR-05
7	FW81454-301 "-301"	116	106	9	138	36	59.0	0	S-20
8	FW82178-B5018	112	103	15	139	35	59.2	0	S-30
9	Dusty	114	105	13	139	34	58.3	0	VS-80
10	Lewjain	112	103	14	140	35	58.4	0	VS-60
11	FW82169-318	104	95	17	140	35	60.0	0	MR-20
12	FW81464-333	115	106	11	139	35	60.7	0	MR-10
13	FW82202-324	117	107	7	139	37	61.8	0	MR-10
14	FW 205-19B	104	95	18	145	32	59.2	0	R-00
15	FW83117 D5015	121	111	3	137	40	60.7	0	MR-05
16	FW83117 D5039	118	108	5	137	37	61.2	0	VS-90
17	FW83115 D5068	117	107	6	138	37	58.8	0	VS-90
18	FW83115	115	106	10	139	40	57.4	0	MR-10

* Date is the number of days starting with January 1 (May 1 = 121 days).
** Stem-rust readings are the reaction types (R = Resistant, MR = Moderate Resistance, S = Susceptible, VS = Very Susceptible) and the percent of stem area infected.

The wheat varieties in Figure 2 are the more popular winter wheats grown in the Pacific Northwest. The field in which they were planted is on a northerly slope and exposed to northerly winds. It has a sandy loam soil. There were 24 plots of each variety and survival was recorded in the middle of March when growers were deciding whether to reseed their fields. At that time, if two-thirds of the stand remained, then it was considered a toss-up if one should replant or not. The estimated survival percentages and grain yields in Figure 2 may serve as a helpful guideline for future replanting or "over-seeding" decisions. The data may also serve as a demonstration of the frustrations of making judgment calls on stand condition when the grower most decide keep or plant some other crop.

Stem rust was the most notable disease in the wheat plots in 1989. The wheats reaction to the infestations are given in Tables 4 and 6. Though some yield reduction was caused by the stem rust, the most resistant white winter wheat FW 205-19B had the lowest yield.

Table 5. Eastern Oregon Irrigated Soft White Winter Wheat: test weight*, flour yield, flour ash, milling score, flour protein, mixograph absorption corrected, and cookie diameter corrected of twelve winter wheats grown in a 1989 trial, where residual soil nitrogen was the nitrogen source. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Variety	Test weight	Flour yield	Flour ash	Milling score	Flour protein	Mixograph absorption corrected	Cookie diameter corrected
	lbs/bu	%	%		%	%	cm
Malcolm	62.3	71.6	0.42	85.3	8.9	53.4	8.90
Dusty	60.6	70.0	0.42	83.4	8.8	55.2	8.83
FW771697 G19	62.8	71.5	0.36	87.8	9.8	53.8	9.16
FW "-301"	62.6	72.2	0.38	88.7	8.9	53.5	9.49
FW81463 307	61.5	72.0	0.40	87.2	8.5	52.8	9.26
FW82169-318	61.2	72.7	0.40	88.0	9.5	53.9	9.13
FW82178 B5018	61.0	71.7	0.40	86.9	9.5	53.7	9.09
FW83115	62.2	72.5	0.36	90.2	8.9	53.4	9.26
FW83115 D5068	62.1	72.8	0.38	89.4	9.6	55.2	9.02
FW83117 D5039	62.7	72.2	0.36	89.9	9.1	54.9	9.10
FW205 19B	59.5	71.0	0.40	85.8	10.2	53.1	9.32

* Milling and baking test results were supplied by the USDA ARS Western Wheat Quality Laboratory, Pullman, Washington.

A dependence on residual nitrogen from applications to preceding crops can cause some early cereal plant development problems during cool fall days. The previous crop has probably consumed the greater portion of available nitrogen needed by seedlings, so seedlings do not have the vigor required to develop good tillers or establish a healthy root system.

The stands in trials reflected a lack of adequate nitrogen. The baking and milling tests, however, were very satisfactory. Proteins were low. Flour yields were good and milling scores were high (Table 5.).

Most of the red winters reported in Table 6 do not have very good bread quality. They do have good yields, tolerance to root diseases, and the stem rust present in 1989.

If cereal production in the Treasure Valley should change so that growers would use the cereals for scavenging residual nitrogen after vegetable crops, some type of starter fertilizer may still be necessary so plants can develop a root system to go after the nitrogen. Varieties with good root disease resistance will be required. In addition, those tillage practices which encourage inhibition of water and root penetration into the soil will need modification. Paper thin soil barriers (caused by implements such as disks) restrict water movement and help soil diseases to develop. So growers may have to think of fracturing their soil prior to planting the cereals in the fall.

Table 6. Eastern Oregon Irrigated Red Winter Wheat: grain yield, date 50% headed, test weight, plant height, percent lodging, and stem rust* reactions of red-seeded winter wheat selections evaluated. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Entry	Name	Yield 1988	Yield 1989	Yield Average	Date**	Test weight	Plant height	Lodging	Stem rust
		bu/ac	bu/ac	bu/ac		lbs**	inches	%	
1	FW741037-006	160	125	142	139	58	37	0	R-00
2	FW771595 G305	151	115	133	139	60	34	0	R-00
3	FW771595 G306	162	119	140	138	60	38	0	R-00
4	FW741037G304	158	98	128	139	61	31	0	R-00
5	FW75344-105	145	117	131	139	61	32	0	R-00
6	Neeley	135	103	118	136	60	37	0	R-Tr
7	FW83061B6017B	166	114	140	136	60	37	0	VS-90
8	FW86F111	152	108	130	135	61	36	0	VS-40
9	FW83242 24001	162	104	133	139	60	33	0	R-00
10	FW84039 H5039		102	102	139	59	35	0	R-00
11	FW84040 B6015		114	114	141	58	38	0	R-00
12	FW84064 B6029		104	104	138	58	34	0	S-20
13	FW81255-Y6004		110	110	142	57	36	0	R-00
14	FW81255-Y6005		106	106	142	57	36	0	VS-80
15	FW83291-B5004		98	98	141	58	40	0	R-00
16	FW84047-H5002		103	103	142	58	34	0	MR-05
17	FW84045-H5012		108	108	140	60	38	0	R-00
18	Malcolm		114	114	140	59	36	0	VS-90

* Stem-rust readings are the reaction types (R = Resistant, MR = Moderate Resistance, S = Susceptible, VS = Very Susceptible) and the percent of stem area covered by pustules.

** Test weight and heading date are the average of the Hermiston and Irrigon locations since they were not recorded at Ontario. Heading date is the number of days starting from January 1 (May 1 = 121).

AN EVALUATION OF FOLIAR APPLIED HERBICIDES FOR THE CONTROL OF BROADLEAF WEEDS AND WILD OATS IN SPRING WHEAT

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Purpose

Harmony Extra and Express were evaluated for crop tolerance and weed control when combined as tank-mixes.

Procedures

Bliss variety of spring wheat was planted on April 11, 1989, in silt loam soil with a 7.1 pH and organic matter content of 1.0 percent. Stephen variety of fall wheat was the previous crop grown in the field. Following the harvest of Stephen wheat in the fall of 1988 the field was deep-chiseled (24 inches) twice, fertilized with 100 pounds of phosphorus and 60 pounds of N, and plowed 12 inches deep with a moldboard plow. The seed bed was prepared after plowing with a ground hog (tiller-cultipacker) and left over winter. One-hundred-twenty pounds of wheat was seeded per acre at six-inch spacing between rows using a John Deere double disc-opener drill. Redroot pigweed and Cayuse variety of oats were broadcast seeded before the wheat was seeded. The field was harrowed twice with a double set of spike-tooth harrows before being corrugated in preparation for furrow irrigation.

Trial #1

The herbicides (Table 1) were applied as single and tank-mix combinations. The wheat was in the 3-4 leaf stage and about four inches tall. Redroot pigweed and oat populations were dense. Other weed species included lambsquarters, kochia, hairy nightshade and shepherds purse. All plants of the broadleaf species were two to three inches tall. The oats ranged from plants with one leaf to plants with two tillers. Oat species consisted of both the seeded tame oats and wild oats (*Avena fatua*). The herbicide were applied on May 15 between 9 and 11 AM. The wind was gusting to 5 mph when the herbicides were applied. The skies were clear and the air temperature 67° F. Soils were moist below the surface. The wheat had been irrigated on May 5, ten days before the herbicides were applied.

Trial #2

The herbicides (Table 2) were sprayed during the morning of May 22. The skies were clear, wind calm, and air temperatures 76° F. The older wheat plants had three to four tillers, redroot pigweed was three to four inches tall, and both lambsquarters and kochia was four to six inches tall. The oat plants ranged in size from one leaf to plants with five tillers. The trial area was irrigated on May 18.

Trial #3

The herbicides (Table 3) were applied on May 17. The majority of the wheat plants had three tillers with approximately eight inches of foliage growth. The oat plants varied from one leaf to four tillers. The lambsquarters and kochia plants were three to five inches tall and the redroot pigweed was one to three inches tall.

Spray Information for All-Treatments

The herbicides for all treatments were applied as double overlap broadcast applications. Teejet fan nozzles size 8002 were spaced 10 inches apart on an 8.5 foot boom. The boom was mounted on a single bicycle wheel plot sprayer. Spray pressure was 35 psi and water as the carrier was applied at the rate of 28 gallons per acres. X-77, nonionic surfactant, was added to all treatments that included Harmony Extra and Express at the rate of 0.25 percent v/v. Individual plot size was nine feed wide and 25 feet long. Each treatment was replicated three times using a complete randomized block type experimental design.

Results

Crop injury and percent weed control are reported as numerical ratings from visual observations. Ratings ranged from 0 to 100. Zero indicates no herbicide symptoms on plants. A rating of 100 indicates plants were killed by herbicide activity. Ratings from 0 to 50 indicates a degree of stunting with most severe stunting occurred with a rating of 50. Ratings above 50 indicates the beginning of stand losses and severe stunting.

Each treatment was evaluated at 10, 30, and 50 days following treatment application. The initial herbicide activity of Express and Harmony Extra applied singly was noticeably slower than when these materials were tank-mixed with Buctril, Bronate, 2, 4-D and Curtail. This effect was only noticeable at the 10-day ratings. Broadleaf weed control was excellent with all tank-mix combinations that included Harmony Extra and Express. Harmony Extra and Express were also effective treatments for control of broadleaf seedling weeds. Harmony Extra also gave early suppression of the oat plants but the plots were soon infested by oats in the trial area.

Each of the oat materials including Hoelon, Puma, and Tiller resulted in good to excellent control of oats. Oat control was reduced in tank-mix combinations that included Banvel with Hoelon and Buctril with Puma. Broadleaf weed control was not effected by Banvel in the tank-mix treatments.

Wheat yields were significantly reduced by oat competition in the check plots (Table 4). Wheat yield were also slightly less when Puma was tank-mixed with bromoxynil or dicamba when these treatments were compared to grain yields of other treatments.

Table 1. Crop injury and weed control ratings from herbicides applied in the spring to Bliss variety of spring wheat. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Herbicide	Rate	Crop Injury			Weed Control: Pigweed			Lambsquarters			Kochia			Hairynightshade			Oats		
		10	30	50	10	30	50	10	30	50	10	30	50	10	30	50	10	30	50
	lbs ai/ac	%																	
Harmony Extra	0.0113	0	0	0	72	96	99	63	98	99	60	95	96	60	82	100	15	40	5
Harmony Extra	0.0141	0	0	0	68	100	100	65	100	100	63	100	100	65	100	100	20	50	5
Harmony Extra + 2,4-D	0.0113 + 0.25	0	0	0	98	100	100	95	100	100	95	100	100	95	100	100	0	0	3
Harmony Extra + 2,4-D	0.0141 + 0.25	0	0	0	98	100	100	98	100	100	98	100	100	96	100	100	0	0	3
Harmony Extra + Buctril	0.0113 + 0.125	0	0	0	96	100	100	99	100	100	96	100	100	98	100	100	0	0	3
Harmony Extra + Buctril	0.0141 + 0.125	0	0	0	98	100	100	99	100	100	95	100	100	95	100	100	0	0	3
Harmony Extra + Banvel	0.0113 + 0.094	15	8	7	96	100	100	95	100	100	98	100	100	98	100	100	0	0	10
Harmony Extra + Banvel	0.0141 + 0.094	15	10	5	96	100	100	98	100	100	98	100	100	98	100	100	0	0	7
Express + 2,4-D	0.0078 + 0.25	0	0	0	95	100	100	95	100	100	96	100	100	95	100	100	0	0	15
Harmony Extra + 2,4-D + Hoelon	0.0141 + 0.25 + 1.0	5	5	3	98	100	100	98	100	100	95	100	100	93	100	100	75	90	96
Express + 2,4-D + Hoelon	0.0078 + 0.25 + 1.0	5	5	3	98	100	100	96	100	100	95	100	100	96	100	100	70	85	95
Harmony Extra + 2,4-D + Puma	0.0141 + 0.25 + 0.09	5	5	3	97	100	100	98	100	100	98	100	100	98	100	100	85	95	99
Express + 2,4-D + Puma	0.0078 + 0.25 + 0.090	5	8	5	95	100	100	97	100	100	95	100	100	96	100	100	90	95	100
Hoelon	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	65	80	96
Puma	0.090	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	85	95	100
Harmony Extra + Banvel + Hoelon	0.024 + 0.094 + 1	8	5	5	98	100	100	98	100	100	98	100	100	95	100	100	65	60	70
Express + Banvel + Hoelon	0.0156 + 0.094 + 1	0	5	5	98	100	100	96	100	100	96	100	100	96	100	100	60	60	75
Express + Banvel	0.0156 + 0.094	0	5	5	96	100	100	98	100	100	96	100	100	98	100	100	0	0	5
Harmony Extra + Banvel	0.024 + 0.094 +	0	0	3	98	100	100	98	100	100	98	100	100	96	100	100	0	0	10
Check	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2. Crop injury and weed control ratings from herbicides applied in the spring to Bliss variety of spring wheat. Malheur Experiment Station, Oregon State Universit Ontario, Oregon, 1989.

Herbicide	Rate	Crop Injury			Weed Control: Pigweed			Lambsquarters			Kochia			Hairynightshade			Oats		
		10	30	50	10	30	50	10	30	50	10	30	50	10	30	50	10	30	50
	lbs ai/ac	%																	
Buctril	0.187	0	0	0	60	75	83	90	95	98	85	90	83	85	90	95	0	0	0
Bronate	0.5	0	0	0	100	100	100	90	98	100	85	92	98	85	92	95	0	0	0
Buctril + Harmony Extra	0.187 + 0.008	0	0	0	90	100	100	100	100	100	90	98	98	80	95	95	15	20	5
Buctril + Harmony Extra	0.187 + 0.004	0	0	0	80	90	93	90	95	97	80	95	92	85	95	98	10	15	0
Buctril + Express	0.187 + 0.008	0	0	0	85	95	98	100	100	100	90	95	87	80	90	95	8	8	0
Buctril + Express	0.187 + 0.004	0	0	0	80	85	95	90	92	95	85	88	93	83	90	85	5	10	0
Harmony Extra	0.016	0	0	0	60	75	98	60	80	95	60	85	92	60	85	95	12	15	0
Express	0.016	0	0	0	63	75	95	62	85	93	63	80	88	60	80	90	8	8	0
Curtail 205	0.625	0	0	0	83	85	93	70	85	85	55	70	80	75	80	85	0	0	0
Curtail 205 + Buctril	0.625 + 0.25	0	0	0	83	98	98	90	95	98	85	90	93	85	90	95	0	0	0
2,4-D + Harmony Extra	0.25 + 0.008	0	0	0	83	90	98	80	90	92	80	88	90	75	85	93	10	12	5
MCPA + Harmony Extra	0.25 + 0.008	0	0	0	80	88	85	80	90	94	80	85	92	80	85	80	15	15	8
2,4-D	0.5	0	0	0	78	85	90	80	85	87	60	75	78	70	80	85	0	0	0
Check	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Visual evaluations taken 10, 30, and 50 days from date of application.
Average of 3 replications.

Table 3. Crop injury and weed control ratings from herbicides applied in the spring to Bliss variety of spring wheat. Malheur Experiment Station, Oregon State University Ontario, Oregon, 1989.

Herbicide	Rate	Crop Injury				Weed Control: Pigweed				Weed Control: Lambsquarters				Weed Control: Kochia				Weed Control: Oats			
		R_1	R_2	R_3	Avg.	R_1	R_2	R_3	Avg.	R_1	R_2	R_3	Avg.	R_1	R_2	R_3	Avg.	R_1	R_2	R_3	Avg.
	lbs ai/ac	%																			
Puma	0.074	10	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	100	100	100	100
Puma	0.090	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	100	100	100
Tiller	0.66	5	0	5	3	100	100	100	100	100	100	100	100	85	90	88	87	96	92	95	94
Tiller	0.78	0	0	10	3	100	100	100	100	100	100	100	100	85	90	90	88	98	99	98	98
Puma + 2,4-D	0.082 + 0.25	10	5	0	5	30	50	65	48	40	40	70	50	30	30	60	40	100	100	100	100
Puma + Buctril	0.082 + 0.33	0	5	0	2	80	60	80	73	95	50	95	80	95	50	90	78	95	92	88	91
Puma + Banvel	0.082 + 0.125	20	25	10	18	100	100	95	98	100	100	98	99	100	100	98	99	80	80	75	78
Puma + Harmony Extra + Banvel	0.082 + 0.024 + 0.094	0	0	0	0	100	100	100	100	100	100	100	100	100	100	100	100	85	90	85	86
Check	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Final evaluation taken at harvest time. August 3, 1989.

Table 4. Wheat yields from Wild Oat Herbicide Trials. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Herbicides	Rate	Wheat Yields R_1	R_2	R_3	Avg.
	lbs ai/ac	bu/ac			
1. Puma	0.074	77.8	84.7	79.9	80.8
2. Puma	0.090	80.2	72.8	80.8	77.9
3. Tiller	0.66	72.5	72.0	78.8	74.4
4. Tiller	0.78	72.4	83.9	83.9	80.1
5. Puma + 2,4-D	0.082 + 0.25	67.2	70.4	93.1	76.9
6. Puma + bromoxynil	0.082 + 0.33	82.8	64.6	72.8	73.4
7. Puma + dicamba	0.082 + 0.125	67.6	63.8	82.0	71.1
8. Puma + Harmony Extra + dicamba	0.082+.024+.094	83.0	73.4	83.2	79.9
9. Check	-	41.0	45.4	59.1	48.5
LSD .05					11.7
CV %					9.2

1. Yield of Oats harvested and cleaned from check plot 43.9 25.3 26.1 31.8

2. Area harvested with plot combine 88 sq ft from center of each plot (4 ft wide x 22 feet long).

RECOVERY OF SOIL NITRATE BY STEPHENS WHEAT

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Ontario, Oregon, 1989

Introduction

In the Treasure Valley, wheat is often used as a rotation crop between onions, sugar beets, potatoes, and sweet corn. All of these have moderate to high N requirements. Wheat is fertilized with 100 to 200 lbs N per acre based on grower experience or soil samples to 1 or 2 feet deep. Yet considerable supplies of nitrogen may be left deeper in the soil profile and wheat roots may effectively explore the soil to 5 or 6 feet deep. Winter wheat may be able to supply much of its nitrogen needs from residual fertilizer N from other crops in the rotation.

Objectives

To determine the potential of winter wheat to extract residual nitrate from the subsoil. To determine if deeper soil sampling could fine tune wheat nitrogen management. To evaluate the benefit and destination of nitrogen fertilizer applied to a wheat crop.

Materials and Methods

Stephens wheat was planted in the fall of 1988 on a Greenleaf silt loam following onions. The average soil depth to hard lime cemented soil was 3 feet 5 inches. Soil nitrate N was estimated at 194 lbs/ac in the spring of 1989 (Table 1).

Table 1. Spring soil nitrate supply before fertilization. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Soil depth	Nitrate	Nitrogen	Probable N supply
feet	ppm	lbs N/ac	lbs N/ac
0-1	4	14	14
1-2	16	56	56
2-3	24	84	84
3-4	27	95	40
Total			194

Wheat was fertilized with 0, 100, or 200 lbs N/ac in the form of urea. Soil samples to two feet depth in the present study indicated nitrogen fertilizer needs of 150 lbs/ac. Each treatment was replicated five times in a complete block replicated trial. Plot size was 13 feet by 30 feet.

At flowering 13 ft^2 was clipped from each plot to determine plant N content. Flag leaf samples were taken at flowering over the entire plot interior for N content. At harvest 9 ft^2 were harvested to determine harvest index and straw N content. The grain from the center of each plot was harvested with a Wintersteiger Nurserymaster small plot combine. Grain was analyzed for bushel weight, protein, hardness, and N content. Soil was sampled in each plot for nitrate and total N to 5 foot depth.

Calculations include uptake in the grain, total plant N uptake (at flowering and at harvest), and N extraction from the subsoil.

Results

With large soil nitrate supplies in the subsoil, Stephens wheat produced 147 bu/ac with no fertilization (Table 2). Urea fertilization had no statistically significant effects on grain yield or bushel weight. Grain protein and total grain N extraction increased.

Table 2. Response of Stephens Soft White Winter Wheat to N fertilization in the presence of residual subsoil nitrate supply. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Spring	Total Biomass		Harvest	Grain	Grain	Grain	Grain
	Flowering	Harvest	index	protein	test wt	yield	N
lbs/ac	t/ac	t/ac	-	%	lb/bu	bu/ac	lb N/ac
0	4.77	9.01	0.491	9.96	59.7	147.5	147.8
100	4.78	9.16	0.515	10.60	60.1	157.0	167.7
200	4.80	9.18	0.507	11.74	59.7	155.1	183.6
LSD(.05)	ns	ns	ns	0.81++	ns	ns	17.3++

[1]based on 60 lb/bushel
++F significant p = .01

Without fertilization, wheat was capable of mobilizing 148 lbs N/ac into the grain. Efficiency of N fertilization was extremely low. Once all plant analyses and soil analyses are complete, total N uptake and N movements will be determined.

Conclusions

Stephens wheat was capable of extracting 148 lbs/ac N from residual soil N and mobilizing the N into the grain. Soil tests only 1 or 2 feet deep may be poor indicators of the N supply available for wheat. Further studies are planned to evaluate when fertilizer N is not necessary.

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 the Malheur County of Oregon to planting only those varieties ranking above minimum requirements.

Procedures

Twenty-two commercial and 26 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 on Owyhee silt loam soil where onions and wheat, respectively, were 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 1988. 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 and was broadcast and incorporated by using a spike-tooth harrow before planting.

The commercial varieties and experimental lines were planted in separate trials. Commercial checks were planted with experimental lines for comparison purposes. 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 alleyways between the ends of each plot. Approximately 12 viable seeds per foot of row were planted. The seed was planted on April 26 and 27 with a cone-seeder mounted on a John Deere model 71 flexi-planter equipped with disc openers. After planting the sugar beets were furrowed and surface-irrigated to assure moisture for uniform seed germination and seedling emergence.

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

The sugar beets were harvested on October 17, 18, 19, and 20. The foliage was removed by rubber flail beaters 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 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 evaluate for 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 6.783 tons of sugar per acre to a low of 5.850 tons per acre, with a variety mean of 6.358 tons per acre. Eleven varieties had sugar yields equal to or greater than the mean. Of these 11 varieties, Mono Hy 176, Mono Hy 55, Tasco PM9, and WS-41 produced a sugar yield significantly greater than the mean (Table 1).

Yield of recoverable sugar for experimental lines ranged from 7.133 tons of sugar/acre to a low of 6.023 tons of sugar/acre, with an entry mean of 6.568 tons of sugar per acre. Thirteen of the 26 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 lower this year than in 1988. Sugar beet quality was generally good, but the lower root yields also resulted in about 0.2 tons/ac lower yield of recoverable sugar for 1989 when these data are compared to 1988 results.

Table 1. Performance data from sugar beet lines evaluated as commercial varieties. Malheur Experiment Station, Oregon State University, Ontario, Oregon 1989.

Company	Variety	Beet yield	Sucrose	Conductivity	Root NO_3	Extraction	Recoverable sugar	Curly top ratings
		tons/ac	%		ppm	%	tons/ac	
American Crystal	ACH-190	42.45	17.70	644	116	86.51	6.500	6.4
	ACH-177	41.94	17.88	638	105	86.62	6.495	5.0
	ACH-200	44.03	16.91	668	119	86.05	6.405	5.7
	ACH-199	42.60	17.16	690	106	85.81	6.271	3.7
	ACH-173	42.90	16.77	625	110	86.57	6.229	3.8
	ACH-31	42.36	17.02	678	128	85.93	6.193	5.6
	ACH-139	41.95	16.93	637	104	86.45	6.140	4.7
	ACH-184	41.58	17.01	636	106	86.49	6.117	5.8
Betaseed	8654	45.20	16.64	711	129	85.43	6.426	5.2
	9380	43.32	17.11	637	104	86.49	6.413	5.9
	8555	43.51	16.93	669	113	86.04	6.336	5.1
	8428	40.88	17.41	679	112	86.00	6.119	4.4
Holly	HH-39	42.61	16.52	676	113	85.86	6.044	5.9
	HH-32	41.12	16.58	680	85	85.82	5.850	4.4
Mono-Hy	176	46.68	16.70	589	104	87.03	6.783	4.2
	55	47.33	16.59	650	116	86.22	6.767	5.7
	R1	44.92	16.57	640	106	86.34	6.426	5.5
	R2	44.97	16.38	697	106	85.56	6.304	5.3
	RH183	43.30	16.44	677	116	85.84	6.110	
TASCO	PM9	47.30	16.53	614	130	86.67	6.772	3.9
	WS-41	45.63	16.85	635	97	86.46	6.650	5.1
	WS-88	45.52	16.75	684	135	85.80	6.528	4.1
LSD(.05)		1.81	0.24	45	28	0.61	0.281	-
P-Value		.0000	.0000	.0000	.1699	.0000	.0000	-
CV(S/mean)		4.23	1.49	7.0	25	0.72	4.47	-
Mean		43.73	16.88	657	112	86.18	6.358	-

Table 2. Sugar, root yields, and quality evaluations from 27 experimental lines of sugar beets. Malheur Experiment Station, Oregon State University, Ontario, Oregon 1989.

Company	Variety	Beet yield	Sucrose	Conductivity	Root NO_3	Extraction	Recoverable sugar	Curly top ratings
		tons/ac	%		ppm	%	tons/ac	
American Crystal	ACH-191	43.03	17.48	685	139	85.93	6.460	5.8
	ACH87-349	40.70	18.25	653	172	86.48	6.424	6.3
	ACH-31	42.11	17.19	649	141	86.35	6.252	5.6
Betaseed	Beta 8450	47.92	16.88	701	209	85.62	6.928	6.0
	Beta 8351	46.35	16.93	639	206	86.42	6.785	4.9
	5BC-6204	47.45	16.75	742	213	85.05	6.760	6.2
	5BC-6214	46.95	16.70	671	213	85.96	6.743	4.0
	Beta 8654	44.46	16.65	676	177	85.89	6.357	5.2
Holly	87N147-018	45.72	16.85	605	158	86.84	6.690	5.4
	87C143-016	45.24	16.62	587	173	87.03	6.542	4.6
	85T144-014	44.77	16.40	610	157	86.69	6.367	5.6
	87T148-018	43.52	16.55	649	191	86.22	6.209	5.1
	88T153-028	43.51	16.44	624	179	86.52	6.183	5.5
	HH-39	42.34	16.51	639	142	86.34	6.035	5.9
	885152-06	41.64	16.64	596	156	86.92	6.023	5.3
Mono-Hy	HM-2912	48.59	16.61	679	152	85.84	6.929	4.7
	HM-2913	46.69	16.66	599	192	86.88	6.756	4.7
	HM-2910	45.93	16.79	625	173	86.58	6.678	5.4
	HM-55	46.52	16.55	664	161	86.02	6.621	5.7
	HM-2911	45.22	16.80	654	198	86.20	6.552	4.7
	HM-2905	45.61	16.33	651	140	86.15	6.417	4.6
TASCO	E8079	48.76	16.88	620	154	86.66	7.133	3.3
	E7141	47.92	16.87	659	152	86.15	6.964	4.5
	WS-88	47.84	16.84	675	174	85.93	6.926	4.1
	E8034	46.44	16.97	680	179	85.90	6.768	3.5
	E2158	43.28	16.82	674	180	85.95	6.254	5.0
LSD(.05)		1.745	.2721	56	39	0.75	0.287	-
P-Value		.0000	.0000	.0000	.0000	.0000	.0000	-
CV(S/mean)		3.90	1.64	8.80	23.15	0.881	4.438	-
Mean		45.33	16.81	650	172	86.25	6.568	-

THE TOLERANCE OF SEEDLING SUGAR BEETS AND PERCENT WEED CONTROL FROM BETAMIX AND TANK-MIXES OF BETAMIX WITH STINGER AND POAST HERBICIDES

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Ontario, Oregon 1989

Purpose

Trials were conducted to compare the tolerance of sugar beet and percent weed control to sequential applications of Betamix and Betamix tank-mixed with Stinger and Poast herbicides when applications were begun to sugar beets at time of emergence, at cotyledon to two true-leaves, at two to four true-leaves and at four to six leaf stage of development.

Material and Methods

The trials were conducted in a field that was divided into three sections. One of the three sections was treated with two pounds ai/ac of Nortron, another section was treated with four pounds ai/ac of Roneet, and the third section was left untreated with a preplant soil active herbicide. Nortron and Roneet were applied as double overlap broadcast applications and soil incorporated by using a triple-K field cultivator and spike-tooth harrow. To improve uniformity of incorporation the tillage equipment was used twice. The second tillage operation was done in a direction at right angle to the first. Incorporation depth was approximately two inches. Soils in the trial area were silt loam texture of the Owyhee series. Organic matter was 1.2 percent and soil pH was 7.3. The field was moldboard plowed in the fall of 1988 and fine-tilled in the spring before the herbicides were applied.

TASCO, WS-88 variety of raw seed was planted on April 28 using a Beck drill. Immediately after planting the field was watered by furrow irrigation. The first application of Betamix treatments were applied on May 9. The sugar beets were emerging and sugar beets varied in size from the crook to early cotyledon. Herbicide treatments included Betamix at 0.33 pounds ai/ac, Betamix + Stinger at 0.3 and 0.05 pounds ai/ac, Betamix + Poast at 0.33 and 0.09 pounds ai/acre and Betamix + Stinger + Poast at 0.3, 0.05, and 0.09 pounds ai/acre respectively. Dates for continuing to apply the first application of the set of postemergence treatments were on May 17, (cotyledon to two true-leaves), May 27 (two to four true-leaves) and June 2 (four to six true-leaf sugar beets). Sequential treatments were applied at weekly intervals following the application of the initial treatments. The total number of treatments received by sugar beets depended on when the initial treatments were begun. Emerging sugar beets received four applications, cotyledon to two leaf beets received four applications, two to four and four to six leaf beets each received a total of three applications. The same application procedures were followed in the two sections of the field which had preplant applications of Nortron and Roneet and the non-plant treated section.

Each herbicide treatment was replicated three times and arranged at random in each replication. Individual plots were four rows wide and 25 feet long. Herbicides were applied using a single wheel bicycle plot sprayer equipped with an eight foot boom and four 65012 fan teejet nozzles mounted on the boom to spray over the center of each row. Spray pressure was 42 psi and water volume was 21.2 gallons per acre.

Size of weeds ranged from cotyledon to broadleaf and grasses six inches tall. As the time of applying the first application was delayed from time of sugar beet emergence to six leaves, weed size increased and herbicide treatments were less effective. Weed species included pigweed, hairy nightshade, lambsquarters, kochia, and annual species of summer grasses. Preplant herbicides were not effective in controlling all weed species. The preplant herbicides were applied to evaluate the tolerance of postemergence herbicides growing in herbicide treated soil. Because of the number of times the postemergence treatments were applied at different stages of sugar beet growth all different weather conditions at time of application existed. Rain showers were the only weather condition that delayed time of applying the postemergence treatments. In some cases rain showers occurred during spraying operations. On those occasions, application of treatments were delayed until leaf foliage was dry. Time of day and air temperatures were not considered during application and treatments were applied when sugar beets and weed growth were at the proper growth stage as originally planned for time of herbicide application.

Results

Sugar beets emerged uniformly following the applications of irrigation water. Sugar beets emerging through Roneet showed typical symptoms of Roneet with cupped cotyledons but further symptoms were not noted. Nortron had no affect on emerging sugar beets.

Sugar beets were tolerant to all applications of Betamix and Betamix tank-mix combinations regardless of time of application (Table 1). Sugar beet tolerance readings were taken four days after the application of herbicides and all ratings for injury were five or less on a rating scale of 0-100. All broadleaf species of weeds were controlled by Betamix alone and Betamix + Stinger when applications were begun at emergence and cotyledon to two true-leaves. Broadleaf weed escapes occurred when Betamix and Betamix + Stinger treatments were delayed until the sugar beets had developed four true-leaves. Hairy nightshade and kochia species were the more common weed species escaping because of more tolerance to Betamix with increase in size and also to some extent because of canopy affect from larger leaves of older sugar beet plants. Grass control was excellent in all plots when Poast was included in the tank-mix combination. All herbicide tank-mixes were compatible. Stinger may have increased the activity of Betamix in tank-mix combinations when applied to larger broadleaf weeds. Stinger also gave excellent suppression to normal growth of Canada thistle and volunteer potatoes when applications were started before sugar beets had more than four leaves.

When emerged weeds were killed by the initial treatments, subsequent applications kept the plots weed-free until the trial was disced up the last week of July. All weeds to large to control with the initial application were never controlled by sequential treatments and continued to grow.

Similar studies will continue in 1990. Betamix will be applied at 0.2, 0.3, 0.4, 0.5, and 0.75 pounds ai/ac to evaluate lower rates for weed control and higher rates for sugar beet tolerance. Treatments will be applied prior to sugar beet emergence, at emergence, and when the sugar beets are in the cotyledon to four true-leaf growth stage. Treatment application beyond four leaf sugar beets will be dropped in 1990.

Table 1. Sugar beet injury and percent weed control from postemergence applications of Betamix, Stinger, and Poast to seedling sugar beets. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Herbicides	Rate	Applied	Crop injury	Pig-weed	Hairy-Night-shade	Lambs quarters	Kochia	Barn-yard grass	Volunteer Wheat
	lbs ai/ac		%						
Betamix	0.3	emergence	0	100	100	100	100	92	80
Betamix + Stinger	0.3 + 0.05	emergence	0	100	100	100	100	90	85
Betamix + Poast	0.3 + 0.09	emergence	0	100	100	100	100	100	100
Betamix + Stinger + Poast	0.3 + 0.05 + 0.09	emergence	0	100	100	100	100	100	100
Check	-	-	0	0	0	0	0	0	0
Betamix	0.3	cot 2-leaf	0	100	100	100	100	90	80
Betamix + Stinger	0.3 + 0.05	cot 2-leaf	0	100	100	100	100	88	83
Betamix + Poast	0.3 + 0.09	cot 2-leaf	0	100	100	100	100	100	100
Betamix + Stinger	0.3 + 0.05	cot 2-leaf	0	100	100	100	100	100	100
+ Poast	+ 0.09	cot 2-leaf	0	100	100	100	100	100	100
Check	-	-	0	0	0	0	0	0	0
Betamix	0.3	2-4 leaf	0	75	58	72	53	63	50
Betamix + Stinger	0.3 + 0.05	2-4 leaf	0	75	60	78	62	65	52
Betamix + Poast	0.3 + 0.09	2-4 leaf	0	77	58	63	50	100	100
Betamix + Stinger + Poast	0.3 + 0.05 + 0.09	2-4 leaf	0	78	62	76	63	100	100
Check	-	-	0	0	0	0	0	0	0
Betamix	0.3	4-6 leaf	0	30	22	27	18	40	20
Betamix + Stinger	0.3 + 0.05	4-6 leaf	0	38	28	33	20	40	20
Betamix + Poast	0.3 + 0.09	4-6 leaf	0	28	20	22	16	98	96
Betamix + Stinger + Poast	0.3 + 0.05 + 0.09	4-6 leaf	0	42	30	35	25	99	96
Check	-	-	0	0	0	0	0	0	0

Ratings: 0 = no effect, 100 = all plants killed.
Evaluated on June 27
Average of three replications from trial not treated with preplant applications of Roneet or Nortron.

TOLERANCE OF SEEDLING SUGAR BEETS TO BETAMIX EC AND OTHER FORMULATIONS OF BETAMIX AND ADJUVANTS

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Ontario, Oregon 1989

Purpose

To compare several new formulations of Betamix and adjuvants to Betamix 1.3 emulsifiable concentrate (ec) for tolerance to sugar beets in the cotyledon and two leaf stage of development.

Procedures

Eight different treatments of Betamix formulations or adjuvants were applied to cotyledon and two true leaf sugar beets as single and/or repeat applications. Mono Hy R_2 variety of sugar beets was planted on May 23 in silt loam textured soil of the Owyhee series. The field had previously grown a crop of winter wheat. The stubble after harvest was shredded and the field fertilized with 100 pounds of phosphate and 60 pounds of nitrogen before plowing. The field was bedded in the fall. Roneet at four pounds ai/ac was applied before planting and incorporated with a spike-tooth bed harrow. After planting, the field was corrugated and watered by furrow irrigation. The sugar beets emerged uniformly. The first application of postemergence treatments to cotyledon sugar beets was applied on June 1. The sugar beets looked excellent and free of weeds from the preplant application of Roneet. On June 8, the applications were made to two true leaf sugar beets. These treatments consisted of both first time single applications and repeat applications to sugar beets previously treated at the cotyledon growth stage. Injury to sugar beets caused by the SN38584 1.45 SC CR 1191 applied at the cotyledon stage was noted on June 8 when the second application was applied to these plots.

The sugar beet injury ratings for treatments were taken on June 8, June 15 and June 22. The trial was observed on July 3 and the study terminated on July 5 when the field was disced.

The herbicides were applied using a single wheel bicycle plot sprayer equipped with a boom 7.5 feet long. Four teejet fan nozzles size 6506 were mounted on the boom so a nozzle was located over the center of each row of the 4 row by 25 foot plots. Distance between individual rows was 22 inches. Spray pressure was 42 psi and water as the herbicide carrier was applied at a volume of 48 gallons/acre. The cotyledon treatments were applied in the evening between 7 and 8 p.m. The skies were clear, wind was calm, and air temperatures were 71° F. The application made to two leaf sugar beets was applied during mid-morning. Again wind was calm, air temperature was 68° F, and skies were partly cloudy. In each case, the sugar beets were irrigated three days before the herbicides were applied. Soil moisture and growing conditions were considered excellent when herbicides were applied to both the cotyledon and two leaf sugar beets.

Results

Sugar beet tolerance and ease of using the Betamix 1.3 ec formulation was superior to the 70% and 80% formulations with the added adjuvant. SN 38584 1.45 SC CR 1191 was very difficult to use because of the thick sticky film left on all spray containers and spray nozzles. Sugar beets were much more sensitive to the 1.45 formulated material and quite severe burns occurred to sugar beet leaves when this treatment was applied to both cotyledon and two leaf beets. Sugar beets were most tolerant to the 0.3 lb rate applied as repeat treatments. Higher rates at 0.5 and 0.75 pounds ai/ac caused injury to the young leaves but sugar beet stands were not reduced by any of the herbicide treatments. By July 3, the sugar beets in all treated plots had recovered from herbicide injury symptoms and were growing rapidly. Some reduction in size of leaf foliage was noted in plots treated at the higher rates of all herbicides. Reduction in foliage size was most noticeable in the 1.45 formulation plots which was consistent for each replication.

Table 1. Crop injury ratings for Betamix and different formulations of Betamix and adjuvants to cotyledon and two leaf sugar beets. Malheur Experiment Station, OSU, Ontario, Oregon, 1989.

Herbicide	Rate	Timing	June 8				June 15				June 22			
			1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
	lbs ai/ac		%											
Betamix 1.3 EC CP 211	0.5	2 leaf	-	-	-	-	8	12	8	9	5	5	5	5
Betamix 1.3 EC CP 211	0.75	2 leaf	-	-	-	-	15	15	20	17	10	15	10	12
Betamix / Betamix 1.3 EC CP 211	0.3 + 0.3	cot + 2 leaf	0	0	0	0	0	0	0	0	10	5	5	7
SN38584 80WG CR1174 + adj	0.5	2 leaf	-	-	-	-	10	15	10	12	0	0	0	0
SN38584 80WG CR1174 + adj	0.75	2 leaf	-	-	-	-	20	15	15	17	10	15	10	12
SN38584/SN38584 80WG + adj	0.3 + 0.3	cot + 2 leaf	0	0	0	0	0	0	5	2	0	0	0	0
SN38584 70WP CR1184 + adj	0.5	2 leaf	-	-	-	-	15	10	15	13	5	10	10	8
SN38584 70WP CR1184 + adj	0.75	2 leaf	-	-	-	-	20	15	15	17	10	15	10	12
SN38584/SN38584 70WP + Adj	0.3 + 0.3	cot + 2 leaf	0	0	0	0	5	0	5	3	0	0	0	0
SN38584 1.45 SC CR1191	0.5	2 leaf	-	-	-	-	25	35	30	30	20	25	25	23
SN38584 1.45 SC CR1191	0.75	2 leaf	-	-	-	-	40	35	35	37	35	30	30	32
SN38584/SN38584 1.45 SC CR1191	0.3 + 0.3	cot + 2 leaf	15	20	20	18	30	25	20	25	15	20	20	18
Control	-	-	0	0	0	0	0	0	0	0	0	0	0	0

Ratings: 0 = no herbicide effect, 1-50 = degree of stunting, chlorosis, and leaf burn, > 50 = stand reduction.

THE CONTROL OF THREE SPECIES OF ANNUAL GRASSES IN SUGAR BEETS WITH FOLIAR APPLIED HERBICIDES

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Ontario, Oregon, 1989

Purpose

To evaluate five herbicides at a total of twelve rates for sugar beet tolerance and control of green foxtail (Setaria viridis), barnyardgrass (Echinochloa crus-galli) and witchgrass (Panicum capillare) when applied as foliar treatments to seedling grasses and sugar beets at varying rates.

Procedures

Seed of green foxtail, barnyardgrass, and witchgrass was seeded with a cyclone seeder on the surface of a sandy loam soil and mixed with the soil to an approximate depth of two inches with a triple-K and spiketooth harrow as the soil seedbed was prepared for planting WS-88 variety of sugar beets. The experimental site was located on the Spark's farm approximately 1.5 miles north of Nyssa, Oregon, on Highway 20. The sandy loam textured soil contained 0.89 percent organic matter with a pH of 6.9. The previous crop (1988) grown in the field was pinto beans.

The sugar beets were planted on April 12 and watered by furrow irrigation on April 14 to furnish soil moisture for both crop and weed seed germination. Both the sugar beets and weed species emerged within 10 days. The emerged broadleaf weeds growing in the crop row were removed by handweeding. A total of three handweeding were required to keep the plot areas free of broadleaf weeds until the study was completed.

The herbicide treatments were applied on May 24. Each grass species varied in size from one leaf plants to plants with as many as three tillers and three to four inches tall. Sugar beet plants ranged in size from two to six leaves. The size of individual plots were four rows wide and 25 feet long. Rows were spaced 22 inches apart. The herbicide treatments were applied using a single wheel bicycle plot sprayer equipped with a boom 7.5 feet long with four nozzles spaced on the boom to be centered above each row in the four row plots. Nozzles were teejet fan nozzles size 8003. Spray pressure was 35 psi and water was applied as the herbicide carrier at a rate of 28 gallons per acre. While spraying, skies were cloudy, the air calm, air temperature was 58°F, and soil temperature at the four-inch depth 61°F. All environmental conditions were good for plant growth and both sugar beets and grass species were growing rapidly. Fertilizer additives included 100 pounds of P_2O_5 plowed down in the fall with 60 pounds of Nitrogen. An additional 60 pounds of nitrogen as Uran was applied during irrigations after crop emergence.

The treatments were evaluated on June 6 and June 20 for grass control and crop tolerance. A rating of zero indicates that herbicides had no effect on plant growth. A rating of one hundred indicates plants were killed. Numerical ratings between zero and one hundred indicates the percent suppression of plant growth when plants in treated plots were compared to plants growing in plots not treated with herbicides.

Results

R017-3664, Poast, and Select gave excellent control of all three species of grass at rates of 0.06, 0.25, and 0.094 pounds ai/ac. Assure and Fusilade were considerably less active on green foxtail than was R017-3664, Poast, or Select. Witchgrass was the more sensitive of all grass species to herbicide treatments. Barnyardgrass was intermediate in sensitivity and green foxtail was most tolerant. The sugar beets were very tolerant of all herbicides without evidence of symptoms at any rates. Plots treated with R017-3664, Poast, and Select were free of grass on July 19, when the trial area was disced. Regrowth of green foxtail was occurring in Assure and Fusilade treated plots. R017-3664 has excellent potential and interest as a grass herbicide.

Table 1. Percent crop injury and control an annual species of grass from herbicides applied as Foliar treatments. Malheur Experiment Station, Ontario, Oregon, 1989.

Herbicides	Rate	Crop injury 1	2	3	Avg	Green Foxtail 1	2	3	Avg	Barnyardgrass 1	2	3	Avg	Witchgrass 1	2	3	Avg
	lbs ai/ac	%															
R017-3664	0.03	0	0	0	0	94	97	92	94	98	100	98	98	100	100	100	100
R017-3664	0.06	0	0	0	0	99	98	99	98	100	99	99	99	100	100	100	100
R017-3664	0.09	0	0	0	0	100	100	100	100	100	100	100	100	100	100	100	100
Assure	0.03	0	0	0	0	55	60	60	58	90	85	85	86	95	90	95	93
Assure	0.06	0	0	0	0	80	75	80	78	98	99	99	98	99	100	99	99
Assure	0.09	0	0	0	0	92	90	90	90	99	100	100	99	100	100	100	100
Assure	0.125	0	0	0	0	99	97	99	98	100	100	100	100	100	100	100	100
Fusilade 2000	0.125	0	0	0	0	50	45	50	48	85	80	85	83	90	85	85	83
Fusilade 2000	0.1875	0	0	0	0	70	65	75	70	95	98	92	95	98	99	99	98
Fusilade 2000	0.25	0	0	0	0	85	80	80	82	100	100	100	100	100	100	100	100
Poast	0.1875	0	0	0	0	98	95	90	94	99	99	95	98	99	98	99	98
Poast	0.25	0	0	0	0	100	98	99	99	100	100	100	100	100	100	100	100
Select	0.094	0	0	0	0	99	99	99	99	100	100	100	100	100	100	100	100
Select	0.125	0	0	0	0	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

Evaluated June 6.

Table 2. Second evaluation for percent crop injury and control of annual species of grass from herbicides applied as foliar treatments. Malheur Experiment Station, Oregon State University, Ontario, Oregon 1989.

Herbicides	Rate	Crop injury 1	2	3	Avg	Green Foxtail 1	2	3	Avg	Barnyardgrass 1	2	3	Avg	Witchgrass 1	2	3	Avg
	lbs ai/ac	%															
R017-3664	0.03	0	0	0	0	95	98	95	96	96	98	98	97	100	100	100	100
R017-3664	0.06	0	0	0	0	99	98	100	99	100	100	100	100	100	100	100	100
R017-3664	0.09	0	0	0	0	100	100	100	100	100	100	100	100	100	100	100	100
Assure	0.03	0	0	0	0	45	50	50	48	85	80	85	83	90	85	90	88
Assure	0.06	0	0	0	0	70	70	70	70	95	969	98	96	98	99	97	98
Assure	0.09	0	0	0	0	90	85	85	86	100	100	100	100	100	100	100	100
Assure	0.125	0	0	0	0	98	98	96	97	100	100	100	100	100	100	100	100
Fusilade 2000	0.125	0	0	0	0	40	35	40	38	75	70	70	72	90	85	90	88
Fusilade 2000	0.1875	0	0	0	0	55	60	65	60	90	95	88	91	95	99	99	97
Fusilade 2000	0.25	0	0	0	0	80	75	80	78	100	100	100	100	100	100	100	100
Poast	0.1875	0	0	0	0	96	95	95	95	99	99	98	98	98	98	98	98
Poast	0.25	0	0	0	0	100	100	100	100	100	100	100	100	100	100	100	100
Select	0.094	0	0	0	0	100	100	100	100	100	100	100	100	100	100	100	100
Select	0.125	0	0	0	0	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

Evaluated June 20, 1989

AN EVALUATION OF SOIL ACTIVE HERBICIDES FOR WEED CONTROL AND SELECTIVITY TO SUGAR BEETS

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Ontario, Oregon 1989

Objective

Sugar beet growers and grower representatives are declaring that weeds are their number one production problem. Stringent federal and state labor laws are forcing growers to grow sugar beets with machinery and without labor. Weeds escaping present herbicide treatments are interfering with the full utilization of equipment, especially in the thinning operations. Herbicide treatments to prevent weed emergence or control weeds soon after emergence must be identified if growers are to meet their goal to fully mechanize the production of this crop.

Certain species of weeds are more difficult to control because they are less sensitive to herbicides available for use in sugar beets. Kochia and hairy-nightshade are examples of weeds difficult to control selectively in sugar beets. In certain cases under ideal conditions these weed species have been controlled with herbicides applied both as soil and foliar treatments.

The objective of these studies was to identify the most effective herbicide treatments that would result in consistent control of all broadleaf and grassy weeds in sugar beets. Weed species in these trials included hairy-nightshade (Solanum sarrochoides), lambsquarters (Chenopodium Album), pigweed (Amaranthus retroflekus), kochia (Kochia scoparis) and barnyardgrass (Echenochloa crus-galli). The soil active herbicides were evaluated as fall and spring applied preplant mechanically incorporated applications. The fall herbicide treatments were applied when bedding the field in the fall of 1988. The spring applications were applied and incorporated to fall bedded land after the tops of the beds had been harrowed-off before planting.

Procedures

The fall treatments were applied on November 10. The herbicides were sprayed in eleven-inch bands in the row area and the soil forming the bed was thrown from the furrow area. The herbicide was layered at the base of the bed. In the spring the soil from the tops of the beds was pulled into the furrow area and the layered herbicide in the row area was incorporated with the teeth of the spike-tooth harrow as the seed bed was prepared for planting. The spring treatments were also applied in eleven-inch bands to the soil surface in the bedded row after the beds formed the previous fall had been harrowed nearly flat, leaving just enough of the furrow to mark the bedded rows for planting. The spring applied herbicides were incorporated with a special built harrow to till the beds in preparation for planting.

Fall wheat was the crop grown in the trial area during the 1988 growing season. The stubble was shredded and the field was moldboard plowed before being worked down for fall bedding. One-hundred pounds of phosphate and sixty pounds of nitrogen was plowed under with the grain stubble. Soil texture is a silt loam of the Owyhee series. Organic matter is 1.2 percent and soil pH is 7.3.

The herbicides were applied with a bicycle wheel plot sprayer and a 7.5 foot boon equipped with four 6506 teejet nozzles mounted on the boom so a nozzle was centered over each row. The plots were four rows wide and twenty-five feet long. Spray pressure was 35 psi and water as the herbicide carrier applied at 42 gallons/acre.

Sugar beet variety Mono Hy was planted on April 19. The field was corrugated and watered by furrow irrigation on April 20.

Results

The sugar beets emerged uniformly after one irrigation. Delay in emergence occurred with Roneet and Roneet in combination with Nortron and Antor as indicated by rating under crop injury in Tables 1 and 2. Roneet and Roneet combinations did not reduce sugar beet stands and the herbicide symptoms affecting emergence and early seedling growth was only temporary. Sugar beets in all plots were comparable in size by the time sugar beets in control plots had four true leaves. Sugar beets showed excellent tolerance to Nortron alone or in combination with Hoelon when applied in the fall or spring.

Broadleaf weed control was good with Nortron applied in the fall or spring at the rate of two pounds ai/ac. Haelon in combination with Nortron improved the control of barnyardgrass and sugar beet tolerance was excellent. Weed control from spring applied treatments of Roneet and Roneet plus Antor were generally better than the same treatments applied in the fall. Weed control improved with increase in rate of Roneet plus Antor indicating use rates in silt loam soil should be at least 2 + 2 pounds ai/ac when incorporated by harrowing during seed-bed preparation on fall bedded land. Roneet alone gave better control of red root pigweed than Roneet and Antor combination, but the combination treatments gave better control of Kochia but was less active on pigweed.

Studies were continued with application of Roneet and Antor applied in the fall of 1989. Tank-mix of Roneet and Antor were varied and higher rates of each herbicide was included in the fall applications. These same treatments applied in the fall of 1989 will be applied in the spring of 1990 and evaluated for sugar beet tolerance and weed control.

Table 1. The percent weed control and crop injury from soil active herbicides applied to soil while bedding in the fall of 1988. Malheur Experiment Station, OSU, Ontario, Oregon, 1989.

Herbicide	Rate	Crop injury				Pigweed				Lambsquarters				Hairy Nightshade				Kochia				Lambsquarters			
		1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
	lbs ai/ac	%																							
Nortron	1.5	0	0	0	0	80	85	80	82	70	70	75	72	65	55	70	63	90	93	95	92	65	70	60	65
Nortron	2.0	0	0	0	0	98	95	99	97	90	93	90	91	85	90	85	86	100	99	100	99	75	78	85	79
Nortron + Hoelon	2 + 1.5	0	0	0	0	98	99	99	98	95	90	95	93	90	85	90	88	100	100	100	100	100	100	100	100
Nortron + Roneet	1 + 2	10	15	10	12	75	70	70	72	65	70	65	66	80	80	85	82	50	65	75	63	95	98	95	96
Nortron + Roneet	1 + 3	15	20	10	15	80	85	80	82	75	80	70	75	85	90	85	87	65	50	60	58	98	99	96	97
Nortron + Antor	1 + 1.5	5	10	10	8	75	65	60	68	85	70	75	76	70	75	70	72	70	80	80	76	93	98	94	95
Nortron + Antor	1 + 2	10	10	15	12	75	70	70	72	85	80	80	82	75	80	75	72	85	90	90	88	98	99	99	98
Roneet + Antor	1.5 + 1.5	20	15	10	15	65	50	60	58	55	65	60	60	65	50	60	60	80	75	80	77	99	100	100	99
Roneet + Antor	1.5 + 2.0	15	20	15	16	65	65	70	67	65	70	60	65	65	70	55	63	85	80	80	82	100	100	100	100
Roneet + Antor	2 + 1	15	20	20	18	70	75	75	73	60	70	60	63	70	65	70	67	90	95	95	93	96	100	100	98
Roneet + Antor	2 + 1.5	20	20	25	22	80	75	85	80	75	75	80	76	75	75	60	70	98	98	93	96	100	100	100	100
Roneet + Antor	2 + 2	25	30	25	27	90	80	80	83	80	85	80	82	80	85	80	82	99	100	99	99	100	100	100	100
Pyramin	4	0	0	0	0	60	50	60	57	45	65	60	53	35	45	30	37	50	70	75	65	20	15	20	18
Nortron + Pyramin	1.5 + 2	0	0	0	0	85	80	80	82	65	70	65	67	80	75	80	77	90	95	95	93	70	60	65	65
Nortron + Pyramin	1.5 + 3	0	0	0	0	85	90	85	87	70	75	75	73	85	80	75	80	95	90	95	93	70	65	65	67
Control	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Ratings: 0 = no herbicide effect, 100 = all plants killed.
Evaluated May 31, 1989.

Table 2. Percent weed control and crop injury from soil active herbicides applied and mechanically incorporated in the spring before planting. Malheur Experiment Station, OSU, Ontario, Oregon, 1989.

Herbicide	Rate	Crop injury				Pigweed				Lambsquarters				Hairy Nightshade				Kochia				Lambsquarters			
		1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
	lbs ai/	%																							
Roneet	4	10	15	15	12	98	100	98	98	90	93	90	91	98	95	98	97	45	60	40	48	93	96	96	94
Roneet + Dyfonate	4 + 4	15	10	15	12	96	99	98	98	88	95	90	91	95	98	95	96	45	55	50	50	95	98	95	96
Nortron	2	5	5	0	3	98	99	98	98	92	98	95	95	90	88	95	91	99	100	96	98	85	80	80	82
Nortron + Hoelon	2 + 1.5	0	5	0	2	99	96	98	98	95	92	98	95	90	90	90	90	100	98	98	98	100	100	100	100
Nortron + Roneet	1 + 2	20	25	20	22	80	85	75	80	65	70	75	70	80	85	85	83	90	85	85	86	90	93	90	93
Nortron + Roneet	1 + 3	25	20	25	23	95	95	98	96	70	80	75	75	92	98	95	95	85	80	85	83	95	95	95	95
Nortron + Antor	1 + 1.5	15	10	10	12	75	80	70	75	65	75	70	70	65	60	70	65	88	92	85	88	98	85	98	96
Nortron + Antor	1 + 2	15	20	15	17	80	85	80	82	75	70	70	72	70	75	70	72	90	85	90	88	98	99	98	98
Roneet + Antor	1.5 + 1.5	5	10	10	8	65	60	60	62	70	75	75	73	65	80	75	73	65	70	60	65	99	96	99	97
Roneet + Antor	1.5 + 2	10	15	10	11	75	80	75	76	75	70	70	72	75	80	80	78	75	70	75	73	100	100	98	99
Roneet + Antor	2 + 2	15	20	20	18	98	96	96	96	75	75	75	75	85	90	80	85	80	75	70	75	100	100	100	100
Controll	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Rating: 0 = no herbicde effect, 100 = all plants killed.
Evaluated May 31, 1989.

THE EFFECT OF NITROGEN RATES ON YIELD AND QUALITY OF SIX SUGAR BEET VARIETIES

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Ontario, Oregon, 1989

Purpose

Compare the responses of three rates of fertilizer nitrogen on root yield, percent sucrose, conductivity, percent extraction, and calculated sugar yields on six commercial varieties of sugar beets produced in Treasure Valley of Eastern Oregon and Southwest Idaho.

Procedures

WS-88, WS-PM9, Mono Hy 55, Betaseed 8654, Holly Hybrid 39, and American Crystal 31 cultivars of sugar beets were planted on April 26 in Owyhee silt loam soil where land had been cropped to winter wheat during 1987 and 1988 prior to planting sugar beets in this trial in the spring of 1989. In the fall of 1988 the wheat stubble was shredded and 100 pounds of phosphate and 60 pounds of nitrogen was broadcast before the field was moldboard plowed.

The seed-bed was prepared in the spring and the sugar beet cultivars were planted to utilize a split-plot experimental design. Fertilizer nitrogen rates were classed as main plots and sugar beet varieties designated as subplots. Sugar beet varieties were planted at random within each main plot. Varieties were replicated six times in each nitrogen treatment. Twelve viable seeds were planted per foot of row and thinned to a final stand of eight inches between plants. The fertilizer nitrogen rates were 60, 160, and 260 pounds of nitrogen per acre. The 60 pound rate was the amount of nitrogen plowed down the previous fall. The additional 100 and 200 pounds of nitrogen for the 160 and 260 pound treatments was sidedressed on June 16 after the sugar beets were thinned. Weeds were controlled in the trial area with a preplant incorporated application of two pounds ai/ac of Nortron. The crop was watered by furrow irrigation with the first irrigation applied after planting to assure an ample supply of soil moisture for seed germination and seedling growth.

The sugar beets were harvested on October 19 and 20. The tops were removed with a double-drum flail beater and the crowns scalped with rotating, circular disc knives. The roots from the two center rows of each four-row plot were harvested with a single-row wheel-type lifter then weighed to calculate root yields.

A sample of eight beets were taken from each of the harvested rows and analyzed for percent sucrose, NO_3 and conductivity by personnel at the Amalgamated research laboratory, Nyssa, Oregon, as a measure of root quality and to use data to calculate percent extractable sugar and recoverable sugar yields per acre. The data were analyzed to determine measurable differences for root yields, percent sucrose, conductivity, percent extraction, and recoverable sugar between cultivars at different applied rates of fertilizer nitrogen.

Results

The response of six commercial sugar beet cultivars to three nitrogen rates were tested for root yield, percent sucrose, conductivity readings, root nitrates, and for extractable and recoverable sugar. Root yields, conductivity readings and root nitrogen increased linearly with increases in added nitrogen for all cultivars. However, significant increases in root yields with each increment of added amounts of nitrogen did not occur with ACH-31 cultivar (Tables 1, 3, and 4). Recoverable sugar production was maximum for each cultivar at the budget N rates. Excess plant nitrogen reduced yields of recoverable sugar by lowering root quality (percent sucrose and conductivity), factors important to sugar yields which were not overcome by increases in root yield associated with the additional rates of nitrogen.

Both recoverable and gross sugar yields varied among cultivars (Table 6). All cultivars did not respond equally for yield of recoverable sugar at each nitrogen rate and interactions occurred that were measured significant to the five percent level of confidence. Cultivars WS-88 and WS-PM9 gave the highest yields of recoverable sugar at each nitrogen level. The yield of recoverable sugar for ACH-31 was equal to yield of the WS cultivars at the low nitrogen rate, but sugar yields of ACH-31 dropped considerably as nitrogen rates increased, primarily because of only slight increases in root yield and lower percent sucrose with additional increments of nitrogen. Sugar yields for Mono Hy 55 increased slightly from 60 to 160 pounds nitrogen but did not increase with additional nitrogen. Sugar yields for Betaseed was highest at the 60 pound nitrogen rate and decreased with each additional increment of added nitrogen (Tables 1 and 6).

Table 7, compares the value of the crop produced from each cultivar based on $24.00 per 100 pounds of refined sugar. The value per ton of beets at percent sucrose was calculated from the 1989 contract. WS-88 grossed more dollars per acre than other cultivars when compared at each of the three levels of nitrogen. Dollar return of ACH-31 was equal to that of WS-88 at the low nitrogen level but dollar return declined significantly at the 160 and 260 pound nitrogen rate. WS-PM9 brought the second highest return of cultivar at each nitrogen level. Mono Hy 55, Betaseed 8654, and HH-39 were equal in dollar returned but were significantly less than other cultivars.

The primary objective of this study was to compare cultivars for their ability to forage for available soil nitrogen based on the measured concentration of ppm root NO_3-N at harvest. Root nitrates increased with each increment of added nitrogen for all cultivars (Table 3). Significant differences in the concentration of root nitrates did occur between cultivars from plots treated with fertilizer nitrogen at the 260 pound rate.

Significantly higher amounts of nitrate nitrogen was accumulated in roots from varieties WS-88 and ACH-31. These data indicate that specific cultivars may be more efficient as foragers of soil nitrogen, thus better adapted to extract and utilize nitrogen added as fertilizer. Planting cultivars with greater efficiency to utilize soil nitrogen may result in the need for less added nitrogen to produce an optimum crop. Selecting cultivars with greater efficiency in extracting soil nitrogen may result in less nitrogen carryover as residual and less nitrates getting to ground water.

Extreme differences did occur in the amount of foliage and color for sugar beets treated with different rates of nitrogen. Sugar beets growing in plots with only 60 pounds of added nitrogen never developed enough foliage to cover furrows between rows. Foliage was large and lush in the 160 to 260 pound plots. Indications are that sugar beets have a capacity to forage for needed nitrogen to extreme depths of soil and that when nitrogen quantities are marginal the amount needed for root growth takes priority over that utilized for top growth.

To produce the root yields obtained in these trials (40 + tons/ac) in the 60 pound nitrogen plots the growing sugar beet plants had the capacity to sap a source in the soil from residual nitrogen. Since two years of wheat was grown prior to planting sugar beets in this trial, the nitrogen source was probably at a soil depth beyond three feet and maybe as much as six to seven feet in this field relevant for seed alfalfa but not for sugar beets.

Table 1. Intermean values of root yields for six sugar beets varieties and three rates of fertilizer nitrogen. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

	Rates of fertilizer nitrogen (lbs N/ac)			
Varieties	60	160	260	Mean
		t/ac		
WS-88	47.11	49.08	51.32	49.17 a
WS-PM9	47.01	48.85	50.63	48.83 a
Mono Hy 55	44.32	47.59	50.49	47.13 b
Betaseed 8654	44.83	46.11	49.24	46.73 b
HH-39	46.10	46.71	49.29	47.37 b
ACH-31	45.48	45.61	46.05	45.71 c
Mean	45.81 a	47.35 b	49.50 c	

Table 2. Intermean values of percent sucrose for six sugar beet varieties and three rates of fertilizer nitrogen. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

	Rates of fertilizer nitrogen (lbs N/ac)			
Varieties	60	160	260	Mean
		%		
WS-88	17.57 (0.56)	17.01 (0.98)	16.03	16.87 bc
WS-PM9	17.10 (0.44)	16.66 (1.03)	15.63	16.46 a
MonoHy 55	17.33 (0.53)	16.80 (1.10)	15.70	16.61 a
Betaseed 8654	17.33 (0.39)	16.94 (1.25)	15.69	16.65 a b
HH-39	17.16 (0.44)	16.72 (0.82)	15.90	16.59 a
ACH-31	17.93 (0.75)	17.18 (1.18)	16.00	17.03 c
Mean	17.40a (0.52)	16.88b (1.06)	15.83c	16.70

Table 3. Intermean values for ppm nitrate nitrogen for six varieties of sugar beets and three rates of fertilizer nitrogen. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Varieties	Rates of fertilizer nitrogen (lbs N/ac) 60	160	260	Mean
	- - - - - - - - - - - - ppm	- - - - - - - - - - - -		
WS-88	69 a	113 a	402 ab	195 c
WS-PM9	65 a	96 a	329 c	163 ab
Mono Hy 55	95 a	86 a	268 d	150 a
Betaseed 8654	67 a	103 a	378 b	183 bc
HH-39	53 a	100 a	325 c	159 ab
ACH-31	62 a	105 a	435 a	201 c
Mean	68 a	101 b	256 c	

Table 4. Intermean values for conductivity readings for six varieties of sugar beets and three rates of fertilizer nitrogen. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Varieties	Rates of fertilizer nitrogen (lbs N/ac) 60	160	260	Mean
	- - - - - - - - - micro mhos	- - - - - - - - - -		
WS-88	588 bc	651 b	798 ab	679 b
WS-PM9	559 c	598 c	708 d	622 a
Mono Hy 55	664 a	658 ab	728 cd	683 b
Betaseed 8654	653 a	701 a	828 a	727 c
HH-39	622 ab	692 ab	754 bc	689 b
ACH-31	609 b	680 ab	813 a	701 b
Mean	615 a	663 b	771 c	
LSD(.05)				

Table 5. Intermean values of percent extraction for six varieties of sugar beets and three rates of fertilizer nitrogen. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Varieties	Rates of fertilizer nitrogen (lbs N/ac) 60	160	260	Mean
	- - - - - - - - - - - - - %	- - - - - - - - - - - -		
WS-88	87.20	86.29	84.15	85.88 b
WS-PM9	87.47	86.89	85.25	86.54 c
Mono Hy 55	96.18	86.15	85.00	85.78 b
Betaseed 8654	86.32	85.62	83.68	85.21 a
HH-39	86.68	85.69	84.70	85.69 b
ACH-31	87.00	85.94	83.95	85.63 b
Mean	86.81 a	86.10 b	84.46 c	85.79

Table 6. Intermean values of recoverable sugar per acre for six varieties of sugar beets and three rates of fertilizer nitrogen. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Varieties	Rates of fertilizer nitrogen (lbs N/ac) 60	160	260	Mean
	---------- tons/ac ----------			
WS-88	7.212 a	7.208 a	6.918 a	7.113 b
WS-PM9	7.023 abc	7.070 ab	6.737 a	6.943 b
Mono Hy 55	6.615 d	6.740 bc	6.738 a	6.698 a
Betaseed 8654	6.708 cd	6.688 c	6.463 bc	6.620 a
HH-39	6.860 bcd	6.695 c	6.640 ab	6.732 a
ACH-31	7.087 ab	6.738 b	6.180 c	6.668 a
Mean	6.918 a	6.856 a	6.613 b	6.796

Table 7. Intermean values of dollars per acre for six varieties of sugar beets and three rates of fertilizer nitrogen[1]. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Varieties	Rates of fertilizer nitrogen (lbs N/ac) 60	160	260	Mean
	---------- $/ac ----------			
WS-88	2115 a	2122 a	2049 a	2095 a
WS-PM9	2035 b	2057 b	1957 b	2016 b
Mono Hy 55	1957 d	1978 c	1970 b	1968 b
Betaseed 8654	1981 cd	1979 c	1914 c	1958 b
HH-39	2013 bc	1972 c	1953 bc	1979 b
ACH-31	2095 a	2006 c	1837 d	1946 b
Mean	2033 a	2002 a	1947 b	1994

[1]Value of sugar beets based on $24.00/cwt for sugar.

CORRECTING SUGAR BEET NITROGEN DEFICIENCIES

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Ontario, Oregon, 1989

Nyssa-Nampa Beet Growers and factory fieldmen are cooperating to improve nitrogen fertilizer management. Economic return from sugar beets is closely tied to nitrogen fertilizer management. Growers wish to harvest the greatest amount of recoverable sugar, and receive the highest payment without undue fertilization costs. Typically sugar beets require 0 to 240 pounds per acre of nitrogen fertilizer based on soil sampling for nitrates and field yield history. Nitrogen applications needs for the greatest amount of sugar per acre are less than the amount of fertilizer that produces the greatest beet tonnage.

Severe nitrogen deficiency leads to reduced beet tonnage and reduced total sugar yields per acre even though the beets may have high sucrose concentration. With increasing nitrogen, tonnage tends to increase while sucrose decreases. Excessive nitrogen results in reduced total recoverable sugar per acre due to strong decreases in sugar content. Beets that receive unneeded nitrogen have lower quality due to the presence of nitrate, nitrite, amino acids and ammonium in the beet pulp.

Strong economic incentives exist for growers and processors to cooperate in optimizing nitrogen use on sugar beets. Excessive nitrogen results in the accumulations of nitrogen compounds in the beets. Factories find that the nitrogen salts (nitrates, nitrites, proteins, amino acids, ammonium compounds) in the beets interfere with factory efficiency. Soluble nitrogen compounds get through the diffusion process, the juice purification step, and the crystallization process. For every pound of impurities which are not removed in juice purification approximately one pound of sugar is lost to molasses. Ammonium salts decompose during liming and carbonation, liberating ammonia during heating and evaporation, reducing the efficiency of these operations. Protein nitrogen compounds are generally removable in the juice purification process but as beets deteriorate, the protein nitrogen gradually turns into non-removable or "interfering" amino-acid nitrogen. Since nitrates and nitrites can not be removed in the juice purification step, they increase sugar going to molasses, hence decreasing the recovery of sugar.

Beet Petioles Indicate N Deficiencies

Usually early season soil sampling provides a good guide for beet nitrogen management. Sugar beet growers want to keep their beets from running short of nitrogen in mid-season. Beet petiole analyses provide a key measurement of plant nitrogen status. With regular sampling, petiole nitrates indicate patterns of plant nutrition over time. If petiole nitrate levels are low the grower needs to decide how the nitrogen will be applied, what form to use, and what rate to apply.

Method of Fertilizer Application

If nitrogen deficiency is detected early in the season, sidedressing N fertilizer is an effective method. By July in eastern Oregon and southwestern

Idaho, beet tops are closed to the point that sidedressing would damage the plants. Growers' alternatives are limited to water run, aerial spray, or aerial broadcast fertilization. Water run fertilizer in the form of aqua-ammonia or URAN (urea-ammonium nitrate) is a low cost way to apply nitrogen for furrow irrigated beets.

Water run nitrogen is only effective if the fertilizer is applied correctly. If water run fertilization continues once there is significant runoff, much of the fertilizer is lost. Water run nitrogen needs to be discontinued once the advancing water reaches the bottom edge of the field.

In furrow irrigated fields, the method of N application greatly influences the amount of nitrogen in the runoff water (Table 1). Water-run nitrogen applied during the entire irrigation set or at the end of the irrigation set resulted in large increases in total N content in the runoff water. Nitrogen lost off the field is no longer available to help correct N deficiency symptoms.

Table 1. Increased concentration of total N in runoff water due to five supplemental N application methods. Nitrogen is expressed as the average concentration in the runoff water during an eight hour set, Malheur Experiment Station. Oregon State University, Ontario, Oregon, 1989.

N application method	N rate	Total N concentration increase
	lbs/ac	ppm
1. None	0	0.2
2. Foliar URAN	20	7.9
3. Broadcast urea	40	4.2
4. Water-run URAN, early in set	40	4.0
5. Water-run URAN, all 8 hrs	40	24.9
6. Water-run URAN, last 1/2 hr	40	35.4
LSD(.05)		15.9

Rate of Applied Nitrogen

Once petiole nitrate deficiencies have been discovered, the grower needs to know how much nitrogen it takes to correct the deficiency. To estimate the amount of N needed for a deficient beet crop, an experiment was conducted at the Malheur Experiment Station in the summer of 1989. In the test, 20 lbs of N per acre covered a beet petiole deficiency of 1000 to 1500 ppm nitrate. Forty lbs N/ac corrected a deficiency of 2000 to 3000 ppm nitrate (Figure 1). These responses will have to be tested several more times for greater certainty, but they are a good first estimate.

One week after fertilization a grower should be able to detect petiole nitrate increases. There are a couple of words of caution. If the beet nitrates were falling very fast, increases could be less. Errors in applying the fertilizer will also reduce the nitrogen response.

How long will the fertilizer last?

In 1989 we found that 20 or 40 pounds of N per acre would have a clear response for three to four weeks. After five weeks the effects on petiole N levels wore off (Figure 2). The use of 80 to 120 lbs of water run N per acre had lasting effects even after seven weeks. High nitrates in beets at harvest can reduce beet sugar content, sugar recovery at the factory and the price paid to the grower. So there are clear dangers to using too much nitrogen to correct a small deficiency. Other factors that influence the duration of N response are irrigation intensity, rate of crop growth, soil texture, and weather.

A Careful Strategy

The best strategy would be to add just the right amount of nitrogen to correct the N deficiency. One to two weeks after fertilization, a petiole nitrate test can indicate if a little more nitrogen is still needed. N fertilizer costs will be less and the economic dangers of over fertilization will be avoided.

Acknowledgement

We would like to express our appreciation to the Nyssa-Nampa Beet Growers Association and the Amalgamated Sugar Company of Nyssa, Oregon, for their support during the 1989 growing season. Several nitrogen management experiments will be repeated in 1990 and 1991.

FIG. 1. RESPONSE OF SUGAR BEET PETIOLES TO WATER RUN NITROGEN

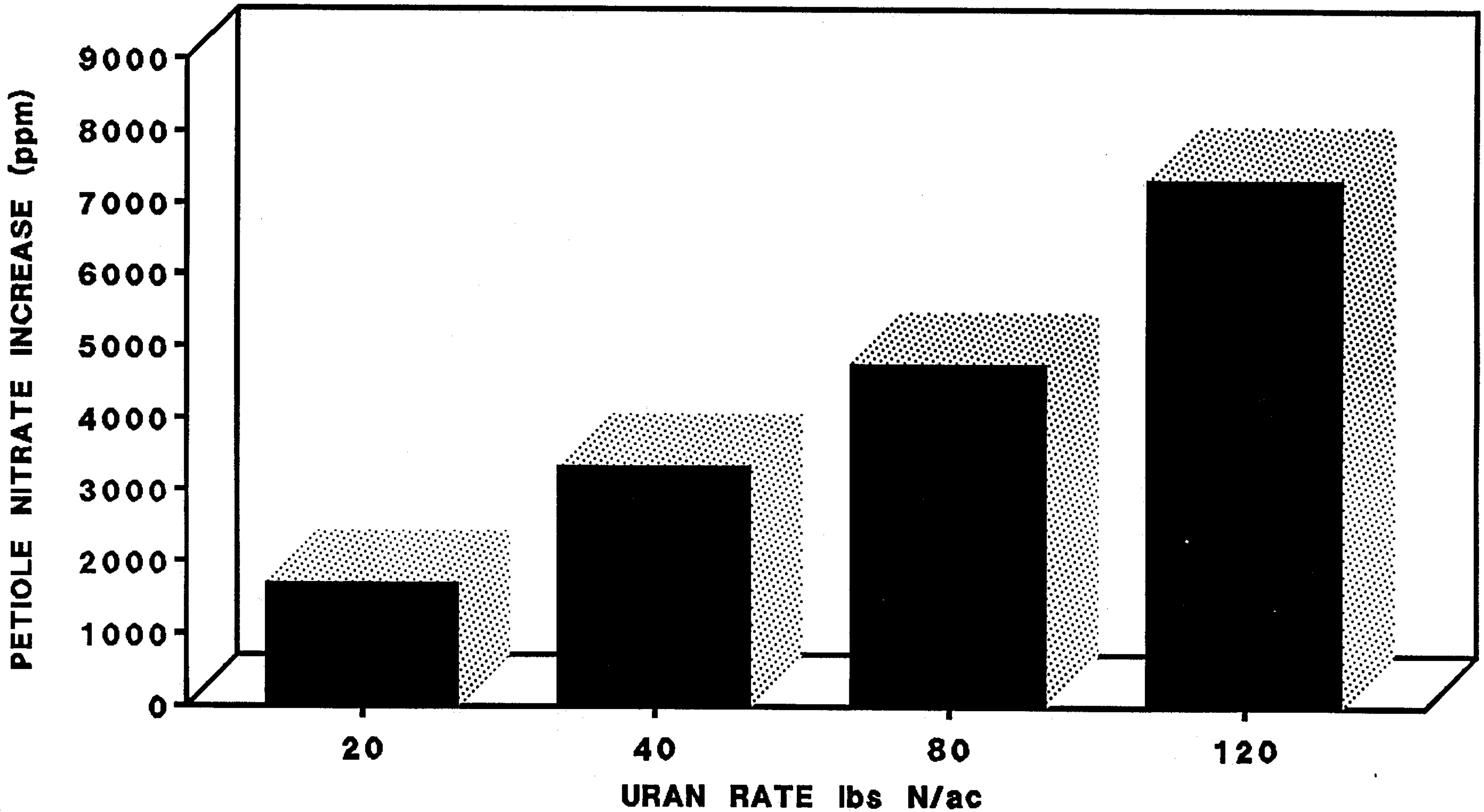
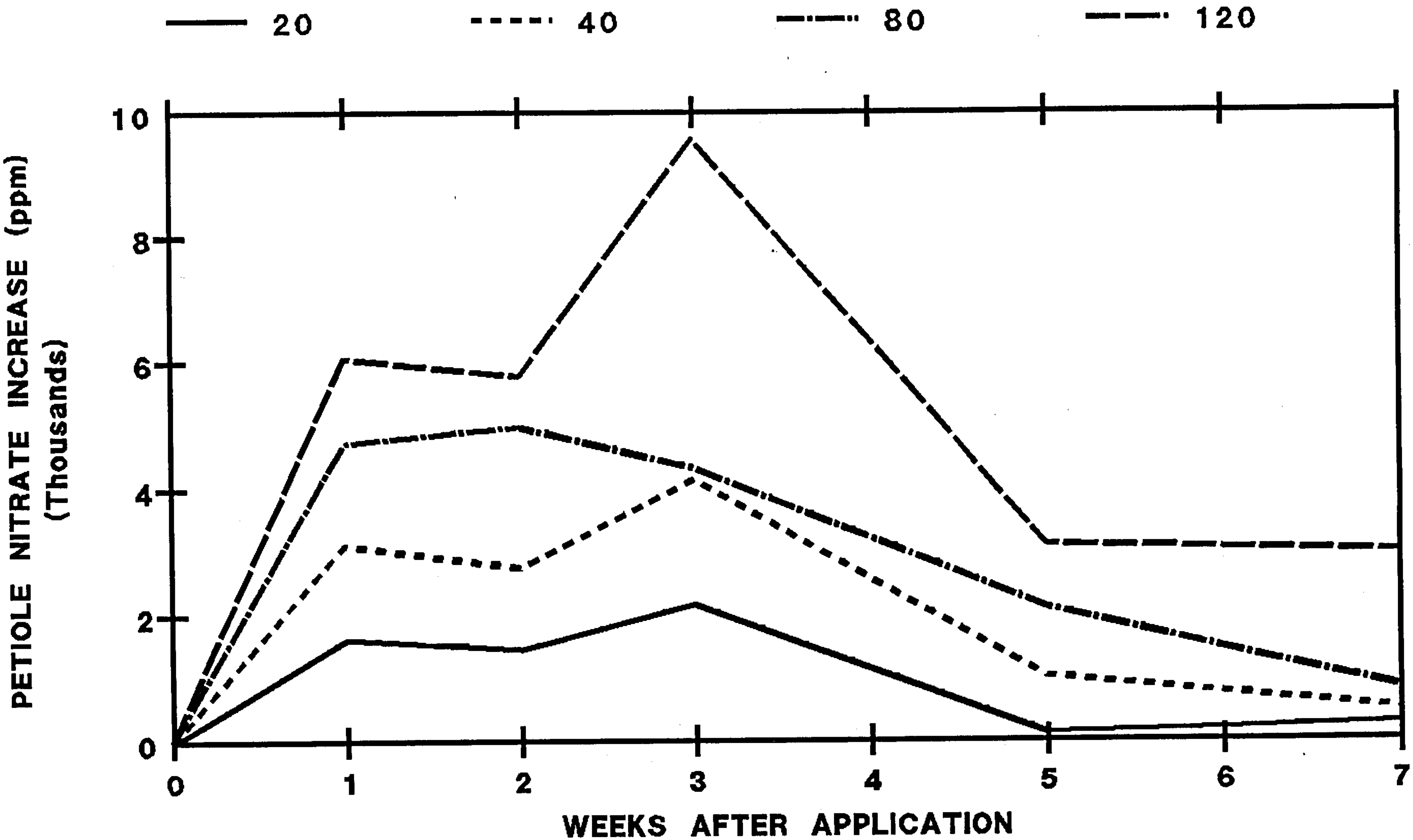


Fig. 2. RESPONSE OF SUGAR BEET PETIOLES TO FOUR RATES OF N OVER SEVEN WEEKS



SUGAR BEET RESPONSE TO SUPPLEMENTAL NITROGEN

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Ontario, Oregon, 1989

Purpose

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 have sponsored research to help answer the question of how to add supplemental nitrogen to furrow irrigated beets and how much nitrogen to apply.

Procedures

Tasco WS-88 sugar beets were planted on 22" rows April 20 on an Owyhee silt loam soil at the Malheur Experiment Station. Soil was sampled to a depth of three feet and 62 lbs nitrogen per acre was sidedressed in the form of ammonium nitrate to provide a total of 180 lbs N per acre. According to the Amalgamated Sugar Company's 1989 Sugar Beet Grower's Guide Book, pp 6-7, the total N supply was short 100 lbs N per acre to provide an adequate nitrogen supply for 36 tons per acre beet yield . Beet petiole nitrates indicated clear deficiency in late June.

Five methods of applying supplemental nitrogen were tested starting on July 7. Each method was replicated four times. Each of the following methods supplied 40 lbs N per acre:

1. URAN was applied as a foliar spray at 20 lbs N per acre two times.

2. Granular urea was broadcast to provide 40 lbs N per acre.

3. URAN was water run during the entire duration of an eight hour irrigation set.

4. URAN was applied during the last 30 minutes of an eight hour irrigation set.

5. "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.

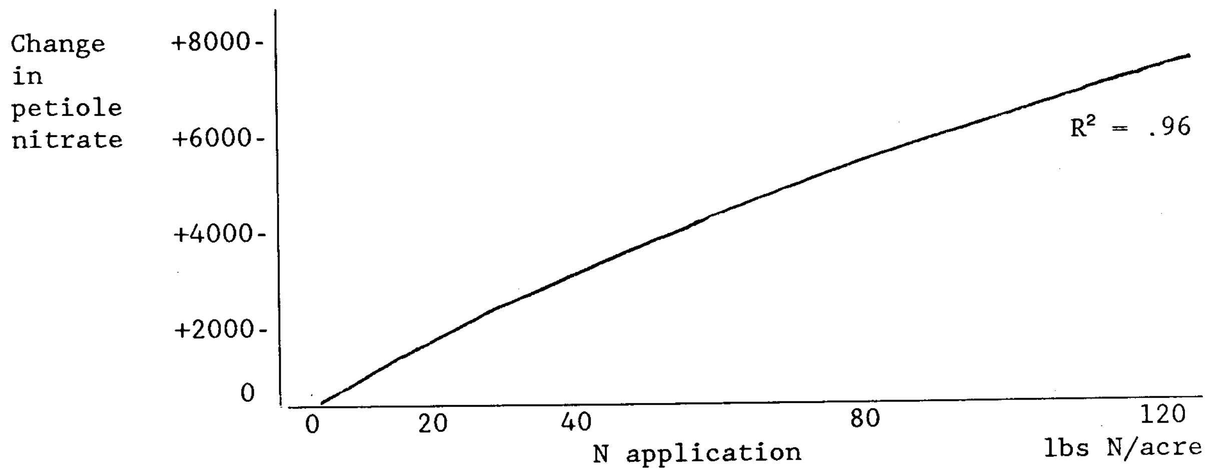
In a separate test to evaluate the petiole response to N rate, five rates of URAN were applied providing 0, 20, 40, 80, and 120 lbs N/acre. All five of the rates were applied July 7 using the "30-90" strategy described above for water run N, and replicated four times.

Response of the beet petiole nitrates was measured 1, 2, 2 1/2, 5, and 7 weeks after N application. Response of petiole nitrates was calculated compared to unfertilized check treatments.

Results

For each 10 lbs of applied N, beet petiole nitrate levels responded by increases of about 750 ppm nitrate above the check (Figure 1). Petiole nitrate responses were efficient at low rates of applied N, 40 lbs or less N per acre.

Figure 1. Response of sugar beet petiole nitrate one to three weeks after URAN application. Data are presented as nitrate increases above the check treatment. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.



High rates of applied N resulted in excessively high petiole nitrate levels, as described on pages 10 and 11 of the 1989 Sugar Beet Grower's Guide Book.

Methods of applying N resulted in widely different petiole N responses (Table 1). Unfortunately, variability in the field introduced error limiting the certainty as to which method is superior. Beet petiole responses of 550 ppm nitrate per 10 lbs applied nitrogen were observed for the "30-90" water run URAN in this trial.

Table 1. Comparison of five methods to apply 40 lbs N per acre to nitrogen deficient sugar beets. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Method	From	Beet petiole nitrate response
		ppm
1. Foliar (20 + 20)	URAN	130
2. Broadcast granular	Urea	240
3. Water run, entire set	URAN	1020
4. Water run, end of set	URAN	370
5. Water run, "30-90"	URAN	2190
LSD(.05)		ns

Discussion

Growers need a practical method to apply supplemental nitrogen once beet canopies close and sidedressing is no longer practical. Water run nitrogen can be used effectively as described above. Using 1989 data, our first estimate is that for each 10 lbs per acre of applied N, a beet petiole response of 550 to 750 ppm nitrate can be achieved.
One practical limitation to achieving these responses is that petiole nitrates in the field could be falling or rising rapidly. Rapid changes can occur if beets are running out of nitrogen, if root systems are extending deeper into the soil that contains reserves of nitrogen, if beets are becoming water stressed, or if irrigation water is carrying significant quantities of nitrogen.

A second limitation is the small data base of these results. This report is based on one field for one year with nitrogen applied at one stage of beet growth. More reliable recommendations for growers can be built by obtaining three or more years information from several locations. The results presented here should be considered only as preliminary.

Nitrogen applied at the very beginning of an irrigation set will be concentrated at the headlands of furrow irrigated fields. Once runoff has begun, mass action of irrigation water will carry much of any water run product off the end of the field. The method described as "30-90" would minimize overloading the headlands with nitrogen while also avoiding wasting nitrogen in the tail water. In order to implement the "30-90" procedure it is necessary to know the amount of the time necessary for the water to advance down 30 percent of the field and the amount of time for the advance to reach 90 percent. The rate of fertilizer application is then set to deliver the correct amount of fertilizer at the right time. Delivering the correct amount of nitrogen at the wrong time during a furrow irrigation is a common cause of poor N response.

A STUDY OF SUGAR BEET NITROGEN RECOVERY

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Abstract

A primary concern of sugar beet growers is maintaining an adequate nitrogen supply throughout the growing season. Severe nitrogen deficiency leads to reduced beet tonnage and reduced total sugar yields. Until recently, only superficial soil measurements have been used in order to determine the additional nitrogen requirements of sugar beets.

The top three feet of the soil profile were tested to calculate the total amount of available nitrogen. Varying amounts of water-run nitrogen amendments were added. At the end of the growing season, the residual nitrogen in the soil was measured and the total plant nitrogen recovery was calculated. Up to 110 lbs/acre of nitrogen recovered by the plants could not be accounted for by the fertilizer application rate and the initial nitrogen conditions to a soil depth of three feet. As sugar beets do not fix nitrogen, the additional N may have been recovered from a depth of greater than three feet.

In addition, the effectiveness of five methods of nitrogen fertilizer application was evaluated in terms of nitrogen loss from the field and concentration of nitrogen in the runoff water. The same evaluation was done for varying rates of water-run URAN.

The data were also used to verify the validity of the petiole nitrate deficiency curve.

Objectives

Existing experiments at the Malheur Experiment Station had objectives related to correcting sugar beet nitrogen deficiencies once the petiole nitrate levels became deficient. These objectives included determining the response of sugar beets to various methods of supplemental nitrogen applications as well as to different rates of water-run URAN.

Additional measurements were made to examine sugar beet nitrogen recovery and nitrogen losses, rather than exclusively beet petiole responses. These objectives were as follows:

1. To study sugar beet nitrogen recovery.

2. To determine the loss of nitrogen in the runoff water due to each application rate and method.

3. To determine the effect of various nitrogen application rates on residual soil nitrate levels.

4. To test the validity of the sugar beet petiole nitrate deficiency curve.

Materials and Methods

Tasco WS-88 sugar beet seed was planted on 22" rows April 20 on an Owyhee silt loam soil at the Malheur Experiment Station. Soil was sampled to a depth of three feet and depending on the results of soil testing an average of 62 lbs nitrogen per acre was sidedressed in the form of ammonium nitrate to provide a total of 180 lbs N per acre. The total N supply was short 100 lbs N per acre to provide an adequate nitrogen supply for 36 tons per acre beet yield according to the Amalgamated Sugar Company's 1989 Sugar Beet Grower's Guide Book, pp. 6-7. Beet petiole nitrates indicated clear deficiency in late June.

Five methods of applying supplemental nitrogen were tested starting on July 7. Each of the following methods supplied 40 lbs N per acre:

1. URAN was applied as a foliar spray at 20 lbs per acre in 20 gallons/acre of water two times.
2. Granular urea was broadcast to provide 40 lbs nitrogen per acre.
3. URAN was water run during the entire duration of an eight hour irrigation set to provide 40 lbs of nitrogen per acre.
4. URAN was applied during the last 30 minutes of an eight hour irrigation set to provide 40 lbs of nitrogen per acre.
5. "30-90," URAN was applied only during the beginning of an eight hour irrigation set (URAN was turned on after the water had advanced 30 percent through the field and turned off when the water had advanced 90 percent through the field.)

Each treatment was replicated four times. Field plot size consisted of four rows of beets 22 inches apart and 292 feet long.

In the separate test to evaluate the beet response to N rate, five rates of URAN were applied providing 0, 20, 40, 80, and 120 lbs N/acre. All five of the rates were applied July 7 using the "30-90" strategy described above and replicated four times.

During nitrogen application, the water inflow was maintained at a constant rate. Water inflow was near constant because water pressure to the gated pipe was kept constant and the pipe was fitted with valves instead of gates. Valve clogging was avoided by passing irrigation water through a trash screen immediately before it entered the distribution pipe. Inflow and outflow rate measurements were taken at regular intervals to allow calculation of total inflow and outflow. At the same time these measurements were taken, representative samples of the inflow and outflow water were taken and frozen for later analysis.

On October 30 and 31, the beets were harvested and the total yield was recorded. Sugar beet and beet top samples were taken. Soil samples were taken to a depth of three feet.

Sugar beet samples were analyzed at the Amalgamated Sugar Tare Lab, Nyssa, Oregon, for total sugar yield, nitrate content, and conductivity. Beet pulp samples were frozen for later reduced nitrogen determination.

Inflow and outflow water samples were pipetted to make 100 ml composite samples to represent each plot. Kjeldahl tests run at Western Laboratories were used to determine the reduced nitrogen content of the water. The water samples were also tested for nitrate N content.

The sugar beet pulp, beet top, and soil samples were analyzed at Western Laboratories for total reduced nitrogen and nitrate N content.

Results and Discussion

Sugar Beet Nitrogen Recovery and Residual Soil Nitrates

Varying rates of water-run nitrogen application had no significant effect on total sugar beet nitrogen recovery at the end of the season in these trials (Table 1). The reason for this is evident in Table 6. The apparent amount of nitrogen supplied was calculated by determining the total amount of nitrogen available at the start of the growing season, adding the rate of water-run nitrogen, and subtracting the residual soil nitrate level.

The values of total N (Tables 1 and 6) underestimate the total amount of nitrogen in the beet plant at harvest. Nitrogen as nitrate in the beet leaves at harvest was not determined. No accounting was made for nitrogen in fine roots or in lost beet parts at harvest. Beets are scalped before digging and a few beets are broken or lost. Scalped beet tissue was neither weighed nor evaluated for nitrate and reduced N content.

Although the apparent amount of nitrogen supplied to the beets varied directly with the application rate, the amount of nitrogen recovered was much higher than the amount of nitrogen supplied. Beets that received an average of 62 lbs N/ac sidedressed and no water-run N contained 196 lbs/ac in the pulp and 70 lbs reduced N/ac in the tops (Table 1). The difference between fertilizer N added to the crop and N removed from the field in harvesting was 62 - 196 = -134 lbs N/ac.

Since the residual soil nitrate levels nitrates in the top three feet of the soil profile ranged only from 24 to 26 lbs/acre, the discrepancies had to be caused by recovery of nitrogen from below a soil depth of three feet, inadvertent nitrogen contamination during other irrigations, and nitrogen from mineralization of soil organic matter. Soil nitrate testing could be done to a depth of greater than three feet to give a more accurate estimate of the amount of nitrogen available to the beets. Hydraulically powered soil sampling equipment may be needed to allow efficient soil sampling below three feet.

Nitrogen Concentration and Losses in Runoff Water

Water samples from two of the application methods showed significantly higher concentrations of reduced nitrogen and nitrates in the runoff water (Table 2). Method 5 (applying all of the URAN at the end of the irrigation set) had extremely high concentrations of both reduced N and nitrates in the runoff water (Columns 3 and 4), as did the method of applying the water-run URAN during the entire 8 hour irrigation period. The resulting losses of fertilizer in the runoff water were also highest for Method 5 (Table 3). Almost 25% of the total amount of nitrogen applied was lost immediately in the runoff water, as seen in the Total N column.

The N concentration and losses in the outflow due to varying N application rates were proportional to the rate of application (Tables 4 and 5). Total nitrogen losses remained low for all rates because of the use of the "30-90" water run URAN method.

Petiole Nitrate Deficiency Curve

The petiole nitrate deficiency curve was found to be an accurate means of evaluating whether a sugar beet crop has deficient or excessive nitrogen levels. The optimal petiole nitrate level curve was estimated. The amount of recoverable sugar was related by multiple regression to the second order polynomial of the ratio of the petiole nitrate level on any given day to the deficiency level for that day. The optimal petiole nitrate level on any given day based on recoverable sugar in the 1989 trials was equal to 2.05 times the deficiency level.

Conclusions

Sugar beets were efficient in recovering residual soil and subsoil nitrates. Beets recovered 266 lbs/ac where only 62 lbs/ac were applied as fertilizer. Of the recovered N, 196 lbs/ac were removed from the field in harvesting the beets. It is very important to realize soil nitrate testing to three feet may often not give a complete estimate of the amount of nitrogen available to sugar beet plants. Beet growers may benefit from soil testing to a depth of five or six feet to provide better information on the amount of soil nitrates already available to beet plants.

The current practices of applying water-run nitrogen during the entire irrigation set or near the end of the set can cause a good deal of nitrogen and nitrate loss in the runoff water and are at best costly to the grower. By applying the fertilizer using the "30-90" strategy, the efficiency of fertilizer application can be increased dramatically.

Petiole nitrate levels observed in 1989 and their relationship to recoverable sugar were consistent with the validity of the deficiency curve. The optimum petiole nitrate level for maximal recoverable sugar was estimated to be 2.05 times the deficiency level based on these two trials on one soil type for only one year.

Acknowledgements

The Nyssa-Nampa Beet Growers Association provided financial support towards the completion of the project. Samples were analysed in the laboratories of Western Labs in Parma, Idaho, and Amalgamated Sugar Company in Nyssa, Oregon. Don Bowers of Amalgamated Sugar Company and John Taburna of Western Laboratories were particularly helpful in assisting with details of this research.

Table 1. Nitrogen recovery by Tasco WS 88 sugar beets grown on a Greenleaf silt loam. Malheur Experiment Station, Oregon State University, Ontario, Oregon 1989.

		Plant N Content			Plant N Recovery				
Water run N rate	Yield	Beet pulp reduced N	Beet pulp NO_3 N	Plant top reduced N	Beet pulp reduced N	Beet pulp NO_3 N	Beet pulp total N	Plant top reduced N	Total N
lbs/ac	tons/ac	%	ppm	%	lbs/ac				
0	38.2	0.24	132	2.5	186	10	196	70	266
40	39.0	0.23	132	2.3	180	10	191	64	255
120	38.8	0.25	120	2.5	195	9	204	79	283

Table 2. Increased concentration of reduced nitrogen and nitrate N in runoff water due to five supplemental N application methods during an eight hour furrow irrigation set, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

		Increased N Concentration In Runoff		
N method	N rate	Reduced N	Nitrate N	Total N
	lbs/ac	ppm		
1. Foliar URAN	20	7.8	0.1	7.9
2. Granular urea	40	3.8	0.4	4.2
3. Water-run URAN "30-90"	40	3.0	1.0	4.0
4. Water-run URAN 8 hrs	40	14.3	10.6	24.9
5. Water-run URAN last 1/2 hr	40	19.5	15.9	35.4
LSD(.05)		-	3.7	15.9
LSD(.10)		5.9		

Table 3. Loss of reduced nitrogen and nitrate N in runoff water following five supplemental N application methods. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

		N Lost In Runoff		
N method	N rate	Reduced N	Nitrate N	Total N
	lbs/ac	lbs/ac		
1. Foliar URAN	40	2.2	0.0	2.2
2. Granular urea	40	1.0	0.1	1.1
3. Water-run URAN "30-90"	40	0.8	0.2	1.0
4. Water-run URAN 8 hrs	40	1.0	1.0	1.8
5. Water-run URAN last 1/2 hr	40	4.9	3.7	8.6
LSD(.05)		3.0	1.1	3.9

Table 4. Effect of water-run URAN rate on the increased concentration of reduced N and nitrate N in the runoff water during an eight hour furrow irrigation set. All rates were applied using the "30-90" strategy. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

N rate	Increased N Concentration In Runoff		
	Reduced N	Nitrate N	Total N
lbs/ac	ppm		
0	.00	.18	.18
20	.24	.53	.77
40	.00	.78	.78
80	.50	1.68	2.18
120	.75	1.30	2.05
Correlation R =	+.48*	+.49*	+.53*

*significant at 95% level.

Table 5. Nitrogen losses of reduced N and nitrate N in runoff water as affected by water-run URAN rates during an eight hour furrow irrigation set. All rates were applied using the "30-90" strategy. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

N Rate	N Lost In Runoff		
	Reduced -N	Nitrate -N	Total N
lbs/ac	lbs/ac		
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*

*significant at 95% level.

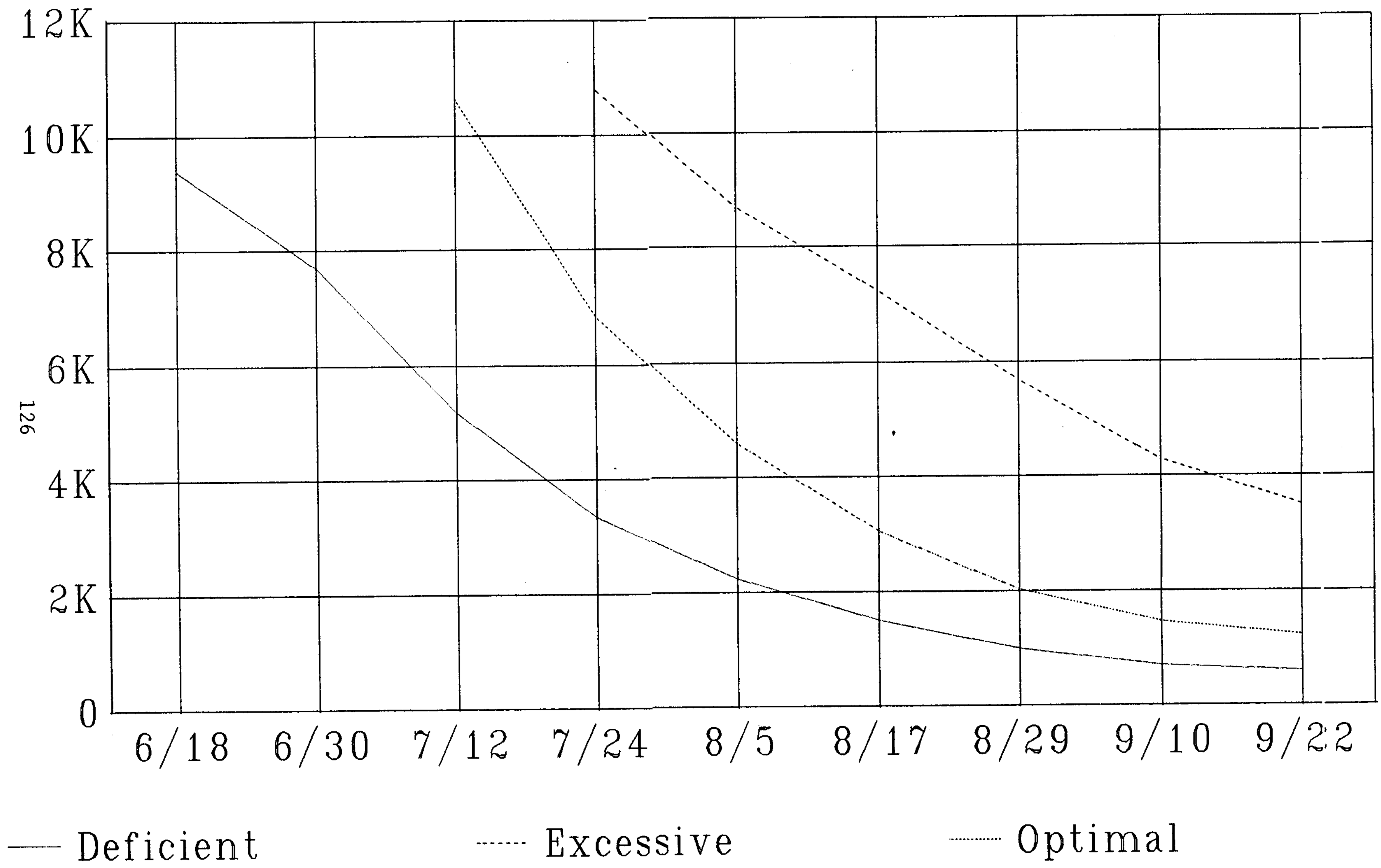
Table 6. Comparison of sugar beet N recovery and apparent available N supplied by the soil. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989.

Water run N rate	Initial N level[1]	Total available N[2]	Final available N[3]	Apparent N supplied	Total plant N recovery	Unaccounted N
lbs/ac						
0	180	180	24	156	266	+110
40	180	220	26	194	255	+61
120	180	300	25	275	283	+8

[1] Soil nitrate 0-3' + sidedressed fertilizer
[2] Initial N level plus water-run N
[3] Soil nitrate 0-3' November 2, 1989, after harvest

Petiole Nitrate Curve

Estimated Optimum for Recoverable Sugar Yield



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EVALUATION OF SUPERSWEET CORN VARIETIES FOR THE TREASURE VALLEY

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Objective

To evaluate new locally adapted supersweet corn varieties with superior agronomic and processing qualities.

Introduction

Supersweet varieties can be three to four times sweeter than normal corn varieties. Supersweets are replacing normal varieties in the fresh market and present an opportunity in the frozen market as well. Improvements in stand establishment and ear quality continue to bring supersweets closer to Golden Jubilee, a local processing standard.

Materials and Methods

The trial was located on an Owyhee silt loam. The preceding crop was sugar beets. One hundred pounds of P_2O_5 per acre were plowed down in November 1988. In the spring, the field was worked down with a "Triple-K" spring-toothed implement and harrowed. Lasso was broadcast sprayed at 3.5 qts/A for weed control. The field was diagonally harrowed, twice, to incorporate the Lasso. The field was bedded to 30 inch centers and then harrowed again to break up clods. The trial was planted on May 2 and the non-wheel rows were irrigated for 24 hours on May 3. On June 6 the trial was sidedressed with 100 lbs N/A as ammonium nitrate and then irrigated for 24 hours. The trial was irrigated nine other times through the season, alternating rows each time.

Thirteen supersweet corn varieties and Golden Jubilee were planted May 2 (Table 1). The plots were in a randomized complete block design with four replications. The plots were four rows wide and 20 feet long with 3 foot alleys at the end of plots. Plant stands were counted on May 25. The plots were thinned to 25,000 plants per acre on June 8, 9 and final stands were counted. The Golden Jubilee plots, which were included for germination comparisons, were removed at this time to avoid cross-pollination with the supersweet varieties. Silking dates were recorded in July and were used to help predict harvest dates for the different varieties. Samples of 12 ears were collected three to five days before the projected harvest date to determine moisture levels (microwave method). The target final moisture was 76 percent. Harvest samples were all primary ears from 15 feet of the center two rows.

Samples were counted, weighed with husks and weighed without husks. Twenty-five ears from each replicate were measured for length, diameter, row number, maturity and over all quality. One composite sample for each variety was sent to the Ore-Ida analytical lab for final moisture and sugar analysis. Nine varieties were frozen for further evaluation. The ears were cut to 6 inches. Samples were steam blanched. The blanch time was adjusted for each variety to ensure adequate enzyme inactivation. Samples were then water cooled 20 minutes. Quick freezing was completed in the Ore-Ida pilot plant belt freezer, 30-40 minutes. Samples were stored in bulk, plastic lined cases at 0°F until a cutting on February 21, 1990. The samples were then cooked and evaluated for appearance, texture, and flavor.

Results and Discussion

The plant stand for the trial was 87.2 percent. Only GSS 3548 and Excel had stands under 80 percent. May was not cold or wet, the factors that reduce plant stands. Maturity uniformity was also good. It seems to parallel emergence uniformity. The trial yield was 7.56 tons/acre. Five varieties had yields above 8 tons/acre. The highest yield was 9.46 tons/acre, FMX 235. All the ears of corn from the trial were moderately small and tapered. The length would have been enough for 6 inch cobs, but the cut ears would have tapered. The ear diameter for the trial was small, 1.76 inches, compared with Golden Jubilee, 1.91 inches. The major quality problems for the trial were poor tip fill and missing kernels, and immature ears. Other problems were short ears and twisting and irregular rows. Over all the varieties had nice refined looking ears. Only FMX 235 had under 16 rows on an ear. The sucrose level on supersweet varieties ranged from 4.8 to 10.9 percent. (Table 2.) Acclaim was a normal sweet corn variety that was mistakenly entered in the supersweet trial.

After evaluating the varieties that were frozen, it is seen that there continues to be different flavors and sweetness among the acceptable looking varieties. Many of the flavors are not what are associated with corn-on-the-cob. Moderate sweetness has been the preference, 7 percent sucrose. The supersweet corn varieties are a duller color when frozen than Golden Jubilee, but when cooked the color is bright and acceptable. In previous years some varieties have come out of storage with kernels of an unacceptable dark color. The dark frozen kernels were not a problem with the varieties this year.

Since new supersweet varieties are being developed by seed companies and improvements have been seen in agronomic and processed quality, evaluations will continue.

Table 1. Supersweet corn varieties evaluated at Malheur Experiment Station, OSU, Ontario, Oregon, 1989

Variety	Seed Company
1- FMX 235	Ferry Morse
2- FMX 280	Ferry Morse
3- Sunset (FMX 77)	Ferry Morse
4- XPH 2686	Asgrow
5- Zenith	Harris Moran
6- HMX 7348	Harris Moran
7- Acclaim 1/	Crookham
8- Nova	Crookham
9- SCH 5277	Illinois Foundation Seed
10- Illini Gold	Illinois Foundation Seed
11- Summersweet 7710	Abbot & Cobb
12- Golden Jubilee	Rogers Brothers
13- GSS 3548	Rogers Brothers
14- Excel	Rogers Brothers

1/ A normal sweet corn variety.

Table 2. Yield and quality of supersweet corn varieties in 1989. Malheur Experiment Station, OSU, Ontario, Oregon. 1/

Variety	Days to Harvest	Emergence (%)	Yield (T/A)	Ears/T	Ear Length (inch)	Maximum Diameter (inch)	Rows (#)	Taper 3/ (inch)	Maturity 4/ Index	Quality (%) 5/ A's	B's	Culls	Final Moisture (%)	Sucrose (%)
1- FMX 235	90	84.4	9.46	2364	8.67	1.83	15	0.17	2.85	72	20	11	75.7	8.9
2- FMX 280 2/	93	85.1	7.29	1933	8.24	1.77	17	0.19	2.75	67	24	9	79.5	7.3
3- Sunset (FMX 77) 2/	94	84.1	8.13	1933	7.30	1.90	17	0.44	2.82	82	11	7	76.4	7.8
4- XPH 2686 2/	92	97.3	8.19	2281	7.91	1.82	17	0.27	2.94	68	24	8	77.6	8.8
5- Zenith 2/	94	82.4	7.02	2003	7.62	1.69	18	0.32	2.69	70	21	9	77.8	8.7
6- HMX 7348	91	85.5	8.55	2309	7.38	1.81	16	0.34	2.93	66	26	8	75.4	10.9
7- Acclaim 6/	91	88.9	8.47	2350	7.00	1.85	19	0.58	2.88	65	30	5	70.0	2.6
8- Nova	91	87.3	5.76	2211	7.46	1.52	16	0.30	2.67	60	33	7	75.2	4.8
9- SCH 5277 2/	97	89.4	6.57	2045	7.34	1.75	18	0.38	2.86	73	20	7	76.7	8.8
10- Illini Gold 2/	92	96.6	7.64	2142	7.53	1.72	16	0.28	2.99	75	21	4	76.3	9.3
11- Summersweet 7710 :	97	93.1	6.64	1947	7.63	1.72	20	0.35	2.62	59	22	19	76.8	10.0
12- Jubilee	...	97.5	...	...	...	...	...	...	...	...	...	...	...	...
13- GSS 3548 2/	94	73.3	6.90	2017	7.09	1.74	17	0.46	2.79	77	17	6	78.3	8.1
14- Excel 2/	92	76.6	7.70	2100	7.55	1.76	17	0.40	2.75	77	16	7	77.9	9.3
Level of significance		0.01	0.01		0.01	0.01	0.01	0.01	0.01					
Trial average	93	87.2	7.56	2126	7.60	1.76	17	0.35	2.81	70	22	8	76.4	8.1
LSD (.05)		4.2	1.20		0.21	0.06	0.63	0.06	0.15					

1/ Data is the mean of 4 replications.
2/ A sample of this variety was frozen.
3/ Taper refers to the difference between maximum ear diameter and diameter six inches from the base.
4/ The maturity index ranges from one to four as maturity advances, with three referring to the optimum stage for harvest.
5/ Quality factors that result in B or cull grade are poor tip fill and missing kernels, < 6" ears, and twisting and irregul
6/ A normal sweet corn variety

CONTROLLING YELLOW NUTSEDGE WITH METOLACHLOR

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1988 and 1989

Introduction

Yellow nutsedge (Cypress esculentus) is clearly defined as the most troublesome and dangerous weed pest infesting row crop land in Treasure Valley. Each year a single plant can produce as many as 700 tubers and each tuber can produce up to five individual plants. The spread and infestation of yellow nutsedge can be generated by seed, tubers are pieces of rhizomateous root stocks. Spreading of tubers in water, movement of soil with machinery is most threatening to starting new infestations. Although seed of yellow nutsedge is viable, new emerging seedling are very sensitive to many herbicides customarily used to control common annual weeds in commonly grown crops.

Nutsedge seed germinating outside of cultivated fields where herbicides are not used can be a source of nutlets for future infestations in adjacent fields. Physiologists working with yellow nutsedge have reported that nutlets of yellow nutsedge will only survive three years in irrigated soils. This is unlike seeds of many weed species which will survive for many years in the soil to germinate when growing conditions are in their favor.

Objectives

The objective of this study is two fold: 1) evaluate the tolerance of all crops grown in rotation with sugar beets to the fall plowdown applications of Dual (metalachlor) for three to four consecutive years, and 2) to determine the optimum rates of Dual for effective control of yellow nutsedge when spring applications are applied as preplant or postplant incorporated treatments in conjunction with fall plowdown applications. Time for applying spring treatments will depend on the sensitivity of the crops to shallow incorporated Dual.

Procedures

A seven acre field of sandy loam textured soil uniformly infested with dense stands of yellow nutsedge was rented as the site for experimental use. The field is located off Highway 20 about one mile north of Nyssa. The field was planted to dry beans in 1988. Dual and Basagran were the herbicides applied to control nutsedge selectivity in the bean crop.

During the first week of November 1988, Dual (metolachlor) was applied at four rates (3, 4, 6 and 8 lbs ai/ac). The herbicides were applied to the soil surface as replicated strips, 64 feet wide, across the width of the field. A 64 foot strip in each replication was left untreated without Dual as a control check plot.

The herbicide treatments were applied with a field sprayer equipped with 8002 fan teejet nozzles as broadcast double overlap applications. Spray pressure was 35 psi and water as the herbicide carrier was applied at 23 gallons per acre. The field was disced twice to incorporate Dual before plowing with a moldboard plow to a depth of twelve inches. The disc was set to cut (6 inches) to incorporate Dual uniformly as deep as possible. Our intentions were to work the soil down after plowing and bed in the fall. Wet rainy weather occurred immediately after plowing and bedding had to be delayed until spring.

In early April (1989) the field was bedded and planted to the following cultivars of different crops: sweet spanish onions (Golden Cascade), sugar beets (WS-88), spring wheat (Bliss), Alfalfa (Wrangler), and sweet corn (Jubilee). Individual crops were planted in strips, eight rows wide, in a direction lengthwise to the field and across the herbicide strips. The herbicide strips and crops were each randomized in replicated blocks with both crops and herbicide replicated three times.

Annual weeds emerging in the crops were controlled with herbicides registered for use in each crop, applied as postemergence applications. Herbicides tested included: Betamix and Poast for sugar beets; Goal, Buctril, Fusilade for onions; Buctril and Poast for Alfalfa; Buctril and MCPA for wheat; and Buctril and Atrazine for corn.

The effectiveness of the Dual treatments for control of yellow nutsedge and tolerance of the crops to Dual were evaluated by visual ratings taken over a period of time from crop emergence until July 28. On July 28, the crops were roto-tilled to kill the plants to dispose of the crop residues to prepare the field for a repeat study in 1989-1990. The study will continue through the 1991 crop year (three years) to evaluate the effectiveness of Dual in reducing field populations of yellow nutsedge under continued use during normal crop rotation.

In November of 1989, applications of Dual were repeated for the second year study. Herbicide treatments were applied in the fall using the same procedure described for 1988. The plowed land was bedded in 1989 and fall wheat (Stephens) and peppermint were planted. Crops for planting in the spring of 1990 will include: sugar beets, onions, dry beans, alfalfa, sweet corn and spring wheat of the Bliss variety.

Results

All crops emerged through all rates of Dual without any symptoms of herbicide injury. The crops were irrigated for seed germination, thus Dual was highly activated with the irrigation. Symptoms normally associated with Dual injury to sugar beets include stand loss after emergence with chlorosis and bleaching to leaves of newly emerged plants. Stand loss or chlorotic symptoms did not occur to sugar beets or other crops at any stage of growth. Selectivity to crops is generated by soil dilution when plowing Dual down. Applications of Dual to the soil surface with shallow incorporation would be lethal, not only to sugar beets but also to onions, alfalfa and wheat.

Essentially all of the yellow nutsedge was controlled with Dual at the six and eight pound ai/acre rate. An occasional nutsedge plant emerged but died soon after emergence before nutlets or seeds were produced. The control of nutsedge was less effective at the three and four pound ai/acre rates (Table 1). Yellow nutsedge did not grow in the wheat, Bliss variety, plots with or without an application of Dual. Bliss variety and maybe other varieties of wheat evidently are producing or excreting toxins from its roots that are phytotoxic to yellow nutsedge. This phenomena is not uncommon among plants in the gramineae family. A thesis study is now underway with a graduate student in the horticulture department at Oregon State University studying the allelopathic effects of different varieties of wheat to yellow nutsedge.

Table 1. Percent control of yellow nutsedge and tolerance of five different crops to four rates of metolachor plowdown in the fall. Nyssa, Oregon, 1989.

Herbicide	Rates	Sweet Corn				Sugar Beets				Onions				Alfalfa				Spring Wheat				Yellow Nutsedge			
		Crop Injury and Yellow Nutsedge Control																							
		1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
	lbs ai/ac	%																							
Metolachlor	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	65	70	75	70
Metolachlor	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	88	85	85	86
Metolachlor	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	98	100	96	98
Metolachlor	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	99	99	99
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

final evaluation: July 1989

Note: Dual (Metolachlor) is registered for use in potatoes, corn, and beans. Refer to Dual labels for registered applications.

USING CROP CANOPY TEMPERATURES TO EVALUATE WATER STRESS

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Oregon State University
Ontario, Oregon, 1989

Introduction

When a crop is well watered, the soil water reserve is high and the plant water content is usually high, barring rot or vascular disease. Plants at high water status have relatively higher transpiration of water from the leaves to the atmosphere. The water transpiration causes evaporative cooling of the crop canopy. A well watered crop has relatively cool foliage.

When water supplies are reduced, plants encounter more difficulty maintaining their water status. Water is held more tightly as stomata close. As transpiration rates decline, evaporative cooling also declines. In bright sunlight the crop becomes detectably hotter than the same crop under well watered conditions.

Recent advances in infrared thermometers have allowed expanded uses of infrared (IR) guns. Infrared can readily be used to detect the temperature of a distant object, such as a hot spot in a potato storage or hot and cool places in a crop canopy. We will discuss the interpretation of canopy temperatures and the usefulness of canopy temperature information.

IR Integration with Other Devices

Crop canopy temperature varies not only with plant water status. It also varies with air temperature, solar intensity, relative humidity, wind speed, and other factors. For an instrument to be useful, enough variables need to be measured, or held relatively constant to get meaningful relationships. The integration of IR thermometer measurements of crop canopy temperatures with air temperature and relative humidity measurements is accomplished by a computer in the IR gun.

Crop Canopy Baselines

As the air becomes drier and drier, the potential for evaporative cooling through plant transpiration increases. If we have a well watered crop, the crop has the potential to be using water at the maximal rate. The maximum canopy cooling effect is measured as a change in temperature (T) as a function of the scarcity of water in the atmosphere. The scarcity of water in the atmosphere is called the water vapor pressure deficit (VPD). The VPD variable takes into account relative humidity and temperature. A maximum cooling curve for sugar beets, at Ontario Oregon, is presented in (Figure 1). The vertical axis of Figure 1 is the difference between the leaf temperature and the air temperature. If we are at zero on the curve, the air and the leaf are at the same temperature.

A graph of maximal canopy temperature can also be made. Under intense sunlight and severe water stress the stomata are closed. Maximal heating of the canopy occurs. A graph of maximal canopy heating is an upper boundary of plant canopy temperatures (Figure 1). Of course, in the field it is possible to observe measurements above the maximum crop canopy temperature by aiming an infrared gun and at hot bare soil. Such a hot spot is not part of the plant canopy.

Crop Water Stress Index

The region between maximum canopy cooling and maximum canopy heating can be arbitrarily divided into a crop water stress index (Figure 2). Water stress index numbers often go from 0 to 1 or from 0 to 10. The scale of 0 to 10 is used in this discussion for simplicity. The crop water stress index (CWSI) is

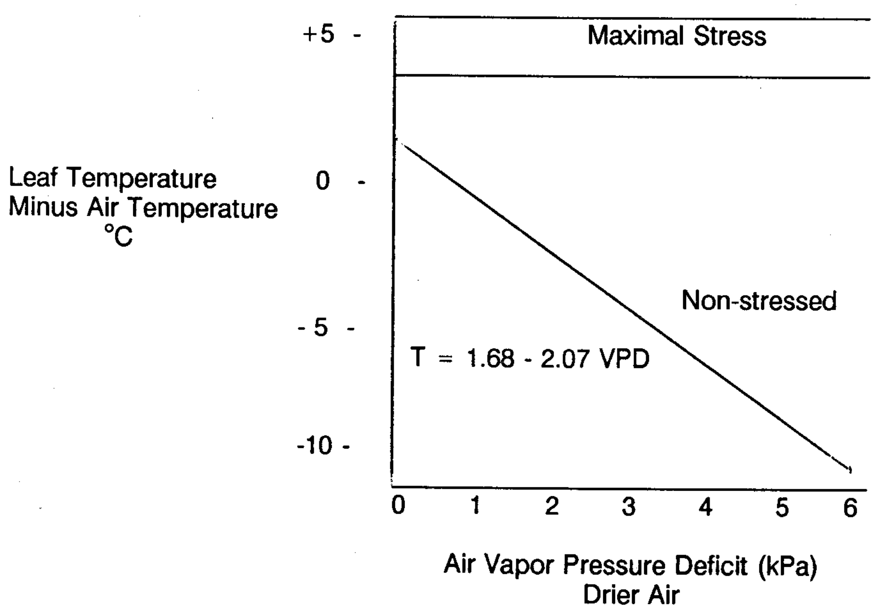

Figure 1. Maximally stressed and non-stressed baselines for canopy cooling of sugar beets Malheur Experiment Station, OSU, Ontario, Oregon, 1987 and 1988.

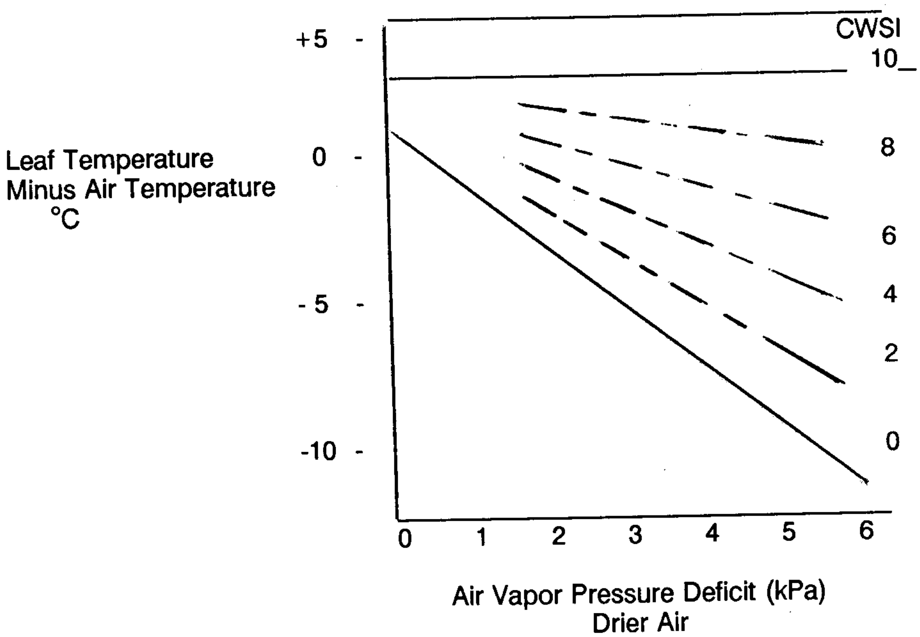

Figure 2. Crop water stress indices for sugar beets, Malheur Experiment Station, OSU, Ontario, Oregon, 1987 and 1988.

extent to which the crop is failing to cool itself through evaporative cooling. When the CWSI is equal to zero, the crop is cool and when the CWSI reading is 8, the crop is extremely hot. Visible wilting occurs with different crops between CWSI of 5 and 10. For example potatoes and sugar beets start to wilt in the middle of the CWSI range while alfalfa wilts higher, and sage brush would wilt near 10. Of course, each crop also has its own baseline curves, and corresponding CWSI relationship.

Crop Examples

Several crop examples are considered; potatoes, sugar beets, and alfalfa seed. These examples are chosen because they demonstrate different degrees of crop susceptibility to water stress and different uses of CWSI information generated with an infrared gun.

A. Potatoes

Potatoes are very sensitive to water stress. Water stress during tuber growth rapidly leads to a loss in tuber grade and internal tuber quality. Longer durations of water stress may lead to crop loss. Although growers intend to maintain their entire potato fields in well watered condition, it is sometimes difficult to check whether or not entire fields are well watered. Scheduled readings of CWSI can readily detect if parts of a field are hotter than other parts. Hot spots in potato fields are usually associated with poor soil water status or root disease. CWSI indices may be a helpful diagnostic tool to locate hot spots.

In trials with a range of applied water from 100% ET to substantial deficiencies, crop canopy temperatures reflected soil water conditions. As CWSI values increased, crop yield declined, tuber specific gravity declined, and the average tuber stem-end fry color became darker. In addition to the declines in yield and internal quality, market grade deteriorated rapidly with increased CWSI (Figure 3). Potatoes are clearly a crop where CWSI must be minimized. Irrigation must be managed to minimize stress on the crop. Even slight deviations from well watered conditions can lead to losses of yield, grade, and internal quality.

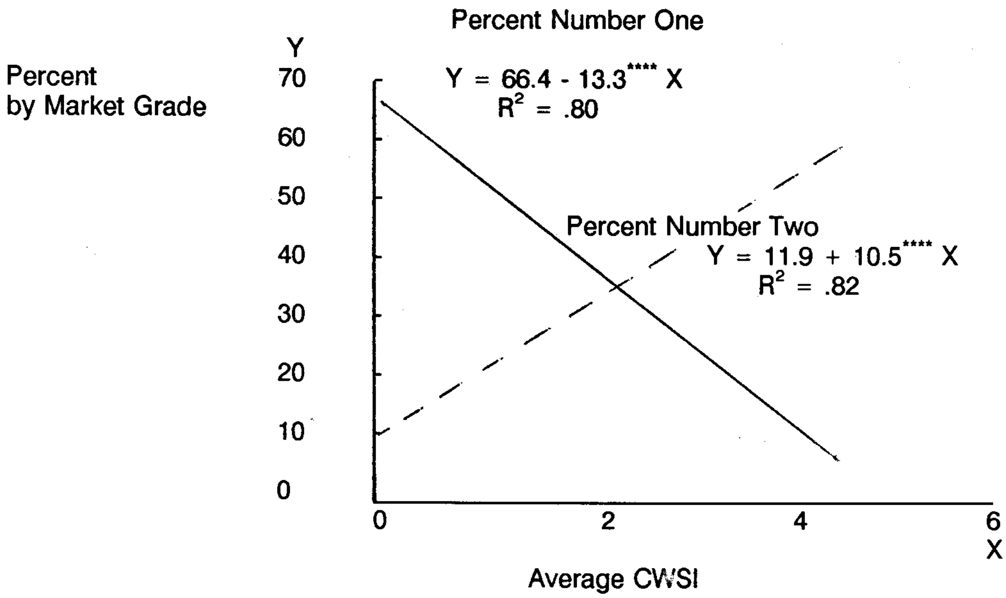

Figure 3. Relationship between Russet Burbank market grade and average crop water stress index, Malheur Experimental Station, OSU, Ontario, Oregon, 1987 and 1988.

B. Sugar Beets

Sugar beets present an example of a crop with greater tolerance to water stress and deeper rooting than potatoes. Sugar beets are very sensitive to plant stand losses and final yield losses if stressed for water while the crop is being formed. Once the canopy has closed over the soil, the crop is not nearly as sensitive to water stress.

In a field trial in 1988 sugar beets were grown under five irrigation criteria (Table 1). All treatments received five 12-hour irrigations from planting until the end of June and one 10-hour irrigation to soften the ground before harvest for a total of 70 hours of furrow irrigation. All irrigations during the season were exclusively in the rows that were compacted by wheel traffic - every other row. The well watered check treatment was watered whenever the soil averaged drier than -0.7 bars, resulting in an additional 100 hours of furrow irrigation during the season. Beets with irrigation criteria of CWSI = 1, CWSI =3, and CWSI = 5 were only watered when the plant canopy in their respective plots reached CWSI = 1, 3, and 5 respectively. Irrigation requirements were 44 hours, 18 hours, and 11 hours above the basic 70 hours and recoverable sugar decreased 5, 8, and 11 percent. When the conservation of irrigation water is needed, large savings may be possible with only moderate losses in total recoverable sugar.

During the 1987 season, regression analyses showed no relationship between July stress and recoverable sugar. In 1988, moderating irrigations during July by only watering with the CWSI = 5 and returning to a well watered condition after July saved 14% of the irrigation water with no loss in recoverable sugar (Table 1).

Table 1. Sugar beet response to irrigation treatments, 1988, Malheur Experiment Station, OSU, Ontario, Oregon.

Treatment	Irrigation hours*	Yield t/ac	Sucrose %	Sugar lb/ac
1. Soil water -0.7 bars	170	38.1	16.6	10390
2. CWSI = 1	114	38.3	15.7	9850
3. CWSI = 3	88	37.9	15.4	9600
4. CWSI = 5	81	35.5	15.8	9300
5. CWSI = 5 only for July	146	37.9	16.6	10300
LSD(.05)	-	1.8	0.6	370

*Based on the hours of irrigation in wheel traffic furrows.

C. Alfalfa Seed

Alfalfa is a very deeply rooted crop that may or may not be using water from deep in the soil profile. Plant use of deep water cannot be conveniently measured using soil probes or other soil water measuring devices.

Alfalfa seed is an example of a crop where water stress is positively associated with seed yields (Figure 4). Of course, water stress cannot be carried to the point of burning up the crop. When CWSI values are taken on alfalfa seed, the areas with the highest CWSI values are associated with higher seed yield. Each time the crop is watered, CWSI values fall. Considering, the association of CWSI patterns with seed yields, patterns that have prolonged low CWSI values between bud stage and seed set are associated with low yields (Figure 5). Low CWSI is associated with high vegetation growth. High CWSI patterns over time are associated with high seed yields.

CWSI patterns suggest that irrigations should be delayed as much as possible. CWSI patterns also suggest that irrigations should be as superficial as feasible so that stress is only partially relieved.

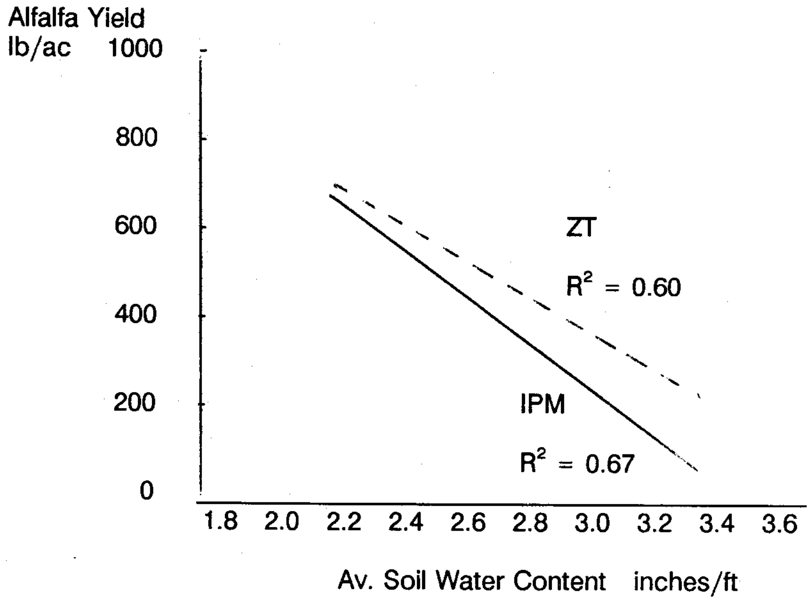

Figure 4. Relationship between the average soil water content (second foot of soil) and Wrangler alfalfa seed yields with zero tolerance and integrated pest management insect control practices. The soil water was averaged during bloom and seed fill. Malheur Experiment Station, OSU, Ontario, Oregon, 1988.

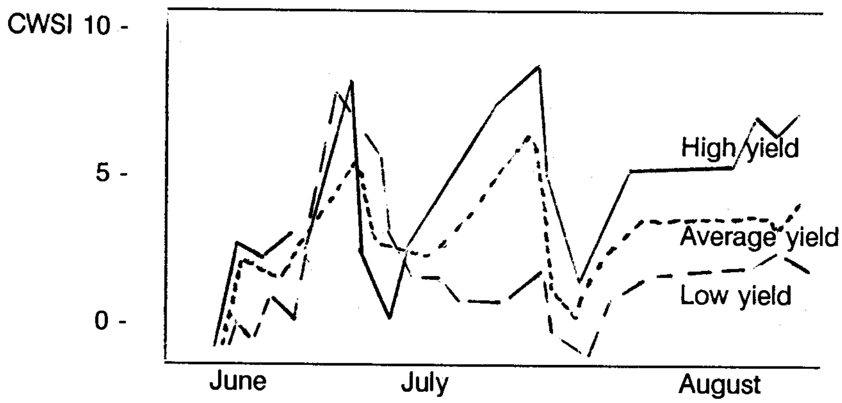

Figure 5. CWSI patterns and associated alfalfa seed yields, 1987. Malheur Experiment Station, OSU, Ontario, Oregon.

D. Comparison of Crops

This brief discussion of the use of infrared gun information has placed emphasis on three contrasting uses. With potatoes, canopy temperatures and CWSI values are useful as an insurance tool to make sure all parts of the field remain cool. If parts of the field are heating, the producer can intervene to determine the cause and correct irrigation management where needed.

In the case of sugar beets, once a well developed crop canopy is formed, CWSI or crop canopy information can be used to conserve irrigation water when necessary. The depth of the useable root zone and the amount of water stored in the lower part of the root zone are important factors in the success of conserving irrigation water. Without CWSI values, it would be difficult to know when deep soil water was no longer adequate or not available to the plant.

The case of alfalfa seed reverses the use of the infrared gun. High CWSI values in the range of 5 to 8 are most closely associated with high yields. Irrigations need to be deferred with a reduced application rate to maintain stress that favors seed production over vegetative growth.

These three crops represent contrasting practical applications of infrared guns. The gun is not a replacement for other key measurements of soil water nor a substitution for good judgment when irrigating according to proven relationships. Rather it is a valuable tool to assist in irrigation management decisions.

Field Operations

During the last three years, infrared gun observations have been made at the Malheur Experiment Station of OSU at Ontario, Oregon. A list of instructions has been developed that is of general use to anyone using a gun.

A. Planning observations

1. Determine a logical sequence of fields. Make measurements in logical parts of each field including

   a. Well watered areas,
   b. Areas where soil water is regularly monitored,and
   c. Areas where problems may occur.

2. Plan how data will be recorded or unloaded onto a computer (optional).

B. Prepare to take readings

1. Make sure the batteries are freshly recharged.

2. Clean the lens.

3. Let the gun equilibrate to the air temperature where it will be used. Otherwise the gun will read an incorrect air temperature and calculate bogus CWSI values.

C. Field conditions

Proper environmental conditions help assure proper readings.

1. Take readings near solar noon. The sun may be nearly straight overhead near 1 p.m. If so, 12 to 2 p.m. would be the best time for readings.

2. Take readings only in bright sunshine.

3. Low wind speed contributes to accurate readings.

4. Foliage must be dry, lacking moisture from previous irrigations or rain showers.

D. Method to make readings

1. Stand inside the field. Readings made while walking down a road or from a pickup compare crop canopy temperatures with air that is not above the crop. The relationships between crop temperature and air temperature are not accurate.

2. Keep the sun at your back and aim the gun directly away from the sun. Otherwise canopy temperature will register too cool.

3. Hold the gun three feet above the canopy. Consistency leads to comparable results.

4. Aim the gun 30 feet from you into the crop. Avoid hitting soil (often too hot) or the sky (often too cold) or distant objects (many temperatures) with your aim.

5. Aim at least 2 seconds before you pull the trigger.

6. Make multiple measurements, 10 to 20 readings per location. These multiple measurements take only a few seconds and the infrared gun will average the readings automatically.

Consistent methods of preparation and field readings will lead to more valuable field observations.