Horticultural Weed Control Report

2003 and 2004

Web downloads

Ed Peachey, Senior Research Assistant
Horticultural Weed Science
Phone: 541-737-3152
Peacheye@science.oregonstate.edu

Ray D. William, Extension Horticultural Weed Specialist
Phone: 541-737-5441
Williamr@ science.oregonstate.edu

Lee Ann Julson
Extension Secretary

Not intended or authorized for publication

Contributors

Susan Aldrich-Markham	Yamhill Co. Extension, McMinnville
Chris Boerboom	Univ. of Wisconsin, Madison
Glenn Fisher	Extension Entomologist, OSU
Diane Kaufman	NWREC, Aurora, OR
Gina Koskela	NWREC, Aurora, OR
Judy Kowalski	NWREC, Aurora, OR
Robin Ludy	Research Assistant, Botany & Plant Pathology Dept., OSU
Carol Smith	Professor of Weed Science, Crop and Soil Science Dept., OSU
Dan McGrath	Marion County Extension, Salem, OR
Bob McReynolds	Dist. Ext. Agent, NWREC, Aurora, OR
James R. Myers	Baggett-Frazier Professor of Vegetable Breeding and Genetics, Horticulture Dept., OSU
Cindy Ocamb	Pathologist, Botany and Plant Pathology
Mary Powelson	Botany and Plant Pathology, OSU
David Rupp	Bioresource Engineering, OSU
John Selker	Bioresource Engineering, OSU
Alex Stone	Horticulture, OSU
Jon Umble	Graduate Student, Entomology
Ray D. William	Extension Horticultural Weed Specialist, OSU

Special thanks to these cooperators and facilitators
Jim Ammon, Wilbur Ellis, Jefferson
Corey Antrim, Antrim Farms
Jim Belden, Stayton
Roger Fitts, Independence
Randy Hopson, OSU Vegetable Res. Farm Manager.
Clifford Horning, Horning Farms, Monroe
Doug Kuenzi, Wilbur Ellis, Jefferson
Sam Sweeney, Dayton

Many thanks to student and summer workers
Daniel Rackham
Martin Histand

Financial Support or Supplies for this Research Provided by:
Agriculture Research Foundation, Corvallis, OR
BASF
Dow Agro Sciences
Oregon Processed Vegetable Commission
Western Region IPM Project, USDA
National Frozen Foods
NORPAC
Syngenta

TABLE OF CONTENTS

Weed Biology

Vegetables

Small Fruits

Water Quality

Other

The Report

Results from vegetation management trials involving horticultural crops conducted during the past year are compiled and reported by faculty members of the Oregon Agricultural Experiment Station, the Oregon State Extension Service, and colleagues who cooperated from adjacent states along with local enterprises. This work was conducted throughout Oregon and involved many individuals.

The contributors sincerely appreciate the cooperative efforts of the many growers, university employees, and local representatives of the production and agrochemical industries. We also gratefully acknowledge financial assistance from individual growers, grower organizations, and companies that contributed to this work.

Information and Evaluation

Crops were grown at the experimental farms using accepted cultural practices (within the limits of experimentation) or trials were conducted on growers' fields. Most experiments were designed as randomized complete blocks with three to five replications. Herbicide treatments were applied uniformly with CO_2 precision plot sprayers. Unless otherwise indicated, preplant herbicide applications were incorporated with a PTO vertical tine rotary tiller operated at a depth of approximately two inches. After critical application stages, crops were irrigated with overhead sprinklers at weekly intervals or as needed.

Crop and weed responses are primarily visual evaluations of growth reduction, ranging from 0-100 percent with 100 as the maximum response for each rating. Phytotoxicity ratings are usually 1-10 with 10 being severe herbicide injury symptoms such as chlorosis or leaf deformation. Additional data such as crop yields are reported for some studies and may be reported in either English or metric systems.

Abbreviations

DAP	Days after planting
WBP	Weeks before planting
WAP	Weeks after planting
WAT	Weeks after treatment
PRE/PES	Preemergence herbicide application/preemergence surface
PPS	Post-plant surface
PPI	Preplant incorporated herbicide application
lb/A	Active ingredient per acre
no./A	Number per acre

Developing an Integrated Management Tool to Predict Hairy Nightshade Growth in Snap Beans

E. Peachey, Horticulture Department

Summary

- Hairy nightshade (HNS) removal for 3 weeks after planting (WAP) eliminated berry production in all plantings except the 2nd planting in both years of the study.
- Four weeks of removal was needed when beans were planted on May 21, 2003 and May 19, 2004 to eliminate berry production.
- Plants flowered slower in early plantings but degree day requirements did not differ significantly for the time to first flower.
- HNS seedlings that emerged from May 20 to June 3 had the greatest potential to produce berries that could significantly impact crop quality.

Introduction

Raptor herbicide effectively controls weeds in snap beans; tolerance is acceptable and weed control is very good. Disadvantages of using Raptor are cost and crop rotation restrictions. Raptor controls black and hairy nightshade (HNS) very well, but in some cases, Raptor may not be needed because nightshade may have emerged too late to produce berries or seeds. The difficulty is predicting when Raptor is needed based on the potential for nightshade berry production. The objective of this study was to determine when intervention with postemergence herbicides or cultivation would preclude hairy nightshade berry or seed production.

Procedures

Snap beans were planted every two weeks beginning on May 7 and May 4 in 2003 and 2004, respectively. Treflan was applied and incorporated before snap beans were planted to eliminate grasses and broadleaves, but allow emergence of hairy nightshade. Within each planting, five treatments were applied to plots with four replications. Treatments included removal of HNS seedlings until 2, 3, 4 and 5 weeks after planting, and a treatment without HNS removal. Removal of seedlings at these intervals allowed determination of the potential of HNS to produce berries or seeds after the four different planting dates. For example, seedlings that emerged 2 weeks after planting represent seedlings that would have emerged after a cultivation or postemergence herbicide applied at 2 WAP. After the seedling removal period was complete, the first emerged seedling was flagged and all other competitors removed for the duration of the crop. Seedlings were located in the middle 1/3 of the area between 30 inch bean rows. When snap beans reached 55 - 60% 1 - 4 sieve beans by weight, HNS plants were pulled,

Table 1. Snap bean sieve sizes and conversions.

Sieve size	Bean diameter	
	1/64”	mm
1	< 14.5	< 5.8
2	14.5 - 18.5	5.8 - 7.3
3	18.5 - 21	7.3 - 8.3
4	21 - 24	8.3 - 9.5
5	24 - 27	9.5 - 10.7
6	27 - 30	10.7 - 11.9
7	30 - >	11.9 - >

weighed, and berries stripped. Berries were weighed and graded according to snap bean sieve sizes (Table 1). Seeds were extracted from 1 - 2 berries of each size class for each harvested plant, counted and stored at 35 F for 4 months. Seed germination potential was tested 4-5 months later. Temperature was measured at the top of the snap bean canopy and data used to predict the number of degree days (base 40 F) needed for nightshade to produce berries.

Results

Days to Flowering. The number of days to development of a fully opened flower differed slightly between years and ranged from 37 to 48 days depending on the planting date (Table 2). The length of time was longer for the earlier planting dates.

Degree days to flowering. The number of degree days (DD) to first flower differed depending on year and planting ($F_{1,3}$= 3.4; P=0.03, year x planting date; Figure 1) and ranged from 459 in 2004 to 541 F in 2003. The inconsistency between the two years was primarily due to the difference in degree days required to produce a flower in the first planting (Figure 1). Increasing the removal period increased the degree day requirements to first flower (Table 3), but this estimate was confounded by different emergence dates.

Table 2. Effect of year and planting date to first flower.

Year	Planting date	Obs.	Days to flower Mean	SE
2003	1	4	48	0.5
2003	2	4	42	0.0
2003	3	4	38	1.8
2003	4	4	36	0.0
2004	1	7	46	0.2
2004	2	8	46	0.7
2004	3	8	40	0.6
2004	4	8	37	0.5

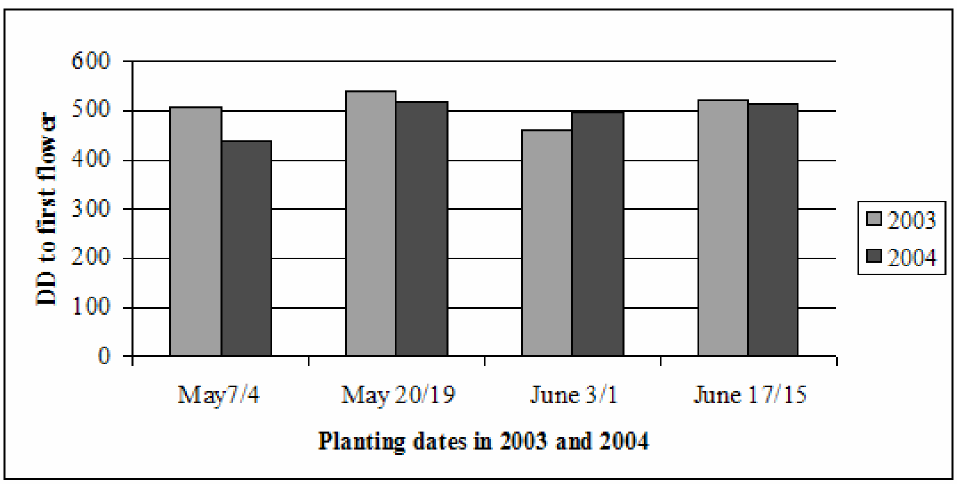

Figure 1. Effect of planting date on degree days to first flower in 2003 and 2004. F=3.4; P=0.03 for year x planting effect (0 weeks of removal only). Number of observations was 4 in 2003 and 8 in 2004.

Table 3. Effect of removal period on degree days to flower and 5 mm berry production.

Removal period	First flower		Berry with 5mm diameter	
	Obs.	Degree days	Obs.	Degree days
No removal after planting	47	498 b	47	683 a
2 weeks of removal	42	506 b	32	690 a
3 weeks of removal	10	586 a	2	684 a

DD to 5 mm berry. Data for the degree days needed to produce a 5 mm berry were pooled across the 0-3 week removal periods because: 1) there was only a slight indication of an interaction between planting date and removal period ($F = 2.6$; $P = 0.06$); 2) the effect of planting date was highly significant ($F = 8.4$; $P < 0.0001$); and 3) there was no effect of removal period on DD needed to produce a 5 mm berry (Table 3).

There was no difference between years for the number of DD required to produce a 5 mm berry ($P = 0.40$). When averaged over years and planting dates, 698 DD were required in 2003 and 679 required in 2004 to produce a 5mm berry, an average of 685 DD. However, the number of degree days needed to produce a 5mm berry differed slightly between years and planting dates ($F = 3.7$; $P = 0.02$) (Figure 2). Fewer degree days were required at the first planting to produce a 5 mm berry than at the second, third, or fourth plantings.

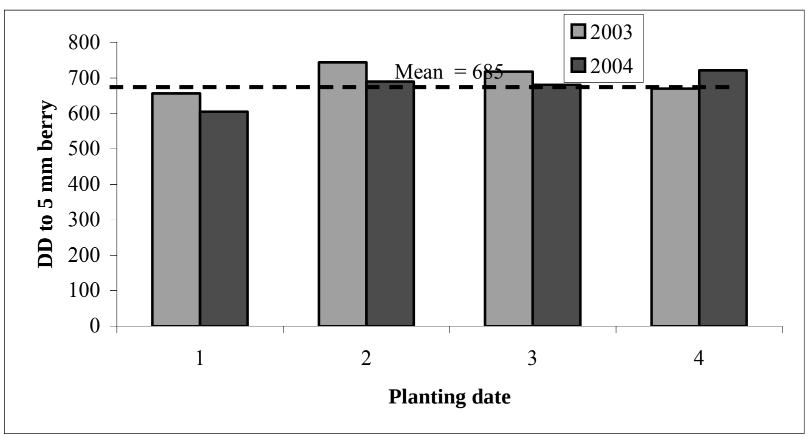

Figure 2. Effect of planting date and year on the number of degree days needed to produce a 5 mm berry.

Berry production. Removal period was the primary factor influencing berry production ($F = 56$, $P = 0.0001$) with a slight interaction between years ($F = 5.4$, $P = 0.01$). Berry production averaged 230, 25, and 0.4 berries per plant for the 0, 2, and 3 week removal treatments, respectively (Fig. 3). A similar trend was noted for berries that exceeded sieve size 2 ($F = 63$, $P < 0.0001$ for effect of removal period; $F=3.7$, $P = 0.0067$ for interaction effect between year and removal period). However, 2 sieve berries were not produced if HNS was removed from plots for 3 weeks in 2004 (Fig. 4).

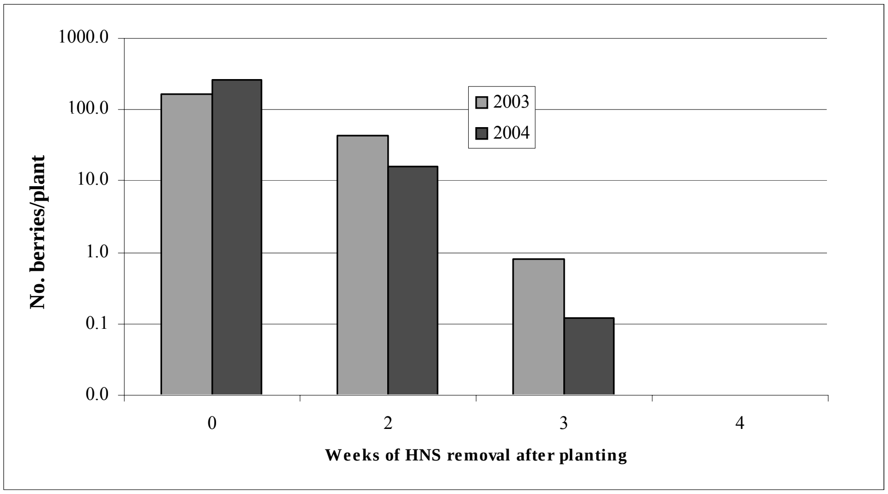

Figure 3. Effect of removal period on total number of HNS berries produced at harvest. Note logarithmic scale.

Figure 4. Effect of removal period on total number of HNS berries ≥ sieve size 2 produced at harvest. Note logarithmic scale.

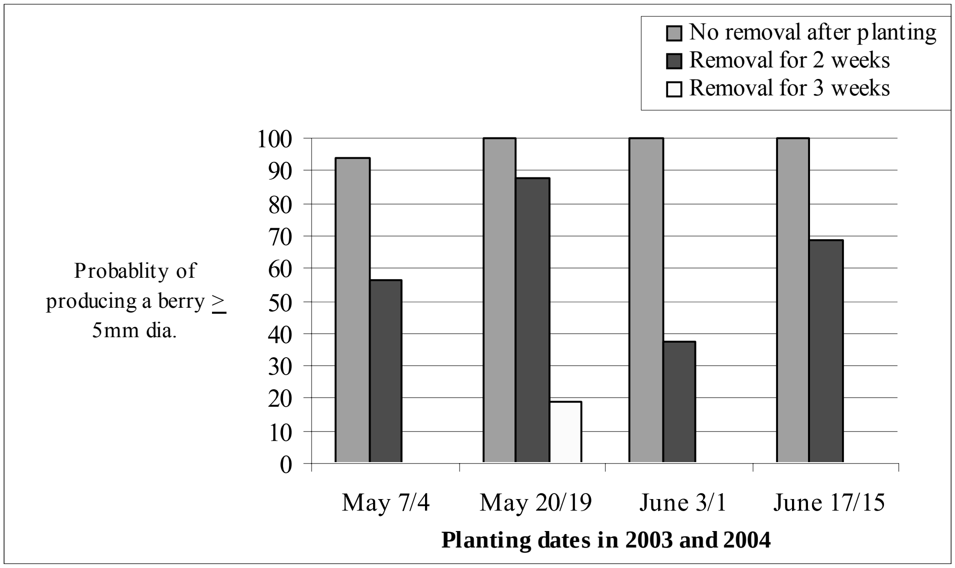

Figure 5. Effect of planting date and removal period on the probability of producing a berry ≥ 5 mm in diameter. Data are average of two years.

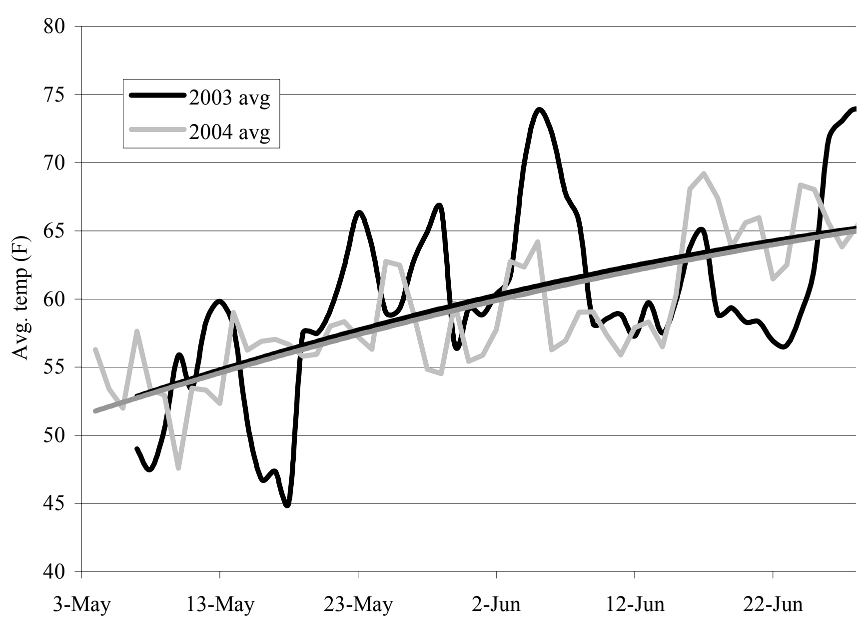

Figure 6. Average temp ((max+min)/2) and trend lines for the first 6 weeks after planting in 2003 and 2004.

Influence of Tillage System on Hairy Nightshade Recruitment and Seed Germination, Mortality, and Dormancy

R. Edward Peachey and Carol Mallory-Smith,
Horticulture and Crop and Soil Science, OSU

Abstract. Seedling recruitment of hairy nightshade is significantly reduced if crops are notill planted rather than conventionally planted, but the cause is unknown. Primary dormancy in hairy nightshade seeds is very high when seeds are first removed from berries. Slower dissipation of primary dormancy of seeds buried near the soil surface during the winter may explain differences in recruitment between conventional (CT) and notillage (NT) systems. The alternative hypothesis is that burial of seeds during winter near the soil surface increases seed mortality, and because this is the zone of emergence for seeds in notillage systems, seedling recruitment is reduced.

Projects conducted from 2001-2004 measured: 1) seedling recruitment in two tillage systems; and 2) the effect of winter burial depth, winter rainfall and near-surface soil temperature on seed germination potential, mortality, and seed dormancy. Seeds were placed in soil tubes at 1 cm below the soil line, and then the soil tubes were buried so that seeds rested at 1, 6, 13, and 25 cm below the field soil surface. Tubes were removed from the field in the spring and placed in a controlled environment with a linear temperature gradient from 22.7 to 36.0 C. Seeds also were extracted from soil in the soil tubes to determine germination potential, mortality, and seed dormancy.

Hairy nightshade seedling recruitment at 30.7 C was more than 15 times greater for seeds buried at 6, 13 and 25 cm than when buried at 1 cm in simulated notill. Recruitment potential was low in March and April but increased to a maximum in May and June. Germination rates for seeds buried at 1 cm were lower and mortality and dormancy greater than for seeds buried from 6 to 25 cm during the winter.

Protecting the seeds buried at 1 cm from rainfall during the winter increased seedling recruitment from 0 to 2 of 10 buried seeds, but had a negligible effect on seed mortality and dormancy. Soil density was negatively correlated with recruitment. Treatment of seeds buried at 25 cm with 1 cm soil temperature reduced recruitment from 4.8 to 2.3 of 10 seeds at 33.3 C, but did not significantly increase seed mortality or dormancy.

Seed dormancy and mortality probably reduced recruitment for seeds buried at 1 cm in NT, but a larger factor was regulating recruitment. Inconsistencies between the recruitment and germination data indicated that recovery of seeds from the soil concealed recruitment trends attributable to the dissipation of primary dormancy, and that seed dormancy did not dissipate consistently during spring.

Factors Controlling Emergence Potential of Wild Proso Millet

E. Peachey, Horticulture Dept., OSU

A preliminary study was initiated in 2002 to determine what factors are most important for regulating WPM emergence. Seeds were buried in October of 2002 in small test tubes under ½ inch of soil, then tubes buried in the soil so that the seeds rested at ½, 5, and 10 inches deep in the soil. In addition, one set of tubes was buried near the soil surface and covered with a Plexiglas 'tent' so that rain would not fall on the soil. The tubes were extracted in spring and placed in receptacles on a germination table with temperatures ranging from 73 to 97 degrees F. Emergence was measured over the course of 14 days. Additionally, seeds were extracted from randomly selected tubes and seeds germinated in Petri dishes to determine what effect burial depth had on seed survival.

Emergence of seeds in April approached 30% of the seeds that were buried at 10 inches, but was less for seeds buried at 5 and 0.5 inches (Fig. 1). Emergence was less when seeds were tested in July, with one exception. Seeds that were covered during the winter had a high level of emergence even though they were buried near the soil surface during winter. There were no significant differences in the number of seeds that remained viable during the winter.

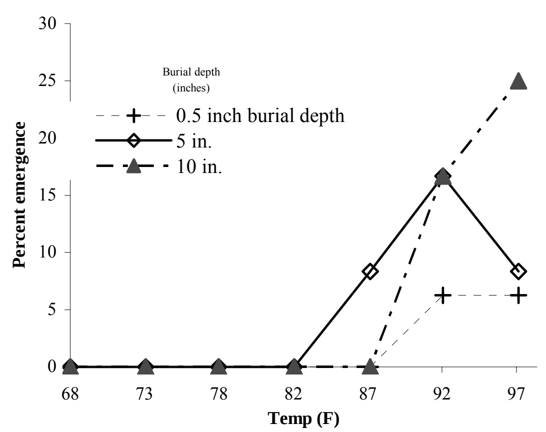

Figure 1. Effect of burial depth on emergence of wild proso millet after 14 days at specified temperature. Seeds tubes were excavated on April 25, 2003.

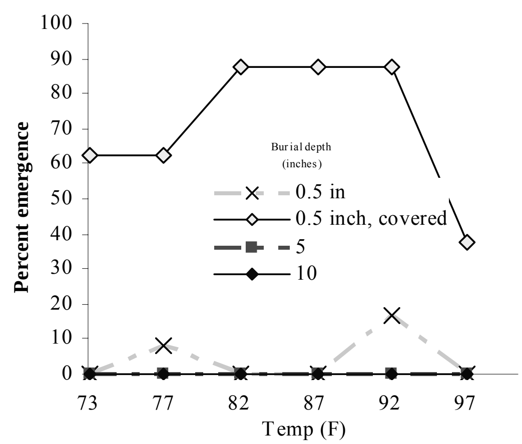

Figure 2. Effect of burial depth on emergence of wild proso millet after 14 days at specified temperatures. Seeds tubes were excavated on July 15, 2003. 'Covered' seeds were buried at the soil surface but a Plexiglas tent prevented rainfall from striking the soil surface. Note difference in scale to Fig. 1.

Weed Control in Table Beets

2004

Ed Peachey, Horticulture Department, OSU

The main objective of this experiment was to determine the potential of using Dual Magnum herbicide for weed control in table beets. Secondary objectives were to evaluate the potential of using Upbeet, Betanex, and Betamix as sequential micro-rate applications.

Methods

Field experiments were placed at a site near Jefferson and at the OSU Vegetable Research Farm. Weed control was the main objective at the Jefferson site, while crop tolerance to Dual Magnum herbicide under wet soil conditions was the primary objective at the research farm.

At Jefferson, PPI herbicides were applied on April 27 and incorporated within 2 minutes with a 16 inch disk. Beets were planted on 18 inch rows on April 29 and PPS (post-plant surface) treatments applied the next day. Plots were 4 rows wide with 24 inches between beds and 30 ft long. Herbicides were incorporated with irrigation water shortly after planting. POST1-3 treatments were applied at the cotyledon, 2-leaf, or 4-leaf stage depending on treatment. Crop injury was evaluated at 4 and 5 WAP, and weed control at 5 WAP and at harvest. Beets were harvested on August 12 from one 2.5 m section of each row in the middle of the plot, graded, and weighed. A field day was held on June 16.

At Corvallis, the soil was a silt loam with an OM content of 4.91% and a CEC of 21.5 meq/100g of soil. Granular fertilizer (435 Lbs 12-29-10) and Roneet herbicide (4pts/A) were broadcast on May 12. The soil was tilled within 5-10 minutes after the Roneet application. Table beets were planted on May 17 with a Gaspardo vacuum precision planter with a 2” spacing between seedlings. Plots were 32’ long and four rows wide with 18” between rows and 2’ between the outside rows of each plot. Additional fertilizer (260 lbs 12-29-10) was dribbled on the surface between rows at planting. Rain (0.42 inches) fell on May 18 one day after planting. Preemergence herbicides were applied on May 19 to very wet soil. Pyramin was applied to all plots to help reduce weed competition with the crop. Irrigation (0.6 in.) was applied on May 20 to incorporate the PES herbicides. The plots were kept relatively wet through the early season to maximize potential effects of Dual Magnum on beet growth. Another 1.20 in. of irrigation water was applied on June 3 following application of the EPOST herbicides on June 1, and 1.01 in. of rain fell from June 6 to June 10. POST herbicides of Spinaid and Aim were applied on June 12 to 4-leaf seedlings. Stand counts were made on June 14 from 6.5 ft of row. Growth reduction estimates due to herbicides were made on June 11 and 23. Beets were harvested on July 30 from 8.2’ of one middle row in each plot. Tops were removed and beets were graded to size as follows: <1” dia.; Grade 1 (1-1 5/8”); Grade 2 (1 5/8-2 5/8”); Grade 3 (2 5/8 - 3.5”); and > 3.5”.

Results

Jefferson (Tables 1-4, Figures 1 and 2). Weed control estimates at harvest accounted for approximately 60% of the yield variability. Dual Magnum PPS alone did not provide adequate control (Table 1), even though crop yield was significantly greater than the check treatment

(Table 2). Dual Magnum applied PPS with Roneet or Roneet + Pyramin treatments significantly improved weed control compared to either Roneet or Pyramin applied singly.

Crop injury was greatest when Aim herbicide was applied. The split application of Dual Magnum did not improve yield compared to the check. Dual Magnum applied with Roneet or both Roneet and Pyramin significantly improved yield compared to Roneet or Roneet + Pyramin.

Field day participants were given 2 votes to rate treatments and rated the following treatments as promising: Treatments 3 (2 votes), 4 (4votes), 5 (1), 18 (1), 19 (1), 23 (1), 26 (1), 30 (2), and 34 (4).

The sequential applications of Betanex, Betamix, and Spinaid following Pyramin or Dual PES provided reasonable weed control and yields. The cost of most treatments was high because of the excessive cost of Pyramin, Spinaid, Betamix, and Betanex. Treatments with Roneet and Dual Magnum would be the most reasonable but were not tested in this experiment. A major point of justification for this research was to find a replacement for Roneet, which is unsettled in the marketplace at this point. If Roneet is unavailable, Dual Magnum plus sequential applications of Upbeet and Spinaid would reduce the cost and amount of herbicides and allow an integrated approach to weed control.

Corvallis (Tables 5 and 6, Figure 3). Stunting of beet growth from Dual Magnum was significant at rates of 0.64 lbs ai/A or above through June 11, but only at 0.96 lbs ai/A on June 23. The effect of Dual Magnum on beet growth was much less when the herbicide was applied EPOST. Stunting was severe with all rates and timings of Outlook herbicide.

Crop yield averaged 22.4 t/A in the check plots. Hand weeding was not needed in any of the plots because Roneet and Pyramin controlled weeds exceptionally well. Crops yields with Dual Magnum applied PES at 0.32 to 0.96 lbs ai/A were statistically equivalent to the untreated check. However, the application of Dual Magnum at 0.96 lbs ai/A reduced the percentage of beets in the combined size class of 1 and 2 from 80 to 60 %, an indication of fewer but larger beets (Figure 3B). The cause for the lower than expected yield of 19.1 t/A in Tr. 1 is unclear. A yield reduction was not expected, even at this very low rate of herbicide (0.32 lbs ai/A) because few if any weeds survived the Roneet and Pyramin applications.

Growing conditions at this site mimicked wet spring conditions that are often encountered in Oregon. Dual Magnum applied PES and EPOST had little to no effect on crop yield at this site at anticipated label rates.

Table 1. Treatment effects on table beet growth and weeds, Jefferson, OR 2004.

Treatments		Timing	POST application dates			Rate	Crop Response						Weed control			
							20-May	30-May		4-Jun		29-Jun	24-June			
			Coty	*2 leaf*	*4 leaf*		Emergence	Phyto	Stunting	Phyto	Stunting	Stunting	Pigweed	Lambs-quarters	Hairy nightshade	Total
						lb ai/A	no/3ft	0-10	%	0-10	%	%	------------------- % ----------------			
1	Roneet	PPI				3.000	47	0	5	1	3	11	53	74	81	53
2	Roneet	PPI				3.000	36	0	6	0	6	3	99	98	100	99
	Pyramin	PPS				3.250										
3	Roneet	PPI				3.000	38	0	29	0	23	10	99	99	99	99
	Pyramin	PPS				3.250										
	Dual Mag	PPS				0.638										
4	Roneet	PPI				3.000	37	0	13	0	10	5	100	100	100	100
	Pyramin	PPS				3.250										
	Dual Mag	POST	*14-May*			0.638										
5	Roneet	PPI				3.000	45	1	13	1	13	0	100	100	100	100
	Pyramin	PPS				3.250										
	Spin aid	POST		*20-May*	*31-May*	0.488										
6	Roneet	PPI				3.000	45	0	24	1	19	5	100	100	100	100
	Pyramin	PPS				3.250										
	Betanex	POST	*14-May*	*20-May*	*31-May*	0.244										
7	Roneet	PPI				3.000	47	0	18	0	20	8	100	100	100	100
	Pyramin	PPS				3.250										
	Betamix	POST	*14-May*	*20-May*	*31-May*	0.244										
8	Roneet	PPI				3.000	46	0	13	0	10	4	100	100	100	100
	Pyramin	PPS				3.250										
	Betamix	POST	*14-May*	*20-May*	*31-May*	0.081										
	Upbeet	POST	*14-May*	*20-May*	*31-May*	0.004										
	MSO		*14-May*	*20-May*	*31-May*	1.5%										
9	Roneet	PPI				3.000	38	3	75	1	58	10	100	100	100	100
	Pyramin	PPS				3.250										
	Upbeet	POST	*14-May*			0.004										
	Aim	POST	*14-May*			0.003										
	MSO	POST	*14-May*			1.5%										
10	Roneet	PPI				3.000	51	5	50	2	43	5	100	100	100	100
	Pyramin	PPS				3.250										
	Spin-Aid	POST	*14-May*	*20-May*		0.244										
	Aim	POST		*20-May*		0.003										

Continued on next page

Table 1. Treatment effects on table beet growth and weeds, Jefferson, OR 2004.

Treatments		Timing	POST application dates			Rate	Crop Response						Weed control			
							20-May	30-May		4-Jun		29-Jun	24-June			
			Coty	2 leaf	4 leaf		Emergence	Phyto	Stunting	Phyto	Stunting	Stunting	Pigweed	Lambs-quarters	Hairy nightshade	Total
						lb ai/A	no/3ft	0-10	%	0-10	%	%	%	%	%	%
11	Roneet	PPI				3.000	39	2	45	0	35	3	100	100	100	100
	Pyramin	PPS				3.250										
	Stinger	POST	*14-May*	*20-May*		0.062										
	Aim	POST		*20-May*		0.003										
12	Roneet	PPI				3.000	44	0	9	0	9	0	97	98	99	97
	Pyramin	PPS				3.250										
	Stinger	POST			*31-May*	0.188										
13	Roneet	PPI				3.000	42	0	14	2	10	13	99	85	98	99
	Pyramin	PPS				3.250										
	Nortron	PPS				1.625										
14	Pyramin	PPS				3.250	47	0	0	1	0	8	30	40	55	30
15	Pyramin	PPS				3.250	41	0	13	0	9	10	97	95	100	97
	Dual Mag	PPS				0.638										
16	Pyramin	PPS				3.250	36	0	1	0	6	21	43	63	74	43
	Dual Mag	POST	*14-May*			0.638										
17	Pyramin	PPS				3.250	48	0	16	0	9	15	85	97	100	85
	Spin-Aid	POST		*20-May*	*31-May*	0.488										
18	Pyramin	PPS				3.250	33	0	18	0	8	5	100	100	100	100
	Betanex	POST	*14-May*	*20-May*	*31-May*	0.244										
19	Pyramin	PPS				3.250	43	0	13	0	11	3	100	100	100	100
	Betamix	POST	*14-May*	*20-May*	*31-May*	0.244										
20	Pyramin	PPS				3.250	45	0	19	0	20	8	100	100	100	100
	Betamix	POST	*14-May*	*20-May*	*31-May*	0.081										
	Upbeet	POST	*14-May*	*20-May*	*31-May*	0.004										
	MSO		*14-May*	*20-May*	*31-May*	0.015										
21	Dual Mag	PPS				0.638	40	0	3	0	3	8	88	96	80	88
22	Dual Mag	PPS				0.319	37	0	10	0	8	13	64	56	43	64
	Dual Mag	POST	*14-May*			0.319										
23	Dual Mag	PPS				0.638	37	0	23	0	21	8	100	100	100	100
	Spin-Aid	POST		*20-May*	*31-May*	0.488										
24	Dual Mag	PPS				0.638	46	0	19	0	11	3	96	99	99	96
	Betanex	POST	*14-May*	*20-May*	*31-May*	0.244										

Continued on next page

Table 1. Treatment effects on table beet growth and weeds, Jefferson, OR 2004.

Treatments		Timing	POST application dates			Rate	Crop Response						Weed control			
							20-May	30-May		4-Jun		29-Jun	24-June			
			Coty	2 leaf	4 leaf		Emergence	Phyto	Stunting	Phyto	Stunting	Stunting	Pigweed	Lambs-quarters	Hairy nightshade	Total
						lb ai/A	no/3ft	0-10	%	0-10	%	%	------------------- % ----------------			
25	Dual Mag	PPS				0.638	47	0	15	0	13	3	100	100	100	100
	Betamix	POST	*14-May*	*20-May*	*31-May*	0.244										
26	Dual Mag	PPS				0.638	40	0	15	2	10	6	100	100	100	100
	Betamix	POST	*14-May*	*20-May*	*31-May*	0.081										
	Upbeet	POST	*14-May*	*20-May*	*31-May*	0.004										
	MSO		*14-May*	*20-May*	*31-May*	0.015										
27	Pyramin	PPS				3.250	43	0	4	0	6	15	95	70	91	95
	Dual Mag	PPS				0.314										
28	Pyramin	PPS				3.250	40	0	18	0	15	5	99	93	94	99
	Dual Mag	PPS				0.953										
29	Pyramin	PPS				3.250	45	0	15	0	13	3	99	97	97	99
	Dual Mag	PPS				1.267										
30	Pyramin	PPS				3.250	47	0	8	0	13	23	25	43	55	25
	Dual Mag	POST	*14-May*			0.314										
31	Pyramin	PPS				3.250	45	0	4	0	4	18	33	66	68	33
	Dual Mag	POST	*14-May*			0.953										
32	Pyramin	PPS				3.250	46	0	13	0	13	13	61	69	84	61
	Dual Mag	POST	*14-May*			1.267										
33	Betamix	POST	*14-May*	*20-May*	*31-May*	0.081	49	0	11	0	10	0	100	100	100	100
	Upbeet	POST	*14-May*	*20-May*	*31-May*	0.004										
	MSO		*14-May*	*20-May*	*31-May*	0.015										
34	Betamix	POST	*14-May*	*20-May*	*31-May*	0.081	46	0	14	0	13	3	100	100	100	100
	Upbeet	POST	*14-May*	*20-May*	*31-May*	0.004										
	Stinger		*14-May*	*20-May*	*31-May*	0.062										
	MSO		*14-May*	*20-May*	*31-May*	0.015										
35-1	Spin-Aid	POST			*31-May*	0.244	44	0	0	0	0	8	80	94	94	80
	Aim	POST			*31-May*	0.003										
35-2	Check				*31-May*	0.000	50	0	0	6	0	15	0	0	0	0
36	Weeded Check					0.000		0	0	0	0	0	-	-	-	-
FPLSD (0.05)							NS	0.5	12	1	12	10	18	25	21	18

Table 2. Treatment effects on yield of table beets, Jefferson, OR 2004.

Treatments		Timing	POST application dates			Rate	Cost	Yield		Grade		Weed control at harvest			
			Coty	*2 leaf*	*4 leaf*			Mean	SD	Mean	SD	Pigweed	Hairy nightshade	Lambs-quarters	Total
							$/A	---t/A---		-----% # 1---		---%---			
1	Roneet	PPI				3.000	26	11.6	4.5	29	7	18	18	0	15
2	Roneet	PPI	=Preplant incorporated			3.000	109	15.6	1.3	21	5	86	95	64	69
	Pyramin	PPS	=Post plant surface			3.250									
3	Roneet	PPI				3.000	118	18.0	3.6	16	2	96	96	69	90
	Pyramin	PPS				3.250									
	Dual Mag	PPS				0.64									
4	Roneet	PPI				3.000	118	20.3	2.6	24	11	91	93	96	88
	Pyramin	PPS				3.250									
	Dual Mag	POST	14-May			0.64									
5	Roneet	PPI				3.000	166	21.7	4.4	16	4	94	96	100	94
	Pyramin	PPS				3.250									
	Spin aid	POST		20-May	31-May	0.488									
6	Roneet	PPI				3.000	171	21.7	6.6	14	2	100	98	99	98
	Pyramin	PPS				3.250									
	Betanex	POST	14-May	20-May	31-May	0.244									
7	Roneet	PPI				3.000	171	19.1	6.0	17	12	99	100	100	98
	Pyramin	PPS				3.250									
	Betamix	POST	14-May	20-May	31-May	0.244									
8	Roneet	PPI				3.000	153	20.4	3.7	20	4	100	100	95	98
	Pyramin	PPS				3.250									
	Betamix	POST	14-May	20-May	31-May	0.081									
	Upbeet	POST	14-May	20-May	31-May	0.0039									
	MSO		14-May	20-May	31-May										
9	Roneet	PPI				3.000	133	18.2	2.7	17	5	94	92	69	85
	Pyramin	PPS				3.250									
	Upbeet	POST	14-May			0.0039									
	Aim	POST	14-May			0.003									
	MSO	POST	14-May												
10	Roneet	PPI				3.000	138	15.5	1.6	21	7	93	81	92	78
	Pyramin	PPS				3.250									
	Spin-Aid	POST	14-May	20-May		0.244									
	Aim	POST		20-May		0.003									
11	Roneet	PPI				3.000	131	24.3	4.4	14	2	96	81	84	79
	Pyramin	PPS				3.250									
	Stinger	POST	14-May	20-May		0.062									
	Aim	POST		20-May		0.003									

Continued on next page

Table 2. Treatment effects on yield of table beets, Jefferson, OR 2004.

Treatments		Timing	POST application dates			Rate	Cost	Yield		Grade		Weed control at harvest			
			Coty	*2 leaf*	*4 leaf*			Mean	SD	Mean	SD	Pigweed	Hairy nightshade	Lambs-quarters	Total
							$/A	---t/A---		-----% # 1---		----------------------------%---------------------------			
12	Roneet	PPI				3.000	141	20.1	2.4	15	5	78	90	92	75
	Pyramin	PPS				3.250									
	Stinger	POST			31-May	0.1875									
13	Roneet	PPI				3.000	152	20.6	5.3	23	12	95	88	94	90
	Pyramin	PPS				3.250									
	Nortron	PPS				1.625									
14	Pyramin	PPS				3.250	83	8.2	3.1	39	10	0	18	0	13
15	Pyramin	PPS				3.250	92	19.1	5.8	17	5	94	45	70	53
	Dual Mag	PPS				0.64									
16	Pyramin	PPS				3.250	92	8.5	3.0	37	6	0	0	13	0
	Dual Mag	POST	14-May			0.64									
17	Pyramin	PPS				3.250	140	13.1	5.5	24	3	20	69	65	28
	Spin-Aid	POST		20-May	31-May	0.488									
18	Pyramin	PPS				3.250	145	20.9	4.3	24	7	99	98	100	96
	Betanex	POST	14-May	20-May	31-May	0.244									
19	Pyramin	PPS				3.250	145	23.0	3.4	15	1	99	96	100	96
	Betamix	POST	14-May	20-May	31-May	0.244									
20	Pyramin	PPS				3.250	104	20.5	2.4	20	6	95	94	98	95
	Betamix	POST	14-May	20-May	31-May	0.081									
	Upbeet	POST	14-May	20-May	31-May	0.0039									
	MSO		14-May	20-May	31-May	1.5%									
21	Dual Mag	PPS				0.64	9	13.9	4.4	24	10	80	25	33	28
22	Dual Mag	PPS				0.32	9	7.3	3.1	38	7	51	0	0	8
	Dual Mag	POST	14-May			0.32									
23	Dual Mag	PPS				0.64	66	17.0	3.3	19	6	95	96	100	94
	Spin-Aid	POST		20-May	31-May	0.488									
24	Dual Mag	PPS				0.64	71	20.7	1.8	18	4	100	89	100	93
	Betanex	POST	14-May	20-May	31-May	0.244									
25	Dual Mag	PPS				0.64	71	20.2	5.2	16	5	100	95	100	94
	Betamix	POST	14-May	20-May	31-May	0.244									
26	Dual Mag	PPS				0.64	53	23.1	3.7	15	4	98	93	91	90
	Betamix	POST	14-May	20-May	31-May	0.081									
	Upbeet	POST	14-May	20-May	31-May	0.0039									
	MSO		14-May	20-May	31-May	1.5%									

Continued on next page

Table 2. Treatment effects on yield of table beets, Jefferson, OR 2004.

Treatments		Timing	POST application dates			Rate	Cost	Yield		Grade		Weed control at harvest			
			Coty	*2 leaf*	*4 leaf*			Mean	SD	Mean	SD	Pigweed	Hairy nightshade	Lambs-quarters	Total
							$/A	---t/A---		-----% # 1---		---------------%	---------------		
27	Pyramin	PPS				3.250	87	17.0	3.7	19	7	58	25	33	33
	Dual Mag	PPS				0.31									
28	Pyramin	PPS				3.250	96	17.7	5.2	21	7	93	45	86	59
	Dual Mag	PPS				0.95									
29	Pyramin	PPS				3.250	100	16.6	3.0	19	7	84	79	63	58
	Dual Mag	PPS				1.27									
30	Pyramin	PPS				3.250	87	5.5	1.4	44	11	0	0	0	0
	Dual Mag	POST	14-May			0.31									
31	Pyramin	PPS				3.250	96	8.0	4.2	35	7	17	17	32	13
	Dual Mag	POST	14-May			0.95									
32	Pyramin	PPS				3.250	100	12.5	2.9	31	11	24	20	30	28
	Dual Mag	POST	14-May			1.27									
33	Betamix	POST	14-May	20-May	31-May	0.081	44	17.7	5.5	18	3	83	85	88	81
	Upbeet	POST	14-May	20-May	31-May	0.0039									
	MSO		14-May	20-May	31-May	1.5%									
34	Betamix	POST	14-May	20-May	31-May	0.081	76	22.3	4.8	15	10	98	100	99	95
	Upbeet	POST	14-May	20-May	31-May	0.0039									
	Stinger		14-May	20-May	31-May	0.062									
	MSO		14-May	20-May	31-May	1.5%									
35-1	Spin-Aid	POST			31-May	0.244	58	6.5	3.7	42	8	89	40	90	50
	Aim	POST			31-May	0.003									
35-2	Check				31-May	0	0	5.9	3.4	44	8	27	23	35	0
36	Weeded Check					0	0	16.1	5.2	29	15	0	0	0	0
FPLSD (0.05)								5.6		11		22	25	32	19

Table 3. Summary table for Dual Magnum effects on weed control and yield, Jefferson, OR 2004.

Treatment		Timing	Rate	Crop response						Weed control at harvest	Yield	Grade
				20-May	30-May		4-Jun		29-Jun			
				Emer.	P	GR	P	GR	GR			
			lb ai/A	no/3ft	0-10	%	0-10	%	0-10	%	t/A	% # 1
Standard treatments												
1	Roneet	PPI	3.00	47	0	5	1	3	11	15	11.6	29
2	Roneet Pyramin	PPI PPS	3.00 3.25	36	0	6	0	6	3	69	15.6	21
Dual Magnum efficacy												
21	Dual Mag	PPS	0.64	40	0	3	0	3	8	28	13.9	24
22	Dual Mag Dual Mag	PPS POST	0.32 0.32	37	0	10	0	8	13	8	7.3	38
Dual Magnum PPS with Pyramin only												
27	Pyramin Dual Mag	PPS PPS	3.25 0.32	43	0	4	0	6	15	33	17.0	19
15	Pyramin Dual Mag	PPS PPS	3.25 0.64	41	0	13	0	9	10	53	19.1	17
28	Pyramin Dual Mag	PPS PPS	3.25 0.96	40	0	18	0	15	5	59	17.7	21
29	Pyramin Dual Mag	PPS PPS	3.25 1.28	45	0	15	0	13	3	58	16.6	19
Dual Magnum PPS with Roneet and Pyramin												
3	Roneet Pyramin Dual Mag	PPI PPS PPS	3.00 3.25 0.64	38	0	29	0	23	10	90	18.0	16
4	Roneet Pyramin Dual Mag	PPI PPS POST	3.00 3.25 0.64	37	0	13	0	10	5	88	19.1	17
Dual Magnum POST with Pyramin												
30	Pyramin Dual Mag	PPS POST	3.25 0.32	47	0	8	0	13	23	0	5.5	44
16	Pyramin Dual Mag	PPS POST	3.25 0.64	36	0	1	0	6	21	0	8.5	37
31	Pyramin Dual Mag	PPS POST	3.25 0.96	45	0	4	0	4	18	13	8.0	35
32	Pyramin Dual Mag	PPS POST	3.25 1.28	46	0	13	0	13	13	28	12.5	31
Check plots												
35-2	Unweeded		-	50	0	0	6	0	15	0	5.9	44
36	Weeded check		-	-	0	0	0	0	0	-	16.1	29
FPLSD (0.05)				ns	0.5	12	1	12	10	19	6	11

Table 4. Site description and herbicide application data, Jefferson, OR 2004.

Site characteristics

Plot size/exp. design	6.5 x 30	4 reps	RCBD
Proceeding crop	Sweet corn		

Herbicide application data

Date	4/27/04	4/30/04	5/14/2004	5/20/2004	5/30/2004
Crop stage		Planted on 4-29	cotyledon, true leaves emerging	2 true leaves	4 leaf
Weeds			Lambsquarters, hairy nightshade, pigweed, all max. 1-2 true leaves		4" weeds in check plots
Application timing	PPI	PPS	EPOST	EPOST2	EPOST3
Start/end time	10-11 A	6-10 A	11-3 P	6:30-8 A	6:30 -8 A
Air temp/soil temp (2")/surface	74/78/83	72/62/76	71/81/87	53/55/54	61//59/59
Rel. humidity	50%	75%	62%	92	90%
Wind direction/velocity	0-2 N	0	all, 1-3	0	<0
Cloud cover	0	0	50-30	0	70%
Soil moisture	good	dry on surface	dry on surface	dry on surface	nearly dry on surface
Plant moisture	-	-	dry	heavy dew	no dew, nearly dry
Sprayer/PSI	BP/30/4 nozzles	BP/30/3 nozzles	BP/30/3 nozzles	BP/30/3 nozzles	BP/30/3 nozzles
Mix size	2100	2100/8 plots	2100/8 plots	2100/8 plots	2100/8 plots
Gallons H20/acre	30	20	20	20	20
Nozzle type	8002	8002	8002	8002	8002
Nozzle spacing and height	20/18	20/18	20/18	20/18	20/18
Soil inc. method/implement	16” disk		rain on 5-18 should have incorporated Dual		

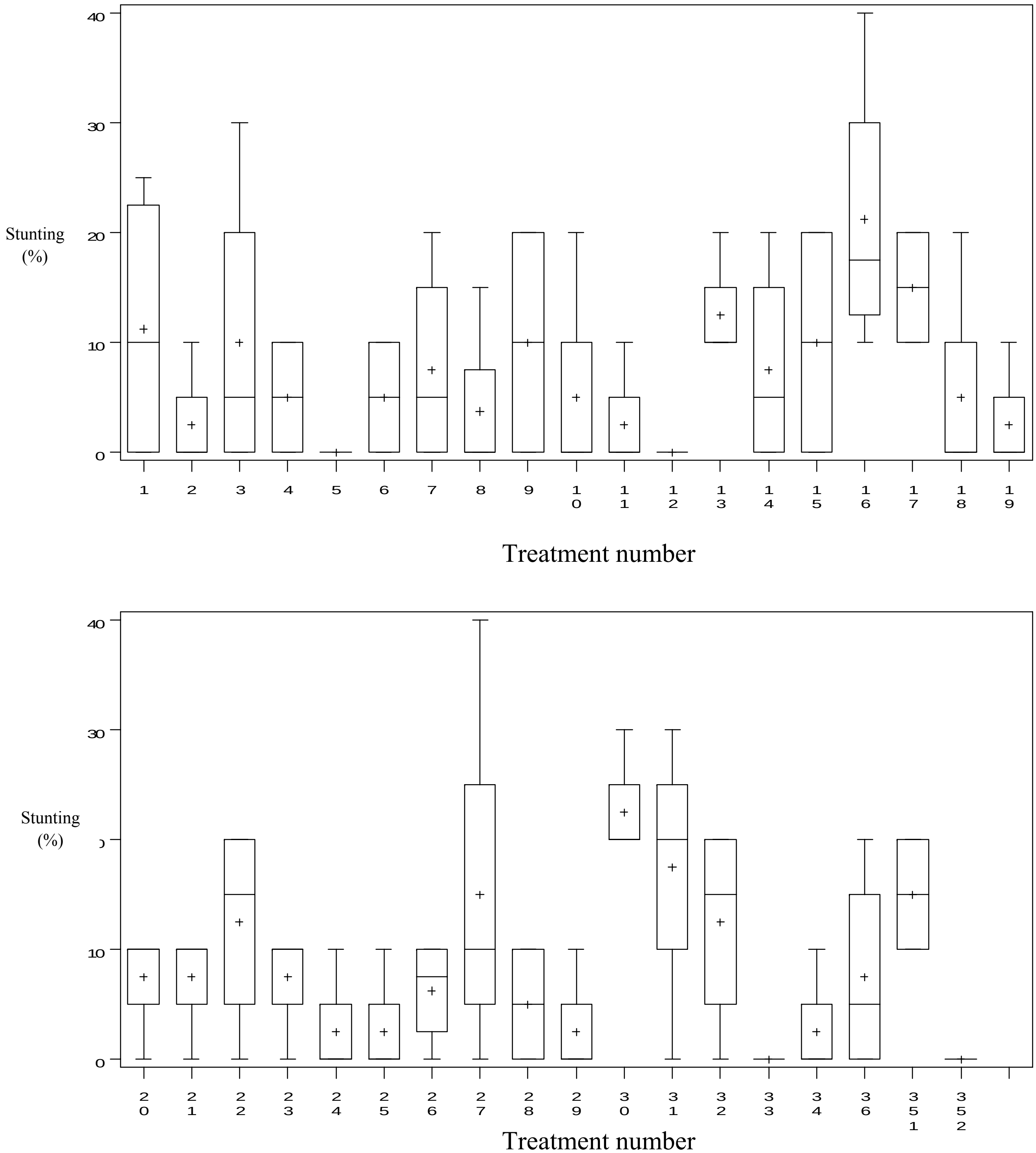

Figure 1. Box and whisker diagram for treatment effects on stunting of table beets on June 29, 2004 (2 months after planting). Mean (+), median (center line), and range (upper and lower slash marks).

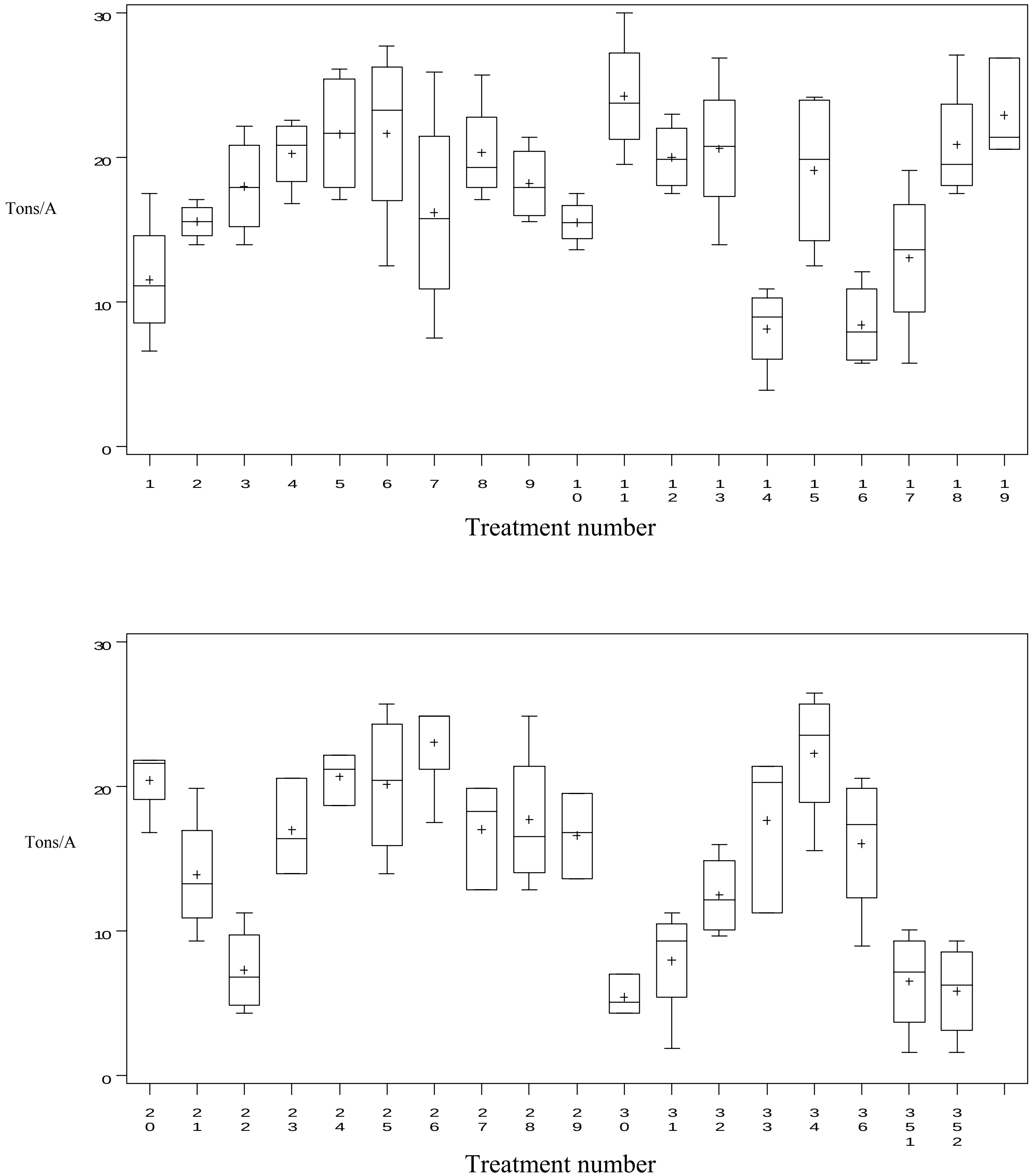

Figure 2. Box and whisker diagram for treatment effects on table beet yield variability. Mean (+), median (center line), and range (upper and lower slash marks).

Table 5. Table beet tolerance to herbicides, Corvallis, 2004.

	Herbicide	Timing	Rate	Obs.	Stand count	Crop injury assessment				Harvest	
						11-Jun-04		23-Jun-04			
						Stunting	Phyto	Stunting	Phyto	Yield	Grade
			lbs ai/A		no/3 ft	%	1-10	%	1-10	t/a	% 1-2
1	Dual Magnum	PES	0.32	4	32	3	0	3	0.3	19.1	88
2	Dual Magnum	PES	0.64	4	33	14	0	8	0.0	21.1	83
3	Dual Magnum	PES	0.96	4	28	33	3	30	0.0	21.4	60
4	Dual Magnum	EPOST	0.32	4	33	0	0	0	0.0	20.2	82
5	Dual Magnum	EPOST	0.64	4	32	10	0	8	0.8	21.3	86
6	Dual Magnum	EPOST	0.96	4	36	14	0	10	0.0	21.8	79
7	Outlook	PES	0.54	4	28	58	1	48	0.0	20.2	58
8	Outlook	PES	1.08	4	12	94	2	86	0.0	14.0	38
9	Outlook	EPOST	0.54	4	31	23	1	15	0.0	20.1	82
10	Outlook	EPOST	1.08	4	36	38	2	25	0.0	19.8	79
11	Spinaid/Aim	POST	0.16/0.003	4	32	0	0	45	5.0	16.6	80
12	Spinaid	POST	0.65	3	37	0	0	3	0.0	21.9	84
13	Check	-	0	8	36	0	0	0	0	22.4	80
	FPLSD $_{(0.05)}$				8	12	ns	13	0.9	4.1	11

Table 6. Schedule and herbicide application data.

Site characteristics

Plot size/exp. Design	6.5*32	4 reps	RCBD	
Proceeding crop	Broccoli			
Soil test	pH 4.8	OM 4.91% LOI	CEC 21.5 meq/100 gr soil	

Herbicide application data

Date	May 12, 2004	May 19, 2004	1-Jun	12-Jun
Crop stage		Planted on may 17	Cotyledon, first true leaves visible	4th leaf emerging, 3.5 inches max ht.
Weeds				
Herbicide/treatment	Roneet	PES including Pyramin on all plots	EPOST Dual M and Outlook	POST
Application timing	PPI	PES	EPOST	POST
Start/end time	2-2:30 PM	6:30-8:30 A	6:30-7A	9:45-9:45A
Air temp/soil temp (2")/surface	62	58/58 /62	54/56/53	65/65/67
Rel humidity		80%	76%	80%
Wind direction/velocity	W 2-4	E 0-1	0	W 1-4 S
Cloud cover	0	100	0	50%
Soil moisture	damp	very wet, rain 0.5" on 5-18	Dry	damp
Plant moisture	-	-		no dew
Sprayer/PSI	Farm tractor 30PSI	Backpack 30 PSI	Backpack 30 PSI	Backpack 30 PSI
Mix size	25gal	2100 mls for non-Pryamin treatments, 3 gal for Pyramin	2100 mls	2100
Gallons H20/acre	30GPA	20 GPA	20 GPA	20 GPA
Nozzle type	8002	8002	8002	8002
Nozzle spacing and height	10"	20/18	20/18	20/18
Soil inc. method/implement	Incorporated within 5 to 10 minutes with roterra set on H with new tines	Irrigation	-	-

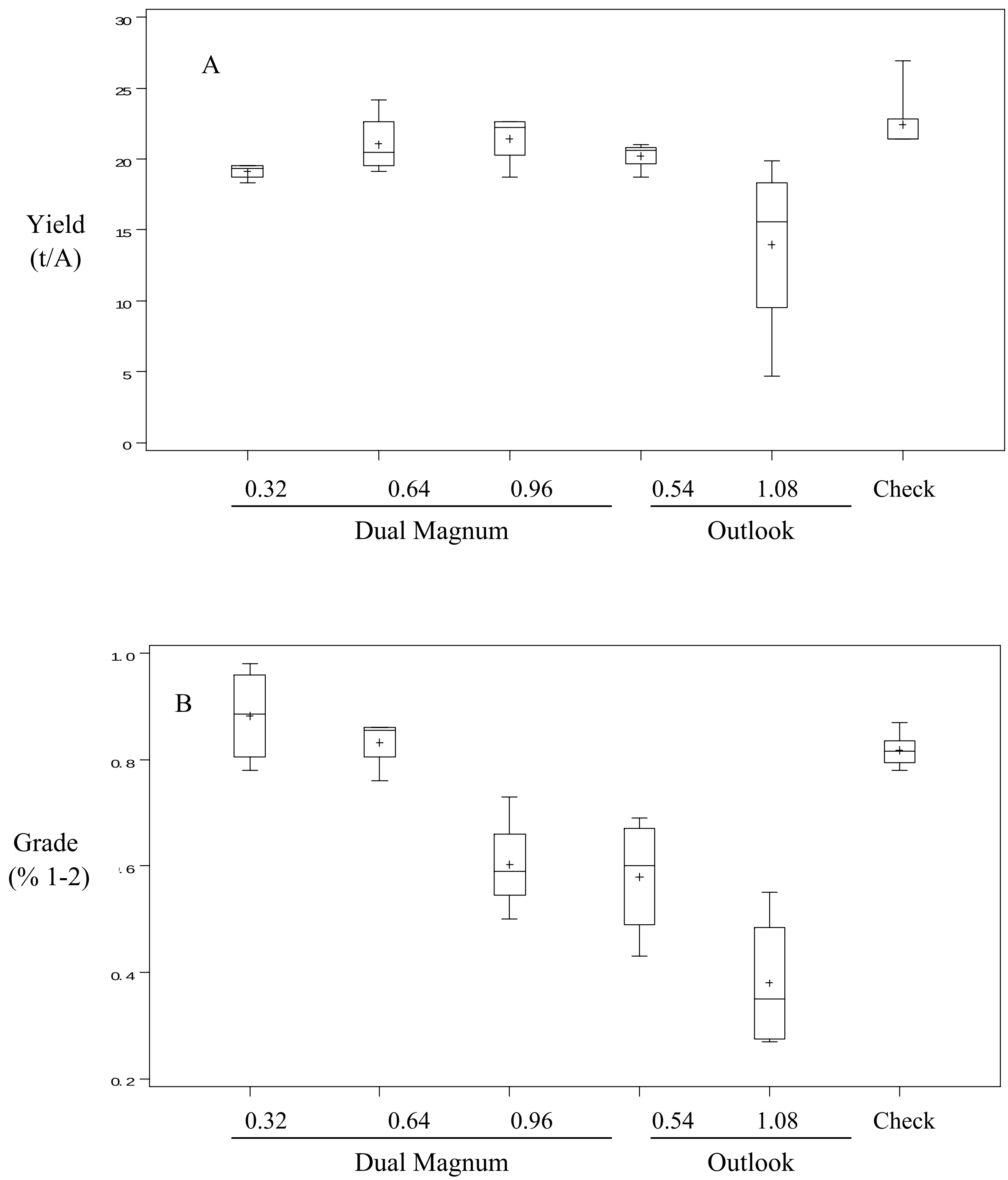

Figure 3. Effect of Dual Magnum and Outlook herbicides applied PES on table beet yield (A) and grade (B), Corvallis, 2004.

Weed Control in Broccoli with Goal 2XL, Goal 4F, and Goal Impregnated Fertilizer

2003

Ed Peachey, Horticulture Department, Oregon State University, Corvallis OR

Objective

Compare potential of Goal impregnated fertilizer and Goal 2XL and 4F formulations applied postemergence for nightshade control in direct-seeded broccoli.

Methods

Weed control in broccoli with Goal herbicide was evaluated at the OSU Vegetable Research Farm near Corvallis, OR, in 2003. Fertilizer was broadcast (800 lbs/A 12-29-10) and incorporated to 6 inches with a rototiller. Treflan (1 pt/A) and Lorsban (1 qt/A) were applied the following day and shallow incorporated with a vertical tine tiller. Broccoli was planted on May 24, 2003 with a Gaspardo vacuum precision planter with four rows per bed and a 12 inch spacing between rows. Four varieties were planted on the four rows: Excelsior, Emerald Pride, Premium Crop, and Monte Cristo. Devrinol was applied to the check plot after planting. Irrigation was applied 2 days later to incorporate the herbicide.

The first impregnated fertilizer treatment was applied on June 11 to broccoli with one full true leaf extended and the second leaf emerging. Irrigation (0.5 inches) was applied within 24 hours after the Goal impregnated fertilizer was applied. The second application was on June 18 to 3-leaf broccoli. The Goal 2XL and 4F treatments were applied to 3-leaf broccoli on June 20. Plots were treated with thiodan on June 26 for diamondback and cabbage looper control.

Weed control was evaluated at midseason and again at harvest, along with crop tolerance. Broccoli was harvested twice from the 16.4 ft of the row planted with the variety Premium Crop.

Results and discussion

The use of Treflan controlled nearly all of the broadleaves expect nightshade and smartweed. Nightshade growth was extremely vigorous. Broccoli emergence differed among the four varieties, probably due to low germination in some of the seed. Premium Crop had the most vigorous and uniform emergence.

The postemergence Goal 2XL and 4F treatments gave phytotoxicity ratings that were higher than normally accepted by growers. However, Goal 4F caused less injury than the 2XL formulation. Goal impregnated fertilizer caused more injury when applied to 1.5-leaf broccoli than has been observed in past years, but still yielded more than any other treatment. The cause of the injury compared to other years was unclear. The application of Goal fertilizer at the 3-leaf stage caused very little injury, and much less injury than any other Goal treatment. However, control of hairy nightshade was very poor with this treatment and yield was significantly reduced. Goal 4F at 16 oz/A had a yield of 5.9 t/A and good hairy nightshade control, even though crop growth at midseason was reduced by nearly 40%. Weed control accounted for nearly 60% of the yield variability in this experiment, and more than 90% of the yield variation

($R^2 = 0.9$) when excluding the most injurious treatments (Trs. 8 and 10, where yield was affected more by crop injury than weed competition).

In summary, data from this experiment indicates that the use of Goal 4F postemergence significantly reduces the risk of injury to broccoli compared to the 2 XL formulation. Goal impregnated fertilizer applied to 1.5-leaf broccoli caused more injury than the 4F formulation early in the season, but also gave the greatest yield and exceptional hairy nightshade control. Future investigations should focus on lower rates of Goal impregnated fertilizer for the 1.5-leaf application and differences in varietal response to Goal applied postemergence.

Table 1. Effect of Goal herbicide application strategy and formulation on growth and yield of broccoli.

	Herbicide	Rate/carrier		Timing	Herbicide rate	Phytotoxicity (6-24-03)	Growth reduction (6-24-03)	Yield	Head count	Average wt of heads	Median head diameter	Average head diameter
					lb ai/A	0-10	%	t/A	No. heads/A	lbs	in.	in
1	Goal 4F	2	oz	3-leaf	0.0625	3.8	17.5	1.6	9208	0.43	6.3	6.6
2	Goal 4F	4	oz	3-leaf	0.125	4.8	32.5	2.0	6375	0.83	7.5	7.7
3	Goal 4F	8	oz	3-leaf	0.25	5.0	27.5	4.9	12041	1.05	7.8	7.8
4	Goal 4F	16	oz	3-leaf	0.5	6.0	37.5	5.9	13104	1.16	7.8	8.0
5	Goal 2XL	4	oz	3-leaf	0.0625	5.0	32.5	3.2	9916	0.88	7.3	7.2
6	Goal 2XL	8	oz	3-leaf	0.125	6.8	45.0	4.3	12041	0.88	7.1	7.5
7	Goal 2XL	16	oz	3-leaf	0.25	7.7	43.3	3.2	9444	0.81	6.2	6.8
8	Goal 2XL	32	oz	3-leaf	0.5	8.0	57.5	1.5	5312	0.72	6.6	6.9
9	Goal on fertilizer	16-16-16	200[1]	>/= 75% full 1 leaf	0.25	6.5	66.3	6.0	11333	0.43	7.0	7.3
10	Goal on fertilizer	16-16-16	200	>/= 75% full 1 leaf	0.5	9.3	74.3	0.6	1417	0.61	3.6	3.6
11	Goal on fertilizer	16-16-16	200	>/= 75% 3 leaf	0.25	1.8	12.5	1.5	9208	0.39	5.5	5.9
12	Goal on fertilizer	16-16-16	200	>/= 75% 3 leaf	0.5	1.3	7.5	2.3	7791	0.55	5.8	6.1
13	Muster	0.3	oz	1.5- 2 leaf	0.014	0.0	0.0	0.0	0	0.00	0.0	0.0
14	Muster	0.6	oz	1.5- 2 leaf	0.028	0.0	0.0	0.0	0	0.00	0.0	0.0
15	Muster	0.9	oz	1.5- 2 leaf	0.042	0.0	2.5	0.3	2833	0.11	2.8	2.6
16	Fertilizer check	16-16-16	200	>/= 75% full 1 leaf		0.0	3.3	0.9	7555	0.22	4.2	4.2
17	Devrinol			PES	2	0.0	0.0	0.0	0	0.00	0.0	0.0
18	Untreated					0.0	0.0	0.0	0	0.00	0.0	0.0
	LSD					1.3	25	2.0	5927	0.42	2.8	2.8

[1] 200 lbs/A of fertilizer

Table 2. Effect of Goal herbicide application strategy on weed control at harvest in broccoli.

	Herbicide	Rate		Timing	Herbicide rate	Hairy nightshade	Smartweed	Total
					lb ai/A		% control	
1	Goal 4F	2	oz	3-leaf	0.0625	34	60	43
2	Goal 4F	4	oz	3-leaf	0.125	48	79	49
3	Goal 4F	8	oz	3-leaf	0.25	79	100	84
4	Goal 4F	16	oz	3-leaf	0.5	98	90	96
5	Goal 2XL	4	oz	3-leaf	0.0625	56	95	68
6	Goal 2XL	8	oz	3-leaf	0.125	91	82	85
7	Goal 2XL	16	oz	3-leaf	0.25	98	91	95
8	Goal 2XL	32	oz	3-leaf	0.5	100	75	87
9	Goal on fertilizer	16-16-16	200	>/= 75% full 1 leaf	0.25	95	94	95
10	Goal on fertilizer	16-16-16	200	>/= 75% full 1 leaf	0.5	100	100	100
11	Goal on fertilizer	16-16-16	200	>/= 75% 3 leaf	0.25	43	81	45
12	Goal on fertilizer	16-16-16	200	>/= 75% 3 leaf	0.5	43	99	50
13	Muster	0.3	oz	1.5- 2 leaf	0.014	5	68	10
14	Muster	0.6	oz	1.5- 2 leaf	0.028	10	100	23
15	Muster	0.9	oz	1.5- 2 leaf	0.042	14	100	28
16	Fertilizer check	16-16-16	200	>/= 75% full 1 leaf		30	100	42
17	Devrinol			PES	2	0	80	11
18	Untreated					5	84	24
$FPLSD_{0.05}$						25	26	22

Table 3. Herbicide application data for broccoli experiment, Corvallis, 2003

Site characteristics

Plot size/exp. design	10 x 25 with 4 replications		
Proceeding crop	Snap beans		
Soil test	pH:6.0	OM:4.83	CEC: 22.3

Herbicide application data

Date	May 23, 2003	May 24, 2003	June 11, 2003	June 12, 2003	June 17, 2003	June 18, 2003
Crop stage		-	1.5 leaf on Premium crop, the most advanced variety	1.5-2 leaf	3 leaf for all, emerging 4th leaf; NS as tall as broccoli	3 leaf for all; emerging 4th leaf
Herbicide/treatment	Treflan 0.5 lbs, Lorsban 1 qt	Devrinol	1st impregnated fertilizer	Muster + 0.25% MSO+2.5 AMS 38%	2nd impregnated fertilizer	Goal 2XL and 4F
Application timing	PPI	PES	1.5 leaf /NS at 4 leaf, probably too large	EPOST	EPOST	EPOST
Start/end time	7:30 AM	12:45-1:15		8-9 AM	6:30 -7 PM	6-6:45 AM
Air temp/soil temp (2")/surface	57/ - /-	75/83/78	68/67/71	55/56/56	74/82/80	54/58/58
Rel. humidity	86%	70%	70%	90%	50%	85%
Wind direction/velocity	E 0-1	S 0-3	0	SW 3-5	W5-7	0
Cloud cover	0	100	100	100		
Soil moisture	Moist	dry and cloddy	surface dry	Very wet	Very dry	Wet
Plant moisture	-	-	Dry	Wet	Very dry	Very wet
Sprayer/PSI	Massey/40 PSI	BP 40 PSI	-	BP 40 PSI	-	BP 40 PSI
Mix size	25 GAL	2100 ml	320 gr/plot of 1 lb	2100 ml	320 gr/plot of 1 lb	2100 ml
Gallons H20/acre	25	25		25		25
Nozzle type	8003	8002		8002		8002
Nozzle spacing and height	10 x 18 high	20/18		4 nozzles/20*18		5 nozzles/20*18
Soil inc. method/implement	Roterra H		Irrigated 1.5 hr immediately afterwards		1 hr at 9:30 the next day	Irrigation at 9:30 AM after all had dried

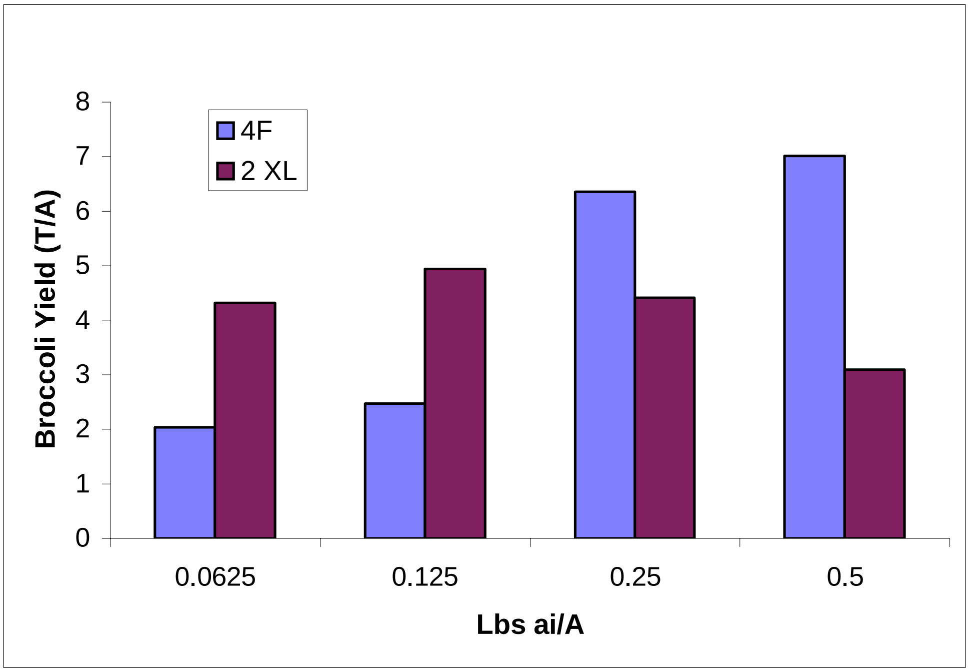

Figure 1. Effect of Goal formulation on yield of broccoli after two harvests.

Evaluation of Herbicides for Use in Rhubarb

(2004)

Gina Koskela and Robert McReynolds
North Willamette Research & Extension Center, Oregon State University, Aurora, OR

Due to the diminishing effectiveness of the herbicides currently labeled for use in rhubarb, this trial was initiated to evaluate the efficacy and phytotoxicity of other herbicides. The trial was conducted in a newly established field at the North Willamette Research & Extension Center, in Aurora, OR. Plots were arranged in a randomized complete block design with four replications. Each plot consisted of a single row 20 ft by 5.5 ft, containing ten rhubarb plants. Untreated weedy plots, untreated weeded plots, and the currently registered combination of pronamide + napropamide, were included for comparison. All treatments were applied using a CO_2 pressurized backpack sprayer equipped with a 3-nozzle (TeeJet 8002 flat fan) boom delivering 40 gals water/A at 30 psi. Dichlobenil was applied by hand using shaker can. Treatments were applied on Jan. 22, 2004 when rhubarb plants were dormant, with tips just showing and no leaves present. At the time of application, there was no wind and sky was overcast; air temperature was 44^{o}F, humidity was 66%, and soil was moist. Phytotoxicity and efficacy evaluations were made at 42, 56, 72 and 86 DAT. Yield data were collected on May 12 (113 DAT) by pulling petioles from plant, removing leaf, then weighing petiole. Weeds present in the plots included annual bluegrass, common groundsel, common chickweed, dandelion, clover, common vetch, and deadnettle.

There were no statistically significant differences in yield between treatments (Table 1). Because the planting was newly established, plant growth was erratic throughout the field, resulting in some plots with missing plants. Therefore, yield data is expressed as yield per plant rather than as yield per plot. On all evaluation dates there were statistically significant differences in phytotoxicity and efficacy between treatments (Table 2).

Table 1. Yield of rhubarb petioles treated with herbicides before leaf emergence.

Treatments	Rate	Yield
	lbs ai/A	lb/plant
Dimethenamid-p	0.75	6.26
Oxyfluorfen	2.00	5.93
Clomazone	1.50	7.72
Linuron	3.00	7.58
S-metolachlor	2.00	4.34
Pronamide + napropamide	2.00 + 2.00	5.95
Prometryn	2.00	6.77
Pendimethalin	1.59	7.54
Halosulfuron + sulfentrazone	0.94 + 0.25	9.08
Dichlobenil	2.00	6.88
Untreated weeded		5.97
Untreated weedy		7.58
Significance (P= 0.05)		ns

Table 2. Phytotoxicity and efficacy ratings of rhubarb.

Treatments	Phytotoxicity [a]				Efficacy [b]			
	42 DAT [c]	56 DAT	72 DAT	86 DAT	42 DAT	56 DAT	72 DAT	86 DAT
Dimethenamid-p	0.00	0.00	0.25	1.00	8.25	8.25	8.00	8.00
Oxyfluorfen	2.25	1.12	2.25	2.75	9.25	9.50	9.00	8.75
Clomazone	1.50	2.75	1.75	2.25	9.00	9.00	8.25	8.75
Linuron	0.50	0.00	0.00	0.00	9.00	9.50	9.00	8.00
S-metolachlor	0.00	0.50	2.25	3.00	9.00	8.75	8.75	8.25
Pronamide + napropamide	0.50	0.25	0.00	0.25	8.50	8.50	9.00	7.50
Prometryn	0.75	0.00	0.25	1.25	8.00	8.25	8.50	8.50
Pendimethalin	0.50	0.00	0.25	0.25	8.25	7.75	8.50	8.25
Halosulfuron + sulfentrazone	1.25	0.00	0.25	0.75	8.75	6.75	8.50	8.75
Dichlobenil	0.25	0.25	1.00	2.50	7.25	8.25	7.5	8.25
Untreated weeded	0.00	0.00	0.00	0.00	10.00	10.00	10.00	10.00
Untreated weedy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Significance (P£ 0.05)	0.85	0.66	1.02	1.43	1.19	2.12	1.00	0.94

[a] Phytotoxicity: 0 = no injury; 10 = all plants dead
[b] Efficacy: 0 = no control (plots weedy); 10 = good control (no weeds)
* Significance at P£ 0.05

Weed Control with Raptor and Surfactants in Snap Beans

2003

E. Peachey, Horticulture Department, OSU

Raptor herbicide was applied to 1-2 leaf snap beans at a site near Crabtree, OR with a severe infestation of black nightshade. Treatments included Raptor with and without surfactant and nitrogen (Sol 32 at 2.5 %). Temperatures exceeded 90 F shortly after application (Figure 1) with a 40 F differential between max and min temperatures 5 DAT.

More crop injury was noted in treatments with Sol 32 than without at 2 DAT (Table 1). Injury was greatest with the surfactant Hasten. Crop injury from Raptor was more prevalent in all treatments at 5 DAT, and again greatest with Hasten. All signs of Raptor injury dissipated at 19 DAT. Weed control at harvest was poor with the R-ll treatment (Fig. 2).

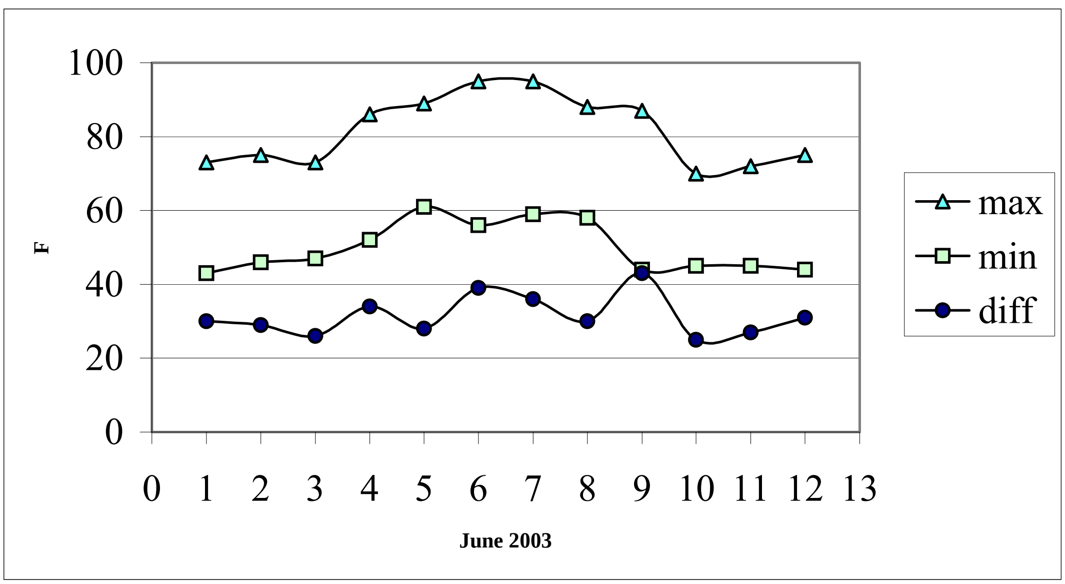

Figure 1. Temperature data.

Table 1. Effect of surfactants and Solution 32 on Raptor herbicide efficacy in snap beans, Crabtree, OR 2003.

	Herbicides	Rate	Obs	Phytotoxicity			Growth reduction			Weed control at harvest		
				2 DAT	5 DAT	19 DAT	2 DAT	5 DAT	19 DAT	Black nightshade	Wild proso millet	Total
		lbs ai/a		------0-10-----			--------%-------			------------ % control --------------		
1	Imazamox	4 oz	4	0.0	2.5	0	1	8	3	75	74	75
	Basagran	1 pt										
2	Imazamox	4 oz	4	0.3	2.5	0	3	4	0	94	85	87
	Basagran	1 pt										
	Moract	1%										
3	Imazamox	4 oz	4	0.5	2.0	0	1	3	0	98	86	91
	Basagran	1 pt										
	Super spread MSO	0.25%										
4	Imazamox	4 oz	4	0.0	2.8	0	4	6	3	95	86	93
	Basagran	1 pt										
	Preference	0.25%										
5	Imazamox	4 oz	4	0.5	2.8	0	3	6	0	99	88	95
	Basagran	1 pt										
	Hasten	1.00%										
6	Imazamox	4 oz	4	0.3	2.8	0	3	10	3	86	85	86
	Basagran	1 pt										
	R-11	0.25%										
7	Imazamox	4 oz	4	1.8	1.8	0	4	3	3	100	95	96
	Basagran	1 pt										
	Moract	1%										
	Sol 32	2.50%										
8	Imazamox	4 oz	4	1.8	2.0	0	4	10	3	96	87	91
	Basagran	1 pt										
	Super spread MSO	0.25%										
	Sol 32	2.50%										
9	Imazamox	4 oz	4	0.8	2.5	0	6	10	0	95	93	95
	Basagran	1 pt										
	Preference	0.25%										
	Sol 32	2.50%										
10	Imazamox	4 oz	4	2.8	3.3	0	4	9	0	99	98	98
	Basagran	1 pt										
	Hasten	1.00%										
	Sol 32	2.50%										
11	Imazamox	4 oz	4	1.1	2.8	0	3	11	0	91	91	95
	Basagran	1 pt										
	R-11	0.25%										
	Sol 32	2.50%										
12	Imazamox	4 oz	4	0.8	2.5	0	4	13	3	90	93	91
	Basagran	1 pt										
	Renegade	1.00%										
	LSD (0.05)			0.9	0.9	ns	ns	ns	ns	11	14	10

Table 2. Application data.

Site characteristics		
Plot size/exp. design	9 x 25	4 reps, RCBD
Herbicide application data		
Date	June 4, 2003	
Crop stage	1-2 trifoliate	
Herbicide/treatment	All	
Application timing	POST	
Start/end time	7:00-8:15 AM	
Air temp/soil temp (2")/surface	76/69/77	
Relative humidity	75%	
Wind direction/velocity	0	
Cloud cover	0	
Soil moisture	Very dry and sealed over	
Plant moisture	Dry	
Sprayer/PSI	BP CO_2 40 PSI	
Mix size	2.1 L/4 plots	
Gallons H20/acre	20	
Nozzle type	5 nozzles, 8002	
Nozzle spacing and height	20/18 above canopy	
Soil inc. method/implement		

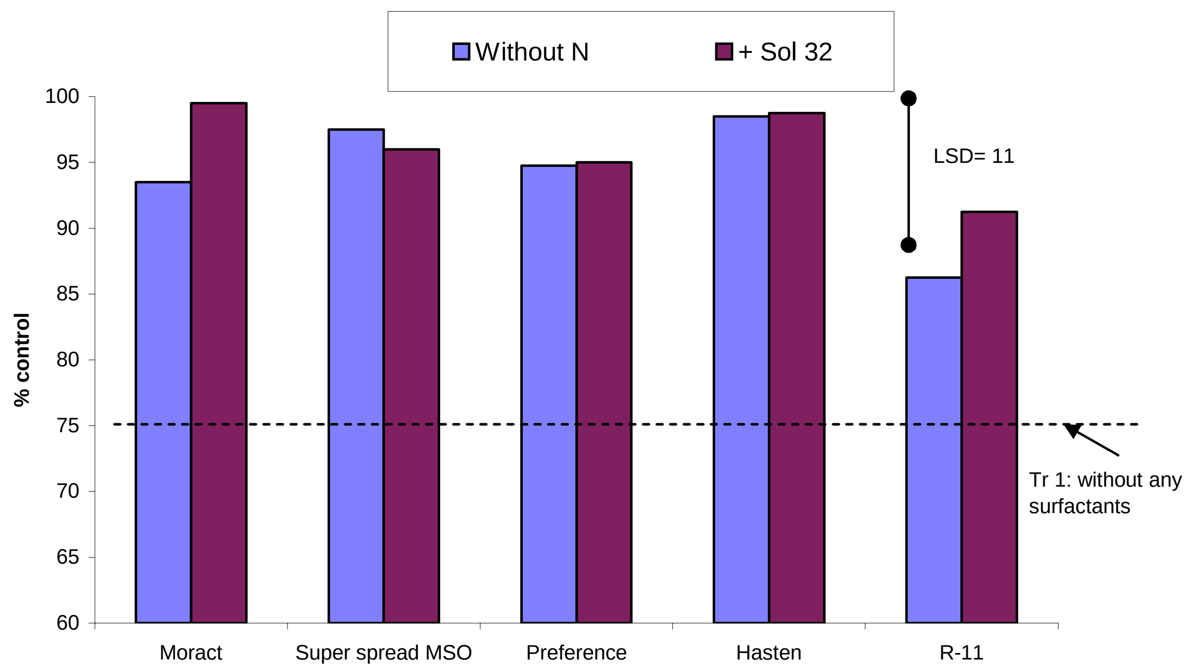

Figure 2. Effect of surfactant and nitrogen (Sol 32) on weed control (primarily black nightshade) at harvest in snap beans.

Snap Bean Tolerance to Raptor Herbicide Under Imposed Adverse Conditions

E. Peachey, Horticulture Department, OSU

Methods

The field was tilled and PPI treatments applied on May 22 to 10 by 25 ft plots at the Vegetable Research Farm near Corvallis OR. The soil type was a silty clay loam with ph of 6.5, OM of 5.43 %, and CEC of 23.7 meq/100 g of soil. Snap beans were planted into a cloddy field at approx. 170,000 seeds/A on May 23, 2003. PES treatments were applied on May 24, followed by very light rain on May 25 and then by a heavy irrigation on May 26. Emerged beans were counted on June 14 in treatments with soil-applied herbicides. EPOST treatments were applied on June 14 and crop injury evaluated at 25 and 50 DAP (3 and 28 days after Raptor herbicide was applied). Snap beans were harvested on August 4. Sandea (halosulfuron) treatments were not harvested because of extremely poor weed control. The millet population was highly variable at harvest and difficult to rate; therefore, weed control was estimated by counting the number of seed panicles in each plot. The red millet volunteered from an experiment in the previous year.

Results

- Emergence was unaffected by Valor and Sandea.
- Phytotoxicity ratings (yellowing of plants when Raptor was applied) were greatest when Basagran was not tankmixed with Raptor.
- Phytotoxicity also was greater with the 8 oz rates of Raptor, but there was no indication that the tankmix with Poast or the Atrazine plus Eptam treatment increased injury over the Raptor + Basagran treatment.
- Growth reduction estimates indicated that application of Raptor to beans exposed to several soil-applied herbicide may have reduced growth more than when soil applied herbicides were not used (Tr. 11).
- Growth was suppressed in Tr. 8 (Poast) and 11 (Dual, Eptam, Treflan, Mocap) when Raptor was applied and the effect lasted well into the season. A portion of the effect in Tr. 8 may have been competition from purslane, but this was not the case in Tr. 11.
- Basagran at 0.5 lb ai/A rather than 0.188 significantly reduced the effect of Raptor on plant growth (Tr. 2 vs 3) at 50 DAP, although some of the growth reduction was likely due to competition from weeds in the treatment with less Basagran applied.
- Purslane control was very poor if Basagran was not tankmixed with Raptor.
- Pod yield was very low in Tr. 5 with the silicone surfactant, possibly due to competition from purslane. Low yields in Tr. 1 and 2 may have been caused by poor purslane control.
- Even though growth was suppressed in Tr. 11 compared to 12, there was no difference in yield or grade.
- There were no statistical differences between treatments for grade, although poor weed control tended to delay maturity.

Table 1. Effect of Raptor, Sandea, and Valor herbicides and on snap beans and weeds, OSU Veg. Res. Farm, Corvallis, OR, 20003.

	Herbicide	Timing	Rate	Obs	12 DAP		25 DAP (3 DAT)		50 DAP (28 DAT)		Weed Control (21 DAT)						
					Emergence	Phyto	Phyto	Growth reduction	Phyto	Growth reduction	Pigweed	Hairy nightshade	Lambs-quarters	Barnyard-grass	Proso Millet	Purslane	Total
			Lb ai/A		No/3'	0-10	0-10	%	0-10	%	------------------------------------%-------------------------						
1	Raptor	EPOST	0.031	4		-	3.5	6.3	1.0	10.0	99	98	75	93	93	10	68
	N		2.5%														
	COC		1%-														
2	Raptor	EPOST	0.031	5		-	0.8	4.0	0.0	16.0	100	100	94	91	94	44	80
	Basagran		0.188														
	N		2.5%														
	COC		1%														
3	Raptor	EPOST	0.031	4		-	1.5	5.0	0.0	6.3	100	100	99	89	93	91	92
	Basagran		0.5														
	N		2.5%														
	COC		1%														
Additional surfactants for weed control																	
4	Raptor	EPOST	0.032	4	-	-	1.0	1.3	0.0	8.8	100	100	95	67	90	95	90
	Basagran		0.5														
	N		2.5%														
	MSO (Super spread)		0.25%														
5	Raptor	EPOST	0.032	4	-	-	2.3	1.3	0.3	8.8	99	100	97	88	90	71	86
	Basagran		0.5														
	N		2.5%														
	Silicone (Syltac)		0.25%														
6	Raptor	EPOST	0.032	3	-	-	0.7	1.7	0.0	10.0	100	100	96	85	85	80	88
	Basagran		0.5														
	N		2.5%														
	Modified seed oil		0.25%														
2x Rates																	
7	Raptor	EPOST	0.062	4	-	-	3.0	2.5	1.8	15.0	100	100	97	96	96	91	95
	Basagran		0.5														
	N		2.5%														
	COC		1.00%														
8	Raptor	EPOST	0.062	4	-	-	3.3	5.0	2.0	27.5	100	100	97	96	96	73	88
	Basagran		0.5														
	Poast		0.28														
	N		2.5%														
	COC		1.00%														
9	Atrazine	PPI	0.0625	4	29	0.4	3.3	3.8	1.8	10.0	100	100	100	100	100	100	100
	Eptam	PPI	2.6														
	Imazamox	POST	0.062														
	Basagran	POST	0.5														
	COC		1.00%														

Table 1. Effect of Raptor, Sandea, and Valor herbicides and on snap beans and weeds, OSU Veg. Res. Farm, Corvallis, OR, 20003.

	Herbicide	Timing	Rate	Obs	12 DAP		25 DAP (3 DAT)		50 DAP (28 DAT)		Weed Control (21 DAT)						
					Emergence	Phyto	Phyto	Growth reduction	Phyto	Growth reduction	Pigweed	Hairy nightshade	Lambs-quarters	Barnyard-grass	Proso Millet	Purslane	Total
			Lb ai/A		No/3'	0-10	0-10	%	0-10	%	----------	----------	----------	---%---	----------	----------	
10	Atrazine	PPI	0.0625	4	30	0.0	0.0	0.0	0.0	0.0	95	82	46	99	99	94	78
	Eptam	PPI	2.6														
11	Dual	PPI	1	4	29	0.8	3.5	11.3	1.4	20.0	100	100	100	100	100	100	100
	Eptam	PPI	2.6														
	Treflan	PPI	0.75														
	Mocap	PPI	1.95														
	Raptor	POST	0.062														
	Basagran	POST	0.5														
	COC		1.00%														
12	Dual	PPI	1	4	29	0.5	0.0	0.0	0.0	0.0	99	94	98	100	99	99	94
	Eptam	PPI	2.6														
	Treflan	PPI	0.75														
	Mocap	PPI	1.95														
Other herbicides																	
13	Valor	PES	0.016	4	28	0.4	0.0	0.0	0.0	0.0	48	81	40	5	0	89	30
14	Valor	PES	0.032	4	28	0.8	0.0	0.0	0.0	0.0	66	88	69	24	0	95	64
15	Sandea	PES	0.032	4	28	1.0	0.0	3.8	0.0	7.5	100	0	70	44	43	100	35
16	Sandea	PES	0.032	4	30	0.8	0.0	5.0	0.0	10.0	99	25	74	92	95	100	69
	Dual	PES	1														
17	Sandea	POST	0.032	4	-	-	5.0	13.8	3.0	17.5	99	24	33	0	0	0	20
	COC		1.00%														
18	Sandea	POST	0.032	4	-	-	3.8	8.8	4.0	15.0	99	94	88	20	0	96	73
	Basagran	POST	1														
	COC		1.00%														
19	RAPTOR	EPOST	0.032	4	-	0.0	1.0	1.3	0.5	7.5	99	98	100	65	80	81	81
	Basagran		0.5														
	N		2.5%														
	R-11		0.25%														
20	Check			4	32	0.0	0.0	0.0	0.0	15.0	0	0	0	0	0	0	0
	FPLSD				NS	0.8	0.9	4.5	0.7	11	22	25	35	30	19	23	18

Table 2. Effect of Raptor, Sandea, and Valor herbicides on weed control and snap bean yield, OSU Veg. Res. Farm, Corvallis, OR, 20003.

	Herbicide	Timing	Rate	Obs.	Weed Control at Harvest								Crop Yield			
					Hairy nightshade	Pigweed	Lambs-quarters	Barnyard-grass	Purslane	Smartweed	Proso millet panicles	Total	Pod yield	Plant biomass	Plant number	Grade
			Lb ai/A	N	--------------------------------%					-------------------------	No/ plot	%	t/A	t/A	No/A	%1-4 sieve
1	Raptor	EPOST	0.031	4	95	100	86	88	5	100	5	68	3.8	13.3	145000	76
	N		2.5%													
	COC		1%-													
2	Raptor	EPOST	0.031	5	97	98	74	87	34	98	3	80	3.8	14.5	142400	59
	Basagran		0.188													
	N		2.5%													
	COC		1%													
3	Raptor	EPOST	0.031	4	97	98	95	79	92	100	1	84	6.6	18.6	154600	52
	Basagran		0.5													
	N		2.5%													
	COC		1%													
Additional surfactants for weed control																
4	Raptor	EPOST	0.032	4	98	100	90	86	95	100	20	80	6.6	17.4	141300	57
	Basagran		0.5													
	N		2.5%													
	MSO (Super spread)		0.25%													
5	Raptor	EPOST	0.032	4	97	99	88	85	55	100	4	84	4.9	17.4	149300	54
	Basagran		0.5													
	N		2.5%													
	Silicone (Syltac)		0.25%													
6	Raptor	EPOST	0.032	3	93	100	82	85	83	100	2	82	5.5	16.8	157200	60
	Basagran		0.5													
	N		2.5%													
	Modified seed oil		0.25%													
2x Rates																
7	Raptor	EPOST	0.062	4	98	100	91	91	63	100	1	92	7.3	20.0	155100	60
	Basagran		0.5													
	N		2.5%													
	COC		1.00%													
8	Raptor	EPOST	0.062	4	97	98	97	97	48	100	2	88	6.1	15.9	137600	64
	Basagran		0.5													
	Poast		0.28													
	N		2.5%													
	COC		1.00%													
9	Atrazine	PPI	0.0625	4	100	100	99	99	78	100	0	98	6.0	19.5	146100	62
	Eptam	PPI	2.6													
	Imazamox	POST	0.062													

Table 2. Effect of Raptor, Sandea, and Valor herbicides on weed control and snap bean yield, OSU Veg. Res. Farm, Corvallis, OR, 20003.

	Herbicide	Timing	Rate	Obs.	Weed Control at Harvest								Crop Yield			
					Hairy nightshade	Pigweed	Lambs-quarters	Barnyard-grass	Purslane	Smartweed	Proso millet panicles	Total	Pod yield	Plant biomass	Plant number	Grade
			Lb ai/A	N	---------------------------------%---------------------------						No/ plot	%	t/A	t/A	No/A	%1-4 sieve
	Basagran	POST	0.5													
	COC		1.00%													
10	Atrazine	PPI	0.0625	4	88	80	35	98	96	67	2	76	7.5	19.1	148700	48
	Eptam	PPI	2.6													
11	Dual	PPI	1	4	100	100	100	75	100	100	0	100	7.6	19.9	160400	59
	Eptam	PPI	2.6													
	Treflan	PPI	0.75													
	Mocap	PPI	1.95													
	Raptor	POST	0.062													
	Basagran	POST	0.5													
	COC		1.00%													
12	Dual	PPI	1	4	88	95	96	99	100	25	1	86	7.3	20.9	155100	58
	Eptam	PPI	2.6													
	Treflan	PPI	0.75													
	Mocap	PPI	1.95													
Other herbicides																
13	Valor	PES	0.016	4	70	35	20	45	50	70	7	25	4.9	13.5	151900	56
14	Valor	PES	0.032	4	95	48	78	48	100	75	19	46	4.8	16.6	150300	64
15	Sandea	PES	0.032	4	0	100	61	73	100	99	12	15	-	-	-	-
16	Sandea	PES	0.032	4	5	100	91	96	100	99	8	40	-	-	-	-
	Dual	PES	1													
17	Sandea	POST	0.032	4	0	100	25	65	0	100	7	15	-	-	-	-
	COC		1.00%													
18	Sandea	POST	0.032	4	50	88	68	45	95	100	12	36	-	-	-	-
	Basagran	POST	1													
	COC		1.00%													
19	RAPTOR	EPOST	0.032	4	73	100	93	55	90	100	1	68	6.2	17.6	155600	64
	Basagran		0.5													
	N		2.5%													
	R-11		0.25%													
20	Check			4	0	0	0	0	0	0	4	0	1.2	4.7	165000	76
	FPLSD				25	25	31	37	52	NS	14	26	2.6	4.49	27300	

Table 3. Schedule and herbicide application, Corvallis, 2003

Site characteristics			
Plot size/exp. design	10 by 25’	4 reps	RCBD
Previous crop	Sweet corn		
Soil test	pH: 6.5	OM: 5.4	CEC: 23.7
Herbicide application data			
Date	May 22, 2003	May 24, 2003	June 14, 2003
Crop stage		-	1-2nd trifoliate
Weeds			1-3 inches
Herbicide/treatment	Trs. 9-12		Raptor treatments
Application timing	PPI	PES	EPOST
Start/end time	3:45-4:15 PM	12:45-1:15 PM	6:30-8:00 AM
Air temp/soil temp (2")/surface	87/88/98	75/83/78	61/63/64
Relative humidity	50%	70%	72%
Wind direction/velocity	E 3-5	S 0-3	None
Cloud cover	0	100	100
Soil moisture	dry	dry and cloddy	dry
Plant moisture		-	dry
Sprayer/PSI	BP CO_2/40 PSI	BP CO_2/40 PSI	BP CO_2/40 PSI
Mix size	2100 ml	2100 ml	2100 ml
Gallons H20/acre	25	25	20
Nozzle type	8002	8002	8002
Nozzle spacing and height	20/18	20/18	20/18
Soil inc. method/implement	Rotera (H depth)		none

Effect of Raptor and Basagran Herbicide on Hairy and Black Nightshade Control

(2004)

E. Peachey, Horticulture Department

A small experiment was initiated at the research farm in an area with an abundance of both hairy and black nightshade. The objective was to determine whether hairy or black nightshade tolerated Raptor herbicide differently. Plots were 10 by 20 ft with only three replications because of limited space. Snap beans where planted on May 17 and Raptor herbicide applied on June 15 to 1st trifoliate beans. All Raptor treatments were applied at 0.031 lbs ai/A (4 oz rate), but Basagran applied at 0, 6, 16 or 32 oz/A. COC (1%) and solution 32 (N at 2.5%) were added to all treatments, and applied with 20 GPA water. Nightshade density was very high at this site.

No significant crop injury was observed from the four treatments. Very few nightshade plants survived. The only statistically significant difference was noted with prickly lettuce density. Raptor did not control prickly lettuce, as is expected with other composites, but the addition of Basagran to the tankmix compensated for the poor efficacy of Raptor. Even though the evidence is weak, the data indicate that black nightshade survival was greater than hairy nightshade survival when Basagran was added to the tankmix. Basagran usually does not control black nightshade as well as hairy nightshade. Over use of Raptor could cause a weed shift to black nightshade, but a more robust experiment is required.

Table 1. Effect of Raptor herbicide on hairy and black nightshade control, 2004.

	Herbicide	Rate	Hairy nightshade	Black nightshade	Prickly lettuce	Pigweed	Total
		lbs ia/A	---------------------no. surviving/ 50 ft sq----------------------				
1	Imazamox	4 oz	2.7	3.3	13.0	0.0	19.0
2	Imazamox Basagran	4 oz 6 oz	3.7	6.3	3.0	0.0	13.0
3	Imazamox Basagran	4 oz 16 oz	3.7	6.0	0.3	0.3	10.3
4	Imazamox Basagran	4 oz 1 qt	3.7	7.7	0.0	0.0	2.3
			ns	ns	0.04	ns	ns

Weed Control in Processing Squash

Ed Peachey, Horticulture, OSU

A squash demonstration plot was planted on June 11, 2003 in preparation for the field day held in July. Golden Delicious processing squash was planted on 30 inch rows with at 1 seed per foot with fertilizer banded at 353 lbs/A (12-29-10). Herbicides were applied on July 12 and plots irrigated with about 0.5 inches of water. Weed control and crop growth were recorded twice, but the crop was not harvested.

Outlook, Sandea + Outlook, and Sandea + Strategy (high rate) herbicide treatments had the best weed control at 4 WAP. However, crop injury was still significant for the Sandea + Strategy treatment at the high rate at 6 WAP. Flumioxazin efficacy was much less than expected. Even though Outlook herbicide only provided 60-70 % control, this level was exceptional compared to all of the other registered treatments. Poor total weed control in some of the treatments was caused by poor grass control (e.g. Tr.1 and 2). Pictures are provided below of selected treatments as an estimate of crop yield. All pictures were taken from the same perspective. The check plot is not pictured but did not produce any marketable fruit.

Table 1. Herbicide effects on Golden Delicious winter squash growth and weed control.

No.	Herbicide	Timing	Rate			Obs.	Plant stand	Phyto		Stunting		Weed control at 4 WAP			
								3 WAP	6 WAP	3 WAP	6 WAP	Hairy nightshade	Powell amaranth	Purslane	Total
			lb ai/A	oz/pts			no/10 ft	------ 0-10 ------		------%-----		--------------------------------% --------------------------------			
1	Sandea	PES	0.031	2/3	oz	3	11	0	0	13	23	32	100	100	40
2	Sandea	PES	0.031	2/3	oz	3	10	0	0	17	13	60	100	83	57
	Command	PES	0.251	2/3	pts										
3	Sandea	PES	0.031	2/3	oz	3	11	0	0	10	27	7	100	100	43
	Curbit	PES	0.750	2	pts										
4	Sandea	PES	0.031	2/3	oz	3	10	0	0	13	13	23	100	100	50
	Curbit	PES	1.500	4	pts										
5	Sandea	PES	0.031	2/3	oz	3	13	0	0	10	3	7	100	100	57
	Strategy	PES	2.000	2	pts										
6	Sandea	PES	0.031	2/3	oz	3	9	0	0	23	23	72	100	100	88
	Strategy	PES	4.000	4	pts										
7	Sandea	PES	0.031	2/3	oz	3	13	0	0	20	3	62	100	97	88
	Outlook	PES	0.469	10	oz										
8	Outlook	PES	0.469	10	oz	3	10	0	0	13	7	63	98	90	93
9	Curbit	PES	1.500	4	pts	3	11	0	0	7	13	10	85	67	47
10	Command	PES	0.251	2/3	pts	2	14	0	0	0	20	45	35	50	10
11	Strategy	PES	4.000	4	pts	3	9	0	0	17	10	33	57	98	57
12	Flumioxazin	PES	0.016	0.5	oz	3	11	0	0	3	20	67	50	7	13
13	Flumioxazin	PES	0.032	1.0	oz	3	12	0	0	3	13	20	57	43	30
14	Check					3	13	0	0	7	37	0	0	0	0
FPLSD (0.05)							ns	ns	ns	14	17	ns	24	36	18

Figure 1. Herbicide effects on weeds and squash yield, viewed after killing frosts. Numbers on pictures refer to treatments listed in Table 1.

Table 2. Herbicide application data.

Date	June 12, 2003
Crop stage	Planted 6-11
Herbicide/treatment	All
Application timing	PES
Start/end time	2:30-3:30 PM
Air temp/soil temp (2")/surface	68/73/75
Relative humidity	70%
Wind direction/velocity	S 3-5
Cloud cover	100%
Soil moisture	Dry
Plant moisture	-
Sprayer/PSI	BP CO_2 30 PSI
Mix size	2.1 L/4 plot
Gallons H20/acre	26/3plots/mix
Nozzle type	6-8002
Nozzle spacing and height	20/18 above canopy
Soil inc. method/implement	Watered in after 2 days

Controlling Wild Proso Millet in Sweet Corn

(2003)

Ed Peachey, Horticulture Department, OSU

The objective was to evaluate efficacy of the most common herbicides on wild proso millet, alone or in combination at cost adjusted rates, and provide a venue for a field day. The field was pre-irrigated before it was tilled for the last time. Herbicides were applied and incorporated with farm-scale equipment, or applied after corn was planted to 20 by 60 ft plots, with 2 replications, on June 23. Weed control was evaluated at midseason and at harvest. A field day was held on July 28.

Wild proso millet (WPM) control was best with the split applications of PPI and PPS herbicides such as Eradicane and Outlook. Eradicane controlled WPM somewhat better than Dual and Outlook (Table 2.2). None of the herbicides applied alone provided satisfactory control. Prowl performed extremely poorly unless applied over Dual Magnum or Eradicane. Lodging is sometimes noted with Prowl but did not occur in this trial even though it was a very late planting.

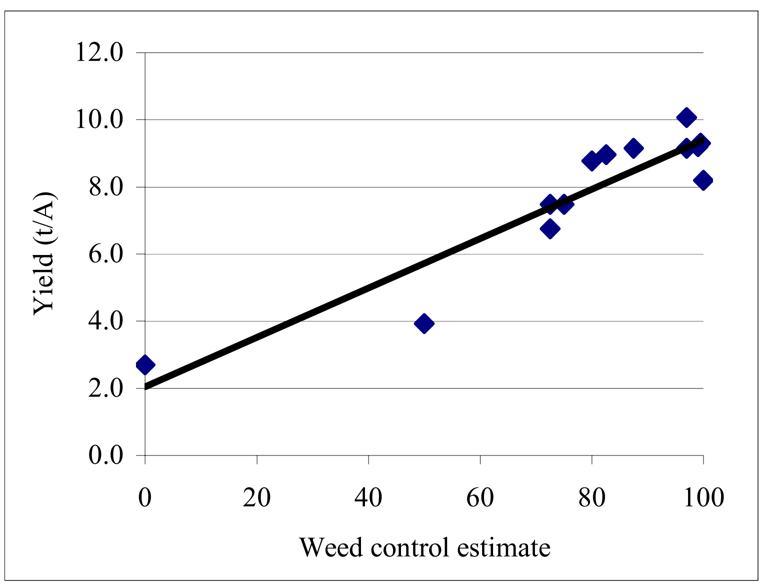

Figure 1. Effect of weed control on yield.

Table 1. Effect of soil-applied herbicides on millet control and corn yield, Monroe, 2003.

	Preplant incorporated	Post-plant surface	Herbicide Rate	Cost of herbicide	Millet control	Corn Yield
			lbs ai/A	$/A	%	t/A
1	Eradicane		3.56	19	83	9.0
2	Dual Magnum		1.44	19	73	7.5
3	Outlook		0.75	19	75	7.5
4		Outlook	0.75	19	80	8.8
5		Dual magnum	1.44	19	73	6.8
6		Prowl	1.30	9	50	3.9
7	Eradicane	Outlook	3.56/0.75	38	100	8.2
8	Eradicane	Dual Magnum	3.56/1.44	38	100	9.3
9	Eradicane	Prowl	3.56/1.30	28	97	9.2
10	Dual Magnum	Outlook	1.44/0.75	38	99	9.2
11	Dual Magnum	Dual Magnum	1.44/0.9	32	88	9.2
12	Dual Magnum	Prowl	1.44/1.3	28	97	10.1
13	Check		-	-	0	2.7

Distinct Efficacy in Sweet Corn with Cultivation and Tankmixes

2003

Ed Peachey, Horticulture Dept, OSU

Methods

The plot was plowed and seedbed prepared on May 8, but due to rain was not planted until May 29. Crisp'n Sweet 710 was planted on a 6 inch spacing 1.5 inches deep with 325 lbs 12-29-10 banded next to the 30-inch row. The soil was drawn back to 3 inches deep so that seeds would be planted into moisture. Planting in furrows also facilitated later cultivation and hilling. Rain fell (0.25 inches) the day after planting. Dual Magnum and Outlook herbicides were applied on May 31 but not incorporated with irrigation until the first irrigation was applied June 24. Postemergence treatments were applied on June 21 followed 3 days later by 1 inch of irrigation. On June 27, all of the plots were cultivated, first with a single row cultivator, then with a four row cultivator on the same day. Weed control was evaluated on July 5 and fertilizer (50 lbs N/A) side-dressed on July 18. Sweet corn was harvested on August 28 from 16.4 ft or row in each plot. All ears were weighed, and then ten ears were husked and weighed to determine the wt of husked ears and percent discard.

Results

Stunting was noted in the Outlook plus Atrazine treatment, but phytotoxicity was only observed in the Distinct + Aim treatment. Weed control at 3 WAT of Distinct and after cultivation was best when preemergence herbicides were used. Atrazine tank mixed with Distinct improved control best at the 0.175 lb ai/A rate. In some treatments it appeared that control of broadleaves allowed more vigorous growth of barnyardgrass, which ultimately resulted in poorer yields. Distinct failed to significantly improve crop yields in some cases even though the plots were cultivated Distinct herbicide was most effective when applied with Atrazine or Basagran or when applied at the highest rate (0.175 lb ai/A).

Table 1. Weed control with Distinct herbicide in sweet corn var. Crispn'Sweet 710, Corvallis, 2003.

	Herbicide	Timing	Rate		Obs	Stunting	Phyto-toxicity	Weed control						
						1 WAT		3 WAT			At harvest			
								Pigweed	Barnyard-grass	Total	Pig-weed	Night-shades	Barnyard-grass	Total
			oz/A	lb ai/A	N	%	0-10	% control						
1	Check (with cultivation)				5	4	0.0	0	0	0	0	0	0	0
2	Distinct	EPOST	2 oz	0.090	4	0	0.0	85	48	81	95	48	54	53
	NIS			0.25%										
3	Distinct	EPOST	3 oz	0.13	4	0	0.0	90	50	68	90	70	13	50
	NIS			0.25%										
4	Distinct	EPOST	4 oz	0.175	4	0	0.0	98	50	82	95	88	43	51
	NIS			0.25%										
5	Distinct	EPOST	2 oz	0.09	4	0	0.0	96	42	62	92	91	26	49
	NIS			0.25%										
	Basagran		2 pts	1										
6	Distinct	EPOST	3 oz	0.13	3	0	0.0	98	63	70	95	80	30	60
	NIS			0.25%										
	Basagran		2 pts	1										
7	Distinct	EPOST	4 oz	0.175	4	0	0.0	91	50	75	94	51	63	61
	NIS			0.25%										
	Basagran		2 pts	1										
8	Distinct	EPOST	2 oz	0.09	4	0	0.0	99	74	87	84	90	51	70
	NIS			0.25%										
	Atrazine		2 pts	1										

Table 1. Weed control with Distinct herbicide in sweet corn var. Crispn'Sweet 710, Corvallis, 2003.

	Herbicide	Timing	Rate			Obs	Stunting	Phyto-toxicity	Weed control						
							1 WAT		3 WAT			At harvest			
									Pigweed	Barnyard-grass	Total	Pig-weed	Night-shades	Barnyard-grass	Total
			oz/A		lb ai/A	N	%	0-10	% control						
9	Distinct	EPOST	3	oz	0.13	3	0	0.0	67	50	65	81	48	57	75
	NIS				0.25%										
	Atrazine		2	pts	1										
10	Distinct	EPOST	4	oz	0.175	4	2.5	0.0	100	95	98	97	95	80	88
	NIS				0.25%										
	Atrazine		2	pts	1										
11	Basagran	EPOST	2	pts	1	4	0	0.0	25	20	24	46	79	85	49
	COC				1%										
12	Atrazine	EPOST	2	pts	1	4	2.5	0.0	100	88	93	98	87	88	88
	COC				1%										
13	Dual Magnum	PES	22	oz	1.32	4	2.5	0.0	99	99	83	95	86	91	83
	Atrazine	PES	1	pts	0.5										
14	Outlook	PES	14	oz	0.6435	4	7.5	0.0	100	95	97	95	65	45	88
	Atrazine	PES	1	pts	0.5										
15	Distinct	EPOST	3	oz	0.13	3	6.6	1.0	99	60	88	89	55	38	50
	Aim	EPOST	1/3	oz	0.008										
	NIS				0.25%										
FPLSD							ns	0.32	25	45	34	26	39	49	38

Table 2. Effect of Distinct herbicide on yield of sweet corn Crisp'n Sweet 710.

	Herbicide		Rate		Obs	Ear count	Yield	Average ear wt.	Average husked ear wt.	Weight of husk	Percent husk	Irregular ears	Ear quality rating
			oz/A	lb ai/A	N	no./A	t/A	lbs	lbs	lbs	%	no./10	0-10
1	Check (with cultivation)				5	8500	3.7	0.78	0.55	0.24	29	0.50	7.1
2	Distinct	EPOST	2 oz	0.090	4	15406	8.0	1.04	0.69	0.35	33	0.00	9.3
	NIS			0.25%									
3	Distinct	EPOST	3 oz	0.13	4	13015	6.7	1.04	0.66	0.38	37	0.25	8.4
	NIS			0.25%									
4	Distinct	EPOST	4 oz	0.175	4	14343	7.2	1.01	0.67	0.34	34	0.00	8.6
	NIS			0.25%									
5	Distinct	EPOST	2 oz	0.09	4	9296	4.8	1.01	0.66	0.35	35	0.00	9.3
	Basagran		2 pts	1									
	NIS			0.25%									
6	Distinct	EPOST	3 oz	0.13	3	11421	5.8	1.02	0.69	0.34	33	0.00	8.9
	Basagran		2 pts	1									
	NIS			0.25%									
7	Distinct	EPOST	4 oz	0.175	4	15140	8.2	1.07	0.67	0.40	37	0.25	9.1
	Basagran		2 pts	1									
	NIS			0.25%									
8	Distinct	EPOST	2 oz	0.09	4	14609	7.6	1.03	0.71	0.32	31	0.00	9.6
	Atrazine		2 pts	1									
	NIS			0.25%									
9	Distinct	EPOST	3 oz	0.13	3	15671	8.5	1.02	0.66	0.36	35	0.25	8.6
	Atrazine		2 pts	1									
	NIS			0.25%									

Table 2. Effect of Distinct herbicide on yield of sweet corn Crisp'n Sweet 710.

	Herbicide		Rate			Obs	Ear count	Yield	Average ear wt.	Average husked ear wt.	Weight of husk	Percent husk	Irregular ears	Ear quality rating
			oz/A		lb ai/A	N	no./A	t/A	lbs	lbs	lbs	%	no./10	0-10
10	Distinct	EPOST	4	oz	0.175	4	16734	8.8	1.05	0.70	0.35	33	0.00	9.3
	Atrazine		2	pts	1									
	NIS				0.25%									
11	Basagran	EPOST	2	pts	1	4	10890	5.3	0.93	0.62	0.31	32	0.00	8.5
	COC				1%									
12	Atrazine	EPOST	2	pts	1	4	16734	9.1	1.09	0.70	0.39	35	0.00	9.1
	COC				1%									
13	Dual Magnum	PES	22	oz	1.32	4	14343	7.7	1.08	0.72	0.36	33	0.00	9.0
	Atrazine	PES	1	pts	0.5									
14	Outlook	PES	14	oz	0.6435	4	17265	9.3	1.08	0.73	0.36	33	0.00	8.7
	Atrazine	PES	1	pts	0.5									
15	Distinct	EPOST	3	oz	0.13	3	12484	6.8	1.09	0.66	0.43	39	0.25	8.6
	Aim	EPOST	1/3	oz	0.008									
	NIS				0.25%									
FPLSD							5647	3.1	0.14	0.07	ns	ns	ns	1.2

Table 3. Schedule and herbicide application data.

Site characteristics

Plot size/exp. design	10 x 30	4 reps	RCBD
Proceeding crop	Sweet corn		

Herbicide application data

Date	May 31, 2003	June 21, 2003
Crop stage	Planted on 5-29	4-6 inch corn
Weeds	-	2"
Herbicide/treatment	Dual Magnum, Outlook	All EPOST treatments
Application timing	PES	EPOST
Start/end time	7:00-7:15	8-9:15
Air temp/soil temp (2")/surface	59/60/59	65/67/69
Rel humidity	95%	68%
Wind direction/velocity	0	sw 3-5
Cloud cover	50%	50
Soil moisture	Damp, wet below, rained 5-30	Very dry
Plant moisture	-	Dry, although light shower before applying
Sprayer/PSI	BP CO_2 40 PSI	BP CO_2 40 PSI
Mix size	2.1 L/4 plot	2.1 L/4 plot
Gallons H20/acre	20	20
Nozzle type	8002	8002
Nozzle spacing and height	20/18 above canopy	20/18 above canopy
Soil inc. method/implement	Light rainfall	-

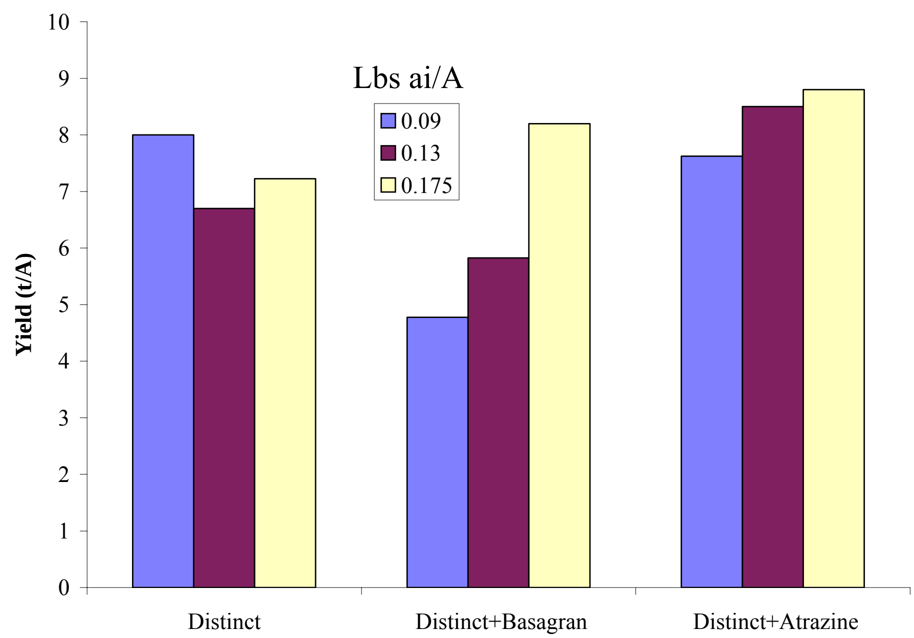

Figure 1. Effect of Distinct herbicide rate and tankmix on sweet corn yield. All plots were cultivated once.

Weed and Sweet Corn Response to Option, Accent, and Callisto Herbicides

2004

E. Peachey, Horticulture Department

The objective of this trial was to evaluate tolerance of sweet corn to Option (formasulfuron) herbicide. Option has a different spectrum of activity than Accent. Sweet corn (Var. Coho) was planted near Independence on July 23 at a site with a known history of wild proso millet and into soil treated with Lorsban. Plots were 10 by 25 ft and each treatment replicated 4 times. Option, Accent, and Callisto herbicides were applied on July 23 to V 3-4 corn. Sweet corn was harvested on September 29 from 10 ft of two rows of each plot.

Results

Evaluation one week after treatments were applied indicated that Option herbicide caused more injury than Accent at recommended rates (see table below). An antagonism was noted between Callisto and Accent. When these two herbicides were tank mixed, the normal splotching caused by Callisto was not present. Stunting of corn growth was dramatic when Option was tankmixed with Callisto and Aim. Sweet corn yield was greatest for Callisto alone. The use of Lorsban may have exacerbated injury levels.

Control of wild proso millet was exceptional for both Option and Accent. Even Callisto gave 98 % control. Option may have provided better control of lambsquarters than Accent, although broadleaf density was low at this site.

Table 1. Weed and crop response to Option, Callisto, and Accent herbicides, Independence, OR, 2004.

	Herbicide	Rate	Obs	Crop response (1 WAT)		Weed control (1 WAT)			Crop Harvest			Weed control at harvest		
				Phyto	Stunting	Wild proso millet	Lambsquarters	Total	Ear number	Yield	Avg. ear wt.	Wild proso millet	Lambsquarters	Total
		lbs ai/A		0-10	%	------- % --------			no./A	t/A	lbs.	----------%-------		
1	Option	0.033	4	1.3	43	99	100	100	29000	10.8	0.70	100	98	99
2	Accent	0.031	4	0.5	24	100	97	99	27700	10.8	0.75	100	94	98
3	Callisto	0.094	4	3.3	13	98	100	99	29400	12.1	0.78	100	100	100
4	Option Callisto	0.033 0.094	4	1.5	43	100	100	100	25900	10.8	0.83	100	100	100
5	Accent Callisto	0.031 0.094	4	0.8	10	100	100	100	29800	10.3	0.75	100	100	100
6	Accent Aim	0.031 0.008	4	2.0	28	100	100	100	27400	11.2	0.80	100	100	100
7	Option Aim	0.033 0.008	4	2.0	45	100	100	100	28700	11.1	0.78	100	99	100
8	Check		4	0.0	0	0	0	0	24400	9.9	0.78	0	0	0
LSD (0.05)				0.9	15.0	2.7	1.5	2.6	3400	1.6	0.1	0.0	3.9	1.1

Inter-regional Sweet Corn Herbicide Tolerance Evaluation

2004

Project Leader, Chris Boerboom, University of Wisconsin - Madison, WI
Cooperator, Ed Peachey, Horticulture , OSU

Sweet corn hybrids and inbreds can be injured by several current or potential herbicides. This creates the need to evaluate either new sweet corn hybrids and inbreds to these herbicides or to evaluate existing hybrids when new herbicides are introduced. There are several challenges to evaluating sweet corn for herbicide tolerance, including the large number of processing and fresh market inbreds and hybrids to be tested, the differing capabilities of the seed companies to evaluate their germplasm, and the cost of conducting field evaluations. In order to maximize the efficiency of tolerance evaluation, increase the number of entries tested, and minimize the cost, it has been proposed that seed companies collaborate with university faculty, where the companies host evaluation sites (e.g. planting and maintenance) and the university faculty spray and rate the trials for tolerance. While this was proposed and conducted in the Pacific Northwest in 2003, it seems likely that the tolerance ratings in the Pacific Northwest may not be representative of the injury potential under Midwest environmental conditions. In addition, it also is likely that sweet corn tolerance needs to be evaluated at several locations to better assess the risk of injury. Therefore, several collaborators were contacted in 2004 to conduct a pilot project to evaluate sweet corn tolerance under a simplified and efficient design across the country.

The objectives for the pilot project were to: 1) evaluate the herbicide tolerance of processing sweet corn at multiple locations using a simplified design; 2) determine the tolerance ratings for Accent and Callisto on the entered hybrids; 3) evaluate how the methods used or plot design can be improved; and 4) monitor the project to determine the costs incurred by both companies and universities.

Similar to the evaluation project in the Pacific Northwest, seed companies were contacted to determine their interest in collaborating by providing hybrids and hosting an evaluation site on one of their research stations. Three companies volunteered for this pilot project and five other university collaborators expressed interest in hosting a site even though they were not able to collaborate with a seed company.

<u>Host - Site; Cooperator</u>
Rogers - Plainfield, WI; Dan Myer
Seminis - Deforest, WI; Kevin Thalacker
Harris Moran - Sun Prairie, WI; Larry Bylsma
University of Minnesota - Waseca; Roger Becker
Cornell University - Ithaca; Robin Bellinder
University of Delaware - Georgetown; Mark VanGessel
University of Illinois - Champaign; Marty Williams and Jerald Pataky
Oregon State University - Corvallis; Ed Peachey

Methods

Each company entered six sweet corn hybrids for evaluation. In addition, Super Sweet Jubilee Plus and Dynamo were entered as sensitive controls for Accent and Callisto, respectively. The seed companies packeted the seed and sent it to the coordinator, who assembled the seed for each site and re-distributed the seed. Each site planted one replication using 20-foot long, single-row plots. Three ranges were planted so that the same entry was in the same row. The first and third range were sprayed with 1X and 2X herbicide rates and the second range was used as the check plot. A preemergence grass herbicide and atrazine was recommended for general weed suppression. The herbicides were applied by university personnel at the V3 growth stage. Accent was applied at 0.67 (1X) and 1.33 oz/a (2X) with 1% crop oil concentrate and 2 lb/a ammonium sulfate. Callisto was applied at 3 (1X) and 6 oz/a (2X) with 1% crop oil concentrate. Evaluations were made by university personnel at 7, 14, and 28 days after application.

Results

Stunting from Accent among the 20 hybrids ranged from 4 to 12% at the 1X rate and from 6 to 23% at the 2X rate at 7 days after treatment (DAT, Table 1). Stunting generally declined by 14 DAT and ranged from 0 to 10% at the 1X rate and from 4 to 18% at the 2X rate. At 7 DAT, Basin had the widest range in injury among the locations with ratings of 0 to 60% and a mean of 15% injury. A variable response among locations was noted with the least average injury at Minnesota and Oregon and the greatest average injury at Delaware and DeForest WI (Table 2). Given the variable response of the sweet corn hybrids (as indicated by the large standard deviations), it was valuable to have multiple sites to assess the tolerance of these hybrids to Accent.

Chlorosis from Callisto among the 20 hybrids ranged from 0 to 10% at the 1X rate and from 1 to 23% at the 2X rate at 7 DAT (Table 3). At the 2X Callisto rate, 8 of the 20 hybrids had 10% injury or greater at 7 DAT, but the injury declined rapidly and only one hybrid had 10% injury at 14 DAT. Dynamo had the greatest injury at both rates at 7 DAT and was included in the trials because it can be injured by Callisto. Among the eight locations, the degree of injury to Dynamo was inconsistent and ranged from 0 to 35% at the 1X rate and from 0 to 60% at the 2X rate.

Overall, the importance of having multiple locations was greater when evaluating Callisto tolerance than Accent tolerance because four of the eight sites did not have significant injury from Callisto (Table 4). The use of both 1X and 2X herbicide rates was important in increasing the confidence in the evaluations at each site because treatments were not replicated at each site. The 7 day evaluation was critical with these postemergence herbicides. The 14 day evaluation was important in assessing recovery, but may not be essential if there was a significant cost to collect this data. There would be little reason to rate Callisto injury at 28 DAT and rating Accent at this time may not be as valuable as the earlier ratings.

The university cooperators were satisfied with the approach used in the pilot project. They found the trials easy to rate and were generally confident in the results when rating single row plots. A second replication would increase confidence at a site, but the inclusion of two rates increased confidence even with the single row plot design. If the university cooperators could collaborate with seed companies, most believed that their cost would be about $25 to 50 per entry. These estimates were based on three ratings. A majority of the university cooperators were interested in continuing this type of sweet corn hybrid evaluation.

Table 1. Accent stunting of 20 sweet corn hybrids averaged across seven experimental locations. Hybrids were rated 7, 14 and 28 days after treatment (DAT) with Accent, which was applied at 0.67 (1X) and 1.33 oz/a (2X) with 1% crop oil concentrate and 2 lb/a ammonium sulfate.

	Sweet corn stunting					
	7 DAT		14 DAT		28 DAT	
Hybrid[a]	1X	2X	1X	2X	1X	2X
	(%)					
Max	4±4[b]	6±10	3±5	6±8	3±5	6±9
Temptation	5±7	7±8	1±2	4±5	3±5	5±6
GH 2547	6±6	8±7	3±4	6±6	3±5	7±9
Obsession	7±6	10±11	4±6	5±7	4±5	4±5
Dynamo	6±7	11±12	3±5	4±7	0	1±2
HMX 1382	5±5	13±10	0	8±10	1±3	0
Powerhouse	6±9	13±13	8±8	9±11	6±7	8±8
HMX 4394	7±9	13±11	4±5	8±10	1±4	4±6
HMX 4395s	7±9	13±11	3±7	9±9	3±5	6±8
GH 2041	8±11	13±15	8±10	14±11	5±6	10±12
Kokanee	10±10	13±12	10±12	10±9	7±10	8±9
GSS 8388	8±9	14±12	6±6	9±9	3±4	11±9
GH 5704	6±11	14±14	4±5	7±9	4±6	6±8
Basin	6±8	15±20	4±6	11±16	5±7	4±6
EX08302418	11±11	15±17	7±10	9±12	4±6	7±6
Bonus	11±16	16±15	9±10	11±16	8±11	9±12
GH 2298	9±11	16±13	3±4	10±9	3±4	4±6
SS Jubilee Plus	9±11	18±19	3±4	4±4	2±5	2±4
EX8462518	12±11	21±13	9±10	13±12	3±5	7±7
Coho	9±8	23±11	3±5	18±11	3±6	12±10

[a]Hybrids are listed in ascending order based on the 7 DAT rating at the 2X rate.
[b]Mean standard deviation.

Table 2. Accent stunting of sweet corn averaged across 20 sweet corn hybrids at each experimental location. Hybrids were rated 7, 14 and 28 days after treatment (DAT) with Accent, which was applied at 0.67 (1X) and 1.33 oz/a (2X) with 1% crop oil concentrate and 2 lb/a ammonium sulfate.

Location	Sweet corn stunting					
	7 DAT		14 DAT		28 DAT	
	1X	2X	1X	2X	1X	2X
	(%)					
Delaware	13±7[a]	25±13	7±5	12±10	2±4	6±5
Illinois	3±4	11±12	0	1±3	0	0
Minnesota	0	0	0	0	0	0
New York	9±11	18±12	4±8	12±9	8±12	13±12
Oregon	4±6	7±9	4±6	8±9	3±4	2±5
DeForest, WI	16±6	20±7	10±8	12±7	7±6	7±6
Sun Prairie, WI	10±11	15±15	10±9	14±13	9±7	13±10
Plainfield, WI	6±7	13±12	4±5	9±10	2±6	7±9

[a] Mean and standard deviation.

Table 3. Chlorosis of sweet corn from Callisto when averaged across 20 sweet corn hybrids at eight locations. Hybrids were rated 7, 14 and 28 days after treatment (DAT) with Callisto, which was applied at 3 (1X) and 6 oz/a (2X) with 1% crop oil concentrate.

Hybrid[a]	Sweet corn chlorosis					
	7 DAT		14 DAT		28 DAT	
	1X	2X	1X	2X	1X	2X
	(%)					
HMX 4395s	0	1±2[b]	0	0	0	0±1
Temptation	0	1±2	0	1±2	0	0
GH 2547	0	2±3	1±1	0	0	0
GH 5704	1±2	2±4	1±2	1±2	0	0
Kokanee	0±1	4±7	1±2	0±1	0	0
EX08302418	1±2	4±4	0	0±1	0	0
Max	5±7	4±6	1±2	2±3	0	0
Powerhouse	0±1	5±8	0	1±2	0	0
Bonus	2±4	6±8	1±2	1±2	0	0
Obsession	5±12	7±16	2±5	4±9	0	2±5
HMX 4394	3±4	8±12	0	3±7	0	0
Coho	4±6	9±13	1±2	5±7	0	0
EX8462518	0±1	10±13	0	2±3	0	0
GH 2041	1±2	10±13	1±2	5±8	1±2	0
GSS 8388	2±3	10±13	1±2	3±6	0	0
HMX 1382	2±4	10±11	0±1	2±5	0	0
SS Jubilee Plus	5±7	11±16	1±2	4±8	0	0
GH 2298	2±4	12±18	0	4±6	0	0
Basin	8±11	15±23	4±7	9±9	0	0
Dynamo	10±12	23±23	2±4	10±11	0	0

[a] Hybrids are listed in ascending order based on the 7 DAT rating at the 2X rate.
[b] Mean standard deviation.

Table 4. Chlorosis of sweet corn from Callisto when averaged across 20 sweet corn hybrids at each experimental location. Hybrids were rated 7, 14 and 28 days after treatment (DAT) with Callisto, which was applied at 3 (1X) and 6 oz/a (2X) with 1% crop oil concentrate.

Location	Sweet corn chlorosis					
	7 DAT		14 DAT		28 DAT	
	1X	2X	1X	2X	1X	2X
	------------------------------------ (%) ------------------------------------					
Delaware	4±5[a]	10±11	1±2	2±5	0	0
Illinois	6±10	19±14	1±4	6±8	0	1±3
Minnesota	0	0	0±1	0±1	0	0
New York	2±3	7±9	2±5	5±8	0	0
Oregon	0±1	1±1	0	0±1	0	0
DeForest, WI	0±1	0±1	0	0	0	0
Sun Prairie, WI	7±9	24±18	1±3	8±8	0	0
Plainfield, WI	0	0	0	0	0	0

[a]Mean̩ standard deviation.

Evaluation of Promising Weed Control Strategies in Newly Established Strawberries

Diane Kaufman, Judy Kowalski, NWREC/OSU
Ed Peachey, Horticulture Department, OSU

A planting of 'Totem' strawberries was established on raised beds at NWREC on May 28, 2003, for the purpose of evaluating new herbicides for weed control and effect on strawberry plant vigor. The following herbicides were applied over the top of the strawberry plants on May 30, 2003: imazapic (Plateau); mesotrione (Callisto); mesotrione + pendimethalin (Callisto + Prowl); dimethenamid-P (Outlook); sulfentrazone (Spartan); and sulfentrazone + pendimethalin (Spartan + Prowl). All treatments were arranged in a randomized complete block design with four replications, with plots 4 rows wide (13.33 ft) by 25 feet long. Because Callisto caused severe damage to strawberry plants at the applied rate (6 oz product/A), additional unreplicated applications at lower rates were made to the border rows on 6/6/03 (3 oz, plants covered) and 6/9/03 (1.5 oz, plants not covered). The effects of experimental herbicides on strawberry plant growth and weed control were monitored through September, 2003.

In addition to the herbicides evaluated, four plots were also set aside for evaluating various organically acceptable weed control practices. In these plots, high-glucosinilate mustard seed meal was applied over the tops of strawberry plants on May 30, 2003 at a banded rate (applied only over the 12 inch wide plant row) of 242 lb/A. Weed control in the area between rows was accomplished by a mixture of cultivation and hand removal of weeds. Vinegar was applied to weeds as needed to provide subsequent in-row weed control.

Evaluations of phytotoxicity of herbicides to strawberry plants and quality of weed control began on June 4, 2003. Phytotoxicity ratings are based on a scale of 0 – 5 with 0 = no observable negative effects and 5 = plants dead. Quality of weed control was evaluated again on August 1, August, 25 and September 29, 2003. A final weed evaluation was conducted on September 29, 2003. Bark mulch was applied to the area between strawberry plant rows during fall, 2003 to provide weed control in the organically managed plots.

Table 1. Treatments and herbicide rates.

Treatments: Common name/Trade name	Rate: lb ai/A / amount of product/A	
Imazapic/ Plateau	0.062	/ 1 oz
Imazapic/Plateau	0.124	/ 2 oz
Imazapic/Plateau	0.248	/ 4 oz
Mesotrione/ Callisto	0.1875	/ 6 oz
Mesotrione + Prowl	0.1875+ 1.24	/ 6 oz + 3 pt
Dimethenamid-P/Outlook	0.65	/ 13.9 oz
Dimethenamid-P/Outlook	0.84	/ 17.9 oz
Sulfentrazone/ Spartan *	0.15	/ 4.8 oz
Sulfentrazone/Spartan	0.15	/ 4.8 oz
Sulfentrazone + Prowl	0.15 + 1.24	/ 4.8 oz + 3 pt
Weeded	------	
Weedy	------	
Mustard seed meal		/ 480 lbs

* Two identical sets of plots were established for Spartan with the intention of dividing these plots into two different cultural practices (runners tucked in late summer or runners allowed to fill in the area between rows) later in the experiment.

Results

Callisto (mesotrione) applied at the 6 oz rate resulted in severe yellowing and stunting of new plant growth within days of application. All plants treated with the 6 oz rate were dead by mid-June. Callisto applied at reduced rates to strawberry plants with 1 to 3 leaves also caused severe damage. Plants covered with 4 inch pots and sprayed with 3 oz of Callisto survived, but were only about half the size of normal plants in early October. Callisto applied at 1.5 oz to uncovered strawberry plants resulted in the death of half of the plants. Even though Callisto has performed well on cranberries, there appears to be very little tolerance for it in strawberries.

Because Plateau (imazapic) looked very impressive when we applied it to strawberry plants at renovation, we wanted to see how early it could be incorporated into a new strawberry planting. By June 4, 2003 plants treated with Plateau were slightly stunted with a yellow discoloration on new leaves. By June 18, Plateau-treated plants were severely stunted with yellow leaves and red mid-veins. All Plateau-treated plants were dead by the end of June.

By June 18, 2003 there were no signs of phytotoxicity in strawberry plants treated with either rate of Outlook (dimethenamid-P) or with Spartan alone or Spartan + Prowl. Some early leaves on plants treated with high glucosinilate mustard seed meal had yellow leaf margins visible on June 18, however subsequent growth was normal. Plant growth was measured on July 23, 2003.

Both rates of Outlook provided excellent (90% or higher) control of annual weeds during June and July, 2003. Although Spartan provided excellent control of annual broadleaf weeds, it provided no appreciable control of barnyard or crabgrass, thus requiring a great deal of hand labor. The mixture of Spartan + Prowl resulted in a quality of weed control similar to that with Outlook. This illustrates the importance of having pre-emergence grass herbicides available for use with Spartan.

Outlook continued to provide good (80-89%) control of annual broadleaf weeds in late August, however, there was increasing pressure, particularly from sow thistle. Grass weed control was still excellent at the higher rate of Outlook, however the lower rate was only providing marginal grass control. The mixture of Spartan + Prowl was continuing to provide excellent control of both broadleaves and grasses. During the month of August, the eight Spartan plots were divided based on handling of runners. In four of the plots (Spartan –1) runners were tucked in to the strawberry plant row as they grew and some hoeing of grass weeds was performed. In the remaining four plots (Spartan-2) runners were allowed to fill in the space between rows and no hoeing of grass weeds was performed. Spartan continued to provide excellent control of broadleaf annual weeds. Although control of grasses with Spartan continued to be poor, it was more effective against annual bluegrass than it had been against barnyard or crabgrass.

The mixture of mustard seed meal and vinegar in plant rows, cultivation between rows, and hand-pulling of weeds had provided good weed control in the organically managed plots. To achieve this level of weed control, plots were cultivated four times (6/20, 7/7, 7/29, and 8/26/2003); plots were hand-weeded three times (7/10, 7/25, and 8/6/2003); and vinegar (acetic acid) was applied to in-row weeds five times (7/8, 7/14,7/20, 8/5, and 8/13/2003). Although the

20% concentration of acetic acid was somewhat more effective than the 5% concentration, both concentrations did a good job of burning back small weeds. The vinegar caused a slight burn on margins of strawberry leaves it contacted, but there was no effect on subsequent growth or unsprayed leaves.

Quality of weed control was poor during September in plots treated with Outlook. Spartan continued to provide excellent control of broadleaf weeds and poor control of grasses. Although the mixture of Spartan + Prowl provided good control of broadleaf weeds during most of September, quality of grass weed control had fallen off considerably.

Table 2. Ratings of phytotoxicity and quality of weed control, June 4 (5 DAT)– 18 (20 DAT), 2003.

Treatments	Phytotoxicity	Phytotoxicity	% Grass weed control *	% Broadleaf weed control *
	6/4/03	6/18/03	6/18/03	6/18/03
Plateau 1 oz	1.19 d	3.88 b	100 a	100
Plateau 2 oz	1.75 c	3.88 b	99.5 a	100
Plateau 4 oz	0.87 de	3.75 b	98.5 ab	100
Callisto 6 oz	3.44 b	5.00 a	86.25 c	100
Callisto + Prowl	4.00 a	5.00 a	96.25 ab	100
Outlook 0.65	0.19 f	0 c	99.25 a	100
Outlook 0.84	0.75 e	0 c	98 ab	100
Spartan 0.15	0.62 e	0 c	93.75 b	100
Spartan 0.15	0.62 e	0 c	95.5 ab	100
Spartan+Prowl	0.88 de	0 c	97.25 ab	100
Significance	<0.0001	<0.0001	<0.0001	NS
Mustard seed meal	0.06	1.5	98	98.25
Callisto 3 oz		3.00		
Callisto 1.5 oz		2.25		

* percent weed control compared to weedy control plots.

Table 3. Strawberry plant growth measurements, July 23, 2003 (55 DAT).

Treatment	Number leaves/plant	Number of runners	Diameter in cm
Outlook 0.65	11.64	2.18	31.60
Outlook 0.84	10.92	1.85	31.46
Spartan 0.15	10.82	1.72	30.68
Spartan 0.15	11.18	2.03	32.13
Spartan+Prowl	9.78	1.25	28.64
Weeded	10.57	1.96	29.86
Weedy	11.86	1.39	29.19
Significance	NS	NS	NS
Mustard seed meal	10	2.18	31.22
Mean	10.85	1.82	30.60

Table 4. Annual broadleaf and grass weed control, expressed as percent control compared to weedy check plots, August 1, 2003 (62 DAT).

Treatment	Broadleaf annuals*	Grasses*	Overall weed control
	-------------------------------------	%	----------------------------------
Outlook 0.65	93 bc	96 a	90 a
Outlook 0.84	96 ab	94 ab	89 a
Spartan 0.15	100 a	10 c	48 b
Spartan 0.15	100 a	8 c	45 b
Spartan+ Prowl	99 ab	89 ab	88 a
Significance	0.001	0.0000	0.0002

* Primary weeds: pigweed, lambsquarters, groundsel, sowthistle, barnyardgrass, crabgrass.

Table 5. Annual broadleaf and grass weed control, expressed as percent control compared to weedy check plots, August 25, 2003 (86 DAT).

Treatment	Broadleaf annuals*	Grasses*	Overall weed control
	-------------------------------------	%	----------------------------------
Outlook 0.65	88.75 b	77.50 ab	87.50
Outlook 0.84	82.50 b	91.25 a	87.50
Spartan 0.15 -1^	98.25 a	55.00 b	86.25
Spartan 0.15 -2^	99.50 a	38.75 bc	73.75
Spartan+Prowl	97.75 a	95.37 a	96.00
Significance	0.0032	0.0043	NS
Mean	-----	-----	86.20
Mustard seed meal	88.75	80	88.75

* Primary weeds: pigweed, sowthistle, groundsel, hawksbeard, crabgrass, annual bluegrass.
^ Spartan plots were divided so that 1= runners tucked in to row, some hoeing; 2= runners not managed.

Table 6. Annual broadleaf and grass weed control, expressed as percent control compared to weedy check plots, September 29, 2003 (121 DAT).

Treatment	Broadleaf annuals*	Grasses*	Overall weed control
Outlook 0.65	23 b	53 a	45
Outlook 0.84	23 b	61 a	40
Spartan –1	90 a	51 a	69
Spartan –2	95 a	30 b	39
Spartan+Prowl	83 a	61 a	63
Significance	0.001	0.03	NS
Mean	-----	-----	51

* Primary weeds: sowthistle, pigweed, lambsquarters, groundsel, crabgrass, annual bluegrass.

Evaluation of Promising Weed Control Strategies in Established Strawberries

2004

Diane Kaufman, Ed Peachey, and Judy Kowalski, N. Willamette Research and Extension Center, Aurora

The study was conducted in a planting of 'Totem' strawberry established on raised beds in May, 2003 at the North Willamette Research and Extension Center. The soil was a Quatama silt loam with 4% organic matter. Plots 4 rows wide (13.33 feet) by 25 feet long were arranged in a randomized complete block design with four replications. Herbicides were applied over the top of strawberry plants on October 3, 2003 (fall application) and January 20, 2004 (winter dormancy application) using a CO_2 pressurized backpack sprayer with a 4-nozzle boom (TeeJet 8002, flat fan) set at 40 PSI and a rate of 20 gallons of spray per acre. As in previous years, runners were not managed in most of the plots and were allowed to grow and fill in the space between berry rows in order to evaluate their contribution to weed control over winter. In the organically managed plots, barkdust (4 to 6 inches deep) was applied between strawberry rows on October 4, 2003. Quality of weed control from the winter herbicide application was evaluated on March 10 (48 DAT) and April 28, 2004 (98 DAT).

Results

Weed control on March 10, 2004 was excellent (90% or higher) in all herbicide treatments in which the runners were allowed to cover the area between rows. The sulfentrazone plots were duplicated so that the quality of weed control from a winter herbicide application could be compared with and without runners between the rows. Because strawberry growers in Oregon traditionally remove excess runners in fall, this treatments would demonstrate the potential contribution of unsuppressed runners to weed control over winter. Weed control was significantly reduced in sulfentrazone plots without the presence of runners. This supports observations made by this researcher from weed trials conducted in strawberries over the last 4 years. When strawberry runners are allowed to cover the ground in fall and winter, they serve as an effective cover crop for weed suppression. Weed control in the organically managed plots, which had few runners due to the thick barkdust mulch, was good (80-89%) in March, 2004. Weeds were hand removed from all plots following the March 10 weed evaluation. By the end of April, the difference in quality of weed control in sulfentrazone plots with and without runners was more pronounced, to the extent that overall weed control was poor (60-69%) in sulfentrazone plots without runners. Metolachlor, imazapic, rimsulfuron, sulfentrazone + dimethenamid-P, sulfentrazone + runners, and the barkdust mulch provided excellent weed control through harvest. The main weeds present over winter were annual bluegrass, common groundsel, hairy vetch, black medic, and white clover.

Winter-applied herbicides were also evaluated for their effect on spring strawberry plant growth and bloom. Strawberry plant growth was normal in all plots, with the exception of those treated with imazapic, in which plants were severely stunted and new growth was yellowishgreen in color (data not shown). Bloom was slightly delayed in plots treated with imazapic or rimsulfuron, and in the organically managed plots.

All plots, with the exception of the organically managed treatment, were cultivated during the first week of May to remove enough runners to have an 8 to 16 inch clear space between rows to facilitate picking. Plants were vigorous, with the exception of plots treated with imazapic, and the crop was 2 weeks early, due to abnormally warm weather. The first pick was scheduled for May 25. However, by May 20, the early ripening fruit had begun to turn brownish in color and dry up. The unexpected deterioration of the early fruit spread quickly through the entire planting, with the exception of the organically managed rows. On the day of the first pick, it was apparent that the organic, rimsulfuron, and imazapic treatments were 1 to 2 weeks behind the other treatments in fruit development. There was also a striking difference in the amount of fruit rot in all plots treated with herbicide versus the organically managed plots. Whereas only 30% of the fruit from the first pick was marketable in the herbicide-treated plots and hand-weeded and weedy controls, 90% of the first pick fruit was marketable from the organic plots (data not shown). Fruit samples from the first pick which were sent to the OSU Plant Disease Clinic tested positive for leather rot (*Phytophthora cactorum*). Although leather rot is a common disease of strawberries grown in the Midwest, it is extremely rare in Oregon. In the Midwest, leather rot is a very serious disease, and causes even normal looking berries to taste bitter and be unmarketable. Fortunately, the disease performed differently here and fruit quality improved over time. Fruit was picked from a 5-foot length of row per plot.

Imazapic applied during winter resulted in significantly lower yields than any other treatment. Based on our results, it appears that strawberry plants have little tolerance for imazapic when applied either at planting (resulted in plant death) or in winter. Although rimsulfuron has a similar mode of action and resulted in some leaf yellowing when applied to strawberries at planting, yields in established strawberries treated with rimsulfuron in winter were similar to those with other herbicides.

Among plots treated with herbicide and the hand weeded or weedy controls, there was a trend for higher total marketable yield in plots treated with sulfentrazone in which runners had been removed. Even though the presence of runners between rows significantly reduced the number of weeds, it also appears to have resulted in lower yields. Because this researcher has been maintaining runners between rows over winter in previous weed control trials with no negative effect on yield, it appears as if leather rot was a crucial factor in this trial. Although the presence of a mound of runners between rows would suppress weeds, it would also reduce air flow and cause the soil to remain wetter for longer periods of time. Increased soil moisture enhances sporulation of *P. cactorum* and facilitates infection by splashing of spores on to developing fruit.

Fruit from the organically managed plots was virtually free of leather rot. In these plots, losses in marketable yield were due primarily to Botrytis fruit rot, which became worse as the pickings progressed. Research conducted in Ohio has shown that the presence of a mulch is as effective at reducing leather rot as the application of a phosphorus acid-based fungicide (eg. Aliette, Fosphite, etc.). The mulch forms a barrier between the soil and the fruit, thereby protecting the fruit from infection by splashing soil. Even though the 4 to 6 inch thick layer of barkdust had been applied between organically managed rows for the purpose of weed suppression, it also provided the benefit of leather rot control.

Table 1. Treatments and herbicide rates.

Treatments: October 3, 2003	Rates	Treatments: January 20, 2004	Rates
	(lb ai/A)		(lb ai/A)
Simazine (grower standard)	1.00	Metolachlor	1.00
Simazine	1.00	Dimethenamid-P	0.84
Simazine	1.00	Dimethenamid-P	1.00
Metolachlor	1.00	Sulfentrazone[1] (grower standard)	0.20
Metolachlor	1.00	Sulfentrazone[1]	0.20
Hand weeded control	-----	-----	-----
Weedy control	-----	-----	-----
Simazine	1.00	Imazapic[2]	0.062
Simazine	1.00	Rimsulfuron[2]	0.25
Simazine	1.00	Sulfentrazone+Dimethenamid-P[2]	0.20 + 0.30
Organically managed[3]	Bark mulch	-----	-----

[1] Two identical sets of plots were established for sulfentrazone with the intention of dividing these plots into two different cultural practices (runners removed/tucked into the berry row or runners allowed to fill in the area between rows) later in the experiment.
[2] Plots treated with imazapic, rimsulfuron, or sulfentrazone+dimethenamid-P were blocked separately beside the other herbicide treatments.
[3] Rows managed organically were beside experimental plots and, therefore, not within the experimental design.

Table 2. Quality of weed control, expressed as percent control compared to the weedy control or number of dandelion plants.

Treatment	Annual bluegrass	Number dandelions	Overall control	Number dandelions	Overall control
	48 DAT	48 DAT	48 DAT	98 DAT	98 DAT
Metolachlor	97.5	0	97.0	0.2	91.2
Dimethenamid-p 0.84	98.0	0.2	96.5	0.5	85.8
Dimethenamid-p 1.00	99.0	0.8	97.0	0.5	86.2
Sulfentrazone + runners	97.5	1.5	95.5	0.2	96.5
Sulfentrazone – runners	85.0	16.8	74.5	29.5	62.5
Hand weeded	-----	3.5	-----	3.0	-----
Weedy	-----	7.8	-----	3.8	-----
LSD (0.05)	6.8	5.3	10.0	7.9	9.4
	99.5	0	99.8	0	98.2
Imazapic					
Rimsulfuron	100	0	99.5	0.5	98.7
Sulfentrazone + dimethenamid-p	100	0	100	0	100
LSD (0.05)	NS	NS	NS	NS	NS
Organic	82.5	0.8	85.2	0.2	96.0

Table 3. First year yield data from four picks.

Treatment	Total yield grams	Marketable yield	Marketable yield	Adjusted berry size
		g	%	g
Metolachlor	1,962	1,016	44.6	11.9
Dimethenamid-P 0.84	2,801	1,860	62.2	12.1
Dimethenamid-P 1.00	2,089	1,364	58.7	12.3
Sulfentrazone + runners	2,179	1,239	58.8	12.6
Sulfentrazone – runners	3,918	3,064	77.2	13.3
Hand weeded	2,905	1,874	62.6	12.5
Weedy	3,022	2,066	65.8	12.8
Significance (0.05)	NS	NS	NS	NS
Imazapic	542	424	81.6	6.9
Rimsulfuron	2,253	1,823	80.1	11.9
Sulfentrazone+ dimethenamid-P	2,158	1,379	63.9	12.3
LSD (0.05)	651	596	NS	0.4
Organic	4,785	3,997	83.4	16.2

Evaluation of New Herbicides for Use in Newly Planted Blackberries

2003

Diane Kaufman and Judy Koskela, NWREC/OSU

Objectives:

1. Evaluate new herbicides for weed control and effect on Marion blackberry plant vigor and growth when applied at establishment.
2. Compare these herbicides to Surflan for effect on plant vigor and growth.
3. Collect data necessary to support registration of promising herbicides.

A planting of Marion blackberry was established at NWREC on June 25, 2003 using plants transplanted to gallon-size pots the previous fall. The purpose of the main experiment is to evaluate the effect of different spacings and cane-burning practices on every-year (EY) Marion blackberries. However eight border rows (four on each side of the main planting) were also established at this time for use in evaluating new herbicides. The following herbicides were applied over the tops of Marion blackberry plants on July 1, 2003: Dual; Gallery + Outlook; Prowl; Simazine; Spartan; Surflan; and Visor. Treatments were arranged in a randomized complete block design with four replications, with plots 30 feet long (5 plants at the conventional 6 foot spacing). The effects of experimental herbicides on Marion blackberry plant growth and quality of weed control were monitored through September, 2003. All plots were hoed on October 2, and experimental herbicides were re-applied on October 6, 2003. Because cane growth was not tall enough to train to the wire, all canes were removed in the border rows prior to herbicide application. Plant growth was rated on August 4 and 19, 2003 based on a scale of 2 to 4 with 2= growth slightly below normal; 3= growth normal; 4= growth slightly above normal. Canes were counted and total cane growth measured on September 29, 2003. Quality of weed control was evaluated on 8/4, 8/18, and 9/30/2003.

Table 1. Treatments and herbicide rates, summer and fall, 2003.

Treatment	Summer rate: lb ai/A	Fall rate: lb ai/A
Dual Magnum	1.25	1.25
Gallery + Outlook	0.75 + 0.35	0.75 + 0.40
Outlook	0.75	0.84
Prowl	3.00	2.00
Simazine	1.33	2.00
Spartan	0.225	0.225 + 0.40 Outlook
Surflan	2.00 and 4.00	2.00
Visor	0.5	0.5

Results

There were no signs of phytotoxicity from any of the herbicides on young Marion blackberry plants. Plants treated with Dual Magnum, Gallery + Outlook; Outlook or Surflan appeared to grow most vigorously. Plots treated with Outlook, Dual Magnum, and Simazine had more canes than plots treated with Visor or the 4 lb ai rate of Surflan. Because the 2 lb ai rate of Surflan was applied to the middle rows (the spacing and caneburning trial) and was not within the experimental design of the herbicide trial in the border rows, the measurements from 4 plots treated with Surflan at the 2 lb ai rate can not be included in the statistical analysis with the other herbicide treatments. However, Plots treated with Simazine and plots treated with Surflan at the 2 lb ai rate had the same number of canes per plot. Plots treated with Outlook had more total cane growth than plots treated with Prowl, Spartan, Surflan at the 4 lb ai rate, or Visor. There were no differences among treatments in average cane length (total cane growth/cane number).

All herbicides provided excellent (90-100%) control of broadleaf weeds on 8/4/03. Grass weed control on 8/4 was also excellent with Dual Magnum, Gallery+ Outlook, Prowl, Surflan, and Visor. Outlook provided good (80-89%) control of grasses, however there was significant pressure from crabgrass. Crabgrass control was marginal with Simazine and poor to non-existent with Spartan. Dual Magnum, Gallery + Outlook, Prowl, Surflan, and Visor continued to provide excellent overall weed control on 8/19/03. Simazine provided good overall weed control, however there was pressure from crabgrass and sowthistle. Weed control in plots treated with Outlook alone was marginal by 8/19 due to the presence of crabgrass, sowthistle, and clover. Plots treated with Spartan were completely overrun with crabgrass. The final weed evaluation was conducted on 9/30/03. By this time annual bluegrass was beginning to be prevalent.

By September 30, 2003 quality of weed control had been reduced among all treatments due to severe weed pressure, particularly in the last replication. In some cases (Prowl, Dual Magnum, Visor), overall weed control on 9/30 was good to excellent in the first three replications. However extreme weed pressure in the last replication tended to skew averages. The mixture of Gallery + Outlook continued to provide good weed control (80-89%), however there was pressure from annual bluegrass and sowthistle. Prowl, Visor, and Simazine provided fair (70-79%) weed control. Weed control in the Dual Magnum plots was marginal due to pressure from crabgrass, sow thistle, and groundsel. Surflan was succumbing to pressure from sow thistle and groundsel. Plots treated with Spartan alone were overrun by grasses. Even though Outlook is primarily a grass herbicide, it was beginning to succumb to pressure from crabgrass and annual bluegrass, in addition to sow thistle and groundsel.

Table 2. Marion blackberry plant growth response to herbicides.

Treatment	Growth rate 8/4/03	Growth rate 8/19/03
Dual Magnum 1.25	4.00 a	3.88 a
Gallery + Outlook	3.75 ab	3.25 abc
Outlook 0.75	3.50 abc	3.38 abc
Prowl 3.00	3.25 bc	2.75 c
Simazine 1.33	3.00 c	3.00 bc
Spartan 0.225	3.00 c*	2.88 c*
Surflan 4.00	3.50 abc	3.50 ab
Visor 0.5	3.00 c	2.88 c
Significance	0.0307	0.0442

* Growth rate evaluations complicated by the fact that plots treated with Spartan became overrun with crabgrass.

.

Table 3. Cane number and total cane length, 9/29/03.

Treatment	Number of canes/plot	Number of canes/plant	Total cane growth (feet)	Average cane length (feet)
Dual Magnum	14.50 ab	2.90 ab	86.27 ab	5.98
Gallery+Out	12.25 bc	2.45 bcd	77.10 abcd	6.67
Outlook	15.75 a	3.15 a	91.31 a	5.82
Prowl	12.25 bc	2.45 bcd	62.23 bcd	5.04
Simazine	14.75 ab	2.95 ab	81.56 abc	5.49
Spartan	13.25 abc	2.65 abc	66.23 bcd	5.04
Surflan 4 lb ai	11.00 c	2.20 cde	62.08 cd	5.69
Visor	10.25 c	2.05 cde	54.98 d	5.30
Significance	0.0387	0.0387	0.0475	NS
Surflan 2 lb ai	14.75	2.95	78.13	5.30

Table 4. Quality of weed control, expressed as percent control compared to weedy control areas between plots, August 4 (33DAT) and August 18 (47 DAT), 2003.

Treatment	Broadleaf weeds 8/4/03 *	Grass weeds 8/4/03 *	Overall weed control 8/19/03*
Dual Magnum	99.50	93.25 ab	91.50 ab
Gallery+Outlook	100	92.25 ab	96.25 a
Outlook	93.75	83.75 b	65.00 c
Prowl	98.75	100 a	98.50 a
Simazine	100	67.50 c	81.25 b
Spartan	100	30.00 d	5.00 d
Surflan 4 lb ai	100	98.25 ab	97.75 a
Visor	98	99.50 a	96.75 a
Significance	NS	0.0000	0.0000
Mean	98.75	-----	-----

* Primary weeds – 8/4/03: pigweed, nightshade, sowthistle, groundsel, crabgrass, barnyardgrass. 8/19/03: sowthistle, groundsel, clover, crabgrass

Table 5. Quality of weed control, expressed as percent control compared to weedy control areas between plots and primary weeds* coming through each herbicide, 9/30/03 (90 DAT).

Treatment	Overall weed control	Crabgrass	A. blue	Sow	Ground	Mallow	Smart	Hawks	Pig
Dual	67.5 a	***	**	***	****	*		*	
Gall+Out	80.0 a	**	***	****	**		*		
Outlook	27.0 b	***	**	****	*		*		
Prowl	78.0 a	*			***	*			
Simazine	70.0 a	****	***	***	*				*
Spartan	50.0 ab	****	*						
Surflan	58.8 a	**	*	****	***	*			*
Visor	79.2 a			**		*		*	
Significance	0.0297								

* Weeds: A. blue= annual bluegrass; Sow= sow thistle; Ground= groundsel; Smart= ladysthumb smartweed; Hawks= hawksbeard; Pig= pigweed.
Weed occurrence: *=1 of 4 reps; **= 2 of 4 reps; ***= 3 of 4 reps; ****= 4 of 4 reps.

Evaluation of New Herbicides for Use in Blackberries

(2004)

Diane Kaufman and Judy Kowalski
North Willamette Research and Extension Center Aurora

The study was conducted in a two year old planting of ‘Marion’ Blackberry established on a Quatama silt loam soil with 4% organic matter at the North Willamette Research and Extension Center. Plots 10 feet wide by 30 feet long (5 plants per plot) were arranged in a randomized complete block design with 4 replications. Herbicides were applied over plots of untrained ‘Marion’ blackberry canes on October 6, 2003 and March 23, 2004, using a CO_2 pressurized backpack sprayer with a 3-nozzle boom (TeeJet 8002, flat fan) set at 40 psi and a rate of 20 gallons of water per acre. Quality of weed control from the fall herbicide application was evaluated on March 10, 2004. Quality of weed control from the spring herbicide application was evaluated April 14 and July 30, 2004.

Thiazopyr, sulfentrazone + dimethenamid-p, and simazine provided the best weed control of the fall-applied herbicides. The main weeds present over winter were common chickweed, annual bluegrass, common groundsel, annual sow thistle, shepherdspurse, white clover, and vetch. Of these, clover was the only weed that survived in plots treated with thiazopyr. Weed control 21 days after the spring herbicide application was excellent (90-100%) in plots treated with thiazopyr, good (80-89%) in plots treated with sulfentrazone + dimethenamid-p, pendimethalin, flumioxazin, and metolachlor, and fair (70-79%) in plots treated with simazine, oryzalin, and dimethenamid-p. Quality of weed control from the spring herbicide application deteriorated as the summer progressed. By 129 days after treatment, thiazopyr provided good weed control, while flumioxazin and pendimethalin provided fair weed control. The main weeds present during spring and summer were crabgrass, redroot pigweed, annual sowthistle, common groundsel, and clover.

Temperatures in early spring, 2004 were warmer than usual, resulting in early emergence of new primocanes. Because some new primocanes were present at the time of the spring herbicide application, we were able to observe the effect of experimental herbicides on primocane burn and growth.

Metolachlor, dimethenamid-p, simazine, oryzalin, and thiazopyr (0.5 lb ai) did not damage newly emerged primocanes. In a previous trial by this researcher, thiazopyr burned back recently emerged primocanes in ‘Meeker’ red raspberry when applied at rates of 0.75 and 1.0 lb ai/A. Pendimethalin resulted in some marginal burn and curling of primocane leaves. Both flumioxazin and sulfentrazone + dimethenamid-p burned new primocanes back completely. Two weeks later, primocanes were growing well in plots treated with metolachlor, simazine, oryzalin, and dimethenamid-P. Primocane growth was intermediate in plots treated with thiazopyr and pendimethalin. New primocane leaves in plots treated with pendimethalin continued to be somewhat curled. Primocane growth was greatly reduced in plots treated with flumioxazin and sulfentrazone + dimethenamid-p.

The effect of the various herbicides on 'Marion' blackberry plant vigor was assessed by measuring primocane number, diameter, and height of two plants per plot during the first week of August, 2004. Although primocane growth in plots treated with flumioxazin and sulfentrazone + dimethenamid-p lagged behind most other treatments during the spring, there were no significant differences among treatments in mean primocane number per plant, cane diameter, or total cane growth measured in early August (data not shown).

Table 1. Treatments and herbicide rates.

Treatments: October 26, 2003	Rates	Treatments: March 23, 2004	Rates
	(lb ai/A)		(lb ai/A)
Metolachlor	1.25	Metolachlor	1.25
Isoxaben + dimethenamid-P	0.75 + 0.30	Flumioxazin	0.075
Dimethenamid-P	0.75	Dimethenamid-P	0.75
Pendimethalin	2.00	Pendimethalin	2.00
Simazine	1.33	Simazine	1.33
Sulfentrazone + dimethenamid-P	0.225 + 0.25	Sulfentrazone + dimethenamid-P	0.225 + 0.25
Oryzalin	2.00	Oryzalin	2.00
Thiazopyr	0.50	Thiazopyr	0.50

Table 2. Quality of weed control, expressed as percent control compared to weedy control areas between plots.

Treatment	Overall weed control from fall application March 10 (156 DAT)	Overall weed control from spring application April 14 (21 DAT)	Overall weed control from spring application June 30 (129 DAT)
Metolachlor	53.8	80.0	66.9
Isoxaben + dimethenamid-p	52.5	-----	-----
Flumioxazin	-----	83.2	75.6
Dimethenamid-P	68.8	73.0	59.4
Pendimethalin	66.2	83.2	76.2
Simazine	87.5	76.2	60.6
Sulfentrazone + dimethenamid-p	91.2	88.8	70.0
Oryzalin	67.5	74.8	55.0
Thiazopyr	94.0	93.8	85.0
LSD (0.05)	16.8	11.1	NS

Table 3. Effect of spring applied herbicides on primocane growth, 2004.

Treatment	Primocane damage rating[1] March 30 (7 DAT)	Primocane growth rating[2] April 21 (21 DAT)
Metolachlor	0	4.0
Flumioxazin	2.6	1.6
Dimethenamid-p	0.1	3.2
Pendimethalin	1.2	2.6
Simazine	0.2	3.6
Sulfentrazone +dimethenamid-p	3.0	1.5
Oryzalin	0	3.5
Thiazopyr	0.2	2.2
LSD (0.05)	0.4	0.8

[1]Damage rating: 0 = no damage; 1 = leaf margins burned; 2 = leaves and cane tips burned; 3 = primocane burned back to the ground.

[2]Regrowth rating: 1 = poor (5 to 10 inches high); 2 = fair (10 to 15 inches high); 3 = good (15 to 19 inches high); 4 = very good (20 or more inches high).

Tillage System and Herbicide Placement Effects on Potential Losses of Metolachlor in Sweet Corn

E. Peachey, D. Rupp, R.D. William, and J. Selker
Horticulture and Bioresource Engineering, OSU

Losses of moderately soluble soil-applied herbicides such as metolachlor may be exacerbated by conservation tillage systems. The objective of this project was to determine whether application of metolachlor to the tilled band in strip-tillage corn would significantly reduce vadose zone losses of metolachlor during the growing season compared to broadcast applications in strip-tillage in conventional tillage systems.

The effect of herbicide placement on potential metolachlor losses in two tillage systems was measured between and below sweet corn rows after metolachlor was either broadcast or banded over the row. Metolachlor at 4 lbs ai/A was applied with a backpack CO_2 sprayer and 20 GPA water. Soil water was collected with four porous suction-cup samplers in each plot, installed after corn planting and located between and under corn rows below the plow pan. Immunoassays were used to determine metolachlor concentrations.

The average concentration of metolachlor in soil water from under and between rows was 5 times greater in strip-tillage than in conventional tillage plots over 4 sampling periods. Banding of metolachlor in strip-tillage corn reduced concentrations by an average factor of 5, and a maximum of 7.8 at approximately one month after the herbicide was applied, more than compensating for the 3-fold reduction due to banding. Additionally, banding of metolachlor in strip-till plots reduced metolachlor concentrations in soil water collected from both between and under rows to levels of metolachlor found in the soil water of conventional tillage plots. The cause of the increased concentrations in strip-tillage is unclear. Infiltration rates in the conventional tillage plots were more than double those in the strip-tillage plots, based on 32 single-ring infiltration tests conducted during the irrigation season.

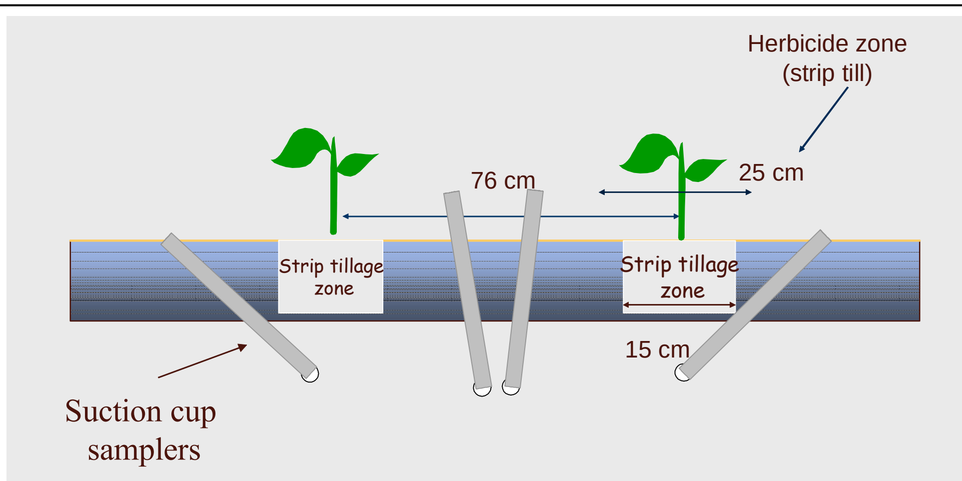

Figure 1. Sampler placement and installation.

Table 1. Effects of herbicide placement, tillage level, and sample collection site on s-metolachlor concentrations in water collected with suction cup samplers at 38 cm below the soil surface in sweet corn.

Main effect	Level	Obs.	S-metolachlor	
			Mean	SE
			(PPB)	
Herbicide placement	Banded	28	2.3 b	0.5
	Broadcast	32	6.4 a	1.6
Tillage level	Conventional	30	2.7 a	0.7
	Strip tillage	30	6.2 a	1.6
Sample site	Row middles	27	4.4 a	1.1
	In row	33	4.5 a	1.4

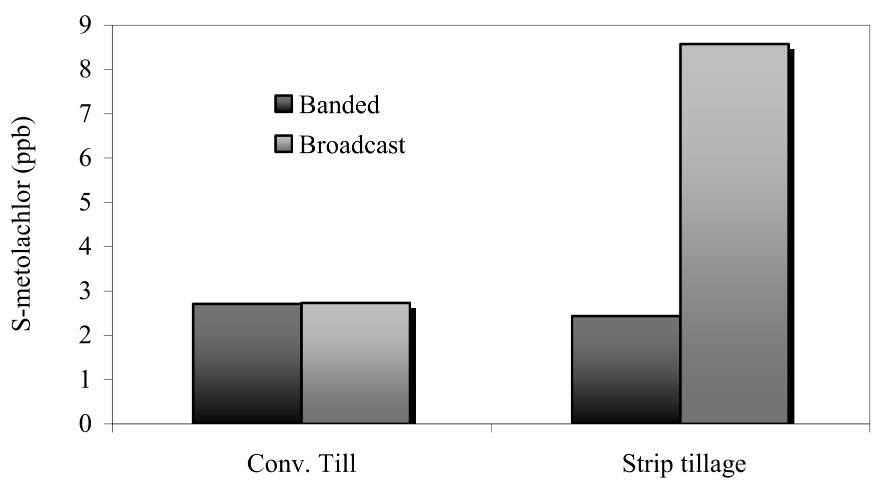

Figure 2. Effect of tillage system and herbicide application on s-metolachlor concentrations 38 cm below the soil surface in sweet corn.

Effect of Nurse Crops on Soil and Pesticide Loss in Newly-planted Grass Seed

S. Aldrich Markham, E. Peachey, and R. D William
Yamhill Co. Extension, McMinnville, and Horticulture Department, OSU

Grass seed fields in the Willamette Valley of Oregon are vulnerable to soil erosion during their establishment period. Not only is the soil sediment from eroded fields detrimental to waterways, the herbicide diuron, which is typically applied at planting, can be carried to waterways attached to the soil particles. Fields are typically planted in October into a smooth seedbed in 10- to 14-inch rows. Rainfall is 40 inches or more per year, falling mostly during the winter when the crop plants are still small and there is little vegetation to hold the soil. Approximately 450,000 acres of grass for seed production are grown in the Willamette Valley. About 20% of these, or 90,000 acres, are newly-planted fields of perennial species.

Since excellent grassy weed control is required in grass seed production, the crop is typically carbon-band planted, with a one-inch wide band of activated charcoal applied as a slurry directly over the seed row. This is followed by an application of diuron over the field. Weed seedlings germinating between the rows are killed, while the charcoal band adsorbs the diuron and protects the crop seedlings. The seedbed must be smooth in order to precisely apply the charcoal band. Any practice for controlling erosion must be compatible with the carbon-band planting system.

This research investigated the feasibility of planting a nurse crop in the field just prior to planting the grass seed crop. A suitable nurse crop species would grow more quickly than the grass in the fall and provide both vegetative cover and root mass to hold the soil. Two requirements for this nurse crop are: 1) it must be able to survive the diuron applied with the carbon-band seeding and 2) it must be able to be removed, without injuring the grass, around the first of March, before it gets so large that it starts to choke out the grass. A nurse crop might be planted only across the sloping parts of a field in contour strips or planted in swales that are particularly susceptible to erosion.

Previous research by the authors had demonstrated that spring oats (planted 1.5 inches deep) can tolerate diuron and that even the least hardy spring oat varieties survive typical winter temperatures in the area. The most effective herbicide for removing an oat nurse crop, Horizon or fenoxaprop (which gave about 80% control), was taken off the market by the manufacturer in 2000 and is no longer labeled for use in grass seed. One goal was to find a labeled herbicide or combination that could remove spring oats without injuring the grass.

Methods – October 2001-April 2002

A nurse crop strip of Cayuse spring oats approximately 25 ft wide was planted in mid-October by the growers in each of three fields, two perennial ryegrass and one tall fescue, located in the Dayton and Rickreall areas. Before the nurse crop emerged, the growers carbon-band planted their grass seed crops and applied diuron. In December the growers also applied ethofumesate (Nortron) for grassy weed control. Ethofumesate has some activity on oats, but by this time the plants were so large (3-4 leaves) that the only effect was slight stunting.

A trial was conducted in one perennial ryegrass field to compare herbicides labeled for grass seed on both their ability to remove the nurse crop and on injury to the grass seed crop. The nurse crops stands in the other two fields were not uniform enough for conducting this type of trial. Plots were 10 feet by 25 feet. Three treatments with three replications – glufosinate (Rely), oxyfluorfen (Goal), and glufosinate plus oxyfluorfen – were applied on 23 February 02 using a backpack CO_2 sprayer. After the final evaluation, the oats remaining in the check plots, as well as the nurse crop stand in the other perennial ryegrass field, were sprayed with glufosinate to remove them. In the tall fescue field, where the grass and nurse crop were irrigated at planting, the oats were so large that they needed to be sprayed with glufosinate in early February then mowed two weeks later to reduce the competition with the crop.

Results and Discussion

The herbicide treatments were evaluated visually on 2 April 02 for percent oat control (Table 1). The perennial ryegrass stand was not killed by any of the treatments (no sections of rows were missing), although the grass was stunted from the combination of herbicide injury and competition from the oat nurse crop. Glufosinate alone and glufosinate plus oxyfluorfen reduced the oat biomass by 85-90%, thus reducing the competition with the grass seed crop to an acceptable level. However, the oat plants that survived still produced seedheads. Small seeds from these stunted plants (so-called "pin oats") are difficult to clean out of grass seed, so they are a worse contaminant than regular-sized oats. Based on a visual estimate of the number of oat plants either alive or dead, glufosinate alone and glufosinate plus oxyfluorfen gave only 65% control. Because of the seed contamination problem, this level of control is less than acceptable.

The serendipitous occurrence of a stand of volunteer meadowfoam (*Limnanthes alba*) from seed left in this field after the previous crop gave the idea for another possible nurse crop species. This meadowfoam had survived the diuron and was thick enough to provide even more vegetative cover than the oats. Another herbicide treatment added to the plots showed that meadowfoam could be 100% controlled with carfentrazone (Aim), already labeled for grass seed, at 0.025 lb ai/a, with no crop injury. An easy-to-kill nurse crop would make the nurse crop practice more readily adoptable by growers.

Methods – October 2002-April 2003

Nurse crop trials comparing meadowfoam, Regreen (a sterile wheat/rye hybrid) and no cover were established with three replications in four growers' fields, located in the Dayton, Newberg and Suver areas. The nurse crops were planted by the researchers using a seed drill. The seeding rate was 25 lbs/a for the meadowfoam and 40 lbs/a for the Regreen. The plots, approximately 35 feet wide by 40 feet deep, were laid out in a contour strip across the slope. Slopes were uniform in each field, ranging from about 5 to 8%. Each grower then carbon-band planted his perennial ryegrass and applied diuron before the nurse crops emerged.

In one field, planted in early October, both the grass seed crop and nurse crops failed because of lack of rain. In the other three fields, planted in late October, they germinated

Table 1. Percent control of the spring oats nurse crop on 4/2/02 in a perennial ryegrass seed field.

Herbicide	Rate	Date applied	Oat growth stage	% Oat control (biomass)	% Oat control (living plants)
Glufosinate	0.375 lb ai/a	2/28/02	6-in, 5 leaves	85	65
Oxyfluorfen	0.375 lb ai/a	2/28/02	6-in, 5 leaves	45	5
Glufos + oxyfluor	0.375 + 0.375 lb ai/a	2/28/02	6-in, 5 leaves	90	65
Check				0	0

successfully. The amount of erosion was estimated by measuring the change in soil surface level on 12 "erosion pins" installed in each plot at the beginning of the season. The erosion pins were made from 0.25-inch wooden dowels, cut 18 inches long and sharpened at one end. These were pushed into the soil in each plot one foot apart in a line across the slope, with six pins placed inside the nurse crop strip and six placed about one foot below the strip. The distance from the top of each pin to the surface of the soil was measured with a ruler. Diuron loss from plots was estimated by collecting water at the bottom of the nurse crop strips and using immunoassays to determine concentration in the runoff water. In early April, after the erosion data was collected, the Regreen was sprayed with glufosinate at 0.375 lb ai/a, using a CO_2 backpack sprayer, to reduce competition with the grass seed crop.

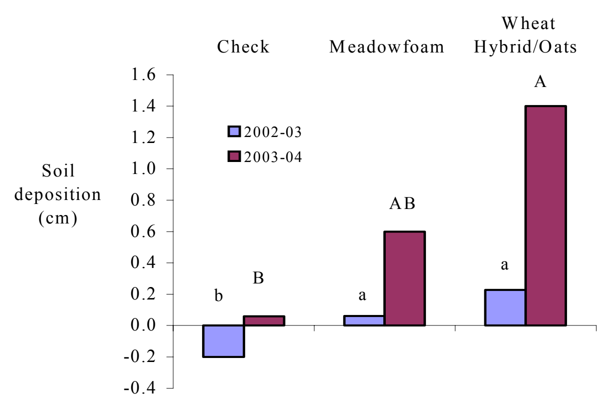

Figure 1. Effect of nurse crops on soil deposition near the lower slope of plots in two perennial ryegrass fields from November through January near Suver, OR. The cereal nurse crop was sterile wheat hybrid in 2002-03 and Monida oats in 2003-04. Bars with the same case letter in the same year do not differ (LSD, P=0.10).

Results and Discussion

The idea behind trying Regreen was that even if it could only be partially removed with herbicide, at least it would not make seed to contaminate the grass seed crop. The Regreen plants stayed relatively small in the fall, and this growth habit made them less suitable as a nurse crop than spring oats, which grow more vigorously in the fall. In order to get enough fall cover with Regreen, the seeding rate would have to be increased from the 40 lbs/a used in this study to at least 100 lbs/a. At the current price of about $1.00/lb for the seed, this would be too costly for most growers.

Establishment of the meadowfoam was marginal at all sites because of diuron injury. The meadowfoam plants remained yellow and stunted, then finally disappeared by early January, though they did fairly well in the carbon bands where they were protected from the diuron. The Regreen was not injured by the diuron, and it performed better than the meadowfoam at all three sites.

Erosion pin measurements at two of the three sites in 2002-03 indicated more soil deposition if nurse crops were planted. Data from the Suver site is shown in Fig. 1. There also was more soil loss outside the nurse crop strips than inside, indicating that the nurse crop was slowing water movement in the nurse crop strip, causing soil to settle from the runoff.

Estimates of diuron loss are presented for the Suver site, and indicated that there was no significant difference between diuron loss from the meadow foam and nursecrop plots (Fig. 2). Mass flow from the check plots may have been slightly higher early in the season, possibly because of the drier soil conditions where the meadowfoam was growing that reduced runoff.

The glufosinate used to remove the Regreen did not perform as well as in the herbicide trial the previous year, possibly because it was sprayed almost a month later and the Regreen was 8-12 inches tall. The Regreen plants turned yellow but did not die, while the grass seed stand was injured.

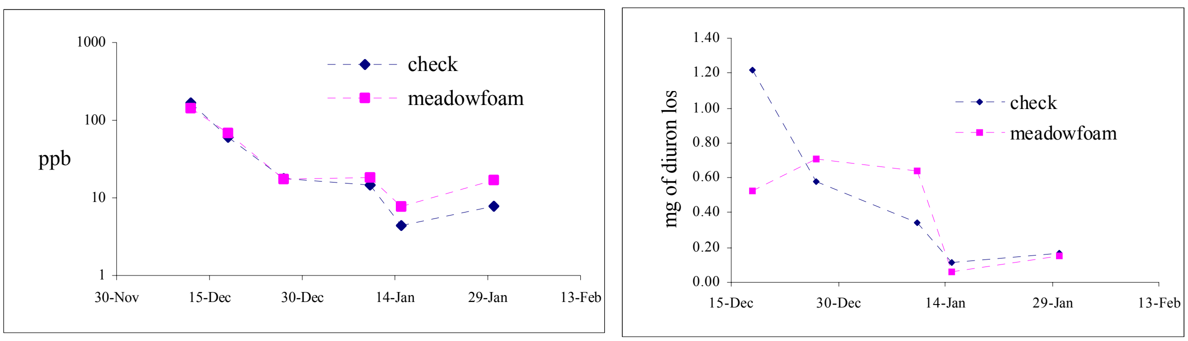

Figure 2. Effect of nurse crops on diuron concentrations (A) and estimated mass flow (B) in water collected at the lower end of the plots, Suver, OR 2002-03.

Methods – October 2003-April 2004

A trial was established at the Horticulture Research Farm in Corvallis to evaluate strategies for improving the survival of a meadowfoam nurse crops under a diuron application and to evaluate the potential use of phacelia (*Phacelia tanacetifolia*) as a nurse crop species. Meadowfoam was planted with a drill at three seeding depths (0.5, 1.0, and 1.5 inches). Across these treatments diuron was applied at three rates (1.5, 2.0 and 2.5 lb ai/a), giving nine combinations of seeding depth and herbicide rate. Phacelia, planted 0.5 inches deep, had the same three rates of diuron. Plots were 20 by 30 feet.

Nurse crop trials comparing meadowfoam, Monida spring oats and no cover were established with three replications in three growers' perennial ryegrass fields, located in the Dayton, Monmouth and Suver areas. The nurse crops were planted by the researchers in mid-October using a seed drill, in plots approximately 35 by 40 feet, laid out in a contour strip across the slope. The seeding rate was 40 lbs/a for the meadowfoam and 100 lbs/a for the oats. Each grower then carbon-band planted his perennial ryegrass before the nurse crops emerged. In two fields, diuron was applied 2.0 lb ai/a, and in the third field it was applied at 2.4 lb ai/a (the rate used by most growers). Slopes were approximately 3 to 5% and uniform in each field.

Erosion was estimated in two ways: 1) by measuring the change in soil surface level on 10 erosion pins installed in each plot at the beginning of the season; and 2) by collecting samples of runoff from the plots, then drying and weighing the sediment. The runoff samples were collected from a bordered one-square-meter area within each plot. The tubs were emptied every 1 to 2 weeks. After a thorough stirring to suspend the sediment, a 1000 ml sample was taken from each tub, and the soil sediment was dried and weighed.

The nurse crops were sprayed at all sites in late March using a CO_2 backpack sprayer. Fenoxaprop at 0.25 lb ai/a was used on the oats rather than glufosinate in order to avoid damaging the grass seed crop, and carfentrazone at 0.025 lb ai/a was used on the meadowfoam. One site was mowed in addition.

Results and Discussion

In the Horticulture Research Farm trials, there was a slight but insignificant improvement in meadowfoam and phacelia emergence with deeper planting depths. However, both species were injured by the diuron. The meadowfoam plants had all disappeared by early spring, but the phacelia made a comeback, possibly due to hard seed that germinated after the diuron had dissipated. Because phacelia did not provide significant cover during the critical winter months, it was judged to have little value as a nurse crop with carbon-band seeding.

In one grass seed field, the Suver site, where the diuron had been applied at the lower rate of 2.0 lbs ai/a, the meadowfoam produced a good stand. The meadowfoam and the spring oats significantly reduced erosion by a similar amount, based on the sediment samples from the one-meter-square plots. By mid-February the cumulative soil loss was about 2,500 lb/a with no cover and only about 1,500 lb/a with the nurse crop (Fig. 3A). This demonstrates that even where the nurse crop stand becomes well-established, it cannot completely eliminate erosion because it is planted at the same time as the grass seed crop. There is very little vegetative cover on the soil during late October and November.

The meadowfoam at the other two sites was injured by the diuron, as had happened 2003. The plants remained small, then finally disappeared by early January, except in the carbon rows.

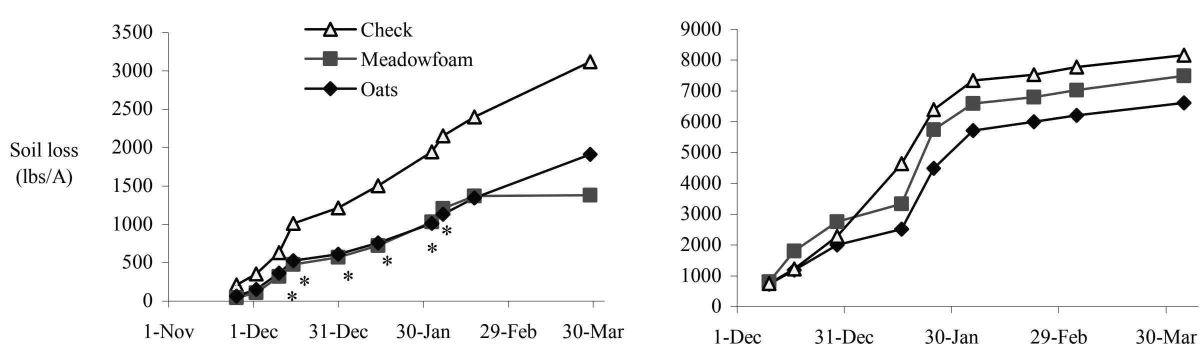

Figure 3. Effect of nurse crops on cumulative soil loss in perennial ryegrass Suver (A) and Dayton (B), OR 2003-04. Cumulative values for the oat and meadowfoam nursecrops followed by * for the same date differ from the check at P=0.10. Note difference in scale between the two charts.

At the Dayton site there was no significant difference in soil loss between the check plots without nurse crops and either of the nurse crop treatments (Fig. 3B). The nurse crops were planted late (29 October 03), and through December and January the oats were too small to provide much vegetative cover. The cumulative soil loss by mid-February was 6,000 to 7,000 lb/a, much higher than the Suver site even though it was not on a steeper slope, due possibly to soil type and previous management. At the Monmouth site, the oats did poorly because of flooding. The plots had inadvertently been located on an area of the field with a permanent seep. In a spray skip, where the meadowfoam had escaped the diuron, it grew well with a half inch of water standing on the surface all winter.

The erosion pin data was measured deposition at the lower end of the plots, giving a measure of the effectiveness of the nurse crop plots as filter strips for sediment. Erosion pin measurements indicated that at the Suver site the oat cover crop significantly increased soil deposition compared to the check without a nurse crop (Fig. 1, 2003-04). A similar trend noted at the Dayton site was statistically insignificant. This deposition measurement is in contrast to the soil loss measurement within the soil enclosures, which estimated the potential of nurse crops to prevent soil from dislodging during rainfall.

Conclusions

We demonstrated that under the best circumstances, nurse crops can reduce erosion potential by half. We were unable, however, to develop a reliable recipe for using a nurse crop successfully in every field. Spring oats always survived the diuron, because they were planted at least 1.5 in deep, but they were difficult to completely control at the appropriate early-March timing. The herbicides labeled for grass seed allowed some oats to survive and produce seed, or they caused unacceptable crop injury, or both.

Meadowfoam is sensitive to diuron. It escaped the diuron and produced a good stand in certain situations, probably because of some combination of factors – high organic matter and/or high clay content in the soil, deep planting, and lower rates of diuron. As long as diuron herbicide is used, however, there is a risk of stand failure. It is possible that if diuron is not used in a new grass seed planting, a meadowfoam nurse crop may provide enough competition to significantly reduce weeds. The weed-control side benefits of a meadowfoam nurse crop were not investigated here, but would be a good topic for future research.

Effect of Herbicides and Irrigation Scheduling on Weed Emergence and Disease Development in Sweet Corn

(2003)

Ed Peachey, Horticulture
Robin Ludy, Botany and Plant Pathology
Jim Myers, Horticulture
Mary Powelson, Botany and Plant Pathology
Alex Stone, Horticulture

Methods

Plots were located at the Vegetable Research Farm near Corvallis with a silt loam soil. The field had a history of root rot. There were four irrigation levels applied to plots. Plots were either pre-irrigated and Jubilee sweet corn (2 seeds/ft) planted (plant to moisture treatment), or the corn was planted into dry soil and irrigated (irrigated-up treatment). These two initial irrigation levels were followed by either a low or high irrigation rate until the 6th leaf stage of corn when roots were dug and radicles evaluated for disease. Thereafter, irrigation rates were the same for all treatments (see Table 1). Dual Magnum (16 oz/A), Outlook (24 oz/A), and Atrazine (2 qts/A) were all applied preemergence shortly after the corn was planted. Hand hoeing augmented herbicides to minimize weed competition. The check plot was untreated until July 25, when Distinct herbicide (4 oz/A) was applied to control purslane.

Results

Corn emergence was best when the soil was pre-irrigated and corn was planted one week later (Table 2). Corn height was greatest under the high irrigation regime, particularly when planted to moisture and followed by the high irrigation level. Corn height was severely restricted by the application of Distinct herbicide in the check plots to control purslane, but also reduced by a lesser degree with Dual Magnum and Outlook, depending on irrigation level.

Weed emergence was primarily related to herbicide (Table 2). There was very little indication that irrigation level was influencing herbicide efficacy, with the exception of purslane.

Radicle root rot ratings at midseason were significantly greater under the high irrigation regimes (Table 2). Mesocotyl and nodal root rot ratings also were influenced by irrigation, but the effect was much less. There was very little indication statistically that herbicides were influencing lesions on the radicle. However, as other experiments have indicated, Dual Magnum may have caused more lesions to form on the radicle than atrazine or Outlook at the low irrigation level (Fig. 1).

Root rot evaluation at harvest indicated similar trends; root rot was greatest in treatments with higher irrigation rates through mid-season (Fig. 2). Additionally, the radicle ratings taken at mid-season were partially correlated with the root rot ratings at the end of the season (Fig. 3), demonstrating the utility of radicle evaluation to predict root rot potential.

Significant firing was observed in treatments with the higher irrigation levels at harvest (Table 3). A second evaluation 2 weeks later found that firing had significantly advanced in the high irrigation plots. Firing was also observed in the low irrigation plots, but at much lower levels.

Sweet corn yield was greatest when irrigation was restricted during the first six weeks after planting (Table 3). The check treatments yielded very poorly because of injury from Distinct herbicide (possibly due to high temperatures after application). Treatment with Dual Magnum and Outlook also tended to yield less than the atrazine treatment under both irrigation regimes. In the end, treatments with very low irrigation levels during the 6 weeks after planting yielded as good as or better than comparative herbicide treatments under high irrigation. This data is contrary to emergence and growth measurements made up to 8 weeks after planting, in which corn height was greater under the higher irrigation levels.

This study indicates that irrigation management may be a tool that can be used to reduce root rot in sweet corn. Depriving corn of water (to the point of severe stress) for the first 6 weeks reduced root rot and firing at harvest, but did not affect corn yield. This result was noted even though irrigation applied during the last half of the growing period was greater than typically applied to sweet corn.

Summary

- Soil herbicide had very little effect on root rot.
- Reducing the irrigation level during the first 6 weeks after planting reduced root rot and firing of Jubilee sweet corn but did not affect corn yield.
- Pre-irrigating the soil before planting improved crop emergence and growth throughout the season, but also caused more root rot than when corn was ‘irrigated up’.
- The rating used to quantify lesions on the radicle was a good predictor of root rot when corn was harvested

Table 1. Irrigation timing and delivery.

17-Jun	**-7**	Pre-irrigated 'plant to moisture' plots.			1.5	1.5
24-Jun	**0**	Planted jubilee, 487 lbs 12-29-10; 6 inch spacing, Lorsban 15 G at 8 oz per 1000ft, 2 inches deep				
25-Jun	**1**	Applied PES herbicides	1	1		
1-Jul	**7**		1	1	1	1
6-Jul	**12**		2		2	
11-Jul	**17**		3		3	
16-Jul	**22**		3.3		3.3	
22-Jul	**28**		2.5	2.5	2.5	2.5
27-Jul	**33**		3		3	
31-Jul	**37**		3		3	
		TOTAL HRS of IRRIGATION to 37 DAP	18.8	4.5	19.3	5.0
		TOTAL IRRIGATION to 37 DAP(estimated inches)	**7.5**	**1.8**	**7.7**	**2.0**
4-Aug	**41**	Root collection for root rot evaluation				
5-Aug	**42**		3	3	3	3
12-Aug	**49**		4	4	4	4
18-Aug	**55**		4	4	4	4
25-Aug	**62**		4	4	4	4
1-Sep	**69**		4	4	4	4
8-Sep	**76**		4	4	4	4
14-Sep	**82**	Rain (equivalent to 2 hrs)	2	2	2	2
27-Sep	**95**	Harvest				
		Total irrigation/rain (inches)	**17.5**	**11.8**	**17.7**	**12.0**
		Percent of maximum irrigation	99	67	100	68

Table 2. Effect of irrigation on early and midseason corn growth, root disease rating, and weed control.

Irrigation level: At planting	Irrigation level: First six weeks	Herbicide	Obs	Corn emergence	Corn height	Corn height (Aug 18, 8 WAP)	Root ratings at midseason: Radicle	Root ratings at midseason: Mesocotyl	Root ratings at midseason: Nodal	Weed control: Lambsquarters	Weed control: Pigweed	Weed control: Nightshade	Weed control: Purselane	Weed control: Grass	Weed control: Misc.	Weed control: Total weeds
				No./10 ft	In.	Ft	------------- 0 – 4	--------------		------------------ No/m sq						------------------
Irrigate up	High	Atrazine	3	12	11.1	7.6	2.9	0.9	0.2	1	0	2	1	0	0	4
Irrigate up	High	Dual Magnum	3	12	12.0	7.5	2.3	0.6	2.9	13	0	4	5	0	0	22
Irrigate up	High	Outlook	3	11	12.0	7.3	2.4	0.9	1.0	12	2	2	1	0	0	17
Irrigate up	High	Check	3	12	12.2	6.2	2.6	0.4	0.9	71	8	33	63	0	0	174
Irrigate up	Low	Atrazine	3	9	9.9	6.6	1.3	0.3	0.0	0	0	5	0	0	0	5
Irrigate up	Low	Dual Magnum	3	12	11.2	5.9	1.7	0.6	0.0	9	0	9	4	0	0	22
Irrigate up	Low	Outlook	3	11	10.2	6.6	1.2	0.1	0.1	0	0	6	0	0	0	6
Irrigate up	Low	Check	3	11	9.8	4.9	0.9	0.1	0.1	37	9	28	20	1	0	96
Plant to moisture	High	Atrazine	3	13	13.9	8.0	2.8	0.7	0.4	0	0	0	0	0	0	1
Plant to moisture	High	Dual Magnum	3	13	13.0	7.5	2.8	0.7	0.6	4	0	10	7	0	0	21
Plant to moisture	High	Outlook	3	12	12.6	6.9	2.1	0.7	1.7	1	0	2	5	0	0	9
Plant to moisture	High	Check	3	14	13.8	7.2	2.1	1.3	0.7	12	12	55	73	0	0	152
Plant to moisture	Low	Atrazine	3	14	12.0	6.9	1.3	0.6	0.0	1	1	1	0	0	0	2
Plant to moisture	Low	Dual Magnum	3	13	12.0	6.7	1.8	0.8	0.1	5	0	5	1	0	0	11
Plant to moisture	Low	Outlook	3	12	12.2	6.6	1.4	0.7	0.0	4	0	5	1	0	0	10
Plant to moisture	Low	Check	3	13	12.1	6.3	1.3	0.6	0.2	41	42	9	8	1	0	101
Analysis of variance [a]																
Soil moisture at planting	Pre-irrigated vs. irrigate up			**	****	***	ns	**	ns	ns	ns	ns	ns	ns	ns	ns
Irrigation after planting	High vs. low			ns	****	****	****	***	**	ns	ns	ns	*	ns	ns	ns
Herbicide				ns	ns	****	ns	ns	ns	*	ns	*	***	ns	ns	****
Irrigation * herbicide				ns	ns	**	ns	ns	ns	ns	ns	ns	*	ns	ns	ns

[a] *,**,***,****: significant effect at P < 0.05, 0.01, 0.001, 0.0001

Table 3. Effect of irrigation level on sweet corn yield, root rot and firing.

Irrigation level during first 6 weeks after planting	Herbicide	Obs	Ear count	Fresh wt yield	Average ear wt	Avg. unhusked ear wt.	Percent husk	Ear width	Irregular ears	Ear quality rating	Firing rating Sept 28	Firing rating Oct 17	Root rot at harvest
			no/A	t/A	lbs	lbs	%	inches	No/10	0-10	0-10	0-10	%
High	Atrazine	6	29000	10.9	0.75	0.54	27	19.5	0.17	9.6	2.5	6.6	64
High	Dual Magnum	6	25000	9.3	0.76	0.55	28	19.5	0.17	9.4	2.3	5.2	60
High	Outlook	6	26000	9.1	0.69	0.54	23	18.9	0.17	9.4	2.5	6.5	62
High	Check/ Distinct POST	6	28000	9.2	0.66	0.53	15	18.3	0.33	9.2	0.9	6.0	63
Low	Atrazine	6	29000	11.2	0.78	0.55	30	19.3	0.17	9.7	0.5	2.6	34
Low	Dual Magnum	6	28000	10.1	0.73	0.55	24	18.5	0.17	9.2	0.3	1.7	39
Low	Outlook	6	30000	11.0	0.74	0.55	28	19.0	0.17	9.7	0.3	1.7	35
Low	Check/ Distinct POST	6	26000	8.4	0.64	0.53	13	18.3	0.33	8.9	0.3	2.4	32
LSD(0.05)			2700	1.1	0.05	0.05	9	0.46	ns	0.5	0.85	2.3	14

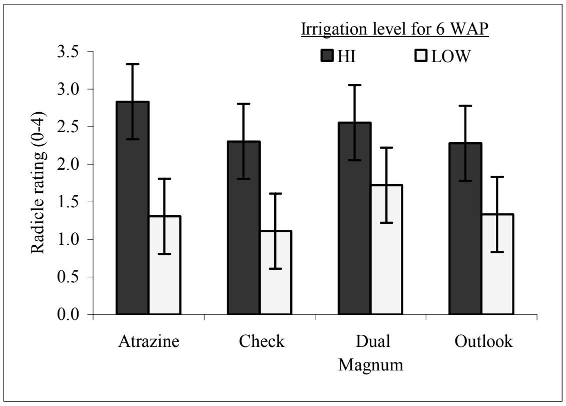

Figure 1. Effect of herbicide and irrigation level for 6 weeks after planting on radicle lesion evaluation (±SE).

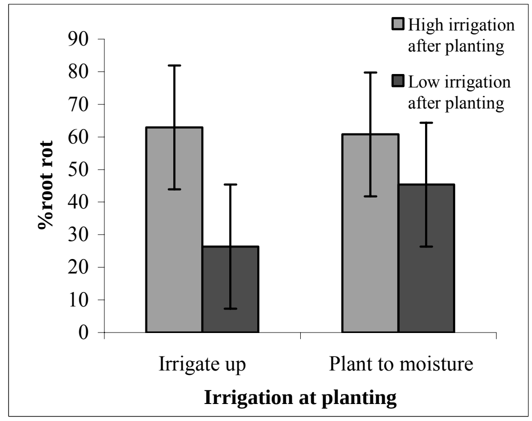

Figure 2. Effect of irrigation level at planting and 6 weeks after planting on root rot at harvest (±SE)

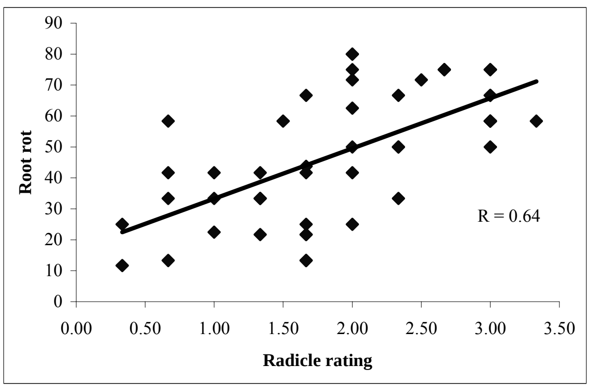

Figure 3. Relationship between radicle lesion rating at 6 WAP and percent root rot at harvest.

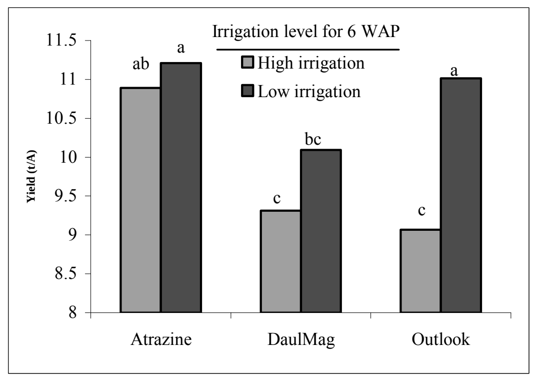

Figure 4. Effect of herbicide and irrigation level on corn yield.

Herbicides and Irrigation Level Effects on Weed Emergence and Root Rot in Sweet Corn
(2004)

Ed Peachey, Horticulture
Robin Ludy, Botany and Plant Pathology
Jim Myers, Horticulture
Mary Powelson, Botany and Plant Pathology
Alex Stone, Horticulture

Project I Summary

- Soil-applied herbicides had very little effect on root rot.
- Reducing the irrigation level during the first 6 weeks after planting reduced root rot and firing of Jubilee sweet corn but did not affect corn yield. The lowest rate of irrigation may have reduced corn yield in 2004.
- Pre-irrigating the soil before planting improved crop emergence and growth throughout the season, but also caused more root rot than when corn was 'irrigated up'.
- The rating used to quantify lesions on the radicle was a reasonable predictor of root rot when corn was harvested.
- Severity of disease on roots and firing in the previous year had no discernible effect on root disease the following year.

Project II Summary

- The higher irrigation levels during the first half of the season increased root rot in sweet corn.
- Root rot in Coho and Jubilee was greater than for Super Sweet Jubilee.
- Coho yield increased linearly with irrigation level during the first half of the season until a maximum of 14 t/A. In contrast, Jubilee yield increased a maximum of only 0.5 t/A when receiving more than 4.5 in. of water until midseason.
- Coho was more tolerant to root rot and yielded more than Jubilee.
- Crown discoloration was correlated with moisture stress, but not consistent among Jubilee, Coho and Super Sweet Jubilee.

Project I. Effect of Irrigation Timing and Amount on Root Rot of Sweet Corn.

Methods

The experiment was conducted at the exact site as in 2003 at the Vegetable Research Farm near Corvallis on a silt loam soil. Treatments were randomized and assigned to different plots than in 2003. Corn was planted in early May and allowed to grow to 18 inches prior to establishment of the plots. The corn was killed with glyphosate and disked into the soil. Radicle evaluation of the corn before it was destroyed found no relationship between root lesions and treatments of the previous year.

The experiment was identical to the experiment in 2003. The plots were 15 ft wide (10 rows) but only the two middle rows were used for ratings and harvest. One of the two middle rows was the variety Jubilee and the other was Coho, and all remaining rows were Jubilee. Both were seeded at approximately 2 seeds/ft on a 30 inch row spacing on June 28.

Four irrigation levels were applied to plots. Main plots of the split plot design were either pre-irrigated before sweet corn was planted ('plant-to-moisture' treatment), or the corn was planted into dry soil and irrigated ('irrigated-up' treatment). These two initial irrigation levels were followed by either a low or high irrigation rates applied to subplots until midseason. After the midseason evaluation (August 10 or 804 DD after planting), irrigation rates were the same for all treatments (see Figure 1.1).

Herbicide treatments were applied to subplots 25 ft long by 10 ft wide and included Dual Magnum (16 oz/A), Outlook (24 oz/A), and Atrazine (1 qt/A) on June 29, 1 day after the corn was planted. Irrigation (0.8 in) was given to all plots on June 30 to incorporate the herbicides. Weed emergence and crop emergence were determined at 4 WAP, then Atrazine and Basagran applied to kill surviving weeds. Hand hoeing augmented herbicides to minimize weed competition.

Irrigation water was collected to determine the amount of water applied (Fig. 1.1). Water was collected with 4 inch PVC caps placed on stands that were raised to the level of the corn canopy at each irrigation. A time domain reflectometer (TDR) was used to monitor soil moisture before and after each irrigation event (Figure 1.2).

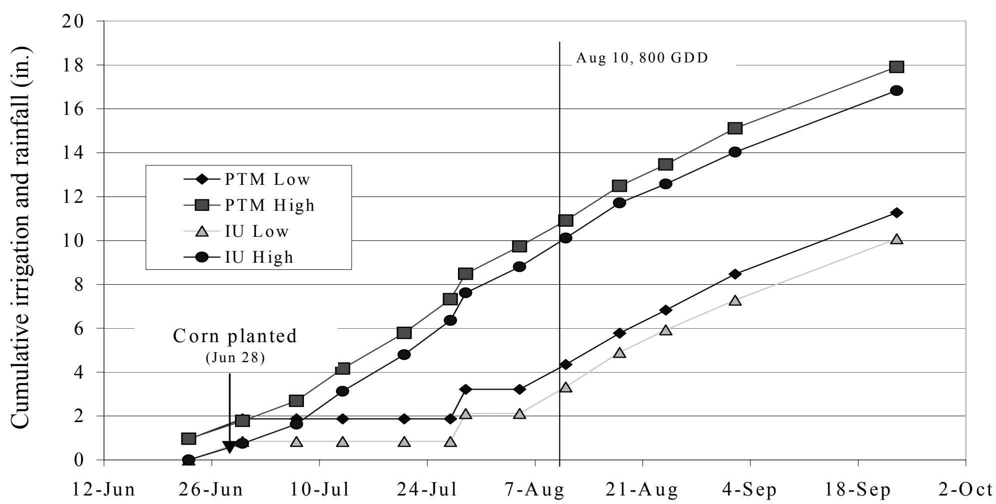

Figure 1.1. Cumulative irrigation and rainfall.

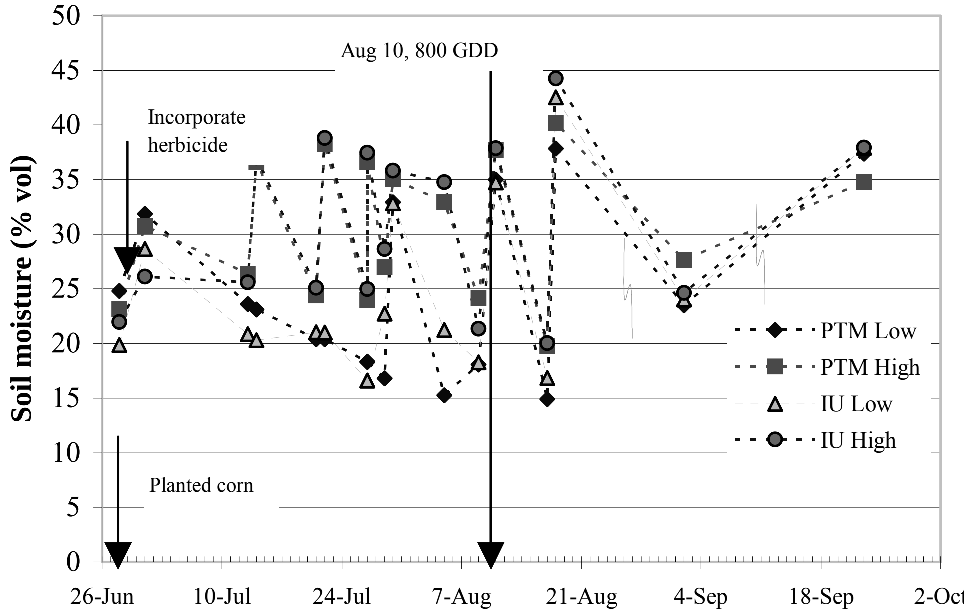

Figure 1.2. TDR soil moisture measurements of the top 6 inches of soil.

Three corn roots were dug from each plot at midseason, roots washed, and radicles evaluated for disease. At harvest, corn ears were pulled from 16 ft. of the two middle rows and weighed. Ten ears were shucked and ear diameter, tip fill, and ear weight determined. Kernels were cut from three ears of each plot and dried to determine moisture level. Three roots were dug from each plot and evaluated for percent rot at harvest.

Results

Weed emergence was primarily determined by herbicide level, although irrigation practice influenced weed emergence in the check plots (Table 1.1). The lowest level of irrigation (irrigating the corn up and applying a low irrigation amount until midseason) significantly reduced weed emergence (Fig 1.3). Hairy nightshade emergence was much greater when the corn was irrigated-up and followed by a high level of irrigation, contrary to the result for total weeds.

Corn emergence was greater for the Jubilee variety than Coho, assuming that the planter delivered the same number of seeds. Plots with the higher irrigation level after planting had greater emergence than plot with the low level of irrigation (Table 1.2 and 1.3). Corn height was lowest in the irrigate-up + high irrigation treatment and greatest in the plant-to-moisture + high irrigation treatment for both varieties (Table 1.2 and 1.3).

Midseason ratings of radicle root quality did not differ between Coho and Jubilee. Radicle rot at midseason was significantly greater under the high irrigation regimes (Table 1.2 and 1.3, Figure 1.4). Plant-to-moisture followed by high irrigation until midseason caused necrosis of 64% of the radicle but only 40% at the low irrigation level. There was very little indication statistically that herbicide applied influenced radicle quality. Root rot evaluation at harvest indicated similar trends; root rot was greatest in treatments with higher irrigation rates through mid-season (Table 1.4). Additionally, radicle rot ratings taken at mid-season were partially correlated with the root rot ratings and firing ratings taken at harvest (Figure 1.5) demonstrating the utility of radicle evaluation to predict root rot potential.

Significant firing of Jubilee of corn at harvest was observed in treatments with the higher irrigation levels at harvest (Table 1.2). Coho exhibited little firing. Firing also was observed in the low irrigation plots, but at much lower levels.

Radicle root rot was greatest when corn was planted-to-moisture and followed by a high rate of irrigation, an indication that root rot was reducing yield. Root rot at harvest was partially correlated with Jubilee yield (Figure 1.7), particularly when under the high irrigation level ($R = -0.95$, $P<0.001$).

Yield of Coho was much greater than Jubilee at the high irrigation levels (Table 1.2, Figure 1.6). Yield of Coho increased with increasing irrigation level and was greatest where corn was planted-to-moisture and then followed by a high irrigation rate until midseason. Jubilee did not respond to irrigation the same as Coho. Yield was lowest when corn was irrigated up followed by a low rate of irrigation until midseason. The highest rate of irrigation only yielded 10.2 t/A (plant-to moisture plus high irrigation until midseason), slightly lower than the yield of corn that was irrigated up and followed by a high rate of irrigation. The lowest yielding treatment for both corn varieties occurred when the corn was irrigated up and was followed by a low irrigation level until midseason. Jubilee yield averaged less than 9 t/A. Percent kernel moisture for this treatment indicated that a delay in maturity offset any potential yield advantage due to reduced root rot.

Comparison to results in 2003

The effect of irrigation on radicle quality and root rot in Jubilee was similar in both years. Increasing moisture early in the season resulted in more diseased root and eventually resulted in more firing. The primary effect was the amount of water applied after planting. The high rate of irrigation after planting caused 54% necrosis of the radicle (56% in 2003 and 52% in 2004), but the low rate of irrigation after planting only had 29% necrosis at mid-season.

The impact on crop yield differed, however, between the two years. In 2003, planting to moisture followed with a high level of irrigation caused a slightly lower yield than if the crops were irrigated up and followed with a low level of irrigation. In 2004, plots with less irrigation early in the season tended to yield less. Correlations of root disease data with corn yields indicated that the higher irrigation levels in 2004 were restricting yields, although not to the level that occurred in 2003.

It appears from the two years of the study that irrigation management may be a good tool to reduce the severity of root rot in sweet corn. The results from 2004 indicate, however, the risk involved in using this strategy. Severely stressing corn for the first half of the season reduced corn yield, even though root rot was much less.

Table 1.1. Effect of irrigation on weed emergence, 2004.

Irrigation level		Herbicide	Obs	Weed emergence					
At planting (AP)	First six weeks after planting (AFT)			Lambsquarters	Pigweed	Nightshade	Purslane	Grass	Total weeds
				------------------ No/m sq					-------------------
IU	High	Atrazine	3	0	0	29	0	0	29
IU	High	Dual Magnum	3	0	0	3	1	0	3
IU	High	Outlook	3	0	0	1	1	0	2
IU	High	Check	3	4	2	103	16	0	125
IU	Low	Atrazine	3	0	0	11	0	0	11
IU	Low	Dual Magnum	3	1	0	7	0	0	9
IU	Low	Outlook	3	0	0	2	0	0	2
IU	Low	Check	3	2	1	4	8	0	15
PTM	High	Atrazine	3	0	0	0	0	0	0
PTM	High	Dual Magnum	3	0	0	3	4	0	8
PTM	High	Outlook	3	0	0	0	2	0	2
PTM	High	Check	3	35	4	22	79	1	140
PTM	Low	Atrazine	3	0	0	0	0	0	0
PTM	Low	Dual Magnum	3	0	0	3	8	0	11
PTM	Low	Outlook	3	0	0	1	2	0	3
PTM	Low	Check	3	3	4	31	60	1	99
ANOVA									
AP				ns	ns	*	*	ns	ns
AFT				ns	ns	*	ns	ns	*
AP x AFT				ns	ns	*	ns	ns	ns
H				ns	*	****	****	ns	****
AP x H				ns	ns	ns	**	ns	*
AFT x H				ns	ns	*	ns	ns	**

IU, irrigate-up; PTM, plant-to-moisture.
ns, not significant; *, P<0.05, ** P< 0.01; *** P< 0.001; **** P < 0.0001.

Table 1.2a. Effect of irrigation timing and level on *Coho* corn growth and yield, 2004.

Variety	Irrigation level		Herbicide	Obs	Emer-gence	Height	Midseason root rot		Corn harvest (marketable ears)								
	At planting	First six weeks after planting					Radicle	Primary roots	Ear number	Fresh wt yield	Ear wt.	Husked ear wt.	Ear dia.	Ear length	Tip fill	Firing rating	Root rot at harvest
					10 ft	In.	% diseased		no./A	t/A	lbs	lbs	in	in	%	1-10	%
Coho	IU	High	Atrazine	3	14	23	46	1	32900	12.2	0.68	0.61	2.0	7.2	95	1	-
Coho	IU	High	Check	3	14	23	57	4	32900	12.7	0.77	0.60	1.9	7.3	95	2	55.7
Coho	IU	High	DualMag	3	14	21	48	0	30800	12.0	0.76	0.51	2.0	7.3	98	1	61.0
Coho	IU	High	Outlook	3	15	19	41	0	32900	11.6	0.94	0.63	2.0	7.3	96	1	-
Coho	IU	Low	Atrazine	3	15	16	23	0	32600	10.5	0.89	0.55	1.9	7.0	95	0	-
Coho	IU	Low	Check	3	11	16	21	0	31900	9.8	0.94	0.54	1.8	7.1	96	0	48.3
Coho	IU	Low	DualMag	3	11	15	14	1	27300	9.3	0.89	0.56	1.9	7.0	98	0	50.0
Coho	IU	Low	Outlook	3	12	15	17	1	30800	10.4	0.79	0.56	1.9	7.0	96	0	-
Coho	PTM	High	Atrazine	3	16	29	63	2	32600	13.6	0.81	0.71	2.1	7.3	98	2	-
Coho	PTM	High	Check	3	15	28	69	3	33300	13.4	0.80	0.73	2.1	7.3	99	2	62.7
Coho	PTM	High	DualMag	3	14	27	71	0	31500	13.3	0.87	0.67	2.1	7.2	97	1	62.7
Coho	PTM	High	Outlook	3	14	25	65	0	37500	15.2	0.81	0.66	2.0	7.2	97	2	-
Coho	PTM	Low	Atrazine	3	15	20	31	0	31900	11.3	0.84	0.64	2.1	7.2	96	0	-
Coho	PTM	Low	Check	3	13	20	54	0	33600	12.2	0.76	0.63	2.0	7.2	95	0	63.3
Coho	PTM	Low	DualMag	3	15	19	35	4	34700	12.3	0.78	0.61	2.0	7.0	95	0	41.3
Coho	PTM	Low	Outlook	3	14	19	46	4	34000	13.4	0.60	0.62	2.0	7.1	97	0	-

IU, irrigate up; PTM, plant to moisture;

Table 1.2b. Effect of irrigation timing and level on *Jubilee* corn growth and yield, 2004.

Variety	Irrigation level		Herbicide	Obs	Emer-gence	Height	Midseason root rot		Corn harvest (marketable ears)								
	At planting	First six weeks after planting					Radicle	Primary roots	Ear number	Fresh wt yield	Ear wt.	Husked ear wt.	Ear dia.	Ear length	Tip fill	Firing rating	Root rot at harvest
Jubilee	IU	High	Atrazine	3	16	23	58	3	29400	12.2	0.68	0.61	1.9	7.3	89	4	77.8
Jubilee	IU	High	Check	3	17	24	33	5	28700	12.7	0.77	0.60	2.0	7.4	93	5	71.1
Jubilee	IU	High	DualMag	3	16	23	50	0	30100	12.0	0.76	0.51	1.9	7.5	90	5	75.6
Jubilee	IU	High	Outlook	3	18	23	46	0	29000	11.6	0.94	0.63	1.9	7.3	92	4	74.4
Jubilee	IU	Low	Atrazine	3	19	17	24	0	31200	10.5	0.89	0.55	1.8	7.3	91	0	41.7
Jubilee	IU	Low	Check	3	19	19	50	0	29000	9.8	0.94	0.54	1.8	7.5	91	1	41.7
Jubilee	IU	Low	DualMag	3	17	17	28	1	28700	9.3	0.89	0.56	1.8	7.3	92	2	55.3
Jubilee	IU	Low	Outlook	3	17	17	27	4	29400	10.4	0.79	0.56	1.8	7.2	91	2	47.2
Jubilee	PTM	High	Atrazine	3	18	28	52	0	31200	13.6	0.81	0.71	2.0	7.2	89	6	70.0
Jubilee	PTM	High	Check	3	18	29	53	0	31200	13.4	0.80	0.73	2.0	7.3	93	5	75.8
Jubilee	PTM	High	DualMag	3	18	26	58	0	26200	13.3	0.87	0.67	2.0	7.3	92	5	71.7
Jubilee	PTM	High	Outlook	3	15	27	73	0	28700	15.2	0.81	0.66	2.0	7.2	92	4	76.4
Jubilee	PTM	Low	Atrazine	3	18	21	31	1	30500	11.3	0.84	0.64	1.8	7.3	92	3	47.2
Jubilee	PTM	Low	Check	3	15	21	35	1	29400	12.2	0.76	0.63	1.9	7.2	95	3	41.7
Jubilee	PTM	Low	DualMag	3	18	21	46	2	29000	12.3	0.78	0.61	1.8	7.1	92	2	47.5
Jubilee	PTM	Low	Outlook	3	17	22	50	3	27600	13.4	0.60	0.62	1.9	7.5	91	2	40.3

IU, irrigate up; PTM, plant to moisture;

Table 1.3. Analysis of variance for effects of irrigation timing and level on corn growth and yield, 2004.

Effect	Emer-gence	Plant height	Midseason root rating		Corn harvest (marketable ears)								
			Radicle	Roots	Ear number	Fresh wt yield	Ear wt	Husked ear wt	Ear dia.	Ear length	Tip fill	Firing rating	Root rot at harvest
V	****	****	ns	*	**	****	****	**	****	***	****	****	ns
AP	ns	****	ns	ns	ns	ns	*	*	**	ns	ns	ns	ns
AFT	*	****	*	ns	ns	**	*	*	**	**	ns	*	**
H	ns	ns	ns	*	ns	*	ns	ns	ns	ns	ns	ns	ns
AP*AFT	ns	ns	ns	ns	ns	*	ns	ns	ns	ns	ns	ns	ns
AP*H	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	ns	ns
AFT*H	ns	ns	ns	*	ns	ns	ns	ns	ns	ns	ns	ns	ns
V*AP	ns	ns	ns	ns	ns	**	ns	ns	ns	ns	ns	ns	ns
V*AFT	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
V*AP*AFT	ns	ns	**	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
V*H	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
V*AP*H	ns	ns	**	ns	ns	*	ns	ns	ns	ns	ns	ns	ns
V*AFT*H	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

V= Variety; AP=Irrigation level at planting, AFT=Irrigation level after planting; H=Herbicide.
ns, not significant; *, P<0.05, ** P< 0.01; *** P< 0.001; **** P < 0.0001.

Table 1.4. Effect of irrigation level on kernel moisture at harvest, 2004.

Irrigation level		Obs	Kernel moisture	
At planting	First 6 weeks after planting		Mean	SE
			%	
Irrigate up	Hi	7	72	1.4
Irrigate up	Low	6	76	1.3
Plant-to-moisture	Hi	7	73	1.0
Plant-to-moisture	Low	6	73	0.9

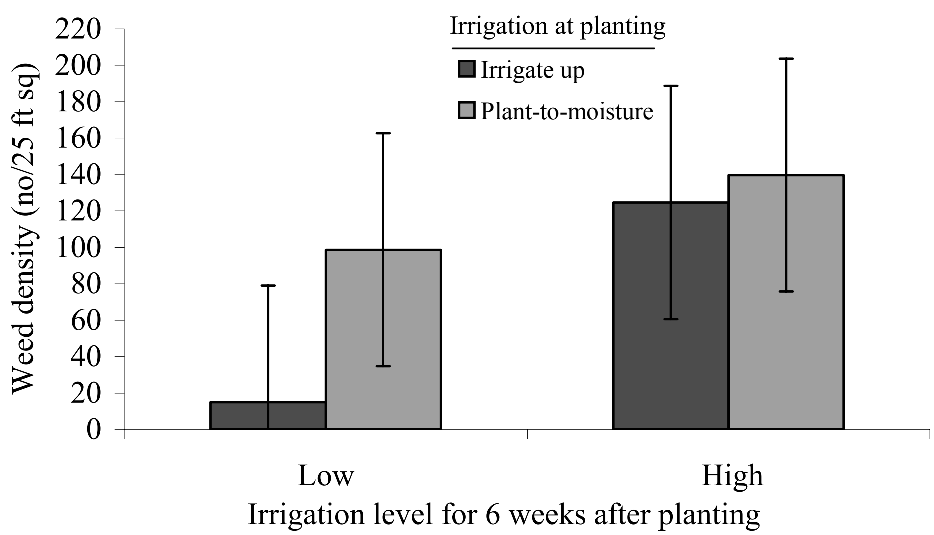

Figure 1.3. Effect of irrigation practice and intensity on total weed density, 2004 (vertical bars are 95% CI).

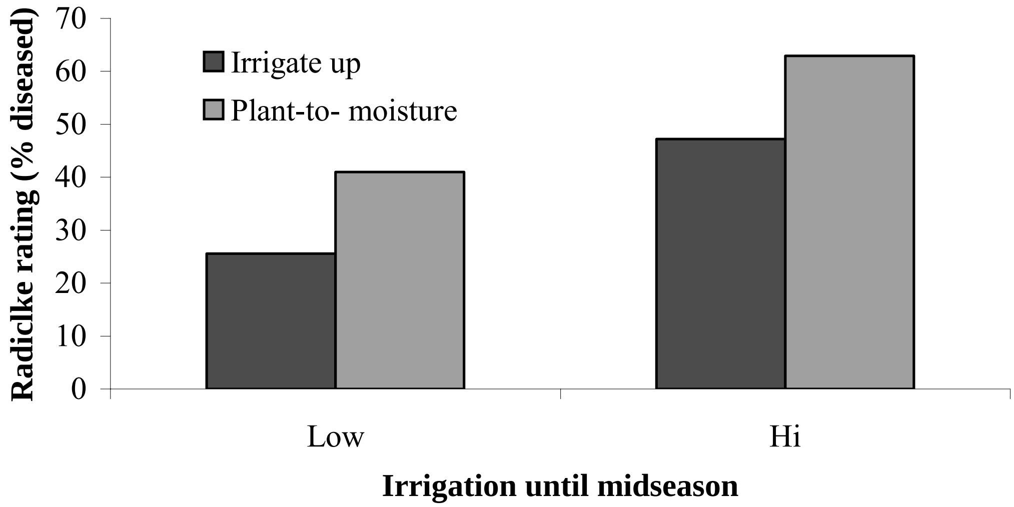

Figure 1.4. Effect of irrigation practice at planting and through midseason on radicle disease rating. Data are averaged over both varieties and all herbicides. P=0.02 for effect of low and high irrigation.

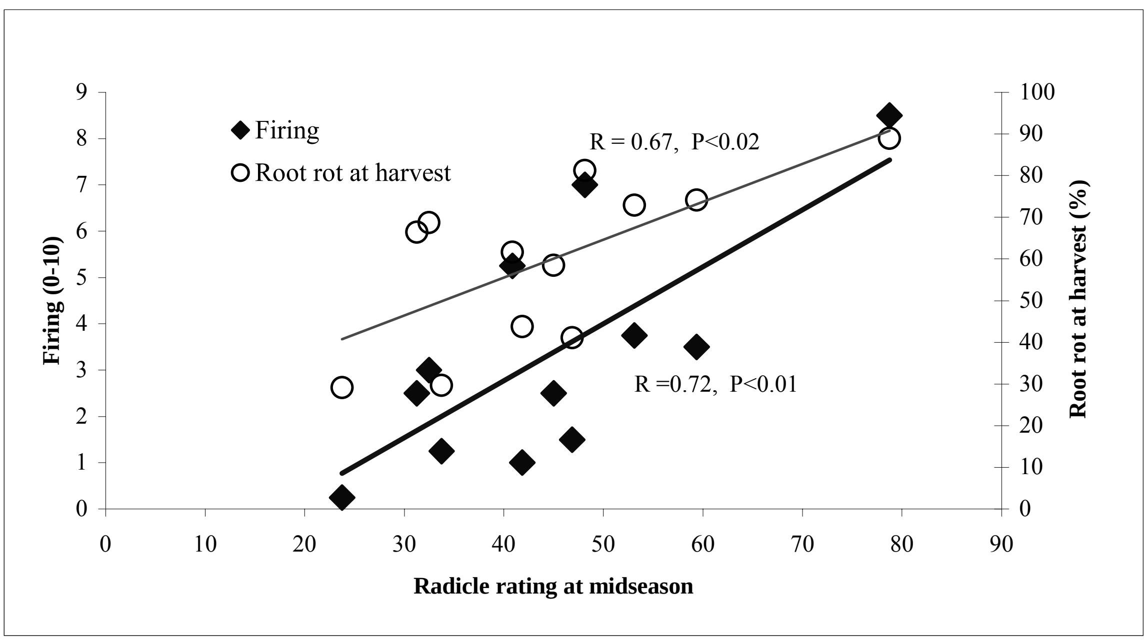

Figure 1.5. Correlation between radicle rating at midseason and firing and root rot at harvest in Jubilee sweet corn. Data are averaged over herbicide levels in each subplot (n=4 for each point).

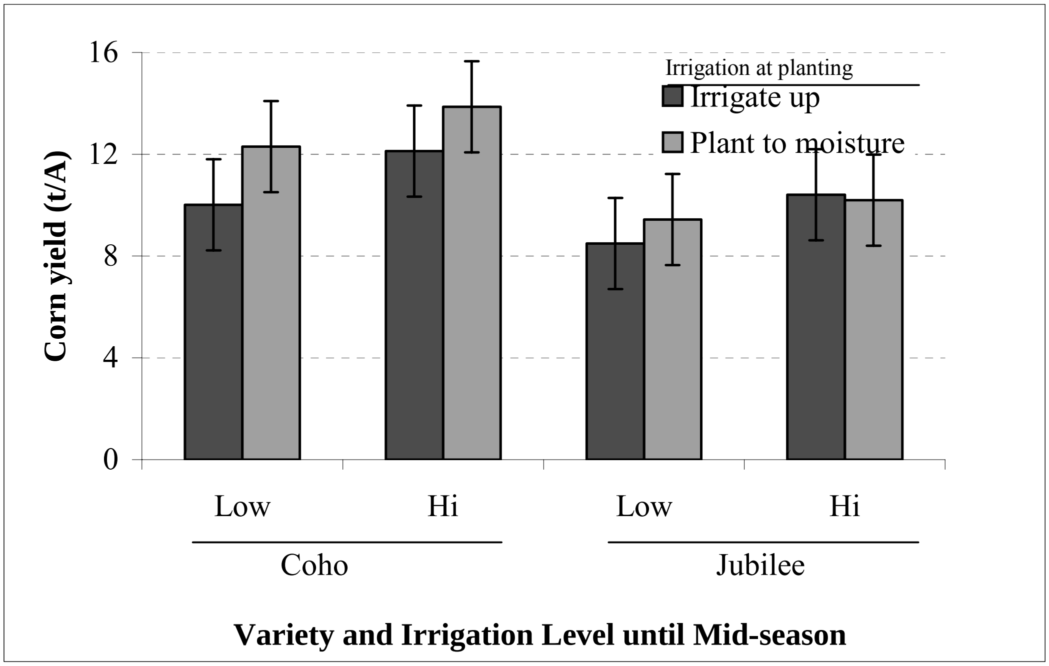

Figure 1.6. Effect of variety, irrigation level at planting, and irrigation level until midseason on yield in 2004. Data are averaged over all herbicide treatments. LSD (0.05) =1.8. P<0.01 for effect of variety and irrigation level (Var x After) on corn yield. Bars are 95% CI of the mean.

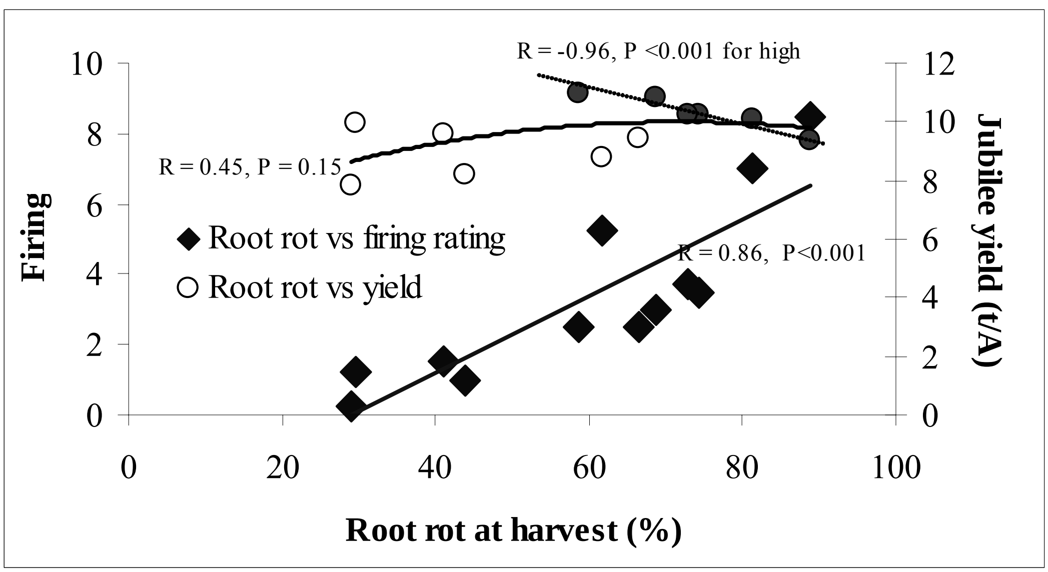

Figure 1.7. Effect of root rot at harvest on firing and yield of Jubilee when averaged across all herbicide treatments. Full circles for yield are high irrigation levels (n=4 for each point and includes Dual herbicide treatment).

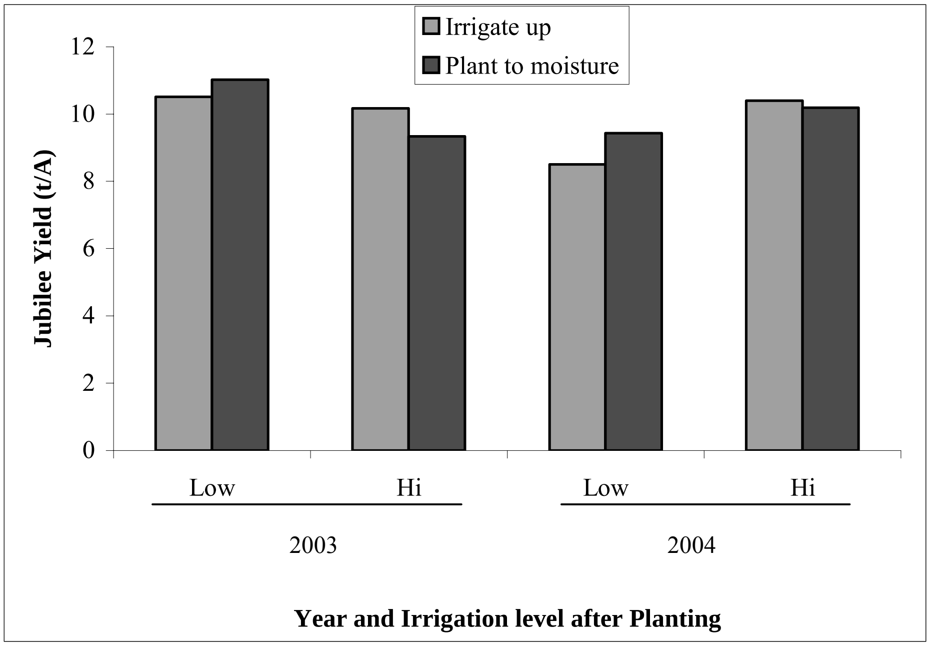

Figure 1.8. Effect of irrigation level at planting and 6 weeks after planting on corn yield in 2003 and 2004.

Project II. Effect of Irrigation Level until Midseason on Disease Development and Yield in Sweet Corn.

Methods

A line source experimental design was used so that a continuum of irrigation water could be applied to corn. Randomized complete block experimental designs are robust when evaluating irrigation, but require a large amount of space to keep plots isolated. Line source experiments can be used without sacrificing information (Braunworth and Mack, 1989). Line source experiments significantly reduce the area needed, an important consideration when trying to locate plots in fields with a previous history of root rot.

Experiments were conducted at three sites on the vegetable research farm. The crop rotation at the first site (LS I) only had one year of corn during the last 10 years and root rot was not expected to have a significant effect on corn yield. The second site (LS II) had a 7 year history of snap beans, sweet corn, and wheat. Previous corn root evaluation in 2003 indicated a moderate level of root rot. A third site (LS III) had a mixed history of snap beans, squash, broccoli, and corn over the last 10 years.

At all sites, irrigation was applied with two irrigation lines that were set side by side through the middle of the plot, and 25 to 30 rows of corn planted on both sides of the irrigation lines on a 30-inch row spacing. The amount of water reaching the corn declined as the distance from the center irrigation line increased (Figs 2.1 and 2.4). The double line provided sprinkler heads on 20 ft. centers rather than 40 ft. and greatly improved the uniformity of coverage. Irrigation was applied with these two center lines until midseason (~800 growing degree days).

At midseason, the entire pot was solid set with single irrigation lines spaced 40 ft apart so that the entire plot received the same amount of irrigation until harvest.

Irrigation data from the first experiment (LSI) were used to calibrate the irrigation systems at all sites, and to predict where plots should be located so that the amount of water each plot received would decline linearly as the distance from the irrigation line increased. The amount of water applied at each site was measured after each irrigation event by collecting water from 32 - 4 inch PVC caps placed throughout the field. The collection caps were placed on the soil between corn rows during the first part of the season, but later were put on adjustable risers so that the collection caps could be raised along with corn growth.

Soil compaction treatments were applied in LSII and LSIII before planting in addition to the irrigation level. A tractor was driven over the plot so that wheel tracks covered the entire plot. A roterra and roller was then used to loosen the surface so that row coverage was possible during planting.

Jubilee, Super Sweet Jubilee, and Coho sweet corn varieties were planted at all sites. Corn emergence, height, root rot at 6-7 weeks after planting (800 growing degree days) and at harvest, firing if present at harvest, and yield (including fresh and husked wt., ear length, tip fill, and net yield) were measured. Crown discoloration was also rated at midseason. This purplish darkening of the pith tissue has been observed early in the season, but it is unclear whether this is a disease or a physiological response to environmental conditions.

Results

LSI

Radicle and root evaluation at mid-season indicated very low levels of root rot at this site with no effect on the radical or roots (Table 2.1). Additionally, irrigation level (which included one rainfall event) during the first 7 weeks of the growing season had very little impact on crop yield at the end of the season (Table 2.2, Figs. 2.1 and 2.2). Jubilee yielded approximately 12 t/A at all irrigation levels except Level 4, which provided less than 2 inches of water to the crop during the first 6 weeks after planting. Coho yielded more than 14 t/A at all three irrigation levels. An important finding was that crown discoloration in Jubilee was correlated with moisture stress, and that the effect of moisture stress on crown discoloration was not consistent among varieties. Coho did not exhibit the same level of crown discoloration as Jubilee across the four irrigation levels.

LSII

The potential of root rot at the second site was much greater than at the first site. The plots with the highest irrigation level had the most severe disease ratings for both the radicle and other roots at mid-season (Table 2.3). There also was an indication that Super Sweet Jubilee was less affected by root rot than Jubilee or Coho. Even though there was no statistically significant effect of compaction on corn roots, the data suggest that root rot was less in compacted soils.

Crown discoloration was greater at the low irrigation level as was noted in LSI, and again inconsistent among the three varieties (Table 2.3).

Coho yield declined linearly in both compacted and uncompacted soil as the amount of irrigation water applied during the first 6 weeks declined (Table 2.4). Jubilee yield did not follow the same trend (Table 2.4, Figure 2.4). The maximum yield of Jubilee was 11.2 t/A at the high irrigation rate, but was reduced by only 0.6 t/A as irrigation during the first 6 weeks declined from 7.6 (Level 1) to 4.5 inches of water. Jubilee plots that received only 2 inches of water during the first 6 weeks after planting produced only 7.7 t/A.

Even though root rot was present in this plot, it was not severe enough to cause firing of the corn. Root rot ratings at harvest tended to be greater for Coho than Jubilee but the trend was not statistically significant. Yield of Jubilee declined as the root rot rating exceeded 50% (Figure 2.5). Crown discoloration was caused by very dry soil conditions during the first half of the season and persisted until harvest, and was more visible in Jubilee than in Coho.

LSIII

Radicle rot rating at midseason were lower at this site than in LSII, but greater than LSI (Table 2.5). Unlike data from LSII, radicle ratings of Jubilee were greater than Coho. SS Jubilee ratings were lower than both Coho and Jubilee. Crown discoloration ratings again were greater for corn at the lowest irrigation levels, and soil compaction may have decreased root rot ratings. Net corn yield was constant through the first three irrigation levels.

Summary

The higher irrigation levels during the first half of the season increased root rot in sweet corn. Root rot in Coho and Jubilee was greater than for Super Sweet Jubilee. Coho yielded the most and was probably the most tolerant to root rot. Super Sweet Jubilee yield was measured in these plots but not presented because of slower and more erratic emergence than Coho or Jubilee. Crown discoloration was greater at low irrigation levels.

Table 2.1. Effect of irrigation level on root rot in sweet corn at midseason, LSI, 2004, a site without root rot symptoms.

Variety	Irrigation level (1=high, 4=low)	Obs	Percent root rot		Crown discoloration
			Radicle	Primary roots	
			-------------------%--------------		0-4
Coho	1	8	0.21	0	1.4
Coho	2	8	0.31	0	1.1
Coho	3	8	0.04	0	1.6
Jubilee	1	7	0.29	0.08	1.4
Jubilee	2	8	0.24	0	1.7
Jubilee	3	7	0.33	0	2.3
Jubilee	4	8	0.24	0	2.9
SS Jubilee	1	4	0.35	0	1.2
SS Jubilee	2	8	0.00	0	1.5
SS Jubilee	3	8	0.11	0	2.4
LSD (0.05)			ns	ns	0.4

Table 2.2. Effect of irrigation level on sweet corn yield, LSI, 2004.

Variety	Irrigation level	Obs.	Ears	Net yield	Ear wt.	Ear width	Ear length	Tip fill
	1=high, 4=low		no/A	t/A	lbs	in	in	%
Coho	1	8	33300	13.8	0.69	2.04	7.7	94.9
Coho	2	8	30700	14.3	0.72	2.08	7.6	97.3
Coho	3	8	33300	14.5	0.70	2.10	7.4	97.3
Jubilee	1	8	30700	12.6	0.72	2.11	7.7	95.4
Jubilee	2	8	28700	11.8	0.70	2.08	7.7	95.6
Jubilee	3	8	29800	12.2	0.67	2.05	7.6	97.3
Jubilee	4	8	28500	11.6	0.67	2.02	7.6	95.8
LSD (0.05)			2400	0.9	ns	ns	ns	1.6

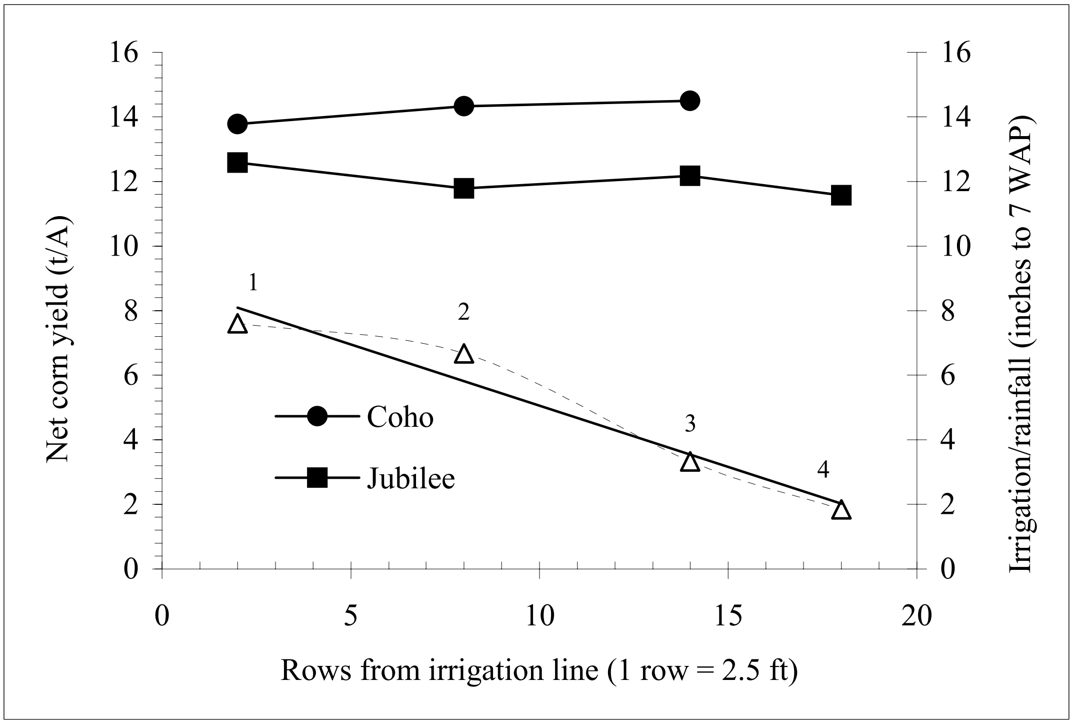

Figure 2.1. Effect of irrigation level (7 WAP after planting) on sweet corn yield.

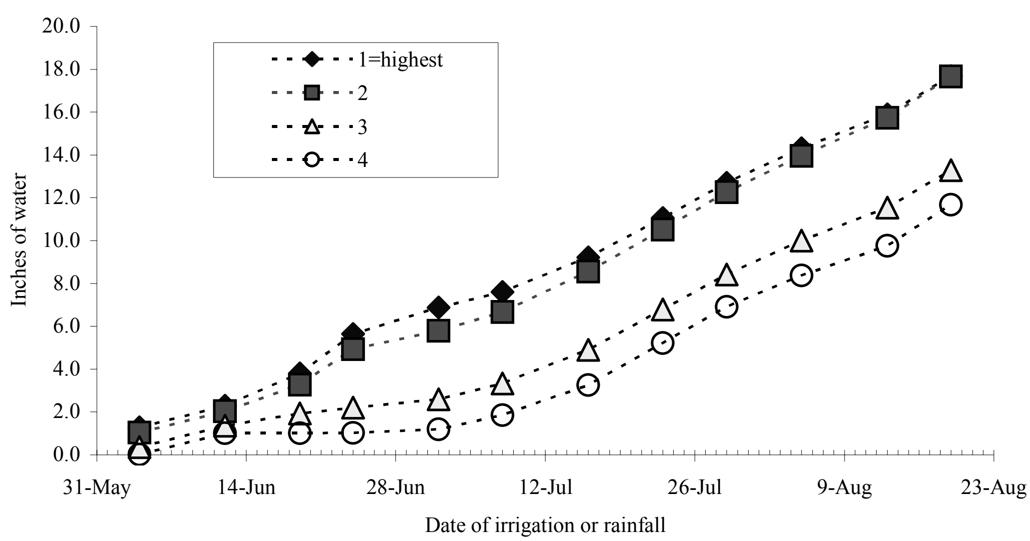

Figure 2.2. Cumulative irrigation in LSI experiment.

Table 2.3. Effect of irrigation level during the first half of the season on root rot in Coho, Jubilee and SS. Jubilee in LS II experiment, 2004.

Variety	Soil compaction treatment	Irrigation for first 6.5 weeks	Obs.	Percent root rot				Crown discoloration	
				Radicle		Primary roots			
		(1=high; 4=low)	N	Mean	SD	Mean	SD	Mean	SD
				------------------------------%		--------------------------		0-4; 4=high	
Coho	Compacted	1	6	63	9	1.5	2.4	1.3	0.2
Coho	Compacted	2	6	41	19	1.9	2.3	1.5	0.3
Coho	Compacted	3	6	19	24	0.2	0.3	1.9	0.6
Coho	Compacted	4	6	20	24	0.1	0.2	2.2	0.7
Coho	Uncompacted	1	8	66	7	2.8	2.0	1.4	0.3
Coho	Uncompacted	2	8	66	12	2.1	3.3	1.3	0.4
Coho	Uncompacted	3	8	28	20	0.1	0.2	1.9	0.4
Coho	Uncompacted	4	8	33	14	0.2	0.2	2.2	0.2
Jubilee	Compacted	1	6	32	23	0.9	1.0	2.1	0.5
Jubilee	Compacted	2	6	52	14	0.7	1.1	1.8	0.5
Jubilee	Compacted	3	5	6	7	0.0	0.1	3.0	0.1
Jubilee	Compacted	4	6	5	8	0.1	0.2	3.0	0.1
Jubilee	Uncompacted	1	7	69	17	0.6	0.6	1.8	0.3
Jubilee	Uncompacted	2	8	61	16	1.8	2.3	2.2	0.5
Jubilee	Uncompacted	3	7	23	18	0.3	0.4	3.0	0.0
Jubilee	Uncompacted	4	7	27	20	0.1	0.1	2.9	0.1
SS Jubilee	Compacted	1	8	36	23	0.8	0.9	2.0	0.3
SS Jubilee	Compacted	2	8	21	18	0.1	0.1	2.6	0.4
SS Jubilee	Compacted	3	8	7	8	0.1	0.1	2.8	0.3
SS Jubilee	Compacted	4	4	12	11	0.4	0.8	2.8	0.4
SS Jubilee	Uncompacted	1	5	36	8	1.9	1.8	1.9	0.3
SS Jubilee	Uncompacted	2	6	41	25	1.0	1.1	3.7	2.8
SS Jubilee	Uncompacted	3	6	12	11	0.2	0.4	3.0	0.1
SS Jubilee	Uncompacted	4	3	5	5	0.0	0.1	2.9	0.1

Analysis of significant effects [a]	Radicle	Primary roots	Crown discoloration
Variety	****	ns	****
Compaction	ns	ns	ns
Variety x Compaction	ns	ns	ns
Irrigation level	****	****	****
Variety x Irrigation level	ns	ns	**
Compaction x Irrigation level	ns	*	ns
Variety x Compaction x Irrigation Level	ns	ns	ns

[a] ****, P≤0.0001; ***, P≤0.001; **, P≤0.01; *, P≤0.05; ns, not significant.

Table 2.4. Effect of irrigation level during the first half of the season on yield and root rot in Coho, Jubilee and Super Sweet Jubilee in LS II, 2004.

Variety	Soil compaction treatment	Irrigation for first 6.5 weeks	Obs	Net yield	Net ears	Avg. ear wt	Ear dia.	Ear length	Tip fill	Root rot
		(1=high; 4=low)		t/A	no./A	lbs	in.	in.	%	%
Coho	Compacted	1	6	12.8	26100	0.99	2.02	7.42	98	56
Coho	Compacted	2	6	12.1	24700	0.98	2.00	7.42	98	42
Coho	Compacted	3	6	11.7	26700	0.87	1.93	7.35	98	37
Coho	Compacted	4	6	8.7	23500	0.73	1.78	7.07	98	29
Coho	Uncompacted	1	8	14.3	29000	0.99	2.05	7.50	98	53
Coho	Uncompacted	2	8	13.1	26400	0.99	2.06	7.46	98	50
Coho	Uncompacted	3	8	11.3	24600	0.92	1.99	7.48	98	35
Coho	Uncompacted	4	8	9.4	24000	0.79	1.91	7.26	99	26
Jubilee	Compacted	1	6	10.5	22400	0.94	2.03	7.83	97	44
Jubilee	Compacted	2	6	10.7	22400	0.96	2.02	7.85	98	53
Jubilee	Compacted	3	6	8.0	21800	0.73	1.83	7.58	95	28
Jubilee	Compacted	4	6	7.1	22400	0.63	1.65	7.72	94	24
Jubilee	Uncompacted	1	8	11.2	24200	0.93	2.00	7.76	95	45
Jubilee	Uncompacted	2	8	10.6	23100	0.92	2.01	7.88	86	64
Jubilee	Uncompacted	3	8	10.6	22900	0.92	1.99	7.80	97	44
Jubilee	Uncompacted	4	8	9.0	23700	0.76	1.88	7.71	96	31
Jubilee	Uncompacted	5	8	7.7	22700	0.68	1.78	7.65	95	35
LSD (0.05)				1.8	3900	0.07	0.10	0.22	10	22

Analysis of effects [a]

	Net yield	Net ears	Avg. ear wt	Ear dia.	Ear length	Tip fill	Root rot
Variety	****	****	****	*	****	*	ns
Compaction	***	ns	***	****	*	ns	ns
Variety x Compaction	ns	ns	ns	ns	ns	ns	ns
Irrigation level	****	ns	****	****	***	ns	****
Variety * Irrigation Level	ns	n	ns	ns	ns	ns	ns
Compaction x Irrigation Level	ns	ns	****	***	ns	ns	ns
Variety x Compaction x Irrigation Level	ns	ns	*	ns	ns	ns	ns

[a] ****, P≤0.0001; ***, P≤0.001; **, P≤0.01; *, P≤0.05; ns, not significant.

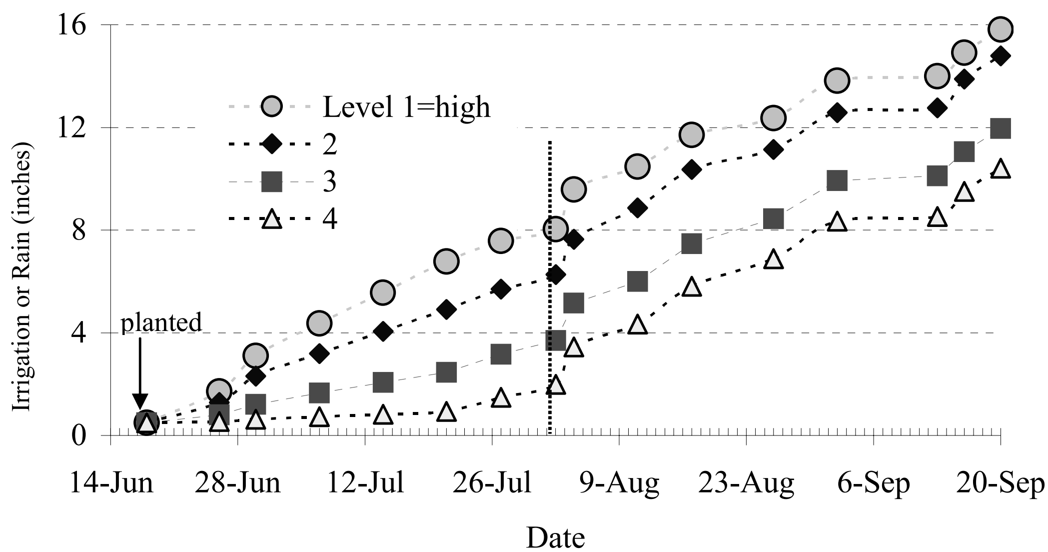

Figure 2.3. Cumulative irrigation for LSII experiment.

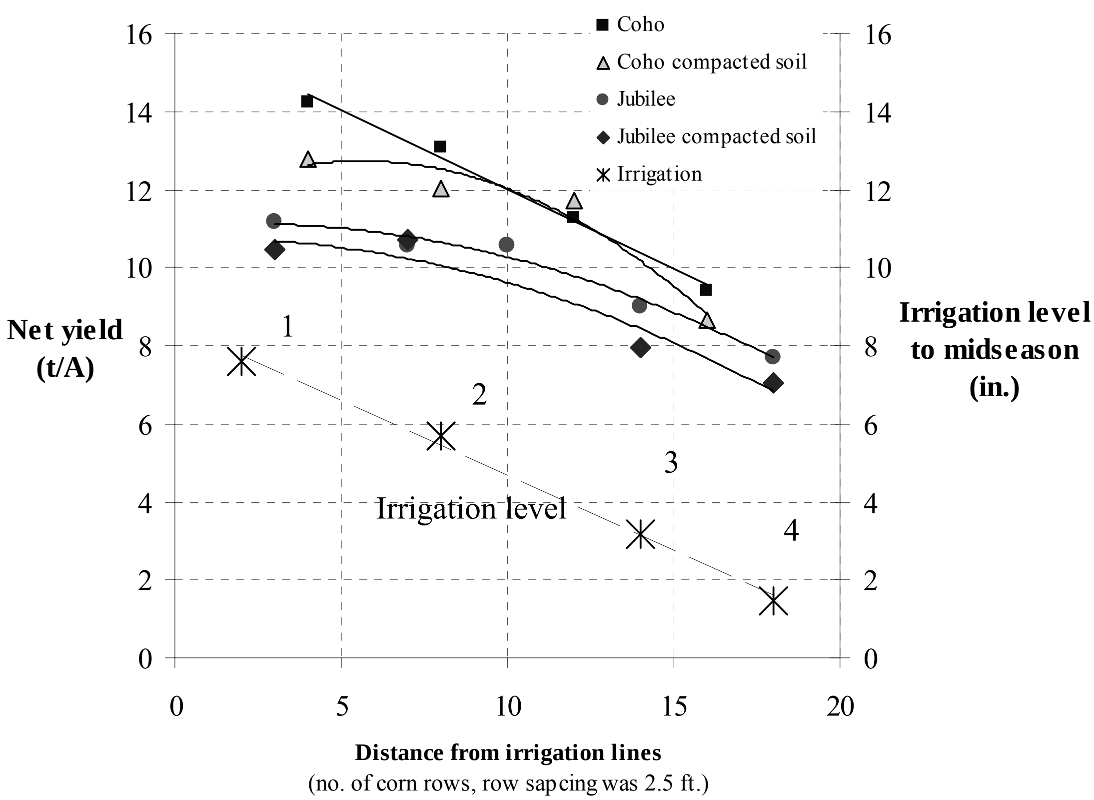

Figure 2.4. Effect of irrigation level to mid-season (800 GDD, 6.5 weeks) on corn yield in normal and compacted soils, LSII 2004.

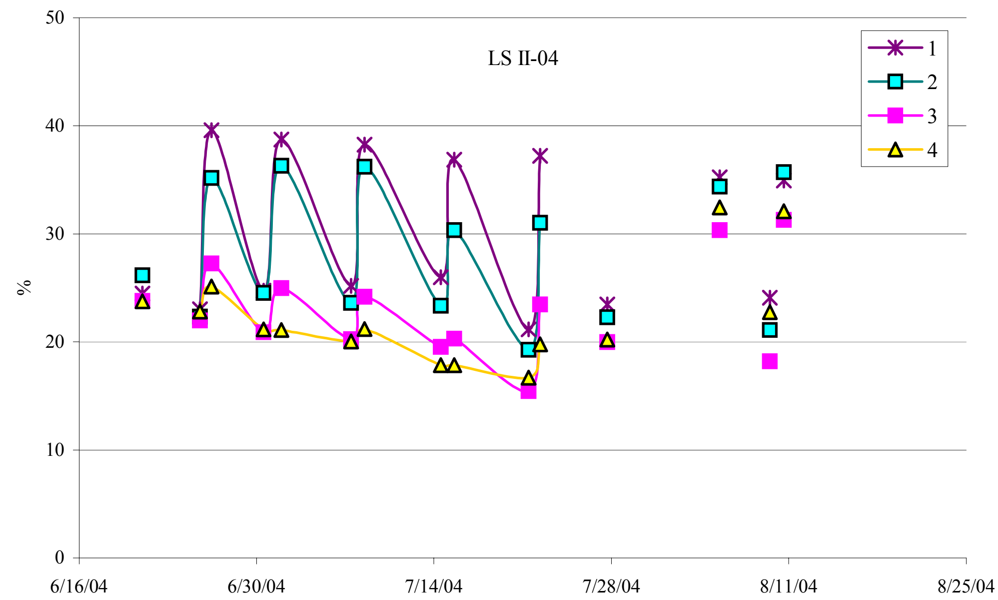

Figure 2.5. Effect of irrigation level on soil moisture to 6 inches in LS II experiment.

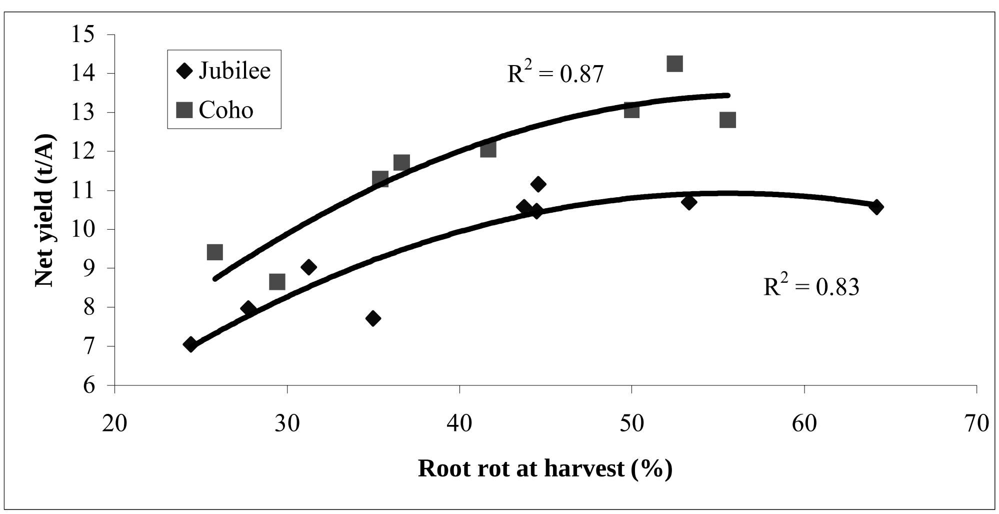

Figure 2.6. Effect of root rot on Jubilee and Coho yields. Yields are average of compacted and uncompacted soil treatments. N= 6 for Coho and 8 for Jubilee.

Table 2.7. Effect of variety, soil compaction and irrigation level on radicle and root rot at midseason in LS III, 2004.

Variety	Soil compaction treatment	Irrigation Level	Obs	Percent root rot				Crown discoloration	
				Radicle		Primary roots			
			N	Mean	SD	Mean	SD	Mean	SD
				--------------------%	--------------------			0-4	
Coho	Compacted	1	8	30	22	0.8	0.7	1.2	0.2
Coho	Compacted	2	8	16	13	0.6	0.7	1.2	0.1
Coho	Compacted	3	8	16	15	0.2	0.2	1.1	0.2
Coho	Compacted	4	8	8	14	0.0	0.0	1.7	0.2
Coho	Uncompacted	1	8	34	22	1.3	1.0	1.3	0.1
Coho	Uncompacted	2	7	26	14	1.1	0.8	1.2	0.1
Coho	Uncompacted	3	8	22	12	0.2	0.3	1.2	0.1
Coho	Uncompacted	4	8	10	6	0.0	0.0	1.7	0.2
Jubilee	Compacted	1	8	43	16	0.7	0.7	1.5	0.2
Jubilee	Compacted	2	8	29	13	0.3	0.3	1.6	0.2
Jubilee	Compacted	3	7	29	25	0.0	0.1	2.2	0.5
Jubilee	Compacted	4	8	2	3	0.0	0.0	3.2	0.6
Jubilee	Uncompacted	1	8	57	17	1.1	0.8	1.5	0.3
Jubilee	Uncompacted	2	8	38	22	0.5	0.7	1.7	0.8
Jubilee	Uncompacted	3	7	27	17	0.1	0.3	2.3	0.3
Jubilee	Uncompacted	4	8	15	11	0.0	0.0	2.9	0.2
SS Jubilee	Compacted	1	8	15	20	0.1	0.2	2.2	0.9
SS Jubilee	Compacted	2	8	23	22	0.5	0.6	1.7	0.4
SS Jubilee	Compacted	3	8	16	16	0.1	0.1	1.7	0.4
SS Jubilee	Compacted	4	7	18	20	0.1	0.1	2.4	0.5
SS Jubilee	Uncompacted	1	7	25	24	0.3	0.4	2.2	0.6
SS Jubilee	Uncompacted	2	7	34	18	0.5	0.4	1.6	0.3
SS Jubilee	Uncompacted	3	7	16	8	0.1	0.1	1.8	0.4
SS Jubilee	Uncompacted	4	7	24	27	0.0	0.1	2.4	0.7
LSD (0.05)				12		0.4		0.4	

Analysis of effects [a]

Effect	Radicle	Primary roots	Crown discoloration
Variety	**	**	****
Compaction	**	*	ns
Variety x Compaction	ns	ns	ns
Irrigation Level	****	****	****
Variety x Irrigation Level	***	**	****
Compaction x Irrigation Level	ns	ns	ns
Variety x Compaction x Irrigation Level	ns	ns	ns

[a] ****, P≤0.0001; ***, P≤0.001; **, P≤0.01; *, P≤0.05; ns, not significant.

Table 2.8. Effect of irrigation level on Jubilee Sweet corn yield, root rot, and crown discoloration at harvest, LSIII, 2004.

Irrigation level 1st 6 WAP	Obs.	Ears	Net yield	Avg. ear wt.	Root rot	Crown discoloration
		no/A	t/A	lbs	%	0-4
1=high	4	34400	13.5	0.78	50	1.3
2	4	32700	12.7	0.77	48	1.5
3	4	33500	13.1	0.78	38	1.7
4	4	33500	12.3	0.73	12	2.0
5	4	32200	10.7	0.66	19	2.6
LSD (0.05)		ns	1.7	0.07	25	0.6

Effect of Vapam, Simulated Crop Rotation, and Tillage on Root Rot in Corn

(2003)

Ed Peachey, Robin Ludy, and Alex Stone, Horticulture Department, OSU

The objective of this research was to determine the effect of Vapam and crop rotation on corn roots that were growing in root rot infested soil. Root rot is a serious obstacle for successful corn production in some areas of the Willamette valley. Results of trials using fumigation to reduce corn root rot in 2002 gave mixed results. In one experiment where the surface was tarped after the Vapam was applied, root rot was substantially reduced by fumigation. However, when applied with a strip applicator at depths of 4 and 12 in., results were much less predictable. This experiment was designed to clarify the potential that Vapam might have to control root rot in corn.

Methods

The site selected for this experiment had a history of corn root rot, and sweet corn had been grown there for at least 5 of the last 6 years. The field was prepared for corn planting by disking and rototilling in mid-June. There were 6 treatments applied in 4 replications in a randomized complete block design.

Soil was excavated from 24 pits at the site on June 16 in preparation for application of treatments (Fig. 1). Each pit was 2.5 ft wide by 4 ft. long and 12 in. deep. The two Vapam treatments were applied on June 17 by spraying a Vapam and water mixture (1:1.3 v/v) in a band at 12 in. below the soil surface or at both 4 and 12 in. Vapam was applied at 70 GPA to both bands resulting in 140 GPA of Vapam applied to the '4 + 12 in.' treatment (see Table 1 for treatments). The soil was moist when the Vapam was applied. For the simulated crop rotation effects, soil that had been used to grow snap beans for more than 15 yrs (bean root rot experimental area) was used to fill the 2.5 by 4 ft. void in the soil. Bean soil was either 6 or 12 in. deep.

Two control plots without Vapam or 'bean soil' were included for comparison. The excavated check had soil that was managed the same as the 'bean soil' and Vapam treatments (i.e. the soil was removed from the pit and then replaced) but without any treatment applied. The soil in the 'unexcavated' check plots was <u>not</u> removed and replaced as with all other treatments; instead, tillage disturbance was limited to the initial disking and rototilling that all plots received when the experiment commenced.

The plots were rolled the same day that treatments were applied. Irrigation water was applied one week after the Vapam application to keep the soil moist. Two rows of Jubilee sweet corn were planted 30 in. apart through each 2.5' by 4' plot on July 7, approx. 3 weeks after the treatments were applied. Corn seeds were planted 2 in. deep with 5 in. between seeds. Basagran and Atrazine were applied as a postemergence tankmix to control weeds.

Trenches were dug through the plots in mid-September to evaluate percent diseased roots and root mass. The wall of each trench was sprayed with water to expose the roots. Pictures were taken of a 12 in. wide by 16 in. deep area at the center of each plot using a mirror, and corn root density evaluated on a scale of 1-10. Pictures of treatments in blocks II and III are presented in Figure 3. Corn plants were carefully removed from each plot by washing the roots from the soil, and roots were rated for relative percentage of diseased root.

Results

Evaluation of diseased roots indicates that replacing soil with 12 in. of 'bean' soil and application of Vapam at both 4 and 12 inches were the most effective treatments for reducing root rot compared to both the excavated and unexcavated checks (Table 1 and Figure 2). Inconsistencies were noted among the treatments for the effect they had on roots at various depths.

All of the treatments increased root density compared to the unexcavated check (Table 1, Figure 3). However, only the Vapam 4+12 treatment improved root density ratings compared to the excavated check when using an alpha of 0.05 for separation of the means. Root density in plots with 12 in of 'bean' soil also differed from the excavated check if a p-value of 0.10 was used to separate the means.

Discussion

Fumigation with Vapam (140 GPA; 70 GPA at 4 and 12 inches) and replacement of corn soil with bean soil to 12 in. significantly improved root density and reduced root rot lesions on corn roots (Table 1, Figs. 2 and 3) Vapam applied at 70 GPA in a 4 in. band and bean soil 6 in. deep did not significantly reduce root rot lesions, although these treatments may have increased root growth.

Vapam significantly improved root growth and reduced root lesions, but only when applied in bands at 4 and 12 in. for a total rate of 140 GPA. This may partially explain the mediocre results with Vapam in 2002. Even though Vapam provided good weed control with as little as 30 GPA when applied in a band 4 in. under the row in 2002, there was very little concrete evidence from 4 field trials that Vapam reduced root rot, even when applied up to 70 GPA. In untarped conditions such as would be expected in sweet corn or other low-margin crops, higher rates of Vapam may be required.

These data also indicate that crop rotation may be an effective strategy for reducing root rot in corn. Replacing corn soil with soil that had been used for growing snap beans for several years significantly reduced the number of lesions on corn roots and increased root density, particularly when the 'bean' soil was 12 inches deep.

A surprising finding was that root growth increased when the soil was removed from the pits and then replaced (excavated vs. unexcavated check). These treatments measured the effect of tillage intensity. However, the disease ratings for the two tillage treatments did not differ, even though pictures of roots in Fig. 3 indicate a distinct difference in root quality between the excavated and unexcavated checks. This observation concurs with the perception of many growers that tillage improves sweet corn growth.

Table 1. Effect of Vapam and simulated crop rotations on root rot and root density in sweet corn.

Treatment	Root disease rating at four depths						Number of roots found below 12"	Root density rating	
	No obs.	Short roots	Roots 1-5" deep	Roots 6-12" deep	Roots > 12" deep	Avg.[a]		Obs.	Mean
	----------percent diseased roots----------						no./ 2 ft of linear row	N	0-10
'Bean' soil 6 in deep	7	7	8	28	10	11	3.1	4	6.0 ab[b]
'Bean' soil 12 in deep	4	0.6	0.6	4	4	1	2.0	3	6.3 a
Vapam band @ 4 in (70 GPA)	4	9	15	14	38	10	2.0	4	5.9 ab
Vapam bands @ 4 and 12 in. (140 GPA)	6	3	2	9	9	3	1.8	4	7.5 a
Check (excavated)	5	14	17	18	25	12	1.0	3	4.0 bc
Check (unexcavated)	4	4	10	31	50	11	0.3	4	2.3 c
FPLSD (0.05)		7	10	14	ns	6	ns		2.7

[a] Excluding roots > 12 inch deep because only a few plots had roots that grew below 12 in.
[b] Separation of means with p-value of 0.10.

Figure 1. Site preparation and root evaluation.

Site after pits were dug

Preparing pits for application of fumigant.

Trenching to expose roots

Effect of Vapam and simulated crop rotation on root density in 2 of the 4 replications in the experiment. The excavated check had the same soil e as all other treatments. The unexcavated check is not shown. See Table 1 for data.

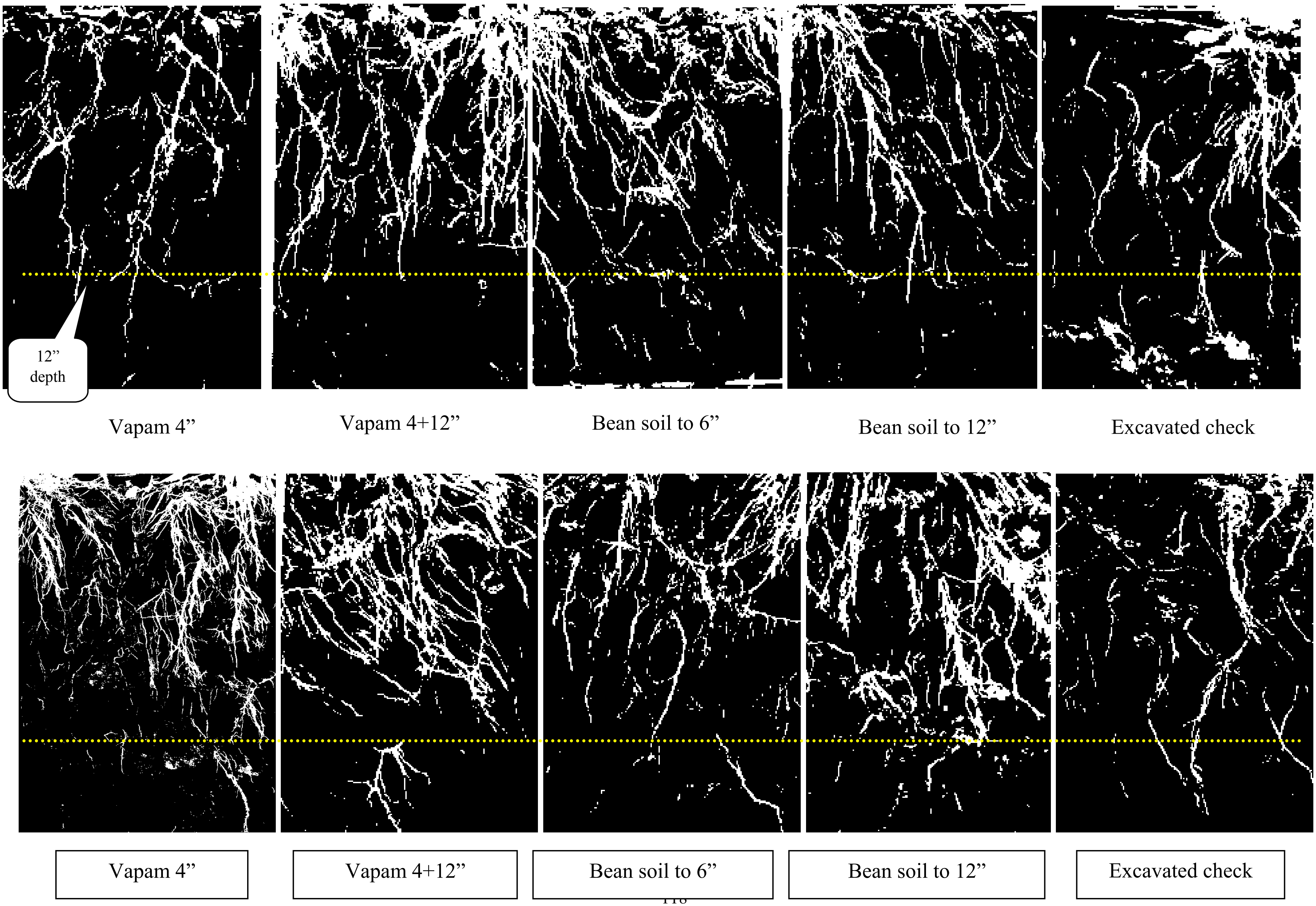

Figure 3. Effect of simulated crop rotation and Vapam on rot root in sweet corn, showing the relative proportion of lesions on the roots.