Horticultural Weed Control Report

2007 and 2008

Web downloads

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Not intended or authorized for publication

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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
DAT	Days after treatment
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

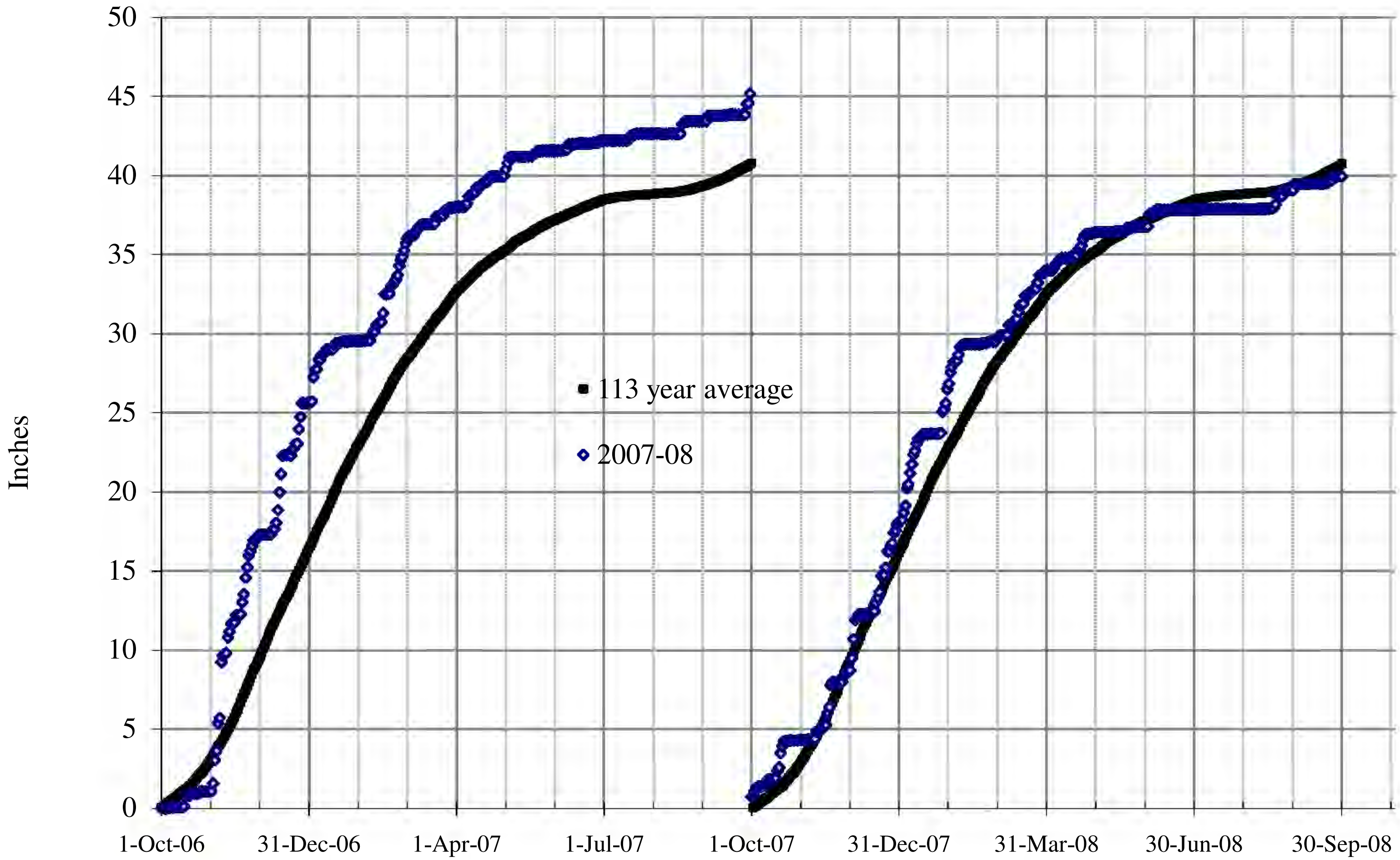

Figure 1. Precipitation (inches) recorded at Hyslop Experiment Station, Corvallis, OR from Oct 1, 2006 to Sept 30, 2008. 113-year average precipitation also recorded at Hyslop Experiment Station.

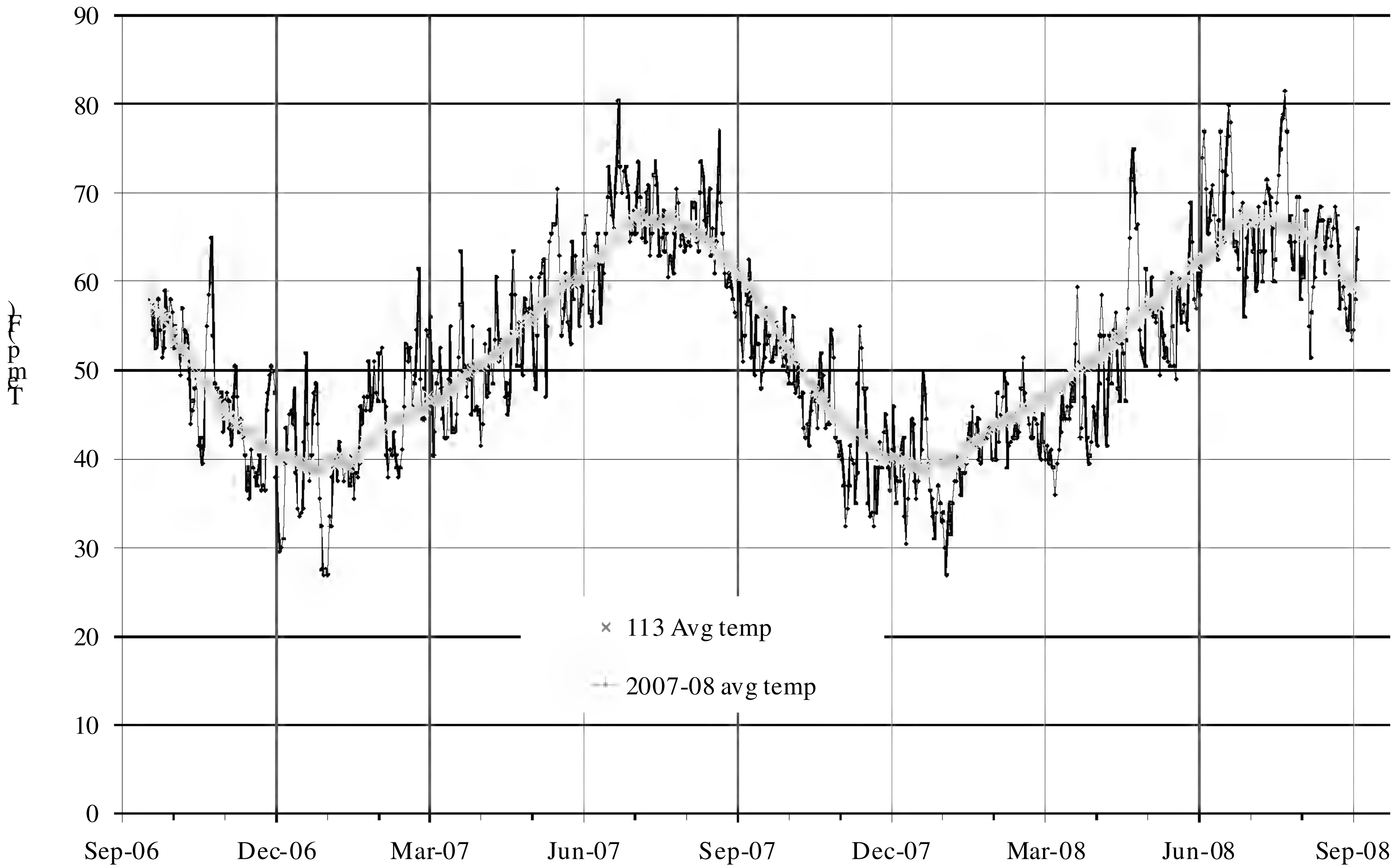

Figure 2. Average temperatures (average of daily max and min) recorded at Hyslop Experiment Station, Corvallis, OR from Oct 1, 2006 to Sept 30, 2008. 113-year average also recorded at Hyslop Experiment Station.

Improving Herbicide Options in Beets, Carrots, and Other Root Crops

2007

Ed Peachey, Horticulture Department, OSU

Methods

Table beets were planted in beds with 3-26 inch rows on May 15, 2007. Preemergence herbicides were applied the next day with a hand-held boom sprayer with 3-8002 nozzles (20 inch spacing on the boom), at 30 PSI, and with 20 GPA of water. Herbicides were incorporated with irrigation water shortly after planting. Postemergence herbicides were applied when beets had cotyledon to 2 leaves, 2 leaves, or 4 true leaves. The predominant weed at the field site was hairy nightshade. Crop injury and hairy nightshade density were evaluated at 3 WAP, and weed control evaluated at harvest. All plots were cultivated once. Beets were harvested on August 2 from one 8.2 ft section of each row in the middle of the plot, graded, and weighed.

Results and Discussion

The overall weed control estimate at harvest accounted for approximately 88% of the yield variability. Neither Dual Magnum nor Ethotron applied alone provided adequate hairy nightshade control (Table 1, Figure 1). However, Dual Magnum tankmixed with Ethotron at the lowest rate of 0.47 lbs ai/A (15 oz/A) reduced hairy nightshade density by 5-fold compared to Ethotron alone at the same rate. Hairy nightshade density was reduced to only 12 plants/m^2 when Dual Magnum was tankmixed with the highest rate of Ethotron. The two higher rates of Ethotron stunted crop growth when applied with Dual Magnum, but did reduce plant stand. The best yields were with Ethotron at 1.88 lbs ai/A or when any rate of Ethotron was tankmixed with Dual Magnum (Figure 2). Future research should examine the synergism between these two herbicides for hairy nightshade control, particularly with reduced rates of Dual Magnum. Dual Magnum will occasionally reduce table beet stands under unfavorable environmental conditions. Lowering the Dual Magnum rate and tank mixing with Ethotron may reduce the potential of crop injury yet maintain acceptable levels of hairy nightshade control.

Ethotron applied POST alone or with Dual Magnum did not provide adequate weed control (Table 2). The addition of Stinger (Tr. 13) to the tankmix at 0.188 lbs ai/A (8 oz) improved weed control when applied to 4-leaf beets. Tankmixing Spin-Aid with Ethotron and applying at the cotyledon to 2-leaf stage controlled 94% of the weeds at harvest (Tr. 14) and yield was very high even though there was stunting of the crop early in the season. These two treatments (13 and 14) yielded 21.3 and 28.2 t/A, respectively (data not shown in table) and did not affect the size of the beets or the number of beets harvested.

Table 1. Effect of Dual Magnum and Ethotron applied PES as a tankmix on hairy nightshade control and table beet yield, Corvallis.

	Herbicide	Rate	Stand	Phytotoxicity	Stunting	Weed control			Beet root harvest	
						Hairy nightshade		Composite	Yield	Grade
						Density	Control			
			13-Jun	*7-Jun*	*13-Jun*	*13-Jun*	*21-Aug*	*21-Aug*	*---- 21-Aug ----*	
		lbs ai/A	*no/4 ft of row*	*0-10*	*0-100 %*	*no./m²*	*%*	*%*	*t/A*	*% 1-2*
1	Dual Magnum	0.64	34	0.0	3	32	63	46	15.3	83
2	Ethotron	0.47	34	0.0	0	69	23	23	9.4	77
3	Ethotron	0.94	37	0.0	4	48	61	60	20.4	69
4	Ethotron	1.88	36	0.5	10	23	96	91	27.5	49
5	Ethotron Dual Magnum	0.47 0.64	41	0.0	3	12	81	71	27.1	61
6	Ethotron Dual Magnum	0.95 0.64	36	0.4	20	13	95	81	28.4	48
7	Ethotron Dual Magnum	1.88 0.64	38	0.1	18	6	94	87	29.8	49
8	Check	-	35	0	0	99	0	0	0	-
	FPLSD (0.05)		Ns	0.7	12	34	22	27	9.1	26

Table 2. Effect of postemergence herbicide applications on weed control in table beets, Corvallis.

	Herbicide	Timing	Rate	Stand	Phytotoxicity		Stunting		Weed control		
					7-Jun	*13-Jun*	*7-Jun*	*13-Jun*	*----------13-Jun ------*		*21-Aug*
									Hairy nightshade	Composite rating	Composite rating
			lbs ai/A	*No/4' row*	*0-10*		*0-100 %*		*---------- % ------------*		*---- % ----*
9	Ethotron Dual Magnum Stinger	4 lf 4 lf 4 lf	0.156 0.640 0.188	33	-	0.8	-	5	-[a]	-[a]	71
10	Ethotron	4 lf	0.313	37	-	0.3	-	5	3	5	30
11	Ethotron Dual Magnum	2 lf 2 lf	0.164 0.640	34	0	0.5	0	0	43	35	33
12	Ethotron Dual Magnum Stinger	4 lf 4 lf	0.313 0.640 0.094	41	-	0.8	-	0	-	-	58
13	Ethotron Dual Magnum Stinger	4 lf 4 lf 4 lf	0.313 0.640 0.188	39	-	0.5	-	0	-	-	76
14	Ethotron Spin-Aid	coty to 2-lf coty to 2-lf	0.164 0.244	37	2.0	0.8	25	30	100	98	94
15	Ethotron Spin-Aid	2 lf 2 lf	0.164 0.488	28	2.8	1.3	21	18	86	83	50
16	Ethotron Spin-Aid	4 lf 4 lf	0.313 0.748	37	-	0.5	-	8	57	54	61
17	Spin-Aid	2 lf	0.488	37	1.0	0.8	9	9	56	60	36
18	Spin-Aid	4 lf	0.748	34	-	1.3	-	13	71	66	40
19	Dual Magnum	2 lf	0.640	35	0.1	0.5	0	3	0	0	23
20	Dual Magnum	4 lf	0.640	33	-	0.0	-	0	0	0	25
	FPLSD (0.05)			ns	0.7	ns	8	12	28	24	23

[a] (-) data missing in this column because the treatment effect was incomplete when this evaluation was made.

Table 3. Herbicide application data.

Date	May 16, 2007	May 31, 2007	June 01, 2007	June 07, 2007
Crop stage	Planted 5-15-07	Cotyledon-2 lf	2-lf	4-lf
Weeds and growth stage				
Hairy nightshade		2lf		2-4" tall
Purslane		2lf, 1/4 in dia.		2-4" tall
Smartweed		2lf		2-4" tall
Herbicide/treatment	PES	Spin-Aid coty-2 lf	2-lf	4-lf
Application timing	PES	coty-2 lf	2-lf	4-lf
Start/end time	7-8 AM	7-7:30	7:15-8 am	6-6:45 AM
Air temp/soil temp (2")/surface	60/62/66	65/62/64	72/72/76	53/56/54
Rel humidity	68%	48%	48%	80%
Wind direction/velocity	0-1 NE	NE 0-0.5	SW 0-1	0
Cloud cover	0	0	0	100
Soil moisture	very Dry	damp irrigated on 5-29	Dry	Dry
Plant moisture	-	light dew	light dew	light dew
Sprayer/PSI	BP 30 PSI	BP 40 PSI	BP 40 PSI	BP 40 PSI
Mix size	2100 mls	2100 mls	2100 mls	2100 mls
Gallons H20/acre	20	20	20	20
Nozzle type	8002	8003	8003	8003
Nozzle spacing and height	3 nozzle boom 20/20	3 nozzle boom 20/20	3 nozzle boom 20/20	3 nozzle boom 20/20
Soil inc. method/implement	1.5 hrs irrigation at 9 AM	None	1 hr at 2 pm	6-8 2 hrs
Soil test	pH=6.2	% OM (LOI) 2.4%	CEC 22.5 meq/100g soil	

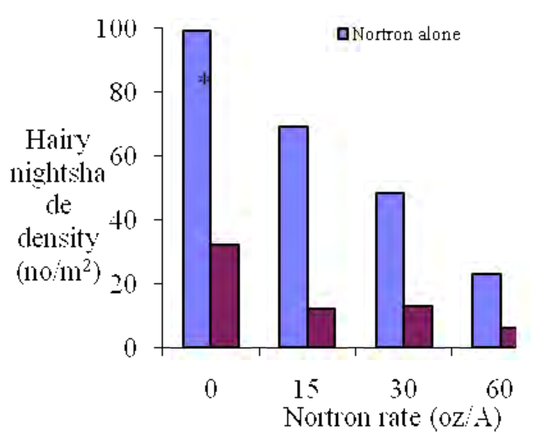

Figure 1. Ethotron and Dual Magnum tankmix effects on hairy nightshade density. (*) Check plot with no herbicides applied.

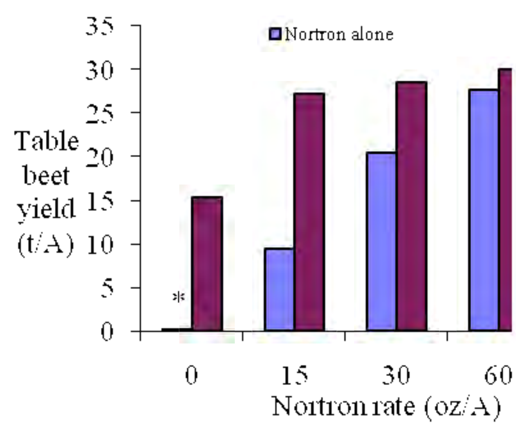

Figure 2. Ethotron and Dual Magnum tankmix effects on table beet yield. (*) Check plot with no herbicides applied.

Weed Control in Table Beets and Carrots with Dual Magnum and Ethotron

2008

Ed Peachey, Horticulture Department, OSU
Tom and Sam Sweeney, Country Heritage Farms, Dayton, OR

SummaryProjects evaluated the potential of controlling hairy nightshade with tankmixes of Ethotron and Dual Magnum and determined table beet tolerance to Dual Magnum in a commercial production system. Hairy nightshade control with Dual Magnum improved nearly linearly as the rate of Dual Magnum increased. Hairy nightshade control improved significantly when Dual Magnum was tankmixed with Ethotron, and the increase in efficacy was most apparent with Ethotron tankmixed at 15 and 30 oz/A. In a commercial field, Dual Magnum significantly improved weed control, but may have reduced yield where irrigation was excessive.

I. Hairy Nightshade Control with Ethotron and Dual Magnum in Root Crops, Research Farm, Corvallis

Methods

Fertilizer with 12-29-10 analysis was broadcast before planting at 300 lbs/A and shallow incorporated with a vertical tine tiller. Table beets and carrots were planted on May 19, 2008 in 25 ft long plots. Two rows of beets and one row of carrots were planted on 26 inch centers. An additional 200 lbs/A of fertilizer was banded at planting. Herbicides were applied with a CO_2 pressured back sprayer at 20 GPA and incorporated with ½ inch irrigation. Soil pH was 5.6, OM (LOI) 2.23% and CEC 18.9 meq/100g soil at planting. Plots were cultivated twice after hairy nightshade counts and weed control evaluations. The check plot was hand- weeded once in addition to cultivation. Beets were pulled from 8 ft of row on August 25 and carrots from 10 ft of row on September 8.

Results

Hairy nightshade was by far the most abundant weed in this experiment. The composite weed control rating at harvest accounted for nearly 80% of the variability in table beet yield and 61% of the carrot yield.

Hairy nightshade control with Dual Magnum improved nearly linearly as the rate of Dual Magnum increased. Hairy nightshade control improved significantly when Dual Magnum was tankmixed with Ethotron, and the increase in efficacy was most apparent with Ethotron tankmixed at 15 and 30 oz/A. Dual Magnum at 5.3 oz/A plus Ethotron at 30 oz/A reduced hairy nightshade emergence by 80% compared to Dual Magnum applied alone, but only 50% when Dual Magnum at 5.3 oz/A was applied with Ethotron at 15 oz/A. Dual Magnum at 5.3 oz/A and Ethotron at 30 oz/A maximized hairy nightshade control with acceptable crop injury. None of the treatments completely controlled hairy nightshade.

Table 1. Effect of Ethotron and Dual Magnum on weed control in root crops, Corvallis, 2008.

Tr. No.	Ethotron	Dual Magnum	Hairy nightshade emergence 4 WAP (18-Jun)	Weed control 5 WAP (25-Jun)					Weed control at harvest	
				Hairy nightshade	Shepherds-purse	Pineapple weed	Common purslane	Composite rating	Hairy nightshade	Composite rating
	oz/A	*oz/A*	*no/m sq*	-----%						-----
1	0	0.0	127	0	0	0	0	0	85	84
2	0	5.3	83	65	83	78	95	73	55	55
3	0	8.0	51	83	94	91	96	81	69	69
4	0	10.7	47	88	97	71	100	87	71	70
5	15	0.0	107	78	5	61	100	75	65	63
6	15	5.3	41	91	95	95	100	91	80	80
7	15	8.0	17	95	98	87	100	97	88	88
8	15	10.7	7	98	99	97	100	98	94	90
9	30	0.0	55	95	61	53	100	84	88	85
10	30	5.3	17	98	98	97	100	97	98	95
11	30	8.0	9	99	100	96	100	99	100	99
12	30	10.7	5	99	100	100	100	99	100	100
13	60	0.0	51	97	95	71	100	95	95	93
14	60	5.3	3	99	100	99	100	99	97	97
15	60	8.0	3	99	100	99	100	98	98	98
16	60	10.7	2	100	100	99	100	99	100	100
17	0	21.3	11	95	100	98	100	95	91	91
18	15	21.3	3	99	100	100	100	98	98	96
19	30	21.3	1	100	100	100	100	100	100	100
ANOVA			*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*
FPLSD			*22*	*6.3*	*15*	*28.6*	*3.5*	*5.9*	*10.8*	*10*

Table 2. Effect of Ethotron and Dual Magnum herbicides on beet and carrot growth and yield.

Crop	Tr. no	Ethotron	Dual Magnum	Emergence (18-Jun)	Stunting (25-Jun)	Phyto. (25-Jun)	Root no.	Yield	Avg. root wt	Grade
		oz/A	*oz/A*	*no/4 ft*	*%*	*0-10*	*no./ft*	*t/A*	*lbs*	*% 1-3*
Beets	1	0	0.0	41	0	0	5.0	31.9	0.66	50
Beets	2	0	5.3	36	0	0	5.6	26.0	0.52	63
Beets	3	0	8.0	36	8	0	4.6	30.7	0.70	52
Beets	4	0	10.7	36	8	0	4.2	33.1	0.77	53
Beets	5	15	0.0	38	5	0	5.2	29.1	0.63	65
Beets	6	15	5.3	38	4	0	6.0	36.8	0.67	61
Beets	7	15	8.0	41	13	0	5.5	41.3	0.78	45
Beets	8	15	10.7	34	20	1	4.1	43.5	1.07	35
Beets	9	30	0.0	32	6	0	4.8	39.3	0.86	51
Beets	10	30	5.3	36	18	1	4.4	42.0	1.01	41
Beets	11	30	8.0	35	24	2	3.9	40.8	1.20	30
Beets	12	30	10.7	36	20	1	5.6	43.5	0.84	46
Beets	13	60	0.0	34	9	0	5.2	41.6	0.83	45
Beets	14	60	5.3	29	25	1	5.3	38.4	0.80	52
Beets	15	60	8.0	38	26	2	4.1	41.8	1.07	30
Beets	16	60	10.7	34	31	2	5.1	40.2	0.85	42
Beets	17	0	21.3	37	21	1	6.5	39.0	0.64	55
Beets	18	15	21.3	27	35	1	4.5	38.7	1.00	34
Beets	19	30	21.3	30	45	3	4.7	41.2	0.92	38
ANOVA				*ns*	*<0.0001*	*<0.0001*	*ns*	*<0.0001*	*<0.001*	*<0.001*
LSD				*13*	*12.8*	*0.97*	*1.6*	*6.97*	*0.13*	*18*
Carrots	1	0	0.0	49	0	0	12.7	18.1	0.14	-
Carrots	2	0	5.3	46	3	0	13.7	15.2	0.11	-
Carrots	3	0	8.0	48	8	0	15.5	20.1	0.13	-
Carrots	4	0	10.7	44	20	0	13.8	20.3	0.15	-
Carrots	5	15	0.0	50	0	0	15.4	17.6	0.12	-
Carrots	6	15	5.3	46	10	0	14.2	21.7	0.15	-
Carrots	7	15	8.0	52	13	0	15.8	22.6	0.14	-
Carrots	8	15	10.7	46	16	0	14.2	23.1	0.16	-
Carrots	9	30	0.0	43	5	0	15.1	21.2	0.14	-
Carrots	10	30	5.3	49	9	0	15.0	23.8	0.16	-
Carrots	11	30	8.0	45	18	0	13.7	22.9	0.17	-
Carrots	12	30	10.7	43	28	0	14.4	22.1	0.15	-
Carrots	13	60	0.0	45	9	0	16.0	25.0	0.16	-
Carrots	14	60	5.3	45	23	0	13.8	23.6	0.17	-
Carrots	15	60	8.0	43	23	0	12.9	23.5	0.18	-
Carrots	16	60	10.7	44	25	0	13.1	21.4	0.17	-
Carrots	17	0	21.3	47	33	0	13.8	21.0	0.16	-
Carrots	18	15	21.3	41	28	0	13.4	21.8	0.16	-
Carrots	19	30	21.3	42	35	0	11.9	20.9	0.18	-
ANOVA				*ns*	*<0.0001*	*<0.0001*	*0.04*	*<0.0001*	*<0.0001*	
LSD				*8*	*12*	*0*	*2.3*	*3.6*	*0.02*	

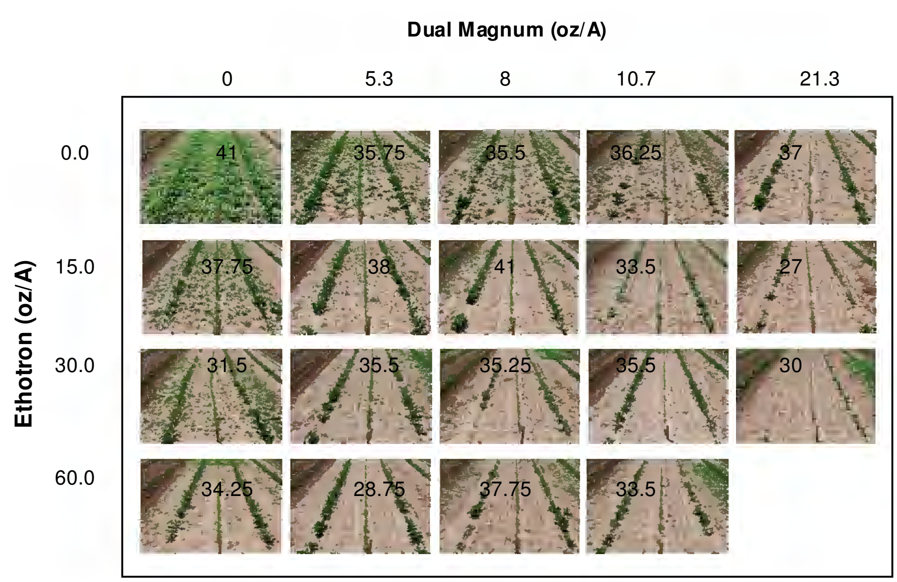

Figure 1. Effect of Ethotron and Dual Magnum tankmixes on crop growth and weed control. Beets are on 2 outer row, and carrots on middle row.

Table 3. Herbicide application data.	
Date	Tuesday, May 20, 2008
Application timing	Preemergence Surface
Start/end time	8-10 A
Air temp/soil temp (2")/surface	69/66/64
Rel humidity	85%
Wind direction/velocity	0-3 SE
Cloud cover	100
Soil moisture	Rained 0.13 during the night prior to treatment
Plant moisture	-
Sprayer/PSI	BP 25 PSI
Mix size	2100 mls
Gallons H20/acre	20
Nozzle type	4-XR-8003
Nozzle spacing and height	4 nozzle boom 20/24
Soil inc. method/implement	Total of 0.5 inches of rain fell/irrigation was applied with 48 hrs after planting

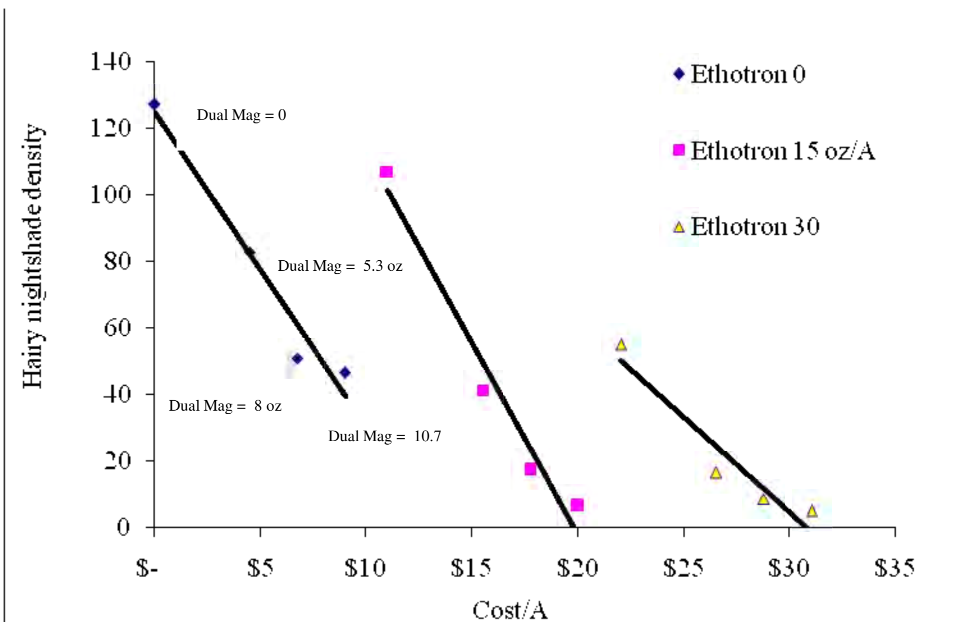

Figure 2. Effect of Ethotron and Dual Magnum tankmixes on hairy nightshade emergence.

II. Table beet tolerance to Dual Magnum in a commercial production field.

Methods

Table beets were planted in a field near Dayton, Oregon. Roneet was preplant incorporated and Pyramin was banded over the row at planting. Dual Magnum was applied broadcast immediately after planting at 10.7 oz/A (0.64 lbs ai/A) on May 22, 2008 to 8 foot strips the length of the field. Crop emergence was measured in 18-3 foot row lengths in each plot on June 10. Beets were machine harvested on Sept 3.

Results

Yield was greater in Test 3 (Roneet+Pyramin+Dual Magnum) than Test 5 (Roneet+Pyramin). The yield in Test 4 was probably low because of a reduced stand that occurred where the irrigation sprinklers drained on the first irrigation set. Test 4 also included some beets from the area of test 3 (see footnote). Revenue per acre was higher in the Test 5 because of smaller beets. These results suggest that Dual Magnum had a slight effect on beet emergence early in the season, which caused larger beets and less value per acre even though yield was greatest where Dual Magnum was applied. Weed control improved with Dual Magnum, even when applied over Roneet + Pyramin (Test 3).

Table 1. Effect of Dual Magnum on table beet emergence, grade, and yield in a commercial field near Dayton, OR

Test	Treatment	Beet emergence (June 10)	Harvest (truck load) data									Estimated yield	Est. value
			Time in	#1	#2	#3	NV	LVS	LRG	SMAL	OTH		
		no/3 ft					*%*					*t/A*	*$/A*
3	Roneet PPI + Pyramin PES + Dual Mag PES	74	9/3/2009 14:07	14	41	21	24	2	5	2	2	38.8	2157
4*	Roneet PPI+ Dual Mag PES	71	9/3/2009 14:07	21	44	6	29	6	0	1	2	26.2	1593
5	Roneet PPI + Pyramin PES	76	9/3/2009 14:07	25	55	7	13	8	0	2	2	32.3	2410

**70% of the beets harvested in this test were from Test Area 4 (Roneet+Dual Magnum) and 30% were from Test Area 3.*

Evaluation of Dual Magnum for Yellow Nutsedge Control in Transplanted Cabbage

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Introduction

Numerous herbicides are registered for use in cabbage, including bensulide (Prefar), DCPA (Dacthal), napropamide (Devrinol), oxyfluorfen (Goal, Galigan, OxiFlo), sethoxydim (Poast), trifluralin (Treflan), clethodim (Select), and clomazone (Command). However, these herbicides provide no control of yellow nutsedge (*Cyperus esculentus* L.). Yellow nutsedge is considered one of the world's worst weeds, and in recent years, has become a serious problem in row crop production in the Pacific Northwest. Vegetable fields have been taken out of production in the Columbia Basin of Oregon due to the intensity of the weed competition caused by yellow nutsedge when no control other than mechanical cultivation was available. It is well-documented that Dual Magnum (S-metolachlor) can significantly reduce the impact of yellow nutsedge as a crop competitor. Dual Magnum is currently labeled in Oregon (EPA SLN No. OR-040009) for use in onion for that purpose. This research was conducted at the request of regional producers to evaluate safety of Dual Magnum as a tool to reduce yellow nutsedge pressure in transplanted cabbage.

Materials and methods

Trials were conducted in 2006 and 2008 in commercial cabbage production fields under center pivot irrigation. The soils were an Adkins fine sandy loam in 2006 and a Shano silt loam in 2008. Treatments (Table 1) were applied in 30 gpa on Jun 21 and Jul 13 in 2006 and 2008, respectively, with a CO_2 backpack sprayer with 4-XR8002 nozzles spaced 20" apart, at 40 psi, and 2 mph ground speed. Cabbage plants were transplanted approximately 1 ft apart in 3 rows/bed with 6 ft between beds in each 20 ft plot either the day before or immediately after herbicide application for post-transplant or pre-transplant treatments, respectively. Plots were visually evaluated in early, mid, and late season for herbicide injury and weed control efficacy. At harvest, ten heads/plot were harvested, trimmed and weighed. The experimental design was a randomized complete block with five replications. Data were evaluated using the SAS GLM procedure, with orthogonal contrasts for comparisons of interest.

Table 1. Herbicide treatments evaluated in transplanted cabbage, 2006 & 2008, Umatilla County, OR.

Treatment	Rate (pt/a)	Application time
Dual Magnum	0.5	Pre-transplant
Dual Magnum	0.9	Pre-transplant
Dual Magnum	1.3	Pre-transplant
Dual Magnum	0.5	Post-transplant
Dual Magnum	0.9	Post-transplant
Dual Magnum	1.3	Post-transplant
Untreated	-	-

Results

In both 2006 and 2008, there were no visual indications of damage due to application of Dual Magnum at any rate tested, either pre- or post-transplant. The yellow nutsedge populations in the trial areas were too low to evaluate control efficacy; grower mechanical cultivation eliminated most of the weeds throughout the season.

In 2006, there were no differences in cabbage yield with Dual applied either pre- or post-transplant at any rate (Table 2). Application rate and timing did not interact. Orthogonal contrasts comparing pre-transplant vs post-transplant application, pre-transplant vs untreated check, and post-transplant vs untreated check also were not significant.

In 2008, there were no differences in cabbage yield with Dual applied either pre- or post-transplant at any rate (Table 2). Orthogonal contrasts indicate that the yield associated with the pre-transplant application was significantly higher than the untreated check. Yield from the post-transplant treatment was similar to the pre-transplant and the untreated check.

With the data from the two trial years combined for analysis, plot yield was greater in 2006 than in 2008 (Table 3), probably due to a one month longer growing season in 2006. Neither rate nor timing significantly affected yield. There were no significant interactions between any treatment variables (data not shown).

Table 2. Effect of Dual Magnum herbicide rate and timing on yield of cabbage, Umatilla County, OR.

Treatment	2006	2008
Rate (pt/a)	Plot yield[1] (lbs)	
0	74	58.2
0.5	64.1	62
0.9	71.3	60.9
1.3	70.3	64.8
P value	*0.14*	*0.28*
Timing		
Pre-transplant	67.1	66.2
Post-transplant	70.1	60.4
Check	74	58.2
P value	*0.35*	*0.1*
Contrasts		
Pre vs Post	0.35	0.34
Pre vs Check	0.13	0.04
Post vs Check	0.38	0.1

[1] Weight of 10 trimmed heads/plot, harvested Nov 18 (reps 1&2), Nov 19 (reps 3-5) in 2006 and Nov 21, 2008.

Table 3. Effect of Dual Magnum herbicide rate and timing on yield of cabbage, Umatilla County, OR.

	Plot yield[1] (lbs)
Year	
2006	69.4
2008	61.8
P value	*0.0002*
Rate (pt/a)	
0	66.1
0.5	63.2
0.9	66.7
1.3	67.9
P value	*0.22*
Timing	
Pre-transplant	66.7
Post-transplant	65.2
Check	66.1
P value	*0.76*

[1] Weight of 10 trimmed heads/plot.

Cucurbit Tolerance to Fomesafen and Other Herbicides

2008

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Summary

The experimental design was a split plot with main effects of cucurbit crop and herbicide treatment with 4 replications in each block. Processing squash (Var. golden delicious) was planted with a John Deere max emerge on May 14 in 2 paired rows on a 2.5 ft row spacing in 30 foot long plots. Zucchini and cucumber were planted on May 15 with a belt planter. Zucchini (var. Tigress) had one row per plot. The cucumber varieties Speedway and Muncher were planted in two separate rows in each plot. Preemergence herbicides were applied in a 6.6 foot band over the 30 foot long plots on May 16. Plots were separated by a 15' fallow strip. Crop injury was evaluated at 4 and 7 weeks after planting (WAP), and weed control at 5 WAP and at harvest.

Results*Cucumber* emergence was extremely low, probably because of the 4 weeks of unseasonably cool and wet weather after planting. Cucumbers were not harvested because of the very weak stand. Crop growth at 4 WAP was reduced 18 and 24% by Reflex herbicide at the 1 and 2.5 pts/A rates, respectively (Table 1). Cucumbers were more tolerant to Dual Magnum than Reflex herbicide. Weed control was good to exceptional with Reflex herbicide, and far surpassed the control provided by Dual Magnum or Sandea (see Tables 3 and 4 for weed control results).

Zucchini emergence, growth and yield were reduced by Reflex at 2.5 pts/A (Table 2). Yield was greatest with Dual Magnum and Reflex at 1 pt/A. Sandea did not control hairy nightshade adequately and yield was low in Sandea plots because of weed competition (Table 3).

Processing squash was the most tolerant of the three cucurbit crops to Reflex herbicide (Table 3). Very little crop injury was noted with Reflex alone (at both rates) or when tankmixed with Dual Magnum and Outlook herbicides. Yield was greatest with Reflex plus Outlook and weed control exceptional (Table 4). Weed control explained 90% of the squash yield variability (regression on means for yield and weed control).

Weed control. Hairy nightshade control with Reflex herbicide was very good compared to Dual Magnum and Sandea. Reflex at 1 pt/A did not adequately control lambsquarters in plots with extremely high densities.

Table 1. Cucumber tolerance to herbicides.

	Treatment	Form	Rates	Product rates	Timing	Emergence	Phyto 4 WAT	Stunting 4 WAT	Stunting 7 WAT
			lbs ai/A			*no./plot*	*0-10*	*%*	*%*
1	Weedy control	- -	-	- -	-	7	0	0	8
2	Command+	3 ME	0.21	0.56 PT/A	PRE	8	1	3	1
	Curbit	3 EC	0.70	1.87 PT/A	PRE				
3	Dual Magnum	7.64 L	0.955	1 PT/A	PRE	8	0	3	1
4	Dual Magnum	7.64 L	1.91	2 PT/A	PRE	6	1	6	5
5	Reflex	2 L	0.25	1 PT/A	PRE	6	3	18	6
6	Reflex	2 L	0.63	2.5 PT/A	PRE	2	4	24	59
7	Reflex +	2 L	0.31	1.25 PT/A	PRE	5	2	21	29
	Dual Magnum	7.64 L	0.72	0.75 PT/A	PRE				
8	Sandea	75% DF	0.031	0.66 OZ/A	PRE	9	0	0	1
9	Sandea+	75% DF	0.031	0.66 OZ/A	PRE	7	0	0	0
	Strategy	2.1 L	0.92	3.5 PT/A	PRE				
10	Sandea+	75% DF	0.031	0.66 OZ/A	PRE	8	0	0	4
	Strategy	2.1 L	0.92	3.5 PT/A	POST				
11	Hand-weeded	--	-	- -	-	7	0	0	0
12	Reflex	2	0.25	1 PT/A	PRE	4	1	11	16
	Outlook	6	0.66	14 OZ/A	PRE				
13	Reflex	2	0.5	1 PT/A	PRE	2	1	11	29
	Outlook	6	0.66	14 OZ/A	PRE				
	FPLSD					3	1	8	18

Table 2. Zucchini tolerance to herbicides.

	Treatment	Rates	Product rates		Timing	Emergence	Phyto 4 WAT	Stunting 4 WAT	Stunting 7 WAT	Harvest	
		lbs ai/A				*no.30 ft of row*	*0-10*	*%*	*%*	*no. fruit/plot*	*tons/A*
1	Weedy Control	-	-	-	-	13	0	1	0	14.3	3.4
2	Command+	0.21	0.56	PT/A	PRE	11	0	3	1	21.8	6.8
	Curbit	0.70	1.87	PT/A	PRE						
3	Dual Magnum	0.955	1	PT/A	PRE	12	0.3	0	0	24.3	7.9
4	Dual Magnum	1.91	2	PT/A	PRE	13	0	0	0	26.8	9.2
5	Reflex	0.25	1	PT/A	PRE	11	0	0	0	25.3	8.8
6	Reflex	0.63	2.5	PT/A	PRE	3	0	10	12	8.7	2.9
7	Reflex +	0.31	1.25	PT/A	PRE	6	0	9	5	16.3	7.0
	Dual Magnum	0.72	0.75	PT/A	PRE						
8	Sandea	0.031	0.66	OZ/A	PRE	13	0	10	7	17.3	4.4
9	Sandea+	0.031	0.66	OZ/A	PRE	14	0	8	3	24.8	7.6
	Strategy	0.92	3.5	PT/A	PRE						
10	Sandea+	0.031	0.66	OZ/A	PRE	15	0	1	4	20.3	5.9
	Strategy	0.92	3.5	PT/A	POST						
11	Hand-weeded	-	-	-	-	13	0	0	4	20.0	5.1
12	Reflex	0.25	1	PT/A	PRE	13	0	4	0	23.5	8.3
	Outlook	0.66	14	OZ/A	PRE						
13	Reflex	0.5	1	PT/A	PRE	9	0.5	8	6	14.8	4.6
	Outlook	0.66	14	OZ/A	PRE						
	FPLSD						0.46	8	5	10.1	3.3

Table 3. Processing squash (Cucurbita maxima, var. Golden delicious) tolerance to herbicides.

	Treatment	Rates	Product rates		Timing	Emergence	Phyto	Stunting	Stunting	Weed control (5 WAP)			
							4 WAT	4 WAT	7 WAT	Hairy night-shade	Powell amaranth	Common purslane	Composite rating
		lbs ai/A				*No/60 ft of row*	*0-10*	*%*	*%*	---------------------- % ---------------------			
1	Weedy Control	-	-	-	-	22	0	0	9	-	-	-	-
2	Command+	0.21	0.56	PT/A	PRE	20	0	0	1	100	99	78	99
	Curbit	0.70	1.87	PT/A	PRE								
3	Dual Magnum	0.955	1	PT/A	PRE	18	0	1	3	79	100	100	90
4	Dual Magnum	1.91	2	PT/A	PRE	22	0	3	1	97	100	100	92
5	Reflex	0.25	1	PT/A	PRE	21	0	3	0	95	100	100	95
6	Reflex	0.63	2.5	PT/A	PRE	20	0	3	0	100	100	70	100
7	Reflex +	0.31	1.25	PT/A	PRE	23	0	4	0	99	100	78	99
	Dual Magnum	0.72	0.75	PT/A	PRE								
8	Sandea	0.031	0.66	OZ/A	PRE	20	1	5	8	28	75	75	50
9	Sandea+	0.031	0.66	OZ/A	PRE	21	0	5	1	100	100	78	100
	Strategy	0.92	3.5	PT/A	PRE								
10	Sandea+	0.031	0.66	OZ/A	PRE	21	0	1	6	45	75	75	60
	Strategy	0.92	3.5	PT/A	POST								
11	Hand-weeded	-	-	-	-	22	0	0	3	5	25	25	18
12	Reflex	0.25	1	PT/A	PRE	21	0	5	1	100	100	100	100
	Outlook	0.66	14	OZ/A	PRE								
13	Reflex	0.5	1	PT/A	PRE	22	0	3	3	100	100	100	100
	Outlook	0.66	14	OZ/A	PRE								
	FPLSD					ns	ns	ns	6	22	39	49	23

Table 4. Treatment effects on processing squash (Cucurbita maxima, var. Golden delicious) yield and weed control at harvest.

	Treatment	Rates	Rates		Timing	Yield			Weed control at harvest			
		lbs ai/A						Avg. fruit wt	Hairy nightshade	Powell amaranth	Lambs-quarters	Composite rating
						fruit/plot	*tons/A*	*kg*	-------------------%---------------------			
1	Weedy control	-	-	-	-	8.0	7.1	5.3	0	0	0	0
2	Command+ Curbit	0.21 0.70	0.56 1.87	PT/A PT/A	PRE PRE	21.0	23.4	7.0	94	73	98	85
3	Dual Magnum	0.955	1	PT/A	PRE	17.8	16.6	5.6	38	99	70	58
4	Dual Magnum	1.91	2	PT/A	PRE	21.5	21.2	5.9	88	98	73	73
5	Reflex	0.25	1	PT/A	PRE	24.0	25.0	6.4	97	100	71	89
6	Reflex	0.63	2.5	PT/A	PRE	23.0	27.3	7.4	99	100	98	99
7	Reflex + Dual Magnum	0.31 0.72	1.25 0.75	PT/A PT/A	PRE PRE	27.3	30.6	7.1	99	100	98	97
8	Sandea	0.031	0.66	OZ/A	PRE	10.5	9.5	5.1	23	98	87	48
9	Sandea+ Strategy	0.031 0.92	0.66 3.5	OZ/A PT/A	PRE PRE	25.3	25.2	6.3	85	100	100	81
10	Sandea+ Strategy	0.031 0.92	0.66 3.5	OZ/A PT/A	PRE POST	14.0	12.0	5.1	35	100	98	35
11	Hand-weeded	-	-	-	-	25.8	27.6	6.8	97	100	100	97
12	Reflex Outlook	0.25 0.66	1 14	PT/A OZ/A	PRE PRE	27.5	30.0	6.8	83	95	99	95
13	Reflex Outlook	0.5 0.66	2 14	PT/A OZ/A	PRE PRE	27.3	31.6	7.4	100	100	100	98
	FPLSD					6.1	6.4	1.2	31	20	32	14

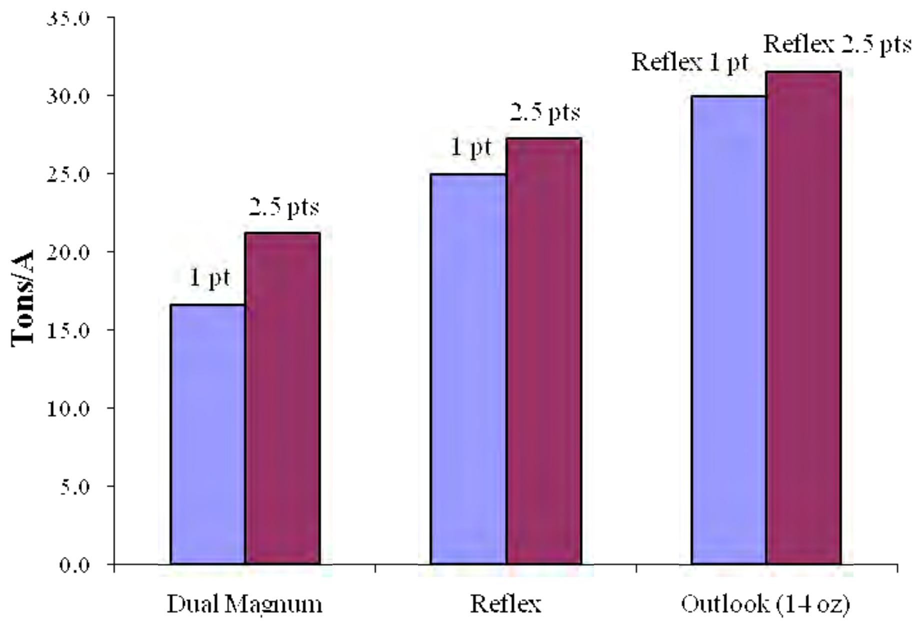

Figure 1. Effect of Reflex herbicide (applied preemergence alone or tankmixed) on Golden delicious squash yield. Weed control was the primary determinant of yield.

Table 5. Herbicide application data**.**

Date	Friday, May 16, 2008	Friday, June 13, 2008	
Crop stage		Cucumber: 1 true leaf, Zucchini: 3rd leaf emerging, Squash: 3rd leaf emerging	
Weeds and growth stage			
Hairy nightshade		coty-2" tall	10-100/m sq
Lambsquarters		coty-2" tall	1-10/m sq
Powell amaranth (pigweed)		2-4 leaf	1-5/m sq
Common purslane		2 leaf	0-1/m sq
Herbicide/treatments	PRE	Tr. 10 (Strategy)	
Application timing	Preemergence surface	POST	
Start/end time	7-10:30 AM	7-730 AM	
Air temp/soil temp (2")/surface	84/85/90	64/58/57	
Rel humidity	31%	60%	
Wind direction/velocity	0-4 (10:30 AM) NE	0	
Cloud cover	0	0	
Soil moisture	dry	dry	
Plant moisture	-	dry	
Sprayer/PSI	BP CO_2/ 25 PSI	BP CO_2/ 20 PSI	
Mix size	5000 ml	2100, 2 bottles	
Gallons H20/acre	20	20	
Nozzle type	4-XR 8003	3-8003 ceramics	
Nozzle spacing and height	20/24	20/24	
Soil inc. method/implement	irrigation on 5-17, 0.5 inch		

Check

Dual Magnum 1 pt

Reflex 1 pt

Reflex 1 pt + Outlook 1 pt

Figure 2. Processing squash 7 WAP (July 4, 2008).

Check

Reflex 1 pt

Reflex 1 pt + Outlook 1 pt

Figure 3. Weed control in processing squash at harvest. Reflex (1 pt/A) did not fully control lambsquarters in this replication, but otherwise provided very good weed control. The addition of Outlook significantly improved weed control and yield.

Spinach, Cilantro, and Parsley Tolerance to Preemergence Herbicides

2008

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Summary
Plots were 8 ft by 20 ft with one row each of spinach, cilantro, and parsley planted with 26 inches between rows on May 21, 2008. The soil type was a silt loam with pH of 5.9, % OM of 2.8, and CEC of 20.7 meq/100 g soil. Herbicides were applied PPS (post-plant-surface) on May 22 with a CO_2 backpack sprayer delivering 20 GPA at 25 PSI. Plots were irrigated with ½ inch of water on May 23 to incorporate the herbicides. Plots were cultivated to reduce weed competition after the first evaluation. A composite weed control rating was made on July 1 and reported in Table 1 (low rate of herbicide only) and Table 2. Significant species at this site were pigweed, lambsquarters, hairy nightshade and common purslane. Crops were harvested as they matured; spinach, cilantro, and parsley at 41, 51, and 77 DAP, respectively.

Results
There were large differences in crop tolerance to these herbicides (summarized in Table 1). All three crops were tolerant to S-metolachlor. Ethofumesate and pronamide were the other two herbicides with good to moderate crop safety on all three crops. Both cilantro and parsley were tolerant to linuron at 0.5 lbs ai/A (Tables 2-4). Tembotrione killed most weeds, spinach, and parsley, but cilantro was moderately tolerant at the rate tested.

Table 1. Summary of spinach, cilantro, and parsley tolerance to herbicides.

Common name	Product	Spinach	Cilantro	Parsley	Weed control at lowest rate
					(%)
Pendimethalin	Prowl H_20	-	T	T	76
S-metolachlor	Dual Magnum	T	T	M	73
Ethofumesate	Nortron	T	M	M	66
Prometryn	Caparol	-	M	M	70
Pronamide	Kerb	M	T	M	60
Dimeth-P	Outlook	R	R	-	85
Linuron	Lorox	-	T	T	68
Flumioxazin	Valor	-	R	-	93
BAS 800	Kixor	-	-	-	71
Tembotrione	Laudis	-	R	-	56
Penoxsulam	Grasp	-	-	-	88
V10142	-	-	-	-	73
Fomesafen	Reflex	-	-	-	86
Lactofen	Cobra	-	-	-	75

T, tolerant; M, moderate tolerance at these rates; R, researchable- possible tolerance at lower rates; (-), no potential, sensitive to this herbicide.

Table 2. Spinach tolerance to PPS herbicides, Corvallis, 2008.

	Herbicide	Timing	Rate	Emergence	Phyto	Stunting	Yield	Weed Control
					(12-Jun-08)	*(26-Jun-08)*		*(1-Jul-08)*
			lbs ai/A	*No./m of row*	*0-10*	*%*	*kg/m or row*	*%*
1	Pendimethalin H_20	PPS	0.500	32	29	65	0.1	76
2	Pendimethalin H_20	PPS	1.000	40	37	40	0.0	84
3	S-metolachlor	PPS	0.67	38	35	0	3.8	73
4	S-metolachlor	PPS	1.337	41	37	8	3.0	59
5	Ethofumesate	PPS	0.375	34	31	30	2.8	66
6	Ethofumesate	PPS	0.750	45	41	5	3.1	76
7	Prometryn	PPS	1.600	17	15	66	1.6	70
8	Prometryn	PPS	3.200	2	2	48	0.1	81
9	Pronamide	PPS	0.500	30	27	29	3.2	60
10	Pronamide	PPS	1.000	27	25	45	2.2	75
11	Dimeth-P	PPS	0.500	27	24	38	2.3	85
12	Dimeth-P	PPS	1.000	31	28	63	1.3	84
13	Linuron	PPS	0.250	35	32	40	2.7	68
14	Linuron	PPS	0.500	21	19	56	1.4	63
15	Flumioxazin	PPS	0.032	1	1	99	0.0	93
16	Flumioxazin	PPS	0.064	0	0	78	0.0	95
17	BAS 800	PPS	0.045	4	4	100	0.0	71
18	Tembotrione	PPS	0.410	15	14	90	0.2	56
19	Penoxsulam	PPS	0.100	3	3	100	0.0	88
20	V10142	PPS	0.050	21	20	91	0.1	73
21	Fomesafen	PPS	0.250	2	2	98	0.0	86
22	Lactofen	PPS	0.13	27	25	58	1.9	75
23	Check			42	38	0	3.3	0
	ANOVA			<0.0001	<0.0001	<0.0001	<0.0001	< 0.0001
	FPLSD (0.05)			16	15	40	1.1	28

Table 3. Cilantro tolerance to PPS herbicides, Corvallis, 2008.

	Herbicide	Timing	Rate	Emergence	Phyto (12-Jun-08)	Stunting (26-Jun-08)	Yield
			lbs ai/A	*no./m of row*	*0-10*	*%*	*(kg/m of row)*
1	Pendimethalin H_20	PPS	0.500	73	0.3	0	0.54
2	Pendimethalin H_20	PPS	1.000	75	0.0	18	0.58
3	S-metolachlor	PPS	0.669	78	0.0	0	0.62
4	S-metolachlor	PPS	1.337	75	0.0	5	0.57
5	Ethofumesate	PPS	0.375	76	0.0	0	0.22
6	Ethofumesate	PPS	0.750	72	0.0	0	0.42
7	Prometryn	PPS	1.600	72	0.8	3	0.47
8	Prometryn	PPS	3.200	64	0.3	25	0.39
9	Pronamide	PPS	0.500	77	0.0	0	0.67
10	Pronamide	PPS	1.000	72	0.5	3	0.41
11	Dimeth-P	PPS	0.500	70	1.0	23	0.24
12	Dimeth-P	PPS	1.000	35	3.5	65	0.12
13	Linuron	PPS	0.250	74	0.3	0	0.50
14	Linuron	PPS	0.500	80	0.0	0	0.52
15	Flumioxazin	PPS	0.032	48	3.8	18	0.38
16	Flumioxazin	PPS	0.064	44	5.5	28	0.31
17	BAS 800	PPS	0.045	35	3.3	48	0.12
18	Tembotrione	PPS	0.410	61	0.5	8	0.37
19	Penoxsulam	PPS	0.100	66	7.3	95	0.00
20	V10142	PPS	0.050	67	1.8	18	0.23
21	Fomesafen	PPS	0.250	2	9.0	78	0.00
22	Lactofen	PPS	0.125	42	6.0	30	0.14
23	Check			72	0.0	0	**0.52**
	ANOVA			<0.0001	<0.0001	<0.0001	0.0002
	LSD (0.05)			14	1.84	28	0.26

Table 4. Parsley tolerance to PPS herbicides, Corvallis, 2008.

	Exp herbicide treatments	Timing	Rate	Emergence	Phyto *(12-Jun-08)*	Stunting *(1-Jul-08)*	Yield
			lbs ai/A	*no/m of row*	*0-10*	*%*	*(kg/m of row)*
1	Pendimethalin H_20	PPS	0.500	25	0.8	20	0.22
2	Pendimethalin H_20	PPS	1.000	26	0.0	18	0.38
3	S-metolachlor	PPS	0.67	30	0.3	33	0.25
4	S-metolachlor	PPS	1.337	29	0.0	50	0.17
5	Ethofumesate	PPS	0.375	39	0.5	15	0.24
6	Ethofumesate	PPS	0.750	34	0.0	5	0.32
7	Prometryn	PPS	1.600	26	0.5	10	0.28
8	Prometryn	PPS	3.200	33	0.8	13	0.25
9	Pronamide	PPS	0.500	26	0.8	25	0.31
10	Pronamide	PPS	1.000	26	0.0	28	0.26
11	Dimeth-P	PPS	0.500	6	1.0	100	0.00
12	Dimeth-P	PPS	1.000	3	5.5	100	0.00
13	Linuron	PPS	0.250	36	0.8	10	0.27
14	Linuron	PPS	0.500	29	0.3	23	0.28
15	Flumioxazin	PPS	0.032	5	4.3	94	0.06
16	Flumioxazin	PPS	0.064	5	6.8	99	0.02
17	BAS 800	PPS	0.045	16	5.8	100	0.02
18	Tembotrione	PPS	0.410	24	0.8	60	0.08
19	Penoxsulam	PPS	0.100	8	4.8	100	0.00
20	V10142	PPS	0.050	22	2.8	93	0.02
21	Fomesafen	PPS	0.250	7	9.0	100	0.00
22	Lactofen	PPS	0.13	15	5.8	85	0.03
23	Check			39	0.0	0	0.31
	ANOVA			<0.0001	<0.0001	<0.0001	<0.0001
	FPLSD (0.05)			13	2.6	22.0	0.20

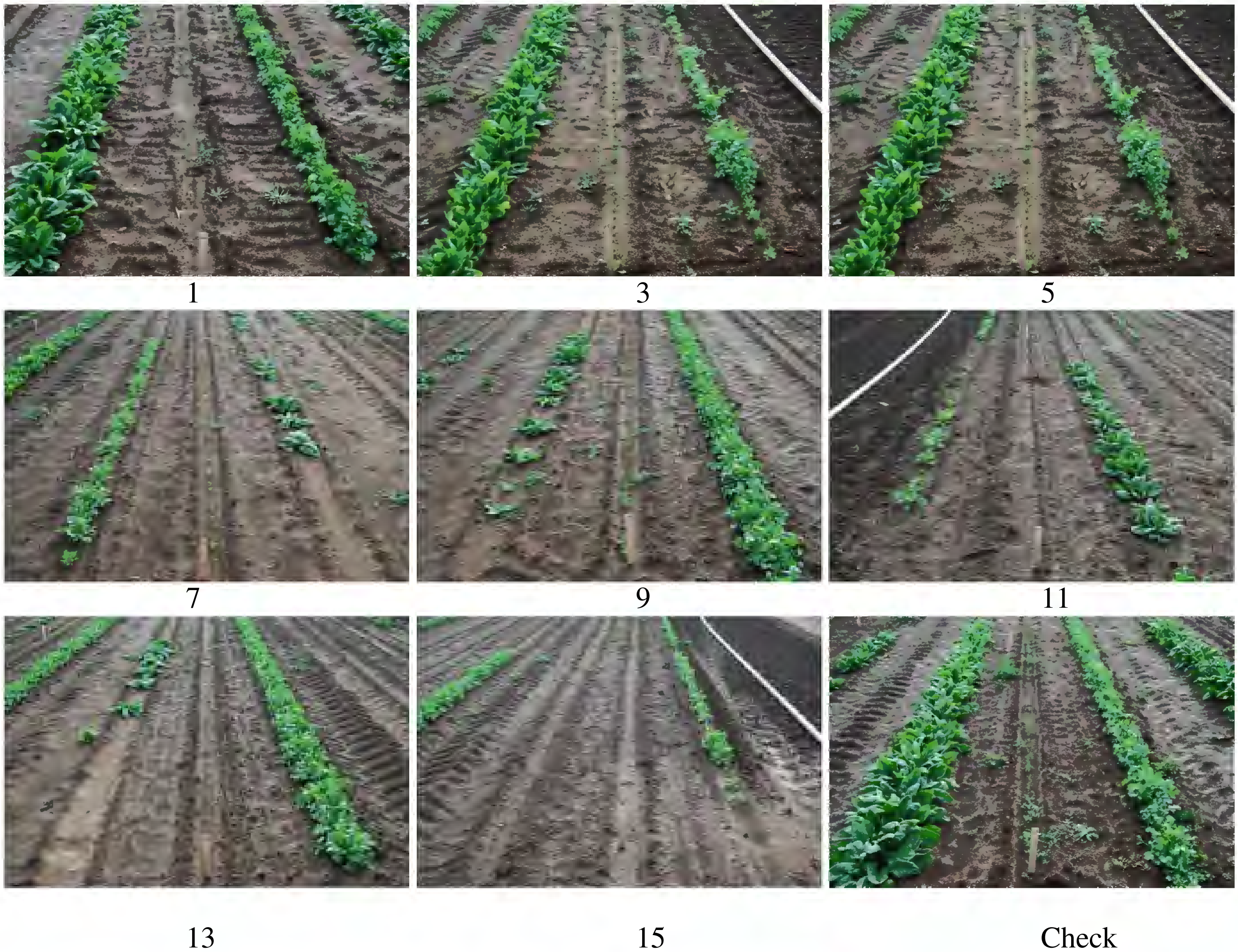

Figure 1. Herbicide effect (1 x rates) on spinach, parsley, and coriander (left to right in photo). See table for treatment numbers and descriptions.

Dry bulb onion tolerance to sequential applications of bentazon applied to control yellow nutsedge (*Cyperus esculentus* L.) in the Pacific Northwest

2007

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Joel Felix, Malheur Experiment Station, Ontario, OR
Rick A. Boydston, USDA, Prosser, WA

Summary

Yellow nutsedge infests onions fields in the PNW, and there are few herbicides registered to control this pest. Nutsedge is prolific if left uncontrolled in onion fields because the crop has little competitive effect on nutsedge growth. Registered herbicides that suppress nutsedge growth include S-metolachlor and dimethenamid-P but do not provide adequate control. Basagran suppresses nutsedge, but preliminary data indicate that sequential low-rate applications will be needed to avoid significant crop injury. The objective of this project was to determine dry bulb onion tolerance to sequential applications of bentazon applied with and without surfactant (COC).

Methods

Three field experiments were conducted in 2007 in Oregon (Corvallis and Ontario) and Washington (Prosser). Onions were planted in both furrow and overhead irrigated systems from March through June. Yellow dry bulb types planted were Vaquero and Ranchero at Ontario, Vaquero at Prosser, and Sabroso at Corvallis. Bentazon treatments included: application of bentazon four times at two week intervals beginning at the 2- and 3-leaf growth stages at 0.25 and 0.5 lbs ai/A, respectively, and bentazon applied twice to 3- and 5-leaf onions at 1.0 lb ai/A. Prophylactic herbicides (oxyfluorfen, bromoxynil, and sethoxydim) were applied and cultivation and hand weeding used on all plots to minimize effects of other weed competition on yield. Data were analyzed with SAS and means separated with FPLSD at alpha 0.05. Mean yield from Prosser is average of blocks 3 and 4 only, which had a low density of nutsedge.

Early season onion growth was unaffected by four biweekly sequential applications of bentazon at 0.25 lbs ai/A beginning at the 2-leaf stage (POSTA). Bentazon applied at 0.5 lbs ai/A 4 times biweekly beginning at the 3-leaf growth stage (POSTB) increased crop injury by 4, 20 and up to 29% at Ontario, Corvallis and Prosser, respectively. At Corvallis, two applications of bentazon applied at 1.0 lb ai/A beginning at the 3-leaf stage of onions and again four weeks later (POSTC) caused approximately the same amount of injury as four applications of bentazon applied at 0.5 lb ai/A (POSTB). In contrast, two applications of bentazon at 1.0 lb ai/A (POSTC) significantly increased crop injury and reduced yield of the variety Vaquero at Ontario compared to four biweekly applications of bentazon applied at 0.5 lbs ai/A (POSTB) (Fig.1). Onion yield was reduced by 10 to 15% at Ontario and 20 to 32% at Prosser and Corvallis, respectively when bentazon was applied four times (POSTB) at 0.5 lbs ai/A (Fig.1). Applying crop oil concentrate with bentazon significantly increased crop injury at all sites and timings, and reduced yield at all timings at Prosser and Corvallis.

Sites	Irrigation	Soil type	%OM	pH	Planting date	Onion yield in check plots
						t/A
Ontario	Furrow	Silt loam	2	7.8	23-Mar	77
Prosser	Furrow	Loam	0.8	6.4	1-May	41
Corvallis	Overhead	Silty clay loam	2.6	5.8	2-Jun	16.5[a]

[a]Yield at Corvallis was low because of a late second planting. The first experiment was abandoned because of poor crop emergence.

Summary. Nutsedge growth was suppressed with bentazon, but bentazon also injured the onions and in some cases reduced yield. Onion yields were lower when bentazon was applied with COC. Nutsedge control with bentazon was marginal at the one site infested with nutsedge (45% for bentazon applied at 0.5 lbs ai/A POSTB). Dimethenamid-P and s-metolachlor applied at the Prosser site controlled nutsedge better than the bentazon treatments. Future research should evaluate sequential applications of s-metolachlor or dimethenamid-P and bentazon, and the effect of environment on crop tolerance to bentazon.

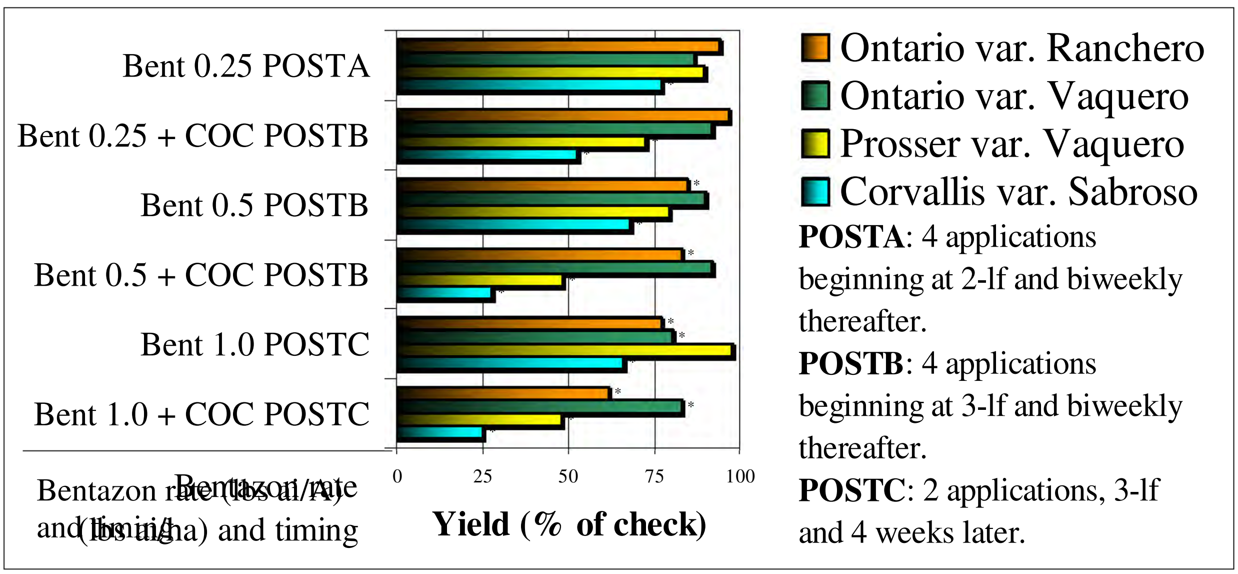

Fig. 1. Effect of bentazon rate, timing, and surfactant on yield of dry bulb onion. Bars followed by an asterisk (*) differ from the yield of the check (P=0.05)

Bell Pepper Tolerance to Dual Magnum Herbicide

2007

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Methods

Tolerance of bell pepper to Dual Magnum was evaluated in an experiment near Lebanon, Oregon. Treflan was pre-plant incorporated before peppers were transplanted. Bell peppers were transplanted on June 4, 2007 and Dual Magnum treatments applied over the top of pepper plants 2 hours later. Plots were irrigated within 12 hours of herbicide application. Plots were cultivated/rototilled and hand hoed to remove weeds and reduce weed competition. Peppers were harvested from 10 ft of row in each plot on September 21.

Results and Discussion

Dual Magnum applied postemergence caused very slight stunting and discoloration (phytotoxicity) of the peppers at 10 DAT at the 4 pt/A rate, but symptoms generally dissipated by 4 WAT. Symptoms were not visible at the 1 and 2 pt/A rates. Crop yield was reduced slightly by the 4x (4 pt/A) rate. Dual Magnum at all rates significantly improved weed control.

Summary

This experiment demonstrates that bell pepper crop tolerance to Dual Magnum applied post-transplant is more than adequate at the 1 pint/A rate. Amending the SLN registration for Dual Magnum to allow post transplant applications will greatly improve weed control in bell peppers.

Table 1. Site and application data.

Plot size/exp. Design	RCBD, 4 reps	5 (2 rows wide) x 20 ft
Soil test	pH	6.96
	CEC	34.5
	OM	3.45
Herbicide application data		
Date		June 4, 2007
Weeds		none
Herbicide/treatment		Dual Magnum
Application timing		POSTTR (applied 2 hrs after transplanting)
Start/end time		3:45-4 PM
Air temp/soil temp (2")/surface		72/77/78
Rel humidity		68%
Wind direction/velocity		SW 3.2
Cloud cover		100%
Soil moisture		Dry
Plant moisture		Dry
Sprayer/PSI		BP/30 PSI
Mix size		2100 mls
Gallons H20/acre		20
Nozzle type		3-8003 ceramic
Nozzle spacing and height		20/24” above canopy
Soil inc. method/implement		irrigated on 6/4

Table 2. Effect of Dual Magnum applied after transplanting on bell pepper yield near Lebanon, Oregon, 2007.

	Dual Magnum rate	Stunting		Phytotoxicity		Weed control	Fruit number	Yield	Avg. fruit wt.
		14-Jun	*2-Jul*	*14-Jun*	*2-Jul*	*14-Jun*	*------------- 21-Sept---------------*		
	pts (lbs ai)/A	*------- % ------*		*------ 0-10 -----*		*%*	*No./10 ft of row*	*t/A*	*lbs/fruit*
1	1 pt (0.95)	0	0.5	0	0	92	108	31.1	0.45
2	2 pt (1.9)	0	0.5	0	0	92	122	32.2	0.41
3	4 pt (3.8)	6.7	1.7	1.7	0	99	108	24.6	0.35
4	Check	0	0.0	0	0	0	120	33.1	0.42
	FPLSD (0.050	*6*	*0.8*	*3*	*-*	*6*	*17*	*8.5*	*0.13*

Rhubarb Tolerance and Weed Control with Quinclorac
2007-08

Ed Peachey and Robert McReynolds
OSU Horticulture Department

Field bindweed (C*onvolvulus arvensis*), hedge bindweed (*Calystegia sepium*), and Canada thistle (C*irsium arvense*) are difficult weeds to control in perennial crops such as rhubarb. Quinclorac is an herbicide that controls or suppresses these weeds depending on rate and time of application. Weeds of the Polygonaceae family such as dock and rhubarb are tolerant to quinclorac. The goal of this project was to determine rhubarb crop response to quinclorac when applied at times compatible with rhubarb culture, and to evaluate the potential of suppressing or controlling field and hedge bindweed and Canada thistle.

Methods
Experiments were located at 3 sites. The rhubarb plot at the North Willamette Research and Extension Center (NWREC) near Aurora, Oregon was kept nearly weed free so that crop response to quinclorac could be measured. Hedge bindweed had completely over-run the field at the Dayton, Oregon site, and Canada thistle covered nearly half of the field at the site near Needy, Oregon.

Quinclorac was applied to rhubarb in the fall of 2007, early in the spring as soon as the target weeds had emerged, and again after the first harvest. Rhubarb was harvested twice from small areas within 10 by 20 foot plots in 2008. The crop was mowed after the first harvest to simulate a full field harvest. The rate of quinclorac was 8 or 16 oz/A in 20 GPA water with 1% MSO and 2.5% UAN (32%N). Application dates are listed in the tables below. Each treatment was replicated 3 times.

Results
NWREC. Rhubarb was very tolerant to quinclorac at 8 oz/A (0.75 lbs ai/A), the maximum expected use rate. There was a slight indication that quinclorac may have reduced total yield at 16 oz/A, but the effect was not consistent across application timing or rate (Table 1). Repeated measures analysis indicated no interaction between treatment and harvest date. No effects were visible and the field had very uniform growth.

Dayton. Quinclorac had little effect on rhubarb growth or yield (Figure 1). Other factors - such as variability within the stand and the patchiness of other competing weeds - influenced yield more than quinclorac. Quinclorac provided 75 to 81% control of hedge bindweed.

Needy. Canada thistle was the primary target at this site. Quinclorac suppressed Canada thistle by as much as 50% when applied in the spring at 16 oz/A (Table 2). The full effect of the sequential ‘Spring plus Summer’ application was not detected as of the June 27 rating. Sequential applications may be needed to eradicate Canada thistle with quinclorac.

Summary
This initial research indicates that quinclorac may provide selective control of bindweed and other difficult perennials in rhubarb. The primary challenge will be finding the optimum time of application, when rhubarb leaves do not shield the bindweed. Sequential applications may be needed to control more difficult weeds such as Canada thistle.

Table 1. Effect of quinclorac on rhubarb yields, NWREC near Aurora, OR 2008.

	Timing	Date	Rate	Petiole harvest								
				May 8			June 10			Sum of harvests		
				Wt.	No.	Avg. wt.	Wt.	No.	Avg. wt.	Wt.	No.	Avg. wt.
			oz/A	kg		g	kg		g	kg		g
1	Sept., bf frost	6-Sept-07	8	15.9	226	69	9.2	121	79	26.0	347	74
2	Sept., bf frost	6-Sept-07	16	16.0	279	55	7.2	87	91	24.3	366	73
3	Fall after frost	29-Oct-07	8	14.9	237	60	11.0	135	95	27.8	372	78
4	Fall after frost	29-Oct-07	16	15.2	237	65	6.6	76	94	22.5	313	80
5	Spring	8-May-08	8	8.9	155	62	8.4	101	91	21.6	256	77
6	Spring	8-May-08	16	18.6	281	65	11.2	145	82	30.5	426	74
7	Check	-	-	14.7	244	60	6.4	74	88	22.5	318	74
	LSD (0.05)			ns	ns	ns	5.1	41	ns	ns	ns	ns

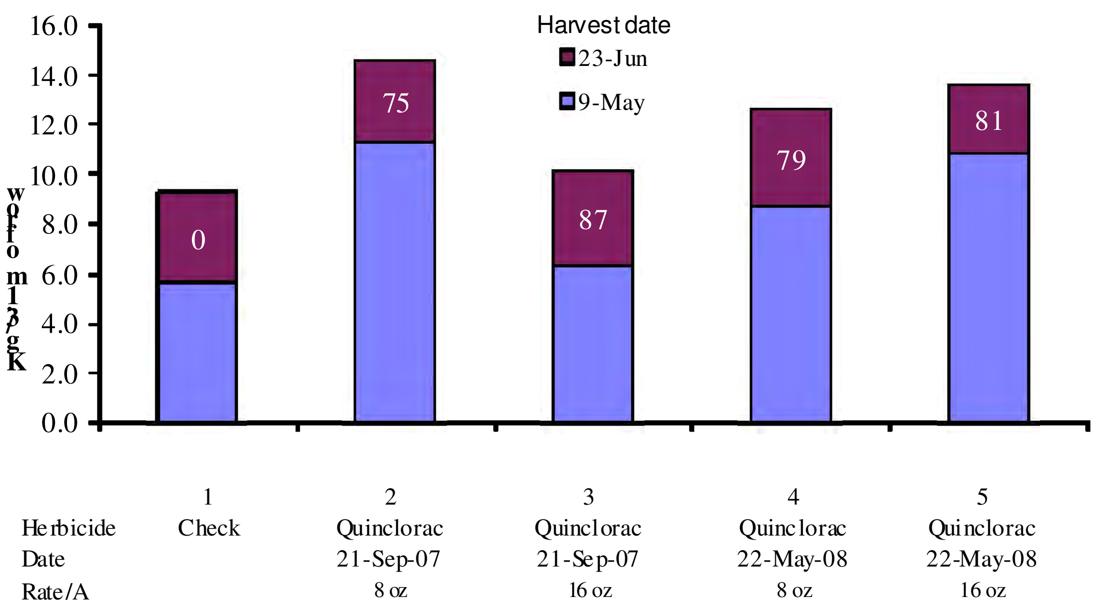


Figure 1. Effect of quinclorac on yield of rhubarb that was harvested on May 9 and June 23 at Dayton, OR. Values on the bars are percent field bindweed control on June 23.

Table 2. Effect of quinclorac on rhubarb growth and Canada thistle at Needy, OR 2008. Application dates and rates in italics have yet to be applied.

	Timing	Rate	Application date	Stunting		Canada thistle control
				May 4	June 17	June 27
		(oz/A)		----------------------	%	----------------
1	Spring	8	9-Apr-08	0	5	30
2	Spring + Summer	8 8	9-Apr-08 17-Jun-08	0	5	50
3	Spring	16	9-Apr-08	5	2	23
4	Spring + Summer	16 16	9-Apr-08 17-Jun-08	5	2	37
5	Summer	8	17-Jun-08	0	3	33
6	Summer + Fall	8 *8*	17-Jun-08 *1-Oct-08*	0	3	47
7	Summer	16	17-Jun-08	0	0	33
8	Summer + Fall	16 *16*	17-Jun-08 *1-Oct-08*	0	0	27
9	Fall	*8*	*1-Oct-08*	0	3	-
10	Fall + Spring	*8* *8*	*1-Oct-08* *8-Apr-09*	0	3	-
11	Fall	*16*	*1-Oct-08*	0	0	-
12	Fall + Spring	*16* *16*	*1-Oct-08* *8-Apr-09*	0	0	-
13	Summer + Fall + Spring	8 *8* *8*	17-Jun-08 *1-Oct-08* *8-Apr-09*	0	3	17
14	Summer + Fall + Spring	16 *16* *16*	17-Jun-08 *1-Oct-08* *8-Apr-09*	0	3	50
15	Check	-	-	0	0	0
	FPLSD (0.05)	-	-	ns	ns	33

Effect of Asulox on Weed Control in Spinach Grown for Seed

2007

E. Peachey, Horticulture Department, OSU

Methods

The effectiveness of Asulox for weed control in spinach grown for seed was evaluated at 2 locations in 2007. Asulox was applied at 3, 6, 3+3, and 6+6 pts/A to 6-14 lf spinach with 20 GPA of water. All Asulox treatments included 0.25% non-ionic surfactant (NIS). Treatments were applied to plots in a randomized complete block design. Crop injury and weed control were evaluated at 1, 2, and 6 weeks after treatment (WAT). Plants were harvested from 8.2 ft of row in each plot, dried and weighed. One outlier was removed from the data set at the Pratum site because the 3+3 pt/A treatment yielded far above the average of the other plots in that treatment.

Results and Discussion

Spinach growth at the Cordon road site was less than at Pratum. At Pratum, the 6 pt/A and 6+6 pt/A treatments reduced crop growth by 25 to 48 % on June 14 (1 WAT the second application). However, crop injury in the 3+3 pt/A treatment was statistically comparable to the 3 pt/A treatment and less than the 6 pt/A treatment. At the Cordon road site, stunting caused by the 3+3 pt/A treatment was comparable to the 6 pt/A treatment at 1 WAT.

There were no statistically significant differences in yield among treatments at either site, but numerical averages indicated that the 6+6 pt/A rate may have reduced crop growth at Pratum.

A split application of Asulox at 3+3 pts/A reduced early season crop injury and improved overall weed control compared to Asulox applied one time at 6 pts/A.

Table 1. Effect of Asulox herbicide on weed control and yield of spinach grown for seed at two sites in western Oregon, 2007.

	Asulox rate	Timing	Obs	Stunting			Phyto			Weed control							Yield data		
				6-Jun	14-Jun	11-Jul	6-Jun	14-Jun	11-Jul	Composite rating	Dog fennel	Shepherds-purse	Dill	Prickly lettuce	Lambsquarters	Pig weed	Stand	Plant dry wt	Avg. plant wt
	pts/A	*Leaf stage*	*No.*	----------------%-------------			--------------0-10------------			------------------------------- % --------------------------							*no./2.5 m of row*	*kg/2.5 m of row*	*g/plant*
Cordon road																			
1	3	6-9	4	1	3	3	0.0	0.0	0.0	46	99	59	25	99	-	-	50	0.49	10.0
2	6	6-9	4	0	8	0	0.4	0.0	0.0	74	98	91	10	98			45	0.43	9.6
3	3	6-9	4	1	13	0	0.3	0.0	0.0	88	99	96	33	98	-	-	53	0.45	8.3
	3	10-12																	
4	6	6-9	4	1	30	0	0.1	0.3	0.0	74	100	100	81	100	-	-	51	0.52	10.7
	6	10-12																	
5	0	-	4	0	0	0	0.0	0.8	0.0	0	0	0	0	0	-	-	53	0.39	7.0
$FPLSD_{0.05}$				*ns*	*15*	*ns*	*ns*	*ns*	*ns*	*39*	*3*	*32*	*28*	*3*	-	-	*ns*	*ns*	*ns*
Pratum																			
1	3	6-8	4	13	3	0	1.0	0.8	0.0	53	-	-	-	-	50	35	30	0.55	15.8
2	6	6-8	4	20	25	0	1.5	2.0	0.0	69	-	-	-	-	89	54	38	0.62	17.0
3	3	6-8	3	13	10	0	1.5	1.5	0.0	81	-	-	-	-	93	73	42	0.75	16.3
	3	10-14																	
4	6	6-8	4	15	48	15	0.9	4.3	0.0	85	-	-	-	-	99	80	34	0.32	8.7
	6	10-14																	
5	0	-	4	0	0	0	0.0	0.0	0.0	0	-	-	-	-	0	0	31	0.47	16.0
$FPLSD_{0.05}$				*ns*	*12*	*6*	*0.4*	*0.7*	*ns*	*22*	-	-	-	-	*18*	*26*	*ns*	*ns*	*ns*

Table 2. Herbicide application data for Asulox treatments.

Date	**Wednesday, May 30, 2007**	**Wednesday, June 06, 2007**
Herbicide/treatment	**Asulox**	**Asulox**
Cordon Road		
Crop stage	6-9 leaf spinach, 2 in tall	10-12 bolting
Other herbicides	Roneet PPI	-
Start/end time	10-10:30 AM	7:45-8 AM
Air temp/soil temp (2")/surface	76/78/84	56/59/56
Rel humidity	36%	70%
Wind direction/velocity	N 0-2	S 0-2
Cloud cover	0	10 %
Soil moisture	Very dry and compacted	Wet
Plant moisture	0	Wet from earlier showers
Sprayer/PSI	BP 40	BP 30
Mix size	2100	2100
Gallons H20/acre	20	20
Nozzle type	3-8003 ceramics	3-8003 ceramics
Nozzle spacing and height	20/24	20/24
Notes	Very hot after application on 6/1-3	-
Pratum		
Crop stage	6-8 lf	10-14 lf just before bolting, buds starting
Other herbicides	Roneet PPI and Spinaid POST	
Start/end time	9-9:30 A	7:15-30 A
Air temp/soil temp (2")/surface	75/72/74	56/59/56
Rel humidity	46%	78%
Wind direction/velocity	1.3 SW	S 2-4
Cloud cover	0	10%
Soil moisture	Dry	Wet
Plant moisture	0	Wet from sprinkles
Sprayer/PSI	BP 30	BP 30
Mix size	2100	2100
Gallons H20/acre	20	20
Nozzle type	3-8003 ceramics	3-8003 ceramics
Nozzle spacing and height	20/24	20/24
Notes	Very hot after application on 6/1-3	-

Weed Control in Sweet Corn with Impact and Laudis Herbicides

2007

Ed Peachey, Horticulture Department, OSU

The test site was near Monroe, Oregon in a field of Jubilee super sweet corn. The soil test indicated a pH of 5.2, soil OM (LOI) of 4.89, and a CEC of 30.0 meq/100 g of soil. The primary weeds present were in order of descending density: smartweed, wild proso millet, pigweed (Powell amaranth), and wild buckwheat. Weeds of secondary importance were lambsquarters and annual ryegrass but densities were too low to evaluate treatment effects. The corn was planted on May 17, 2007. The first treatments (V2-3) were applied on June 5 to corn at V2-3, WPM with up to 4 leaves, hairy nightshade with 2-4 leaves, and smartweed and pigweed with 2-3 leaves. The second sets of treatments were applied to corn at V4-5 on June 18 and 19. The treatments were applied over 2 days because of the large number of treatments and very windy conditions. Most weeds were 4-6 inches tall. Yield was estimated by pulling ears from 20 ft of the center of one row in each plot in three of the four replications.

Results

- Bleaching and burning of corn leaves was noted in a few cases, most prominently when Impact and Laudis were tankmixed with Dual Magnum and atrazine and applied at V4-5 (Trts. 30 and 32). Tankmixes with Outlook generally caused less damage (Table 1).
- Most of the stunting was caused by early season weed competition from the dense carpet of weeds (Table 1).
- Overall weed control varied from 40 to 97% at 7 weeks after planting (4-Jul). The most effective treatments were Impact and Laudis applied with Outlook and atrazine at V2-3 (Trts 14 and 18). Weed control was slightly less when applied with Dual Magnum at this same timing.
- Increasing the methylated seed oil (MSO) rate from 0.25% to 1 % was more important for improving weed control efficacy than adding UAN (Figure 1). In general, overall weed control was better with Laudis and Impact across surfactant levels.
- Yield was correlated with the composite (overall) weed control rating at harvest (R^2= 0.85 for weed control at harvest vs. yield). Split applications of Laudis + atrazine (Tr. 4) and Impact + Outlook + atrazine (Tr. 14) provided yields above 11 t/A with exceptional wild proso millet control (Table 2).
- Tankmixing atrazine with Laudis and Impact produced variable results (Fig 2). Overall, Laudis had slightly better broadleaf control than Impact at similar atrazine rate. Yield declined as the atrazine rate declined, but increased slightly when Laudis was applied without atrazine. A similar, but less dynamic trend was noted with Impact herbicide. A plausible explanation, partially supported by the weed control data, is that as atrazine rate declined, the competitive effect of broadleaved weeds reduced wild proso millet competition with the corn, and because wild proso millet is very competitive, yield was greater than expected at low atrazine rate. Therefore, slight changes in the mix of species that survived the herbicide application made a significant difference in expected yield. Predicting the optimum rate of atrazine to use with these herbicides will be difficult if the objective is optimizing yield. The data suggest that a tankmix of both 2 lbs or 0 lbs/A atrazine will give nearly the same yield.

Table 1. Weed control and sweet corn response to Impact and Laudis herbicides, Monroe, OR, 2007.

	Herbicide	Timing	Date of app.	Rates			Phytotoxicity rating		Stunting		Composite weed control rating
				Product		*lbs ai/A*	*25-Jun*	*4-Jul*	*25-Jun*	*4-Jul*	*4-Jul*
							0-10		---------------%---------------		
1	Untreated						0.0	0.0	18	24	0
2	Laudis	V4-5	18-Jun	3	oz	0.082	0.0	0.0	15	11	81
	MSO			1	%						
	UAN			2.5	%						
3	Laudis	V4-5	18-Jun	3	oz	0.082	0.0	0.0	18	20	96
	Atrazine			1	pt	0.500					
	COC			1	%						
	UAN			2.5	%						
4	Laudis	V4-5	18-Jun	3	oz	0.082	0.1	0.0	8	8	93
	Atrazine			1	pt	0.500					
	COC			1	%						
	UAN			2.5	%						
+	Laudis	V8, 20-24 in	7-Jul	3	oz	0.082					
	MSO			1	%						
	UAN			2.5	%						
5	Laudis	V4-5	18-Jun	3	oz	0.082	0.0	0.0	18	13	88
	MSO			1	%						
	UAN			2.5	%						
+	Laudis	V8, 20-24 in	7-Jul	3	oz	0.082					
	MSO			1	%						
	UAN			2.5	%						
Effect of Atrazine Rate on Laudis and Impact efficacy											
6	Laudis	V4-5	18-Jun	3	oz	0.082	0.4	0.0	16	6	96
	Atrazine			2	pt	1.000					
	COC			1	%						
	UAN			2.5	%						
7	Laudis	V4-5	18-Jun	3	oz	0.082	0.0	0.0	17	8	95
	Atrazine			0.66	pts	0.330					
	COC			1	%						
	UAN			2.5	%						
8	Laudis	V4-5	18-Jun	3	oz	0.082	0.3	0.0	20	11	94
	Atrazine			0.22	pts	0.110					
	COC			1	%						
	UAN			2.5	%						
9	Laudis	V4-5	18-Jun	3	oz	0.082	0.0	0.0	10	6	93
	COC			1	%						
	UAN			2.5	%						
10	Impact	V4-5	18-Jun	0.75	oz	0.016	1.5	0.0	20	14	93
	Atrazine			2	pts	1.000					
	COC			1	%						
	UAN			2.5	%						
11	Impact	V4-5	18-Jun	0.75	oz	0.016	0.0	0.0	8	5	81
	Atrazine			0.66	pts	0.330					
	COC			1	%						
	UAN			2.5	%						
12	Impact	V4-5	18-Jun	0.75	Oz	0.016	0.4	0.0	9	10	81
	Atrazine			0.22	pts	0.110					
	COC			1	%						
	UAN			2.5	%						
13	Impact	V4-5	18-Jun	0.75	oz	0.016	0.3	0.0	21	15	85
	COC			1	%						
	UAN			2.5	%						

	Herbicide	Timing	Date of app.	Rates			Phytotoxicity rating		Stunting		Composite weed control rating
				Product		*lbs ai/A*	*25-Jun*	*4-Jul*	*25-Jun*	*4-Jul*	*4-Jul*
							0-10		----------------%----------------		
Effect of Soil Residual Tankmixes and Timing (V2 vs V4)											
14	Impact	V2-3	5-Jun	0.75	oz	0.016	0.0	0.0	5	5	97
	Outlook			18	oz	0.84					
	Atrazine			1	Pt	0.5					
	MSO			1	%						
	UAN			2.5	%						
15	Impact	V4-5	19-Jun	0.75	oz	0.0164	0.8	0.0	11	9	95
	Outlook			18	oz	0.84					
	Atrazine			1	pt	0.5					
	MSO			1	%						
	UAN			2.5	%						
16	Impact	V2-3	5-Jun	0.75	oz	0.016	0.4	0.0	6	3	94
	Dual Mag			24	oz	1.43					
	Atrazine			1	pt	0.5					
	MSO			1	%						
	UAN			2.5	%						
17	Impact	V4-5	19-Jun	0.75	oz	0.0164	1.6	0.0	21	15	92
	Dual Mag			24	oz	1.43					
	Atrazine			1	pt	0.5					
	MSO			1	%						
	UAN			2.5	%						
18	Laudis	V2-3	5-Jun	3	oz	0.082	0.0	0.0	5	0	98
	Outlook			18	oz	0.84					
	Atrazine			1	pt	0.5					
	MSO			1	%						
	UAN			2.5	%						
19	Laudis	V4-5	19-Jun	3	oz	0.082	0.1	0.0	21	19	89
	Outlook			18	oz	0.84					
	Atrazine			1	pt	0.5					
	MSO			1	%						
	UAN			2.5	%						
20	Laudis	V2-3	5-Jun	3	oz	0.082	0.0	0.0	0	0	93
	Dual Mag			24	oz	1.43					
	Atrazine			1	pt	0.5					
	MSO			1	%						
	UAN			2.5	%						
21	Laudis	v4-6	19-Jun	3	oz	0.082	1.1	0.0	9	6	96
	Dual Mag			24	oz	1.43					
	Atrazine			1	pt	0.5					
	MSO			1	%						
	UAN			2.5	%						
Surfactant and nitrogen effects											
22	Impact	V4-5	19-Jun	0.75	oz	0.016	0.0	0.0	15	19	58
	MSO			0.25	%						
23	Laudis	V4-5	19-Jun	3	oz	0.082	0.0	0.0	10	14	40
	MSO			0.25	%						
24	Impact	V4-5	19-Jun	0.75	oz	0.016	0.0	0.0	23	32	63
	MSO			0.25	%						
	UAN			2.5	%						
25	Laudis	V4-5	19-Jun	3	oz	0.082	1.0	0.3	14	15	85
	MSO			0.25	%						
	UAN			2.5	%						
26	Impact	V4-5	19-Jun	0.75	oz	0.016	0.0	0.0	18	17	66
	MSO			1	%						

	Herbicide	Timing	Date of app.	Rates			Phytotoxicity rating		Stunting		Composite weed control rating
				Product		*lbs ai/A*	*25-Jun*	*4-Jul*	*25-Jun*	*4-Jul*	*4-Jul*
							0-10		----------------%----------------		
27	Laudis	V4-5	19-Jun	3	oz	0.082	0.0	0.0	18	16	81
	MSO			1	%						
28	Impact	V4-5	19-Jun	0.75	oz	0.016	0.0	0.0	20	16	66
	MSO			1	%						
	UAN			2.5	%						
29	Laudis	V4-5	19-Jun	3	oz	0.082	0.1	0.0	30	30	86
	MSO			1	%						
	UAN			2.5	%						
30	Impact	V4-5	19-Jun	0.75	oz	0.016	2.3	0.3	14	10	96
	Dual Mag			24	oz	1.43					
	Atrazine			2	pt	1					
	MSO			1	%						
	UAN			2.5	%						
31	Callisto	V4-5	19-Jun	3.00	oz	0.094	0.6	0.0	16	6	58
	Dual Mag			24	oz	1.43					
	Atrazine			0.25	pt	0.25					
	NIS			0.25	%						
32	Laudis	V4-5	19-Jun	3.00	oz	0.082	2.0	0.0	8	8	97
	Dual Mag			24	oz	1.43					
	Atrazine			0.50	pt	0.5					
	MSO			1	%						
	UAN			2.5	%						
33	Impact	V4-5	19-Jun	0.75	oz	0.0164	0.8	0.0	14	8	86
	Atrazine			1	pt	0.5					
	MSO			1	%						
	UAN			2.5	%						
FPLSD (0.05)							0.5	ns	14	14	11

Table 2. Weed control and sweet corn response to Impact and Laudis herbicides, Monroe, OR, 2007.

	Herbicide	Timing	Date	Rates			Weed control at harvest					Ear count	Yield	Ear wt
							Wilds proso millet	Hairy nightshade	Wild buckwheat	Smart weed	Composite			
				Product		*lbs ai/A*	%	%	%	%	%	*no./A*	*t/A*	*lbs*
1	Untreated						0	0	0	0	10	900	0.2	0.45
2	Laudis	V4-5	18-Jun	3	oz	0.082	94	55	59	98	76	20900	7.3	0.70
	MSO			1	%									
	UAN			2.5	%									
3	Laudis	V4-5	18-Jun	3	oz	0.082	71	93	98	98	76	24700	8.6	0.70
	Atrazine			1	pt	0.500								
	COC			1	%									
	UAN			2.5	%									
4	Laudis	V4-5	18-Jun	3	oz	0.082	100	98	99	100	97	30800	11.9	0.78
	Atrazine			1	pt	0.500								
	COC			1	%									
	UAN			2.5	%									
+	Laudis	V8	7-Jul	3	oz	0.082								
	MSO			1	%									
	UAN			2.5	%									
5	Laudis	V4-5	18-Jun	3	oz	0.082	100	100	90	99	96	25600	9.5	0.74
	MSO			1	%									
	UAN			2.5	%									
+	Laudis	V8	7-Jul	3	oz	0.082								
	MSO			1	%									
	UAN			2.5	%									
Effect of atrazine rate on Laudis and Impact efficacy														
6	Laudis	V4-5	18-Jun	3	oz	0.082	88	98	98	100	91	27600	10.3	0.75
	Atrazine			2	pt	1.000								
	COC			1	%									
	UAN			2.5	%									
7	Laudis	V4-5	18-Jun	3	oz	0.082	81	98	91	100	81	27300	9.9	0.73
	Atrazine			0.66	pts	0.330								
	COC			1	%									
	UAN			2.5	%									
8	Laudis	V4-5	18-Jun	3	oz	0.082	74	94	91	98	74	23800	8.8	0.74
	Atrazine			0.22	pts	0.110								
	COC			1	%									
	UAN			2.5	%									
9	Laudis	V4-5	18-Jun	3	oz	0.082	85	93	75	93	81	29900	10.7	0.72
	COC			1	%									
	UAN			2.5	%									
10	Impact	V4-5	18-Jun	0.75	oz	0.016	75	95	98	100	78	27300	10.0	0.73
	Atrazine			2	pts	1.000								
	COC			1	%									
	UAN			2.5	%									
11	Impact	V4-5	18-Jun	0.75	oz	0.016	93	75	56	90	78	25600	8.9	0.70
	Atrazine			0.66	pts	0.330								
	COC			1	%									
	UAN			2.5	%									
12	Impact	V4-5	18-Jun	0.75	oz	0.016	89	76	87	92	73	23200	7.9	0.68
	Atrazine			0.22	pts	0.110								
	COC			1	%									
	UAN			2.5	%									

	Herbicide	Timing	Date	Rates			Weed control at harvest					Ear count	Yield	Ear wt
							Wilds proso millet	Hairy nightshade	Wild buckwheat	Smart weed	Composite			
				Product		lbs ai/A	%					no./A	t/A	lbs
13	Impact	V4-5	18-Jun	0.75	oz	0.016	94	64	56	91	75	24400	8.7	0.71
	COC			1	%									
	UAN			2.5	%									
Effect of Soil Residual Tankmixes and Timing (V2 vs V4)														
14	Impact	V2-3	5-Jun	0.75	oz	0.016	96	99	72	99	94	30800	11.4	0.74
	Outlook			18	oz	0.84								
	Atrazine			1	pt	0.5								
	MSO			1	%									
	UAN			2.5	%									
15	Impact	V4-5	19-Jun	0.75	oz	0.0164	98	99	91	96	94	25300	9.5	0.75
	Outlook			18	oz	0.84								
	Atrazine			1	pt	0.5								
	MSO			1	%									
	UAN			2.5	%									
16	Impact	V2-3	5-Jun	0.75	oz	0.016	80	99	95	96	86	29600	10.9	0.74
	Dual Mag			24	oz	1.43								
	Atrazine			1	pt	0.5								
	MSO			1	%									
	UAN			2.5	%									
17	Impact	V4-5	19-Jun	0.75	oz	0.0164	95	94	98	99	92	22900	8.2	0.72
	Dual Mag			24	oz	1.43								
	Atrazine			1	pt	0.5								
	MSO			1	%									
	UAN			2.5	%									
18	Laudis	V2-3	5-Jun	3	oz	0.082	98	99	88	99	97	26700	10.5	0.79
	Outlook			18	oz	0.84								
	Atrazine			1	pt	0.5								
	MSO			1	%									
	UAN			2.5	%									
19	Laudis	V4-5	19-Jun	3	oz	0.082	98	91	55	95	80	26100	8.9	0.68
	Outlook			18	oz	0.84								
	Atrazine			1	pt	0.5								
	MSO			1	%									
	UAN			2.5	%									
20	Laudis	V2-3	5-Jun	3	oz	0.082	91	95	68	100	88	-	-	-
	Dual Mag			24	oz	1.43								
	Atrazine			1	pt	0.5								
	MSO			1	%									
	UAN			2.5	%									
21	Laudis	v4-6	19-Jun	3	oz	0.082	92	100	100	100	96	-	-	-
	Dual Mag			24	oz	1.43								
	Atrazine			1	pt	0.5								
	MSO			1	%									
	UAN			2.5	%									
Surfactant and nitrogen effects														
22	Impact	V4-5	19-Jun	0.75	oz	0.016	84	49	75	65	53	-	-	-
	MSO			0.25	%									
23	Laudis	V4-5	19-Jun	3	oz	0.082	86	15	91	80	45	-	-	-
	MSO			0.25	%									

	Herbicide	Timing	Date	Rates			Weed control at harvest					Ear count	Yield	Ear wt
							Wilds proso millet	Hairy nightshade	Wild buckwheat	Smart weed	Composite			
				Product		*lbs ai/A*	------------------------	--------	%	--------------------		*no./A*	*t/A*	*lbs*
24	Impact MSO UAN	V4-5	19-Jun	0.75 0.25 2.5	oz % %	0.016	96	36	83	84	63	-	-	-
25	Laudis MSO UAN	V4-5	19-Jun	3 0.25 2.5	oz % %	0.082	86	79	68	88	70	-	-	-
26	Impact MSO 1%	V4-5	19-Jun	0.75 1	oz %	0.016	85	75	48	60	68	-	-	-
27	Laudis MSO	V4-5	19-Jun	3 1	oz %	0.082	78	78	80	98	80	-	-	-
28	Impact MSO 1% UAN	V4-5	19-Jun	0.75 1 2.5	oz % %	0.016	95	64	45	40	68	-	-	-
29	Laudis MSO UAN	V4-5	19-Jun	3 1 2.5	oz % %	0.082	90	51	74	81	70	-	-	-
30	Impact Dual Mag Atrazine MSO UAN	V4-5	19-Jun	0.75 24 2 1 2.5	oz oz pt % %	0.016 1.43 1	88	94	99	99	90	25600	9.3	0.73
31	Callisto Dual Mag Atrazine NIS	V4-5	19-Jun	3.00 24 0.25 0.25	oz oz pt %	0.094 1.43 0.25	15	99	99	100	40	22400	7.0	0.62
32	Laudis Dual Mag Atrazine MSO UAN	V4-5	19-Jun	3.00 24 0.50 1 2.5	oz oz pt % %	0.082 1.43 0.5	87	99	99	98	88	27300	10.3	0.76
33	Impact Atrazine MSO UAN	V4-5	19-Jun	0.75 1 1 2.5	oz pt % %	0.0164 0.5	96	90	95	94	80	26700	9.4	0.70
FPLSD (0.05)							14	26	33	19	13	5800	2.5	0.09

Table 3. Participant evaluation of corn growth and weed control at the field day on July, 2007. Treatments were evaluated in only one replication of the four in the experiment. Lines highlighted in gray were given an average overall rating $\geq$ 8.0. Twelve respondents on average. See Tables 1 and 2 for a description of treatments applied.

Treatment	Overall treatment rating			Corn growth			Wild proso millet control			Hairy nightshade control			Smartweed control			Composite weed control rating		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
	0 (very poor) to 10 (optimal)																	
1	0.1	0.0	1.0	1.3	0.0	4.0	0.1	0.0	1.0	0.1	0.0	1.0	0.1	0.0	1.0	0.1	0.0	1.0
2	4.3	0.0	8.5	4.6	2.0	8.0	8.9	7.0	10.0	2.0	0.0	8.0	7.1	0.0	9.5	5.0	0.0	9.0
3	7.4	4.0	10.0	7.7	4.0	10.0	7.6	3.0	10.0	9.2	7.0	10.0	9.7	8.0	10.0	7.4	0.0	9.5
4	8.5	6.0	10.0	9.0	7.0	10.0	9.5	8.0	10.0	9.4	8.0	10.0	9.7	9.0	10.0	8.8	5.0	10.0
5	8.0	6.0	9.5	7.6	6.0	9.5	9.6	8.0	10.0	9.6	8.0	10.0	9.6	8.0	10.0	8.4	4.0	10.0
6	8.2	6.0	10.0	8.7	6.0	10.0	7.3	3.0	10.0	8.6	6.0	10.0	9.6	8.0	10.0	7.9	4.0	9.5
7	6.8	4.0	9.0	7.4	4.0	9.5	6.0	1.0	8.5	7.8	2.0	10.0	7.4	2.0	10.0	6.7	1.0	9.0
8	6.5	4.0	9.0	7.7	6.0	10.0	5.3	1.0	8.5	7.5	2.0	10.0	7.6	1.0	10.0	6.3	1.0	9.0
9	6.0	2.0	9.0	7.8	6.0	10.0	5.5	1.0	8.0	6.6	1.0	9.0	7.9	5.0	10.0	6.1	1.0	9.0
10	6.4	3.0	9.0	7.0	5.0	9.5	5.4	1.0	8.0	9.0	6.0	10.0	9.0	6.0	10.0	6.5	3.0	9.0
11	6.3	3.0	9.0	6.8	3.0	9.5	6.3	0.5	10.0	6.7	0.0	10.0	5.3	0.0	9.0	6.1	2.0	9.0
12	7.2	3.0	9.0	7.6	6.0	9.0	7.2	3.0	9.0	7.1	0.0	10.0	6.5	0.0	9.5	6.7	3.0	9.5
13	6.4	3.0	9.0	7.4	4.0	9.0	7.1	2.0	9.5	7.1	2.0	10.0	5.0	0.0	8.5	6.1	1.0	9.0
14	8.8	8.0	10.0	9.5	8.0	10.0	7.7	2.0	10.0	9.8	8.5	10.0	9.6	8.0	10.0	8.7	7.0	10.0
15	6.8	4.0	9.0	7.6	6.0	9.0	8.0	6.0	9.5	8.0	4.0	10.0	5.5	3.0	9.0	6.9	3.0	9.0
16	7.1	3.0	9.0	7.9	4.0	10.0	6.1	3.0	9.0	8.0	4.0	10.0	8.3	2.0	10.0	7.3	5.0	10.0
17	6.7	3.0	9.0	6.2	3.0	9.0	7.9	5.0	9.5	6.6	2.0	9.5	8.2	3.0	10.0	6.9	4.0	9.0
18	7.5	3.0	9.5	8.4	7.0	10.0	8.7	3.0	10.0	8.7	3.0	10.0	7.5	3.0	10.0	7.8	3.0	9.5
19	6.7	4.0	9.0	7.0	4.0	9.0	8.3	3.0	10.0	5.6	2.0	9.0	7.5	0.0	10.0	6.9	4.0	9.0
20	8.0	4.0	9.5	9.2	8.0	10.0	7.0	3.0	9.5	8.8	3.0	10.0	7.2	3.0	9.0	7.6	3.0	9.2
21	8.4	7.0	9.5	7.8	6.0	9.0	8.7	8.0	10.0	9.0	2.0	10.0	9.0	2.0	10.0	8.4	5.0	10.0
22	3.2	1.0	5.0	3.4	1.0	6.0	7.5	2.0	10.0	2.9	0.0	7.0	1.1	0.0	3.0	2.6	0.0	6.0
23	2.9	0.0	5.0	3.3	1.0	6.0	5.3	1.0	9.0	1.6	0.0	9.0	4.3	0.0	9.0	3.3	0.0	9.0
24	3.6	1.0	5.5	4.2	2.0	7.0	7.6	4.0	10.0	3.9	1.0	7.0	1.2	0.0	4.0	3.0	0.5	5.5
25	4.8	2.0	7.0	4.7	2.0	7.0	6.9	1.0	10.0	3.5	0.0	7.5	5.7	1.0	9.0	4.6	1.0	8.0
26	3.7	2.0	6.5	4.8	2.0	6.5	7.8	5.0	10.0	4.5	2.0	7.0	1.7	0.0	4.0	3.5	2.0	7.0
27	6.5	4.0	8.0	6.9	5.0	8.5	7.6	5.0	10.0	6.2	3.0	9.0	8.4	6.0	10.0	6.9	4.0	9.0
28	4.3	1.0	7.5	5.0	3.0	7.5	7.4	0.0	10.0	4.6	0.0	8.5	2.8	0.0	9.0	4.4	0.0	8.5
29	5.8	2.0	9.0	6.4	0.5	10.0	7.0	0.0	9.5	4.8	1.0	9.0	6.4	2.0	9.0	5.9	3.0	9.0
30	7.7	4.0	9.5	7.5	5.0	10.0	7.0	0.0	9.5	8.2	5.0	10.0	7.5	2.0	9.5	7.7	3.0	9.5
31	4.7	1.0	7.0	5.9	3.0	8.0	0.7	0.0	3.0	8.2	6.0	10.0	6.8	2.0	9.5	4.4	1.0	8.0
32	6.8	3.0	9.0	5.5	3.0	8.0	7.7	3.0	10.0	8.9	7.0	10.0	8.3	3.0	10.0	7.3	3.0	9.5
33	6.1	3.0	8.5	5.0	3.0	8.0	8.0	7.0	9.5	6.2	3.0	9.0	7.4	3.0	9.0	6.6	3.0	9.0
34	4.3	3.0	7.0	4.3	3.0	7.0	8.4	7.0	10.0	3.9	1.0	7.5	3.3	1.0	7.5	4.3	2.0	7.0

Table 4. Herbicide application data.

Date	Tuesday, June 05, 2007	Monday, June 18, 2007	Tuesday, June 19, 2007	Saturday, July 07, 2007
Crop stage	v2, v3 very close	v4, almost v5 (2-5%)	v4, almost v5 (2-5%)	
Weeds and growth stage				
Wild proso millet	up to 4 lf	v4-5, max 6 in, most 4"	v4-5, max 6 in, most 4"	
Hairy nightshade	to 4 lf, most 2 lf	4-6"	4-6"	
Smartweed	2-3 lf	4-6"	4-6"	
Powell amaranth	2-3 lf	4-6"	4-6"	
Herbicide/treatment		tr 2-13	tr 14-34	tr 4-5
Application timing	VEPOST Residual	V4-5	V4-5	24-30 in tall
Start/end time	7-7:30	7-9 am	6-9 am	7-8
Air temp/soil temp (2")/surface	57/61/62	71/66/67	74/71/74 (9 am)	68/66/66
Rel humidity	80%	71%	76%	58%
Wind direction/velocity	2-4 SW	3-6 N	0-5(9 am) N	1-2 NE
Cloud cover	100	0	0	0
Soil moisture	dry	very wet, just irrigated	very wet	wet, irrigation 24 hrs before
Plant moisture	beads of rain on leaves	wet from irrigation	wet from heavy dew	wet from heavy dew
Sprayer/PSI	BP 30	BP 20	BP 20	BP 30
Mix size	2100 mls	2100 mls	2100 mls	2100 mls
Gallons H20/acre	20	20	20	20
Nozzle type	XR 8002	XR 8003	XR 8003	XR 8003
Nozzle spacing and height	20/24	20/24	20/24	12 in above corn
Soil inc. method/implement	irrigation within 2 days	-	-	-

Soil test	pH	OM	CEC
	5.2	4.89	30.0

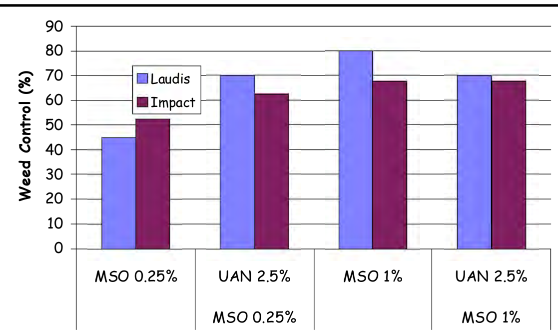


Figure 1. Effect of surfactant on weed control with Laudis and Impact herbicides.

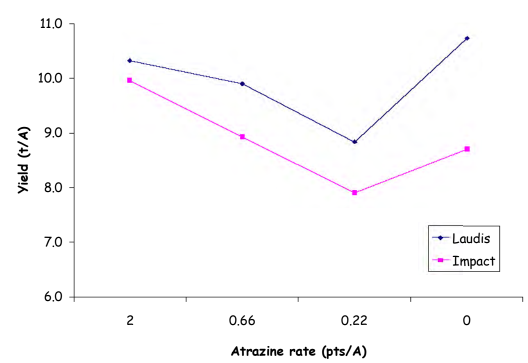


Figure 2. Effect of atrazine tankmixes with Laudis and Impact on corn yield. Note scale of y-axis.

Weed Control with HPPD herbicides Topramezone and Tembotrione in Sweet Corn
2008

Ed Peachey, Horticulture dept, OSU

Two experiments were located near Stayton, Oregon in 2008 to evaluate the efficacy of HPPD inhibitor herbicides in sweet corn. Both sites were strip-tilled. The variety Coho was planted on May 26 in Exp I and Kokanee on May 30 in Exp II. Barnyardgrass was the predominate weed in Exp. I and wild proso millet was abundant in Exp. II. PRE herbicides in Exp I were applied 1 day after planting and incorporated with approximately ½" irrigation and rainfall within 3 days. POST herbicides were applied at V2-4 and V4-6 (depending on site) with a backpack sprayer delivering 20 GPA at 20 to 30 PSI (depending on environment). Plots were 10 feet wide by 30 feet long with 4 rows of corn per plot. Treatments were replicated 4 times in a RCB design.

Results

Stayton I (barnyardgrass site). Weed emergence appeared to be delayed by the small grain/common vetch cover crop residues that remained between and in rows after strip-tillage. Slugs were abundant and bait was applied twice by the grower to reduce damage to the corn. PRE herbicides BAS 800 and 781 caused significant injury to the corn. Weed control with the HPPD herbicide treatments was good to exceptional if atrazine was included in the tankmix (Table 1 and 2). Purslane control was particularly poor if Laudis and Impact were applied without atrazine.

Sweet corn yield was average to low at this site considering the vigor of this variety (Table 2). Weed density was moderate and did not significantly reduce corn yield in the untreated check. However, the data suggest that corn yield may have been compromised by tankmixing and applying HPPD herbicides with either Outlook or Dual Magnum herbicides at V 5-6 (Figure 1). Contrast analysis indicated that sweet corn yield declined by 14% when Impact or Laudis were applied at V5-6 rather than V3-4 (F=16.6, P=0.0001). A 7% decrease in yield occurred when Dual Magnum was tankmixed with the HPPD herbicides rather than Outlook (F=3.9, P=0.06). Similar results were noted in 2007 but the effect was attributed to early season weed competition that occurred before Impact and Laudis were applied at V4-5. However, in this experiment, weed density was insufficient to reduce crop yield (check yield did not differ significantly from other treatments), thus indicating that the herbicides themselves were impacting the crop directly and reducing yield when applied at V5-6.

Stayton II (wild proso millet site). The variety at this site was Kokanee and wild proso millet and lambsquarters were the most common weeds. No differences were noted in weed control among the 8 treatments. Impact and Laudis tankmixed with either Dual Magnum or Outlook and atrazine gave exceptional control of wild proso millet and lambsquarters whether applied at V3-4 or V4-5. Tankmixes with Dual Magnum caused more injury to the crop (leaf necrosis) than tankmixes with Outlook, but this did not affect crop height. Sweet corn yield in HPPD treatments averaged only 8.5 t/A. Weed competition in the check plots reduced yield by 20%. There was no difference in yield between treatments that were applied at V2-3 rather than V4-5.

Table 1. Sweet corn tolerance and weed control, early to mid-season, Stayton I, 2008.

	Herbicide	Timing	Date	Rate	Obs	6 WAP (6-July)		8 WAP (25-July)		Obs	Weed control 8 WAP (25-July)		
						Phyto	Stunting	Phyto	Stunting		Barnyard-grass	Purslane	Composite rating
				lbs ai/A		*0-10*	*%*	*0-10*	*%*		--------------%--------------------		
1	Check	-	-	-	4	0	0	0	4	8	0	0	0
2	BAS800	PRE	27-May	0.09	4	0	3	0	1	4	0	0	15
3	BAS 781	PRE	27-May	0.87	4	0	13	0.3	5	4	69	75	91
4	Outlook	PRE	27-May	0.84	4	0	0	0.3	3	3	90	100	93
5	Outlook Impact Atrazine MSO UAN 28%	PRE v5-6	27-May 6-Jul	0.84 0.016 0.50 1.00 2.50	4	0	5	1.8	14	4	100	100	99
6	Impact Atrazine MSO UAN 28%	v5-6	6-Jul	0.016 1.00 1.00 2.50	4	-	-	0.3	6	4	93	100	90
7	Impact Atrazine COC UAN 28%	v5-6	6-Jul	0.016 1.00 1.00 2.50	4	-	-	0	0	4	95	100	93
8	Laudis Atrazine COC UAN 28%	v5-6	6-Jul	0.082 1.00 1.00 2.50	4	-	-	0.3	0	3	98	100	96
10	Laudis MSO UAN 28%	v5-6	6-Jul	0.082 1.00 2.50	4	-	-	0.3	4	4	94	65	85
11	Impact MSO UAN 28%	v5-6	6-Jul	0.016 1.00 2.50	4	-	-	0	3	4	88	73	85
12	Accent COC UAN 28%	v5-6	6-Jul	0.016 1.00 2.50	4	-	-	0	8	4	91	70	84

Table 1 cont'd

	Herbicide	Timing	Date	Rate	Obs	6 WAP (6-July)		8 WAP (25-July)		Obs	Weed control 8 WAP (25-July)		
						Phyto	Stunting	Phyto	Stunting		Barnyard-grass	Purslane	Composite rating
				lbs ai/A		*0-10*	*%*	*0-10*	*%*		--------------%--------------------		
13	Accent+isoxadifen COC UAN 28%	v5-6	6-Jul	0.016 1.00 2.50	4	-	-	0	8	4	90	55	84
14	Accent+isoxadifen Aim COC UAN 28%	v5-6	6-Jul	0.016 0.016 1.00 2.50	4	-	-	1.0	12	3	93	100	94
15	Impact Outlook Atrazine MSO UAN	v3-4	21-Jun	0.016 0.84 0.5 1.00 2.50	4	0	0	0	10	4	99	100	98
16	Impact Outlook Atrazine MSO UAN	v5-6	6-Jul	0.016 0.84 0.5 1.00 2.50	4	-	-	1.5	14	4	90	100	93
17	Impact Dual Magnum Atrazine MSO UAN	v3-4	21-Jun	0.016 1.43 0.5 1.00 2.50	4	0	0	0.3	0	4	95	100	95
18	Impact Dual Magnum Atrazine MSO UAN	v5-6	6-Jul	0.016 1.43 0.5 1.00 2.50	4	-	-	1.3	10	4	97	100	97
19	Laudis Outlook Atrazine MSO UAN	v3-4	21-Jun	0.082 0.84 0.5 1.00 2.50	4	0	0	0.3	0	4	98	100	99

Table 1 cont'd

	Herbicide	Timing	Date	Rate	Obs	6 WAP (6-July)		8 WAP (25-July)		Obs	Weed control 8 WAP (25-July)		
						Phyto	Stunting	Phyto	Stunting		Barnyard-grass	Purslane	Composite rating
				lbs ai/A		*0-10*	*%*	*0-10*	*%*		---------------%---------------------		
20	Laudis Outlook Atrazine MSO UAN	v5-6	6-Jul	0.082 0.84 0.5 1.00 2.50	4	-	-	0.5	5	4	99	100	98
21	Laudis Dual Magnum Atrazine MSO UAN	v3-4	21-Jun	0.082 1.43 0.5 1.00 2.50	4	0	4	0.3	4	4	96	100	97
22	Laudis Dual Magnum Atrazine MSO UAN	v5-6	6-Jul	0.082 1.43 0.5 1.00 2.50	4	-	-	1.5	15	4	97	100	95
	FPLSD (0.05)					ns	6	0.8	10		16	26	12

Table 2. Effect of HPPD inhibitor herbicides on sweet corn yield and weed control at harvest Exp. I, Stayton, OR, 2008.

	Herbicide	Timing	Date	Rate	Obs	Weed control at harvest				Corn harvest		
						Barnyard-grass	Purslane	Crabgrass	Composite rating	Ear no.	Yield	Avg. ear wt.
				lbs ai/A		------%			------	*No/A*	*t/A*	*lbs*
1	Check	-	-	-	8	0	0	0	0	22700	9.2	0.8
2	BAS 800	PRE	27-May	0.09	4	0	75	100	35	21100	9.1	0.9
3	BAS 781	PRE	27-May	0.87	4	93	100	100	93	26400	9.9	0.8
4	Outlook	PRE	27-May	0.84	3	96	96	100	96	24400	9.3	0.8
5	Outlook	PRE	27-May	0.84	4	100	100	100	100	22700	8.9	0.8
	Impact	v5-6	6-Jul	0.016								
	Atrazine			0.50								
	MSO			1.00								
	UAN 28%			2.50								
6	Impact	v5-6	6-Jul	0.016	4	98	100	100	96	22000	9.0	0.8
	Atrazine			1.00								
	MSO			1.00								
	UAN 28%			2.50								
7	Impact	v5-6	6-Jul	0.016	4	96	100	100	95	25300	10.3	0.8
	Atrazine			1.00								
	COC			1.00								
	UAN 28%			2.50								
8	Laudis	v5-6	6-Jul	0.082	3	100	100	100	99	22900	9.1	0.8
	Atrazine			1.00								
	COC			1.00								
	UAN 28%			2.50								
10	Laudis	v5-6	6-Jul	0.082	4	96	100	95	97	23700	9.7	0.8
	MSO			1.00								
	UAN 28%			2.50								
11	Impact	v5-6	6-Jul	0.016	4	100	100	75	93	23500	9.6	0.8
	MSO			1.00								
	UAN 28%			2.50								
12	Accent	v5-6	6-Jul	0.016	4	100	81	100	93	20900	7.7	0.7
	COC			1.00								
	UAN 28%			2.50								

Table 2 cont'd

	Herbicide	Timing	Date	Rate	Obs	Weed control at harvest				Corn harvest		
						Barnyard-grass	Purslane	Crabgrass	Composite rating	Ear no.	Yield	Avg. ear wt.
				lbs ai/A		-------------------------------	%	-------------------------------		*No/A*	*t/A*	*lbs*
13	Accent+isoxadifen	v5-6	6-Jul	0.016	4	98	94	100	95	23100	8.7	0.8
	COC			1.00								
	UAN 28%			2.50								
14	Accent+isoxadifen	v5-6	6-Jul	0.016	3	99	100	100	99	22100	8.0	0.7
	Aim			0.016								
	COC			1.00								
	UAN 28%			2.50								
15	Impact	v3-4	21-Jun	0.016	4	98	100	100	99	25900	10.0	0.8
	Outlook			0.84								
	Atrazine			0.5								
	MSO			1.00								
	UAN			2.50								
16	Impact	v5-6	6-Jul	0.016	4	98	100	100	98	23300	9.1	0.8
	Outlook			0.84								
	Atrazine			0.5								
	MSO			1.00								
	UAN			2.50								
17	Impact	v3-4	21-Jun	0.016	4	100	100	100	100	21300	8.6	0.8
	Dual Magnum			1.43								
	Atrazine			0.5								
	MSO			1.00								
	UAN			2.50								
18	Impact	v5-6	6-Jul	0.016	4	97	100	100	97	19800	7.9	0.8
	Dual Magnum			1.43								
	Atrazine			0.5								
	MSO			1.00								
	UAN			2.50								
19	Laudis	v3-4	21-Jun	0.082	4	98	100	100	98	26100	10.3	0.8
	Outlook			0.84								
	Atrazine			0.5								
	MSO			1.00								
	UAN			2.50								

Table 2 cont'd

	Herbicide	Timing	Date	Rate	Obs	Weed control at harvest				Corn harvest		
						Barnyard-grass	Purslane	Crabgrass	Composite rating	Ear no.	Yield	Avg. ear wt.
				lbs ai/A		-------------------------------%			---------------------------------	*No/A*	*t/A*	*lbs*
20	Laudis	v5-6	6-Jul	0.082	4	100	100	100	100	21100	8.3	0.8
	Outlook			0.84								
	Atrazine			0.5								
	MSO			1.00								
	UAN			2.50								
21	Laudis	v3-4	21-Jun	0.082	4	98	100	100	97	27000	10.3	0.8
	Dual Magnum			1.43								
	Atrazine			0.5								
	MSO			1.00								
	UAN			2.50								
22	Laudis	v5-6	6-Jul	0.082	4	99	100	100	99	21500	8.1	0.8
	Dual Magnum			1.43								
	Atrazine			0.5								
	MSO			1.00								
	UAN			2.50								
	FPLSD (0.05)					4	12	16	15	4300	1.4	0.1

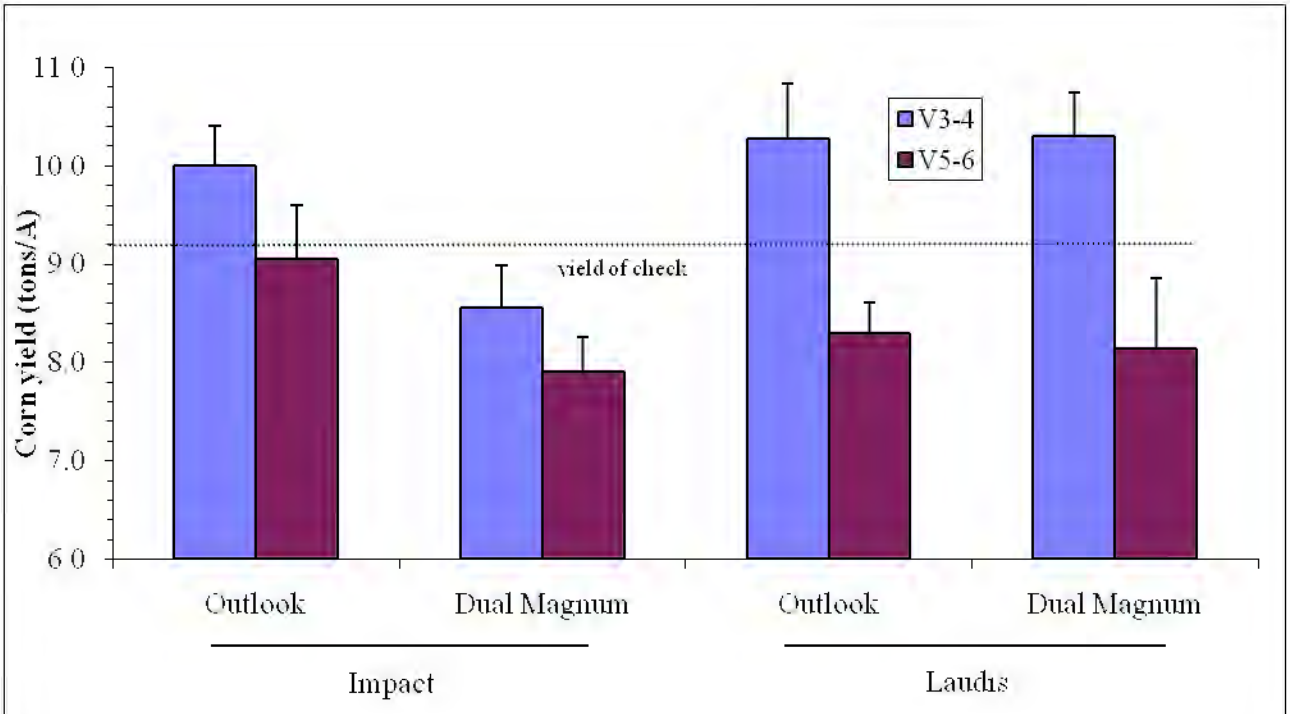


Figure 1. Effect of HPPD herbicide timing and tank mix partner on Coho sweet corn yield (+SE), Stayton I, 2008.

Table 3. Herbicide application data for Stayton I.

Date	Tuesday, May 27, 2008	Saturday, June 21, 2008	Sunday, July 6, 2008
Crop stage	Var. Coho planted May-26	V 3-4	V 5-6, 14-18 inches tall
Weed density and growth stage	-	-	(see Figure 2 below)
Application timing	PRE	V3-4 treatments	V5-6 treatments
Start/end time	11-11:30 A	2-2:30PM	7-9 AM
Air temp/soil temp (2")/surface	72/67/72	84/85/86	61/60/61
Rel humidity	60%	80%	80%
Wind direction/velocity	0-2 SW	0-2 SW	5-10 N, with direction of rows
Cloud cover	100	100	100
Soil moisture	Wet	Very dry	Very dry in block 1, very wet in blocks 2-4
Plant moisture	-	Dry	Dry
Sprayer/PSI	BP 25 PSI	BP 30 PSI	BP 20 PSI
Mix size	2100/4 plots	2100/4 plots	2100/4 plots
Gallons H20/acre	20	20	20
Nozzle type	5-XR8003	5-XR8003	5-XR8003
Nozzle spacing and height	20/24	20/24	20” above weeds, which were up to a foot tall, 6-8 inches above corn canopy to mitigate spray drift
Soil incorporation	Irrigation	-	-

Figure 2. Exp I at V5-6 application timing, July 6, 2008.

Table 4. Sweet corn tolerance and weed control, early to mid-season, Stayton II, 2008.

	Herbicide	Timing	Rate	Obs	Early to midseason crop ratings				Weed control 7 WAP (25-July)		
					5 WAP (6-July)		7 WAP (25-July)		Wild proso millet	Common lambs-quarters	Composite rating
					Phyto	Stunting	Phyto	Stunting			
			lbs ai/A	*No.*	*0-10*	*%*	*0-10*	*%*	---------- % ----------		
1	Check		0	4	0	0	0	8	0	0	0
2	Impact	V2-3	0.0164	4	0	4	0	9	92	100	93
	Outlook		0.84								
	Atrazine		0.5								
	MSO		1								
	UAN		2.5								
3	Impact	V4-5	0.016	4	-	-	1.0	15	95	96	94
	Outlook		0.84								
	Atrazine		0.5								
	MSO		1								
	UAN		2.5								
4	Impact	V2-3	0.016	4	0	6	0.3	5	95	100	96
	Dual Magnum		1.43								
	Atrazine		0.5								
	MSO		1								
	UAN		2.5								
5	Impact	V4-5	0.016	4	-	-	1.5	16	92	98	93
	Dual Magnum		1.43								
	Atrazine		0.5								
	MSO		1								
	UAN		2.5								
6	Laudis	V2-3	0.082	4	0	0	0	0	95	99	94
	Outlook		0.84375								
	Atrazine		0.5								
	MSO		1								
	UAN		2.5								
7	Laudis	V4-5	0.082	4	-	-	0.5	5	93	100	94
	Outlook		0.84375								
	Atrazine		0.5								
	MSO		1								
	UAN		2.5								
8	Laudis	V2-3	0.082	4	0	0	0.3	6	95	100	94
	Dual Magnum		1.43								
	Atrazine		0.5								
	MSO		1								
	UAN		2.5								
9	Laudis	v4-5	0.082	4	-	-	1.5	8	91	100	94
	Dual Magnum		1.43								
	Atrazine		0.5								
	MSO		1								
	UAN		2.5								
	FPLSD				ns	ns	0.6	ns	8	3	6

Table 5. Effect of HPPD inhibitor herbicides on sweet corn yield and weed control at harvest Stayton II, 2008.

	Herbicide	Timing	Rate	Obs	Weed control at harvest			Corn yield		
					Wild proso millet	Common lambsquarters	Composite rating	Ears	Fresh wt.	Avg. ear wt.
			lbs ai/A		----------------- % -------------------			*no./A*	*tons/A*	*lbs*
1	Check		0	4	0	0	0	18300	6.7	0.71
2	Impact Outlook Atrazine MSO UAN	V2-3	0.016 0.84 0.5 1 2.5	4	96	100	94	22900	8.7	0.77
3	Impact Outlook Atrazine MSO UAN	V4-5	0.016 0.84 0.5 1 2.5	4	93	97	90	22000	7.7	0.70
4	Impact Dual Magnum Atrazine MSO UAN	V2-3	0.016 1.43 0.5 1 2.5	4	93	100	93	22000	8.7	0.80
5	Impact Dual Magnum Atrazine MSO UAN	V4-5	0.016 1.43 0.5 1 2.5	4	98	99	96	22900	8.3	0.72
6	Laudis Outlook Atrazine MSO UAN	V2-3	0.082 0.84 0.5 1 2.5	4	94	100	94	22400	8.6	0.77
7	Laudis Outlook Atrazine MSO UAN	V4-5	0.082 0.84 0.5 1 2.5	4	95	100	95	21600	8.4	0.78
8	Laudis Dual Magnum Atrazine MSO UAN	V2-3	0.082 1.43 0.5 1 2.5	4	96	100	95	22900	8.7	0.76
9	Laudis Dual Magnum Atrazine MSO UAN	v4-6	0.082 1.43 0.5 1 2.5	4	96	100	96	21800	8.6	0.79
	FPLSD (0.05)				8	3	3	ns	ns	ns

Table 6. Herbicide application data for Stayton II.

Date	Saturday, June 21, 2008	Sunday, July 6, 2008
Crop stage	V2-3 (var. Kokanee planted May 30)	V 4-5, 14-18 inches tall
Weed density and growth stage	-	(see Figure 3 below)
Herbicide/treatment	2,4,6,8	3,5,7,9
Application timing	EPOST	LPOST
Start/end time	11:30-12 PM	6-7 AM
Air temp/soil temp (2")/surface	82/82/84	61/60/61
Rel humidity	80%	80%
Wind direction/velocity	0-2 SW	5-10 N, with direction of rows
Cloud cover	90	100
Soil moisture	Dry, sandy	Very dry, will irrigate within 2 days
Plant moisture	Dry	Dry
Sprayer/PSI	BP 30 PSI	BP 20 PSI
Mix size	2100/4 plots	2100/4 plots
Gallons H20/acre	20	20
Nozzle type	6-XR 8003	6-XR 8003
Nozzle spacing and height	20/24	20/24

Figure 3. Exp II at V4-5 application, July 6, 2008.

Effect of Atrazine on Laudis Activity

2007

Ed Peachey, Horticulture Department, OSU

Atrazine is typically recommended as a tank mix with HPPD inhibitor herbicides to broaden the spectrum. However, this practice conflicts with the objective of reducing or eliminating atrazine use in sweet corn production. Additionally, complete weed control in sweet corn is seldom needed, unless growers want to avoid recharge of the weed seed bank. Sweet corn is a very competitive crop, and it may be possible to avoid atrazine applications altogether when using HPPD inhibitor herbicides, yet maintain expected sweet corn yield. The objective of this experiment was to determine the effect of atrazine rate on Laudis weed control efficacy when applied to sweet corn with very different competitive abilities.

Methods

Two varieties of sweet corn were planted on May 23. Quickie had a harvest maturity of 75 days and Var. 128 had a maturity of 110 days. There was a big difference in height and leaf area index (LAI) between the two varieties as well. At silking, Quickie averaged 54" tall with a LAI of 2.02, while var. 128 was 97 inches tall with a LAI of 3.78. The two varieties were over-seeded slightly, then thinned to 23,000 plants/A. A weed free check-plot was maintained by applying Outlook and atrazine after planting, and removing escapes by hand during the season. Laudis was applied at 1 oz/A, 1/3 the rate that will eventually be labeled for weed control in corn. Treatments with Laudis were applied POST on June 23 when corn was at V4-5 and was 12-16 inches tall, depending on variety. Leaf area index and corn height was determined when the corn was at 50% silking.

Results and Discussion

As mentioned above, the two corn varieties had very different growth characteristics. Var. 128 was extremely competitive and yield was reduced by a maximum of 53% in the untreated and weedy check plots. In contrast, yield of Quickie in the untreated plots was reduced by as much as 72%, even though the corn was harvested only 75 days after planting. The plots were irrigated very well, with about 1.3 to 1.6 inches of water applied weekly, and this likely reduced the competitive effect of the weeds on corn yield.

Although there were few differences in yield noted, there was a significant difference in weed control between the two varieties across the atrazine levels that were applied with Laudis. Weed control at harvest was estimated at less than 60% when Laudis was applied to Quickie, but did not fall below 85% with Var. 128. Weed control increased as the rate of atrazine tankmixed with Laudis increased, but only when the tankmix was applied to the short season variety Quickie. Weed control did not improve when increasing rates of atrazine were applied to the more competitive variety (Var. 128).

Two additional treatments compared Laudis and Impact herbicides applied without atrazine, but tankmixed with Outlook herbicide. These treatments used the recommended rate of Laudis herbicide (3 oz/A) and Impact (0.75 oz/A). The weed control provided by the substitution of Outlook with these HPPD herbicides was roughly equivalent to tankmixing the herbicides with 1.2 oz/A of atrazine.

Table 1. Effect of atrazine rate on HPPD inhibitor efficacy in sweet corn when applied to two varieties, Var. 128 and Quickie, 2007.

	Herbicide	Rate	Weed Control 4WAP					Weed Control at Harvest					Harvest		
			Purslane	Pigweed	H. nightshade	Witchgrass	Composite rating	Purslane	Pigweed	H. nightshade	Witchgrass	Composite rating	Plant stand	Ear no	Yield
Var. 128		fl oz/A	--					% --					no/A	no/A	tons/A
1	Outlook PRE Atrazine PRE	21 19	100	100	100	100	100	100	100	100	85	100	24000	27000	14.0
2	Atrazine Laudis	32 1	100	100	100	83	99	100	100	100	98	100	24300	25000	14.6
3	Atrazine Laudis	10.6 1	95	100	100	81	94	100	100	100	97	98	25000	27100	14.6
4	Atrazine Laudis	3.5 1	73	95	99	55	84	100	96	98	94	94	24200	25900	15.1
5	Atrazine Laudis	1.2 1	55	100	98	85	75	100	100	98	98	97	23600	26000	14.4
6	Laudis	1	23	84	88	62	68	100	100	87	95	88	23600	24500	13.9
7	Impact Outlook	0.75 18	80	100	95	99	83	100	100	97	99	96	22900	25700	13.9
8	Laudis Outlook	3 18	41	100	92	83	74	100	99	94	99	95	23300	25700	13.8
9	Check	-	-	-	-	-	-	-	-	-	-	-	21900	18900	7.9
Quickie															
1	Outlook PRE Atrazine PRE	21 19	100	100	100	100	100	100	100	100	100	100	24300	21300	6.8
2	Atrazine Laudis	32 1	100	100	100	79	99	100	100	100	96	98	23700	22400	6.6
3	Atrazine Laudis	10.6 1	97	100	100	38	94	97	98	98	78	88	25300	23300	6.8
4	Atrazine Laudis	3.5 1	85	102	100	55	86	78	98	96	80	83	25100	22700	6.7
5	Atrazine Laudis	1.2 1	68	98	100	22	81	72	96	84	78	79	24900	23500	6.7
6	Laudis	1	43	100	79	32	59	97	96	44	83	53	25300	22100	5.9
7	Impact Outlook	0.75 18	84	100	88	92	82	88	94	73	97	76	24200	21700	5.9
8	Laudis Outlook	3 18	56	100	90	52	71	75	96	71	98	69	25000	22100	5.9
9	Check	-	-	-	-	-	-	-	-	-	-	-	24500	10100	1.9
	FPLSD $_{(0.05)}$		12	5	7	26	7	8	3	11	9	7	ns	1700	1.0

Atrazine Effects on Laudis Efficacy in Sweet Corn
2008

Ed Peachey, Horticulture Department, OSU

Atrazine is typically recommended as a tank mix with HPPD inhibitor herbicides to broaden the weed control spectrum. Atrazine acts as a synergist and enhances HPPD activity. However, this practice conflicts with the objective of reducing or eliminating atrazine use in sweet corn production. Additionally, complete weed control in sweet corn is seldom needed, unless growers want to avoid recharge of the weed seed bank. Sweet corn is a very competitive crop, and it may be possible to avoid atrazine applications altogether when using HPPD inhibitor herbicides, yet maintain expected sweet corn yield. The objective of this experiment was to determine the effect of atrazine rate on Laudis weed control efficacy when applied to sweet corn varieties with very different competitive abilities.

Methods
Two varieties of sweet corn were planted on May 14, 2008 at 26,000 seeds/A. Quickie had a harvest maturity of 75 days and Var. 128 had a maturity of 110 days. There was a large difference in height and leaf area index (LAI) between the two varieties. A weed free check-plot was maintained by applying Outlook and atrazine after planting, and removing escapes by hand during the season. Laudis was applied at 1 oz/A, 1/3 the rate that is labeled for weed control in corn. Treatments with Laudis were applied POST on June 23 when corn was at V4-5 and was 12-16 inches tall, depending on variety. Leaf area index and corn height was determined when the corn was at 50% silking.

Results and Discussion
As mentioned above, the two corn varieties had very different growth characteristics. Var. 128 was very competitive and again suppressed weeds better than Quickie. The addition of atrazine improved weed control most when applied to plots with the variety Quickie (Fig. 4). Var. 128 was very competitive with approximately 90% control when Laudis was applied without atrazine, compared to only 50 to 60% control when the same treatment was applied to Quickie (Figure 4). Yield did not increase with improved weed control, however.

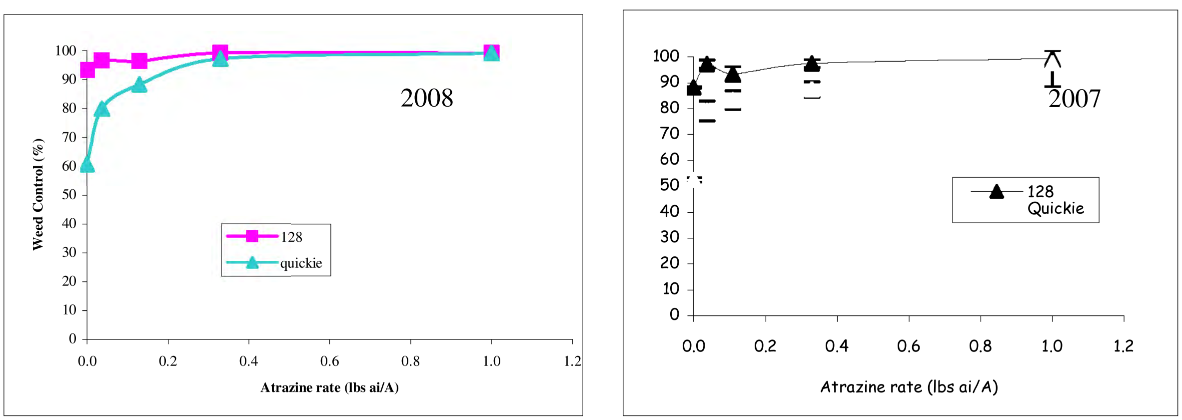


Figure 4. Effect of sweet corn variety and atrazine rate on Laudis efficacy in 2007 and 2008.

Carryover Potential of Impact Herbicide

2007

Ed Peachey, Horticulture Dept, OSU

Methods

The experimental design for the experiment was a strip plot, with herbicide rate, follow-crop, and planting season as the subplots. The soil classification at this site was loam to clay loam (26-35% sand, 40-46% silt, and 21-29 % clay, depending on location in the field). Sweet corn was planted on May 19, 2006 in rows 2.5 ft apart, and Outlook herbicide applied PRE to control weeds. Impact herbicide was applied to subplots within the sweet corn planting on June 28, 2006 at 0.016 and 0.032 lbs ai/A, with one of the subplots of each replicate block not receiving any herbicide. The two herbicide treatments were applied with a back pack sprayer with a 10 ft boom with 15 GPA of water. A few sunflowers were seeded with the corn as an indicator crop, and the solution that remained after the application was measured to ensure that the intended rate was applied.

Following corn harvest on September 11, 2006 the plots were prepared for planting by immediately flailing the corn as close to the soil surface as possible, disking (2x), and rototilling with a vertical tine tiller (2x with Rotera). The corn residue was allowed to decompose for 9 days to facilitate planting. Crimson clover, perennial ryegrass, forage fescue, processing squash (Golden Delicious), snap beans (OR91G), sugar beets, and Chinese cabbage were planted on September 20, 85 days after Impact herbicide was applied to the corn. Pyramin was applied to the beets PES and Devrinol to the Chinese cabbage PES to minimize winter weed competition with the crop. Irrigation was needed to establish the crops. Emerged crop seedlings were counted on Oct. 13, 23 days after the crops were seeded, and growth and phytotoxicity rated 6 WAP. A weather station recorded rainfall, air temperature, solar radiation, humidity, and wind speed at the field site. In the spring of 2007, plots reserved for the spring crops were disked twice and rototilled twice before planting. Crops of mint, Chinese cabbage, table beets, perennial ryegrass, tall fescue, squash, clover, and snap beans were planted between April 19 and 30, 2007.

Results

There were no convincing visual injury symptoms that are typical of HPPD herbicides (pigment loss or whitening and purple tint in new or expanded leaves) (Table 1). The yield data did indicate a possible effect on crimson clover biomass. Snap bean yield was very high and unaffected by treatment. Table beet yield may have been reduced at the 2x rate, but statistically the data were unconvincing. The data did indicate that fewer beets survived until harvest in the 2x treatment. No effects were noted on Golden Delicious squash fruit color, a concern with other pigment disruptors.

The same experiment was initiated in 2007, with an earlier planting date for the fall crops (August 31). As of Nov 4, 2007, no visible symptom has been recorded for any crop. Emergence counts did indicate, however, that squash emergence was likely reduced by Impact herbicide, and that snap bean, sugar beet, and crimson clover emergence may have been reduced by Impact applied in July. However, as mentioned above, there has been no visual effect on crop growth or the bleaching symptoms typically associated with HPPD inhibiting herbicides.

Table 1. Effect of Impact herbicide on follow-crops. Herbicides were applied in June, 2006 and crops planted in the fall of 2006 and the spring of 2007.

Planting Season and Crop	Planting date	Herbicide rate	Emergence/ stand	Phyto rating	Stunting	Biomass/ yield
		1=0.75 oz; 2=1.5 oz/A	*% of check in the fall of 2006*	*0-10*	*%*	#/unit area
Fall planted crops						
				27-Apr	27-Apr	27-Apr
Clover	20-Sep	0	100	0	0	**7.5 a**
		1	107	0	0	**6.4 ab**
		2	100	0	0	**6.1 b**
				Ns	*ns*	*P=0.05*
				27-Apr	27-Apr	27-Apr
Ch. Cabbage	20-Sep	0	100	0.5	2	3.3
seed crop		1	113	1.5	8	4.1
		2	103	2.3	13	3.5
				Ns	*ns*	*ns*
				1-Jul	1-Jul	
Tall Fescue	20-Sep	0	100	0	0	-
		1	86	0	0	-
		2	84	0	0	-
				Ns	*ns*	
				1-Jul	1-Jul	18-Jul
P. ryegrass	20-Sep	0	100	0	0	0.118
		1	102	0	0	0.110
		2	95	0	0	0.101
				Ns	*ns*	*ns*
				25-Jun	25-Jun	25-Jun
Sugar beets	20-Sep	0	**100 a**	0	10	4.4
		1	**101 a**	0	5	5.5
		2	**79 b**	1	28	5.0
			P=0.05	*Ns*	*ns*	*ns*
Squash	19-Sep	0	100	-	-	-
		1	91	-	-	-
		2	93	-	-	-
			ns			
Snap beans	19-Sep	0	**100 a**	-	-	-
		1	**94 ab**	-	-	-
		2	**81 b**	-	-	-
			P=0.05			
Spring planted crops						
			29-May	29-May	29-May	16-Aug
Clover	30-Apr	0	100	0	0	1.5
		1	100	0	0	1.3
		2	100	0	0	1.6
			29-May	29-May	29-May	18-Jul
Ch. cabbage	30-Apr	0	100	0	0	8.2
Napa (leaf crop)		1	92	0	5	8.6
		2	100	0	10	8.6
			ns	*ns*	*P=0.57*	*ns*

Planting Season and Crop	Planting date	Herbicide rate	Emergence/ stand	Phyto rating	Stunting	Biomass/ yield
		1=0.75 oz; 2=1.5 oz/A	*% of check in the fall of 2006*	*0-10*	*%*	#/unit area
			29-May	29-May	29-May	16-Aug
Tall Fescue	30-Apr	0	100	0	0	0.5
		1	100	0	0	0.8
		2	100	0	0	0.9
			ns	*ns*	*ns*	*Ns*
			29-May	29-May	29-May	16-Aug
P. ryegrass	30-Apr	0	100	0	0	0.8
		1	100	0	0	1.2
		2	100	0	0	1.4
			ns	*ns*	*ns*	*Ns*
			29-May	29-May	29-May	16-Aug
Table beets	30-Apr	0	100	0	2.5	**8.3**
		1	116	0	0	**8.0**
		2	116	0	10	**7.0** [a]
			ns	*ns*	*P=0.27*	*P=0.60*
				29-May	29-May	1-Nov
Squash	28-Apr	0	Very poor emergence due to wet spell in early May	0	0	No effect on potential yield or color of fruit.
		1		0	0	
		2		0	0	
				ns	*ns*	
			29-May	29-May	29-May	18-Jul
Snap beans	28-Apr	0	100	0	0	12.3
		1	105	0	0	13.7
		2	100	0	0	12.2
			ns	*ns*	*ns*	*P=0.20*
			14-Jul	14-Jul	14-Jul	16-Aug
Mint	19-Apr	0	100	0	20	0.8
		1	91	0	8	1.3
		2	72	0	0	1.0
			P=0.22	*ns*	*ns*	*Ns*

[a] Beet survival at harvest was 25% lower in the 2x treatment (P=0.10).

Carryover Potential of Impact Herbicide
2008

Ed Peachey, Horticulture Department, OSU

MethodsThe design for the experiment was a strip plot, with herbicide rate and follow-crop as the subplots. Crop main plots were 10 by 70 ft, and Impact rate subplots were 10 by 20 ft (Figure 1). All plots were replicated 3 times. The soil classification at this site was a loam soil (33 % sand, 43 % silt, and 25 % clay) with a pH of 5.8, OM % (LOI) of 1.90, and a CEC of 20.7 meq/100 g of soil. Super sweet Jubilee corn was planted on May 30, 2007 in rows 2.5 ft apart. Outlook herbicide was applied PRE to control weeds, and plots were cultivated when the corn was about 16 inches tall. A few sunflowers were seeded with the corn as an indicator crop. Surviving sunflowers were killed with glyphosate spot treatments just before they produced seeds. Impact herbicide was applied to subplots within the sweet corn planting on July 7 at 0.016 and 0.032 lbs ai/A, with one of the subplots of each replicate block not receiving any herbicide. The solution that remained after the application was measured to ensure that the intended rate was applied. The two herbicide treatments were applied with a back pack sprayer with a 10 ft boom with 15 GPA of water/A.

The corn was mowed 10 days before predicted commercial harvest on Aug 22 and failed close to the ground on Aug 24, 2007. On Aug 26, plots were disked 3 times and a Rotera and roller applied once to prepare a seedbed. Fertilizer was spread on Aug 28 at 400 lbs/A of 12-29-10, followed again by the Rotera and roller at a very slow speed. A weather station recorded rainfall and air temperature at the field site (Figure 2). Irrigation was applied at ~ 1 inch week beginning June 15, 2008.

Field crops were planted with a 7.5 ft wide Nordsten drill with a row spacing of 15 inches. Brassica and beet crops were planted on a 26 inch row spacing with a Gaspardo vacuum seeder, while beans and squash were planted on a 30 inch row spacing with a John Deere max emerge planter. Mint was transplanted at a 1 ft in-row spacing after making 2-60 inch rows with the row clearers set to about 6 inches deep on the John Deere planter. Data for each crop and season were analyzed separately as a RCB design with Block as a class variable and Rate (0, 1, 2) as a continuous variable using PROC GLM of SAS.

Fall planted crops

Crimson clover, perennial ryegrass, forage fescue, processing squash (Golden Delicious), snap beans (OR91G), sugar beets, and Chinese cabbage (Napa) were planted on Aug 30 and 31, 55 days after Impact herbicide was applied to the corn. In a similar experiment in 2006-07, 85 days passed between the Impact application and crop planting. After planting, Pyramin and Dual Magnum were applied to the beets, Dual Magnum and Devrinol were applied to Chinese cabbage, and Outlook was applied to the squash and snap beans. Light rain fell but was not enough to incorporate the herbicides, so the plots were irrigated with about 0.5 inches of water. On Oct 29, Nortron, Aim, and MCPA were applied to the ryegrass and fescue to minimize winter weed competition with the crop. Emerged crop seedlings were counted on Oct. 10, 50 days after the crops were seeded, and growth and phytotoxicity rated on Oct 28. Crops were harvested the following spring and summer as recorded below. Field crops were harvested from 11 ft sq and the Chinese cabbage from 10 ft of the three rows in each plot.

Spring planted crops

Spring plots were disked twice and rototilled three times on May 2 and 3, 2008 to prepare a seedbed. Fertilizer was broadcast at 500 lbs (12-29-10) before the last tillage. Crops of clover, pak choi (leafy brassica, var. Joi Choy), peppermint, perennial ryegrass, snap beans (OR91-G), squash (Golden Delicious), table beets (Detroit dark red) and turf-type tall fescue were planted on May 5 and 6. Herbicides were applied to minimize weed competition (Table 1) and plots irrigated lightly to incorporate the herbicides. Hand weeding, cultivation, and rototilling were used to keep weeds from reducing crop growth. Ryegrass, clover and peppermint were harvested from 11 ft sq in the center of each plot. Snap beans, beets, and pak choi were harvested from 8.2 ft of row.

ResultsFall planted crops

Few effects were noted on crop growth. Emergence counts in November indicated that snap bean and squash emergence may have been reduced by Impact herbicide, but visual evaluations indicated no effects on plant color or growth. Sugar beet mean emergence declined with increasing rate, but did not differ statistically among treatments. Unfortunately, the sugar beet crop was entirely destroyed by geese.

Spring planted crops

Cool and wet weather through mid-June reduced emergence of some crops. No significant effects of Impact herbicide were noted on ryegrass, clover, mint or pak choi. Two attempts at establishing fescue failed because of poor weed control. Table beet yield was marginally tolerant to Impact at 1.5 oz/A, and snap bean pod grade was greatest with Impact at 1.5 oz/A, indicating a potential delay in maturity at the 2x rate. No effects were noted on plant color for any of the crops, including squash.

Table 1. Herbicides applied to plots to reduce weed competition in 2007 and 2008.

Fall planted crops

	Crop	Herbicide	Timing	Date	Rate	
1	Snap beans	Outlook	PRE	3-Sep-07	10.7	oz
2	Processing squash	Outlook	PRE	3-Sep-07	10.7	oz
3	Sugar beets	Pyramin	PRE	3-Sep-07	5	lbs
		Dual magnum	PRE	3-Sep-07	1	pt
4	Clover	Raptor	2 true leaves	1-Oct-07	4	oz
5	Perennial ryegrass	Nortron	2 leaves, wet soil	30-Oct-07	1.5	pts
		Aim		30-Oct-07	1	oz
		MCPA		30-Oct-07	1	pt
		Aim		29-May-07	1	oz
6	Tall fescue	Nortron	2 leaves, wet soil	30-Oct-07	1.5	pts
		Aim		30-Oct-07	1	oz
		MCPA		30-Oct-0	1	pt
		Aim		29-May-08	1	oz
7	Chinese cabbage	Dual Magnum	PRE	3-Sep-07	0.66	pts
		Devrinol		3-Sep-07	2	lbs

Spring planted crops

	Crop	Herbicide	Timing	Date	Rate	
1	Snap beans	Dual Magnum	PRE	6-May-08	1	pt
2	Processing squash	Outlook	PRE	6-May-08	14	oz
3	Table beets	Pyramin	PRE	6-May-08	5	lbs
		Dual Magnum	PRE	6-May-08	1	pt
4	Clover	Raptor	2 true leaves	2-Jun-08	4	oz
		Basagran			8	oz
5	Perennial ryegrass	Nortron	2 leaves	29-May-08	1.5	pts
		Aim			1	oz
		MCPA			1	pt
6	Tall fescue	Aim	2 leaves	29-May-08	1	oz
7	Pak Choi	Dual Magnum	PRE	6-May-08	0.66	pts
		Devrinol		6-May-08	2	lbs
8	Peppermint	-	-	-	-	

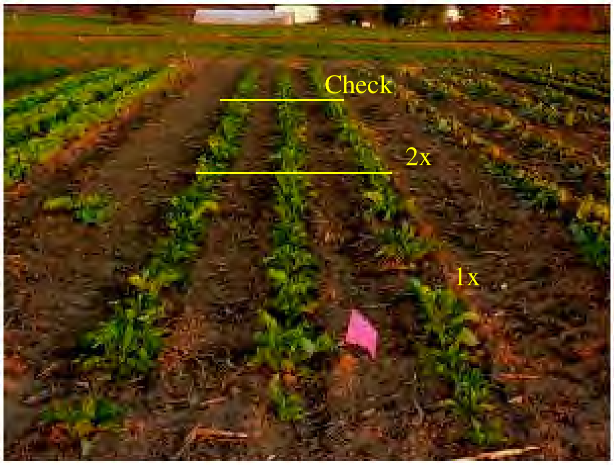
Table 2. Effect of Impact herbicide on fall-planted follow-crops. Herbicides were applied in July 7, 2007 and crops planted on Aug 30-31, 2007.

Planting Season and Crop	Planting date	Impact herbicide rate	Emergence/ stand	Phyto	Stunting	Phyto	Stunting	Total above-ground biomass	Dry matter yield
		1=0.75 oz; 2=1.5 oz/A	*0-10*	*%*		*0-10*	*%*	*kg/unit area*	*kg/unit area*
Fall planted crops									
			10-Oct	*28-Oct*	*28-Oct*	*1-May*	*1-May*	*9-Jul*	*9-Jul*
P. ryegrass	30-Aug	0	100	0	0	0	0	3.3	1.74
		1	95	0	0	0	0	4.1	1.76
		2	104	0	0	0	0	3.1	1.71
			ns	*ns*	*ns*	*ns*	*ns*	*P=0.07*	*ns*
				28-Oct	*28-Oct*	*1-May*	*1-May*	*9-Jul*	*9-Jul*
Tall Fescue	30-Aug	0	-	0	0	0	0	1.5	0.64
		1	-	0	0	0	0	1.3	0.60
		2	-	0	0	0	0	1.6	0.58
				ns	*ns*	*ns*	*ns*	*ns*	*ns*
			10-Oct	*28-Oct*	*28-Oct*	*1-May*	*1-May*	*9-Jul*	*9-Jul*
Clover	30-Aug	0	100	0	0	0	0	2.8	0.97
		1	81	0	0	0	0	2.7	0.94
		2	92	0	0	0	0	2.6	0.92
			ns	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
			10-Oct	*28-Oct*	*28-Oct*	*29-Apr*	*29-Apr*	*30-Apr*	
Ch. Cabbage	31-Aug	0	100	0	0	0	0	22.6	-
Napa cabbage, seed crop		1	94	0	0	0	7	30.2	-
		2	113	0	0	0	27	19.6	-
			ns	*ns*	*ns*	*ns*	*P=0.005*	*P=0.07*	-
			10-Oct	*28-Oct*	*28-Oct*				
Sugar beets	30-Aug	0	100	0	0			*Crop destroyed by geese*	
		1	84	0	0	-	-	-	-
		2	86	0	0	-	-	-	-
			ns	*ns*	*ns*				
			10-Oct	*28-Oct*	*28-Oct*				
Snap beans	30-Aug	0	100	0	0	-	-	-	-
		1	93	0	0	-	-	-	-
		2	88	0	0	-	-	-	-
			P=0.05	*ns*	*ns*				
			10-Oct	*28-Oct*	*28-Oct*				
Squash	30-Aug	0	100	0	0	-	-	-	-
		1	74	0	0	-	-	-	-
		2	67	0	0	-	-	-	-
			P=0.003	*ns*	*ns*				

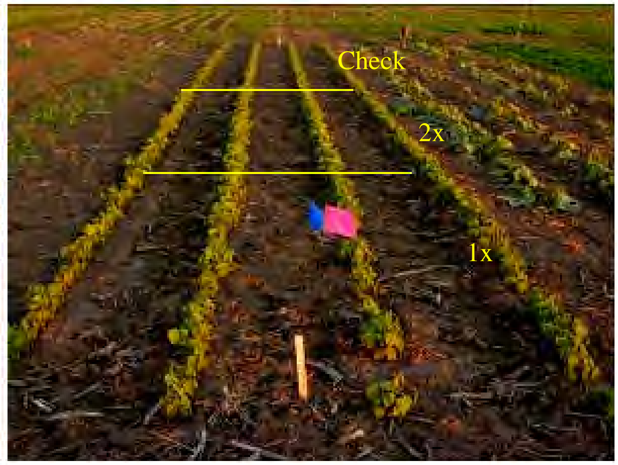
Table 3. Effect of Impact herbicide on spring-planted follow-crops. Herbicides were applied on July 7, 2007 and crops planted May 5, 2008.

Planting Season and Crop	Planting date	Impact herbicide rate	Emergence/ stand	Phyto	Stunting	Phyto	Stunting	Total above-ground biomass/ no. plants harvested	Pod, head, or root yield and grade
		1=0.75 oz; 2=1.5 oz/A	*% of check*	*0-10*	*%*	*0-10*	*%*	*kg/unit area*	*kg/unit area*
Spring planted crops									
			16-Jun	*16-Jun*	*16-Jun*	*25-Aug*	*25-Aug*	25-Aug	
Clover	5-May	0	100	0	0	0	0	3.5/ 0.82[1]	-
		1	79	0	6	0	2	3.6/ 0.85	-
		2	79	0	6	0	2	3.4/ 0.80	-
			ns	*ns*	*ns*	*ns*	*ns*	*ns/ ns*	-
			16-Jun	*16-Jun*	*16-Jun*	*25-Aug*	*25-Aug*	25-Aug	
P. ryegrass	5-May	0	100	0	3	0	0	2.8/ 0.62[1]	-
		1	107	0	0	0	0	2.6/ 0.63	-
		2	86	0	6	0	0	3.1/ 0.72	-
			ns	*ns*	*ns*	*ns*	*ns*	*ns/ ns*	
						25-Aug	*25-Aug*	*25-Aug*	
Mint	5-May	0	-	-	-	0	0	3.8/ 0.96[1]	-
		1	-	-	-	0	0	4.3/ 1.08	-
		2	-	-	-	0	0	4.0/ 1.05	-
						ns	*ns*	*ns/ ns*	
			16-Jun	*16-Jun*	*16-Jun*			*7-Jul*	*7-Jul*
Ch. cabbage	5-May	0	100	0	7	-	-	15.6[2]	10.1
Pak Choi leafy greens		1	120	0	10	-	-	15.6	10.2
		2	160	0	13	-	-	15.0	9.7
			ns	*ns*	*ns*			*ns*	*ns*
			16-Jun	*16-Jun*	*16-Jun*	*25-Aug*	*25-Aug*	27-Aug	27-Aug
Table beets	5-May	0	100	0	7	0	2	19.6[3]	13.9/ 11.5[4]
		1	153	0	7	0	3	17.3	12.9/ 15.4
		2	120	0	13	0	0	14.0	12.8/ 17.3
			ns	*ns*	*ns*	*ns*	*ns*	*ns*	*P=0.16/ ns*
			16-Jun	*16-Jun*	*16-Jun*			5-Aug	5-Aug
Snap beans	5-May	0	100	0	0	-	-	4.8	1.63/ 47%[5]
		1	87	0	0	-	-	4.5	1.50/ 53%
		2	86	0	0	-	-	4.1	1.46/ 54%
			P=0.07	*ns*	*ns*			*P=0.09*	*P=0.56/ 0.06*
			16-Jun	*16-Jun*	*16-Jun*	*25-Aug*	*25-Aug*	*22-Oct*	
Squash	5-May	0	100	0	0	0	0	No effect noted on potential yield or color of fruit.	
		1	122	0	0	0	4		
		2	106	0	13	0	0		
			ns	*ns*	*P=0.01*	*ns*	*ns*		

[1] Fresh wt and dry matter, respectively.
[2] No. Chinese cabbage heads harvested.
[3] No. beet roots harvested/plot.
[4] % grade 1-3 beets.
[5] %1-4 sieve beans.

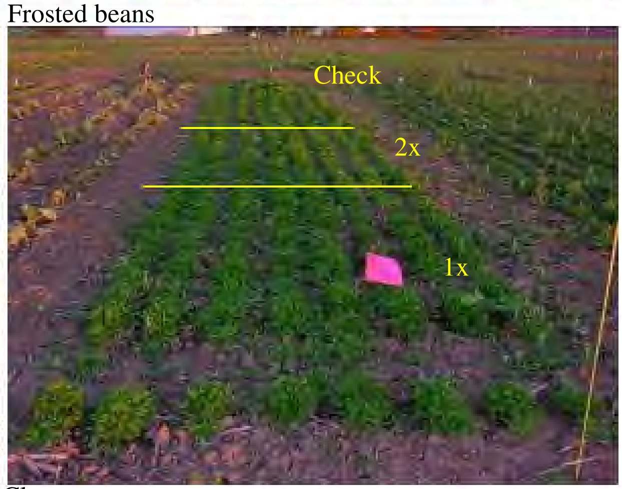


Sugarbeets



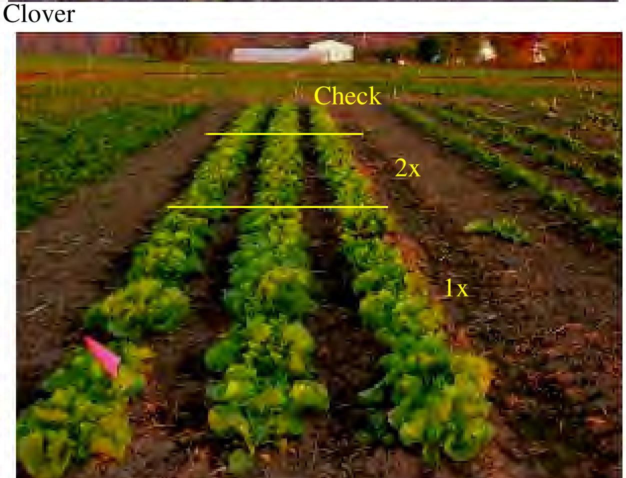
Frosted beans

Frosted squash



Clover

Perennial ryegrass



Napa cabbage

Figure 3. Crop tolerance to Impact herbicide Nov 1, 2007, Corvallis, Oregon. Lines are approximate plot borders for Impact herbicide treatments. These pictures are from the same replicate block, and the order of Impact rate within the sugarbeet plot is the same for the other crops. Fescue is not pictured because the crop was very small at this point. A light frost damaged the snap beans and squash. Note the apparent reduction in squash crop density, even though typical HPPD symptoms were not observed.

Sweet Corn Varietal Tolerance to Accent, Status, and Kixor Herbicides

2008

Ed Peachey, Horticulture Dept, OSU.
Chris Boerboom, University of Wisconsin

Methods

Planting rows were made with a John Deere Max emerge planter on May 23, 2008. Row spacing was 30 inches and fertilizer (450 lbs/A 12-29-10) was banded next to the rows. Sweet corn was planted on May 28 with push-type belt planters set to 1.5 inches deep. Plots were 20 ft long with one row (or variety of corn) per plot, and 15 feet separating each block of varieties (treatment) (see Figure 1). Outlook and atrazine herbicides were applied broadcast over the plots 1 day after planting, and then the plots irrigated with ½" water.

Injury ratings were made at 7, 14, and 28 DAT by comparing herbicide treated plots with the same variety in the untreated block. Ear quality was evaluated by stripping 10 ears in each plot and looking for irregular cob shape or tip fill. The data were analyzed as a strip-plot with main effects of variety and Accent treatment. However, because the plots of this study were not randomized in space, and represent only one of four replications located across the US, the outcomes in the table below should be viewed as preliminary data. A final report from all locations will be forthcoming.

Results

Results of this study will be summarized across the four sites. Data from the one replication located in Corvallis indicated that there were very little if any improvement in crop safety to Accent when the safener isoxadifen was added, and no increase in crop injury when Laudis was tankmixed with Accent (Table 7 and 8). Merit eventually died in all treatments that had been treated with Accent, whether tankmixed with isoxadifen or not. Kixor significantly injured corn when applied preemergence, and there appeared to be differences among varieties, but this injury may have been caused more by the emergence phenology of the variety coupled with rainy weather more than the intrinsic susceptibility of the cultivars. An example of the data published to inform growers on best use of these herbicides is presented in the table below (Table 9) and will be updated this winter.

Table 7. ANOVA For effect of variety (averaged across herbicide treatment of Accent, isoxadifen, and Laudis) and treatment (averaged across variety).

	Injury ratings								
	7 DAT			14 DAT			28 DAT		
	F	P	LSD	F	P	LSD	F	P	LSD
Variety	10.6	<0.0001	9.7	10.2	<0.0001	10.4	86	<0.0001	4.7
Treatment	4.9	0.0093	2.7	2.8	0.06	2.9	1	0.3	1.3

Table 8. Effect of Accent, isoxadifen, and Laudis on sweet corn growth. Each cell is the average response of 40 sweet corn varieties.

Variety	Accent (1.09 oz/A)			Accent (1.09 oz/A) + isoxadifen (0.41 oz/A)			Accent (1.09 oz/A) + isoxadifen (0.41 oz/A) +Laudis (4 fl oz/A)		
	DAT			DAT			DAT		
	7	14	28	7	14	28	7	14	28
	--% injury ---								
Means	7.4	6.8	3.6	4.0	4.0	3.1	3.4	3.5	2.5
Std error	2.1	2.3	2.6	1.8	2.1	2.5	1.8	1.7	2.3

Cottonwood Control in Potted Blueberries

Mikio Miyazoe and Ed Peachey, Horticulture Department, OSU
Jon Umble, Fall Creek Nursery, Fall Creek, OR

Methods

Blueberry seedling plugs were transplanted into one gallon pots on May 14, 2008. Treatments in Exp I (all preemergence before cottonwood seeds fell on pots) were applied on May 28 with a 3 nozzle boom (20 in. spacing) delivering 20 GPA. Following the herbicide application, the potted plants were placed on a trailer and the trailer positioned under cottonwood trees at night and early morning to capture falling cottonwood seeds. The trailer was moved under a sprinkler irrigation system during the day and irrigated four times/day for one hour (~ 1 inch of water) to keep the surface of the pots wet.

Treatments for EXP II and III were applied at the same GPA on June 18 and 25, respectively, but with a hand held, single nozzle sprayer. EXP II measured postemergence control potential of experimental herbicides applied to very small cottonwood seedlings (cotyledon-first true leaf stage). In Exp III, the herbicides of EXP I were applied over: A) pots with small cottonwoods seedlings (primarily cotyledon-first true leaf stage) in pots that were covered with floating row cover material to prevent new recruits; and to B) pots that had all of the cottonwood seedlings removed prior to treatment application, but that were uncovered to allow new seeds to fall on the pots. EXP IIIB was a second test for EXP I treatments, but with slightly larger blueberry plants.

Results

EXP I. There very few symptoms of injury on the blueberry seedlings. Treatments with isoxaben provided the best control of cottonwoods, but Treflan EC applied alone did not. Surflan reduced cottonwood density 6 WAT and provided very good control at 11 WAT. The data suggest that trifluralin does not improve cottonwood control unless it is applied with isoxaben at 1.33 pts/A. Gallery plus Surflan should be considered in future experiments.

EXP II. Flazasulfuron and BAS800 controlled cottonwoods best, but injury to shoots and roots was unacceptable for flazasulfuron at 6 WAT. Halosulfuron also reduced crop growth.

EXP III. There was no significant evidence that herbicides negatively impacted crop growth (data not shown). None of the herbicides provided postemergence control of emerged seedlings in EXP III A (Table 3A). Likewise, there were no statistically significant differences among the herbicide treatments applied in Exp III B (Table 3B), although trends suggest that Gallery, Snapshot, Treflan, and Treflan plus Gallery controlled cottonwoods compared to the check and rimsulfuron.

Table 1. Cottonwood control in potted blueberries, 2008.

	Product	Herbicide	Rate		Obs	Cottonwood Density				Phytotoxicity			Stunting			Visual Cottonwood Control	Fresh Rootball Weight
						3-Jun	*11-Jun*	*25-Jun*	*10-Jul*	*3-Jun*	*11-Jun*	*25-Jun*	*3-Jun*	*11-Jun*	*25-Jun*	*14-Aug*	*14-Aug*
						1WAT	*2 WAT*	*4WAT*	*6WAT*	*1WAT*	*2 WAT*	*4WAT*	*1WAT*	*2 WAT*	*4WAT*	*11WAT*	*11WAT*
			product units	*ai/A*		------------ *No./pot* ------------				-------*0-10 (10=dead)*----			---------- *%* ----------			*%*	*g*
1	Gallery	Isoxaben	0.66 lbs	0.5	8	2	6	2	3	0.4	0	0.1	0	0	0	96	7.9
2	Gallery	Isoxaben	1.33 lbs	1	8	2	11	3	4	1.1	0	0.0	1	0	0	97	6.6
3	Snap shot	Trifluralin + isoxaben	100 lbs	2.5	8	2	10	6	5	1.4	0	0.0	1	0	0	92	6.3
4	Snap shot	Trifluralin + isoxaben	200 lbs	5.0	8	2	11	4	2	1.1	0	0.0	0	0	0	99	7.3
5	Surflan	Oryzalin	2 qts	2	8	2	13	11	8	1.4	0	0.0	6	0	1	99	-----
6	Surflan	Oryzalin	4 qts	4	8	3	15	13	9	1.6	0	0.3	9	0	0	98	-----
7	Treflan	Trifluralin	1 pt	0.5	8	2	13	18	19	2.0	0	0.0	7	0	0	7	-----
8	Treflan	Trifluralin	2 pts	1	8	2	12	12	13	1.6	0	0.0	1	0	0	43	-----
9	Gallery +	Isoxaben	0.66 pts	0.5	8	2	12	5	6	0.4	0	0.0	1	0	0	86	7.3
	Treflan	Trifluralin	1 pt	0.5													
10	Gallery +	Isoxaben	1.33 pts	1	8	1	7	2	2	1.1	0	0.0	0	0	0	99	7.5
	Treflan	Trifluralin	2 pts	1													
11	Mustard meal	225 g/m sq			8	1	9	7	6	1.3	0	0.3	0	0	0	60	-----
12	Check				8	2	17	21	20	0.8	0.1	0.0	0	0	0	0	6.6
	ANOVA					0.125	0.269	0.001	0.001	0.02	0.47	0.71	0.002	-	0.46	<0.0001	-----
	LSD (0.05)					1	ns	9	9	1.0	ns	ns	6	-	ns	9	-----

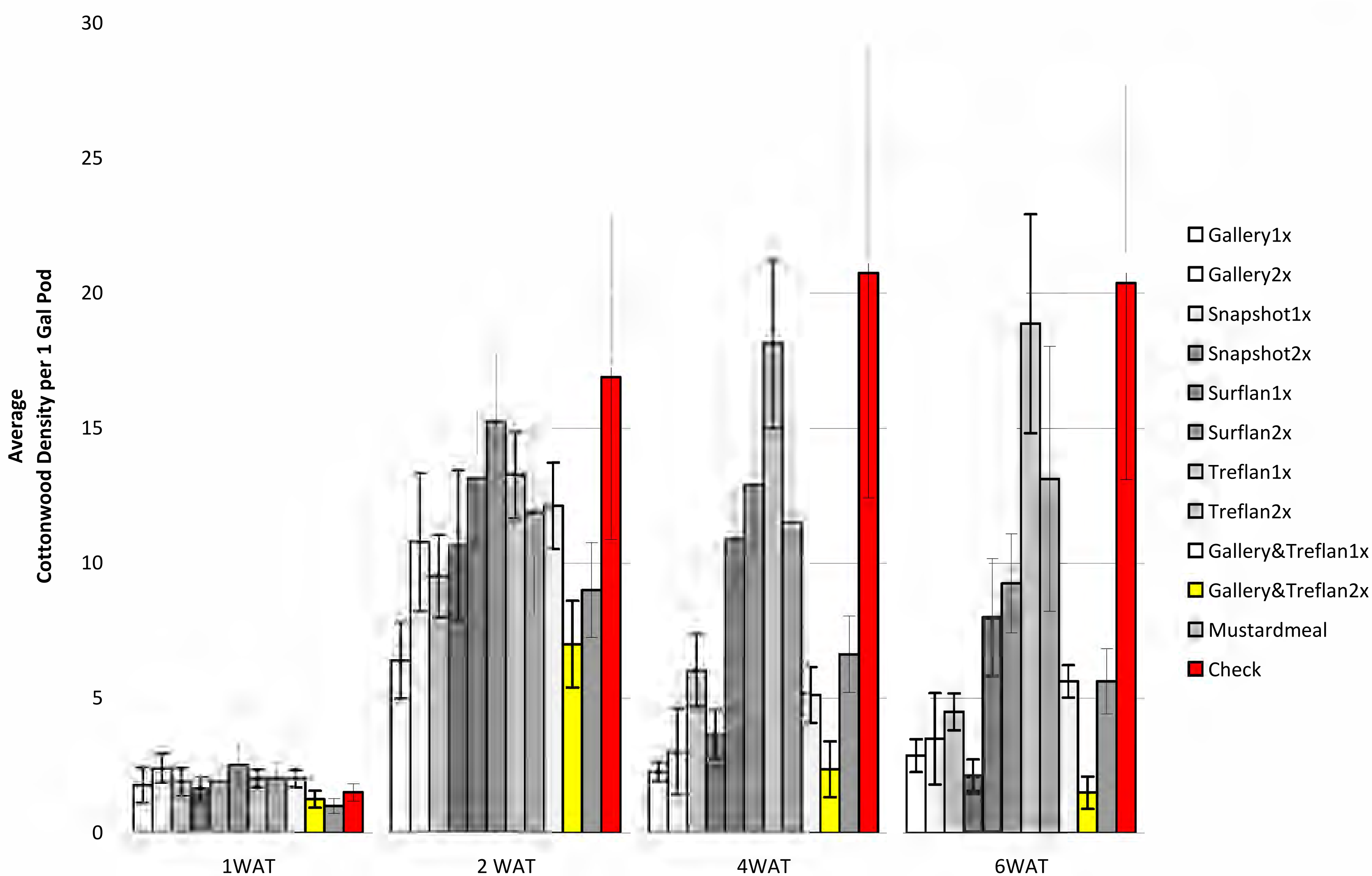


Figure 1. Cotton wood control in potted blueberries to 6 WAT, 2008 in EXP I (± SE)

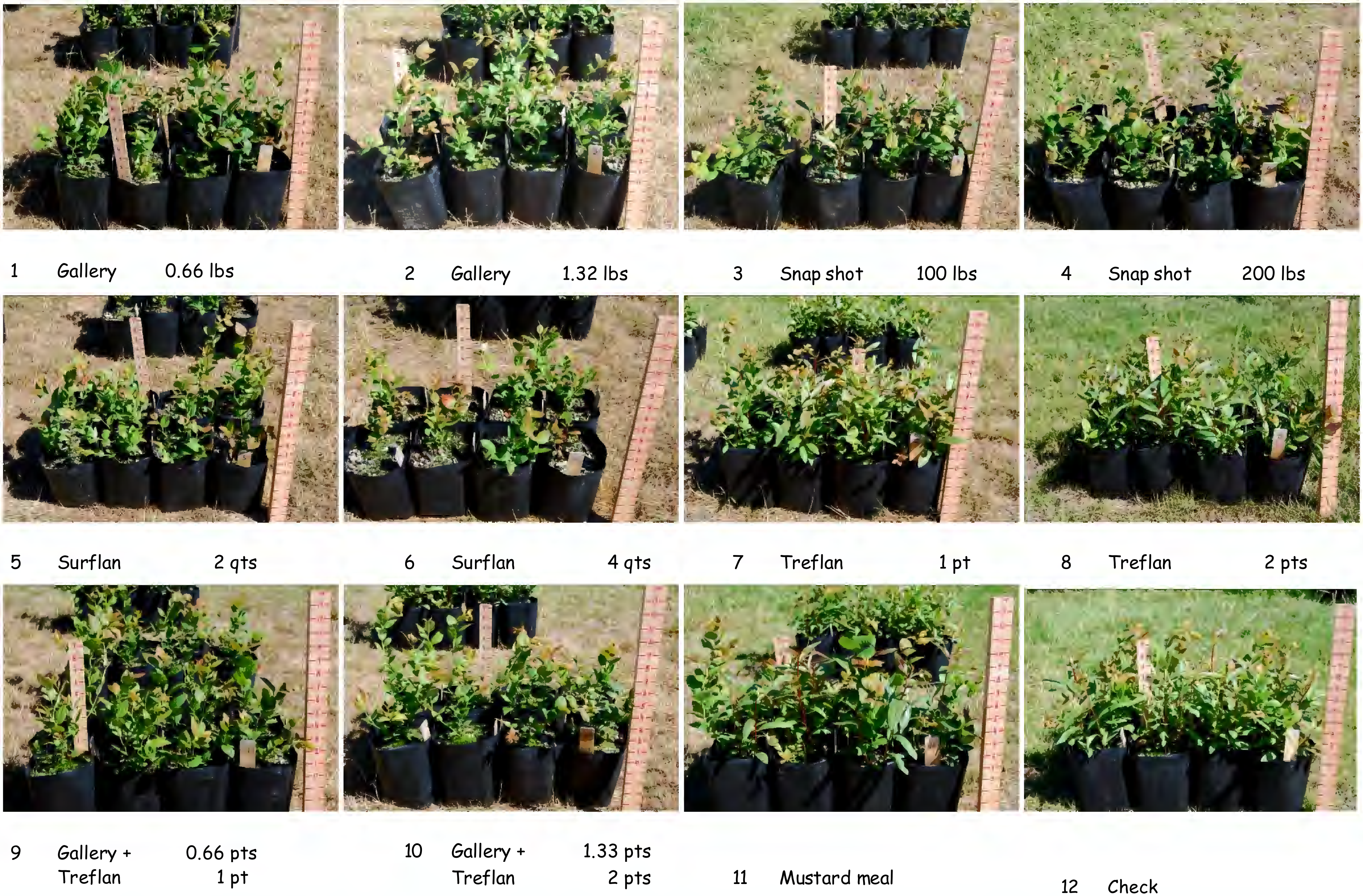


Figure 2. Experiment I treatment effects on blueberries and cottonwoods, July 30, 2008 (9 WAT). All rates are product/A.

1 Gallery 0.66 lbs

12 Check

1 Gallery 0.66 lbs

2 Gallery 1.32 lbs

3 Snap shot 100 lbs

12 Check

3 Snap shot 100 lbs

4 Snap shot 200 lbs

9 Gallery + Treflan 0.66 pts 1 pt

12 Check

9 Gallery + Treflan 0.66 pts 1 pt

10 Gallery + Treflan 1.33 pts 2 pts

Figure 2. Effect of herbicides on blueberry roots of select treatments from Exp 1. All rates are product/A.

Table 2. Postemergence cottonwood control in blueberries, EXP II, 2008. Treatments were applied on 18-Jun.

	Product	Herbicide	Rate		Cottonwood Density				Phytotoxicity			Stunting			Visual Cottonwood Control Rating	Rootball Fresh Weight
			ai/A	*Obs*	*18-Jun*	*25-Jun*	*10-Jul*	*18-Jul*	*25-Jun*	*10-Jul*	*18-Jul*	*25-Jun*	*10-Jul*	*30-Jul*	*14-Aug*	*14-Aug*
					0 WAT	*1 WAT*	*3 WAT*	*4 WAT*	*1 WAT*	*3 WAT*	*4WAT*	*1 WAT*	*3 WAT*	*6 WAT*	*8 WAT*	*8 WAT*
					--------*No/pot*--------				--------*0-10*--------			------------*%*------------			*%*	*g*
12	Check	-	-	8	17	21	20	-	-	-	-	-	-	-	0	6.6
13	Callisto	mesotrione	0.094	2	18	12	15	14	0	1	0	0	0	12	78	------
14	-	V10142	0.05	2	16	15	16	18	0	1	0	0	0	0	60	------
15	Spartan	sulfentrazone	0.125	2	11	4	10	9	4	2	1	5	8	0	53	------
17	Grasp	penoxsulam	0.1	2	14	13	8	6	1	2	2	0	0	0	71	------
18	Paramount	quinclorac	0.375	2	10	10	12	11	0	0	0	0	0	3	68	------
19	Laudis	tembotrione	0.027	2	20	24	20	19	0	0	0	0	3	3	38	------
20	Ronstar	oxadiazon	2 (100# product)	2	9	9	9	8	0	0	0	0	3	0	5	------
21	Devrinol	napropamide	1	2	13	13	11	12	0	0	0	0	0	0	0	------
22	Outlook	dimethenamid-P	0.65	2	32	39	36	35	0	1	0	0	0	12	3	------
23	Kerb	prodiamine	0.5	2	9	8	8	8	0	0	0	0	0	0	6	------
25	Goal tender	oxyfluorfen	0.125	2	10	9	11	10	3	1	1	0	0	0	15	------
26	Sandea	halosulfuron	0.032	2	15	14	12	11	1	3	2	0	5	45	72	1.1
27	-	flazasulfuron	0.033	2	4	3	2	2	1	1	1	0	0	39	95	1.2
29	-	BAS800	0.089	2	6	0.5	1	1	4	2	2	5	0	24	96	4.6
	ANOVA				0.89	0.69	0.81	0.83	0.00	0.36	0.23	0.45	0.51	0.03	<0.0001	------
	LSD(0.05)				ns	ns	ns	ns	2	ns	ns	ns	ns	13	31	------

Figure 3. Effect of select herbicide treatments on blueberry roots of Exp II. The check is labeled as 12.

Table 3. Cottonwood control in potted blueberry plants, Exp IIIA-B, 2008.

	Product	Herbicide	Rate			Obs	A. Cottonwood Density in Unweeded Pots (Herbicides were applied to growing cottonwoods on 25-Jun, 3 weeks after treatments were applied in Exp 1. Pots were covered to prevent new recruits)				B. Cottonwood Density in Weeded Pots (Herbicides were applied after all cottonwood seedlings were removed from pots on 25-Jun. Pots were placed under cottonwood trees after treatment)			
			product	*units*	*ai/A*	N	25-Jun	4-Jul	10-Jul	25-Jul	25-Jun	4-Jul	10-Jul	25-Jul
							0 WAT	*1 WAT*	*2WAT*	*4WAT*	*0 WAT*	*1 WAT*	*2WAT*	*4WAT*
								---------- No/pot----------						
1	Gallery	Isoxaben	0.66	lbs	0.5	4	29	37	30	30	0	0.0	0.0	0.0
2	Gallery	Isoxaben	1.32	lbs	1	4	31	30	28	27	0	0.3	0.3	0.3
3	Snap shot	Trifluralin + isoxaben	100	lbs	2.5	4	13	14	14	15	0	1.0	1.3	1.3
4	Snap shot	Trifluralin + isoxaben	200	lbs	5.0	4	12	13	13	13	0	1.5	0.8	0.8
5	Matrix	Rimsulfuron	1	oz	0.016	4	36	36	33	40	0	0.0	0.8	0.8
6	Matrix	Rimsulfuron	2	oz	0.031	4	29	29	28	35	0	1.0	3.0	3.0
7	Treflan	Trifluralin	1		0.5	4	40	43	39	39	0	0.5	1.0	1.0
8	Treflan	Trifluralin	2		1	4	36	37	38	38	0	1.3	0.8	0.8
9	Gallery +	Isoxaben	0.66		0.5	4	26	26	23	22	0	0.8	0.8	0.8
	Treflan	Trifluralin	1		0.5									
10	Gallery +	Isoxaben	1.33		1	4	18	18	16	16	0	0.5	1.0	0.8
	Treflan	Trifluralin	2		1									
12	Check					4	16	17	16	15	0	1.8	2.3	2.3
	ANOVA						0.09	0.04	0.05	0.01	-	0.230	0.201	0.171
	LSD (a = 0.05)						19	18	17	16	-	ns	ns	ns

Weed Control in Grape with Flazasulfuron

2008

Ed Peachey, Horticulture Dept, OSU

Methods

The experiment was located at the OSU Woodhall Vineyard near Alpine, OR in Chardonnay grapes. Herbicides were applied April 2, 2008 to a 4 ft band in the vine row with TDXL11002 Turbo drop nozzles delivering 20 GPA. There were 3 vines per 20 ft long plot. The experimental design was a randomized complete block with 3 replications. The primary grasses present at the site were tall fescue and bentgrass; the primary broadleaf species present were spotted catsear and dandelion, with a small amount of white clover and other miscellaneous weeds.

Results

Flazasulfuron caused a small amount of leaf whitening on grape at the highest rate, but only on one vine in one plot. No other effects were noted on grape vine growth. Weed control was best with glyphosate early in the season but dissipated by harvest. Flazasulfuron plus glyphosate provided weed control that was as good or better than all other treatments at harvest. However, mean yield of this treatment was lower than all others. Yield of all flazasulfuron treatments was low, although it could not be determined in this study whether the lower yield was caused by the herbicide or weed competition.

Table 1. Effect of flazasulfuron on weed control and grape yield, OSU Woodhall Vineyard, Alpine, Oregon, 2008.

	Herbicide	Date	Rate	Phyto rating		Growth reduction		Weed Control		Weed control				Harvest	
				5-May	10-Jun	5-May	10-Jun	5-May		10-Jun				Composite weed control rating	Fruit yield
								Grasses	Broad-leaves	Grasses	Broad-leaves	Spotted catsear	Composite rating		
			lbs ai/A	*0-10*		*0-100*			-----------	-------------------	%	-------------------	-----------		*lbs/vine*
1	Simazine Glyphosate	2-Apr 2-Apr	3.0 1.0	0	0	0	0	94	68	98	78	82	83	76	5.3
2	Glyphosate	2-Apr	1.0	0	0	0	0	93	92	65	73	85	75	43	4.2
3	Flazasulfuron	2-Apr	0.0445	0	0.7	0	0	85	47	93	47	47	53	27	4.6
4	Flazasulfuron	2-Apr	0.0334	0	0	0	0	85	57	90	30	28	50	43	4.5
5	Flazasulfuron Glyphosate	2-Apr	0.0313 0.750	0	0	0	0	93	83	95	73	73	91	83	3.9
6	Untreated	-	-	-	-	-	-	-	-	-	-	-	-	-	6.1
	ANOVA			ns	ns	ns	ns	ns	0.006	<0.0001	0.0002	<0.0001	<0.0001	0.03	ns
	LSD (0.05)			-	-	-	-	15	42	13	37	35	23	48	2.7

1. Simazine + glyphosate
2. Glyphosate
3. Flazasulfuron 0.0445 lb ai/A
4. Flaz 0.0334 lb ai/A
5. Flaz 0.0331 lb ai/A + glyphos
6. Check

Figure 2. Treatment effects on June 9, 2008.

Table 2. Herbicide application data.

Date	Wednesday, April 02, 2008
Crop stage	Dormant
Weeds and growth stage	Very small seedlings, soil near to completely covered with vegetation
Start/end time	10-12:30 PM
Air temp	58 F
Rel humidity	45%
Wind direction/velocity	1 to 4 SE
Cloud cover	0
Soil moisture	Wet
Plant moisture	Dry
Sprayer/PSI	Back pack, single nozzle, 30 PSI
Mix size	521 mls/3 plots
Gallons H_20/acre	20
Nozzle type	TDXL11002 Turbo drop
Nozzle spacing and height	4 ft band
Comments	Applied after vines pruned and wired up

Blackberry Tolerance to Quinclorac

E. Peachey and D. Kauffman
Oregon State University

Methods

Quinclorac was applied at 0.375 and 0.75 lbs ai/A (8 and 16 oz) to Marion blackberries at 2 sites. Bindweed infested plots at the Dayton site. There were few weeds at the site in Corvallis. No effects were noted on growth or yield at either site.

Table 1. Effect of quinclorac on Marion blackberries, Country Heritage Farms, Dayton Oregon, 2008 (n=6 for treatments 1 and 2; n=3 for check).

	Exp herbicide treatments	Date	Rate	Yield	Wt of 25 berries
			lbs ai/A	*lb/plot*	*g*
1	Quinclorac	24-May-08	0.375	10.7	104
2	Quinclorac	24-May-08	0.750	11.1	112
3	Check	-	-	11.3	102
				ns	ns

Table 2. Effect of quinclorac on Marion blackberries, Corvallis, Oregon, 2008 (n=3).

	Treatment	Date	Rate	Yield	Wt of 25 berries	Wt/cane
			lbs ai/A	*kg/plot*	*g*	*Kg*
1	Quinclorac	18-Jun-08	0.375	13.1	127	4.4
2	Quinclorac	18-Jun-08	0.75	11.2	124	3.7
3	Check	18-Jun-08	-	6.3	126	2.6
				ns	ns	ns

Table 3. Herbicide application data

	Dayton	Corvallis
Date	Saturday, May 24, 2008	Wednesday, June 18, 2008
Crop stage	berries beginning to flower	berries in full flower, 30 day PHI
Start/end time	9:45-10;15	9:45-10;15
Air temp/soil temp (2")/surface	57/ /	57/ /
Rel humidity	80%	80%
Wind direction/velocity	0	0
Cloud cover	100	100
Soil moisture	dry	dry
Plant moisture	dry	dry
Sprayer/PSI	BP 30 PSI	BP 30 PSI
Mix size	2100 mls	2100 mls
Gallons H20/acre	20	20
Nozzle type	1- 80015E	1- 80015E

Control of Glyphosate Tolerant Annual Ryegrass in Hazelnuts

2008

Ed Peachey, Horticulture, OSU
Joe Cacka, Crop Production Services, Rickreal

Methods

Foliar applied herbicides were applied to 20 by 20 foot plots in a RCBD (3 blocks) in an established hazelnut orchard overrun with annual ryegrass that was tolerant to glyphosate. The soil-applied herbicides Simazine (4 lbs ai/A) and Prowl H_20 (3.8 lbs ai/A) were applied in non-randomized strips through the orchard over top of the foliar applied herbicide plots. The plot was mowed by the cooperating grower after the evaluation on May 20 to prevent annual ryegrass seed production, and Gramoxone was sprayed around the base of trees on May 31 to kill plants missed by mowing.

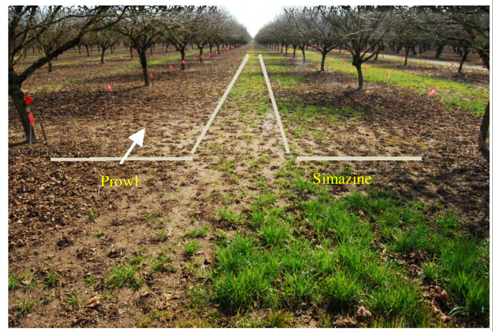


Fig.1. Prowl efficacy on March 13, 2009

Results

Gramoxone was the most effective treatment on May 20, 2008; Prowl and Simazine had no effect on weed growth. Evaluation on March 13, 2009, nearly one year later, indicated that Prowl was the most effective control strategy for annual ryegrass control (Fig 1).

Table 1. Weed control in hazelnuts with foliar and soil applied herbicides.

Foliar herbicide	Rate	Soil herbicide strip	Weed Control			
			May 20, 2008	March 13, 2009		
			Annual ryegrass	Annual ryegrass	Annual bluegrass	Composite rating
	lbs ai/A		*% control*			
Gramoxone	1	None	83	70	85	82
		Prowl		100	100	100
		Simazine		67	95	77
Rely	1	None	43	50	63	40
		Prowl		99	99	99
		Simazine		27	88	37
Fusilade	0.40	None	0	60	43	47
		Prowl		99	100	100
		Simazine		50	72	57
Poast	0.38	None	7	85	0	7
		Prowl		97	100	99
		Simazine		33	17	7
Glyphosate	1	None	7	80	80	82
		Prowl		99	100	99
		Simazine		23	90	60
Check	-	None	0	0	0	0
		Prowl		100	100	100
		Simazine		27	7	17
FPLSD $_{0.05}$				*45*	*24*	*37*

Table 2. Herbicide application data.

Date	Monday, April 07, 2008
Weeds and growth stage	AR up to 12 inches tall
Application timing	POST/PRE
Start/end time	2:30 to 5
Air temp/soil temp (2")/surface	53
Rel humidity	61%
Wind direction/velocity	1-4 W
Cloud cover	90
Soil moisture	very wet
Plant moisture	Damp
Sprayer/PSI	BP/30PSI
Mix size	2100
Gallons H20/acre	20
Nozzle type	4-XR8003
Nozzle spacing and height	20/24
Soil inc. method/implement	Rainfall

Activity-Density and Weed Seed Predation of Carabid Beetles in Farm Fields

2007

Alysia Greco, Jess Green, Nicole Marshall, and Ed Peachey, Horticulture Dept, OSU

Methods

2006. During the summer and fall we measured the seed predation potential and activity density (AD) of carabid beetles in farm fields of the Willamette Valley of western Oregon (WO) and the Columbia Basin of eastern Washington (EW). WO sites were primarily conventional corn, beans and grass fields. EW sites consisted of both organic and conventional corn and carrot fields. Seed predation stations were placed in several areas of the field, along edges, and in the middle. Each station included a pitfall trap to measure activity density of ground beetle species, and three seed plated covered by three different exclosures. There were three types of exclosures: exclosures either excluded all mammals (mice) and insects, only mammals, and one that allowed entry of both mammals and insects. Fifty redroot pigweed seeds were placed on 2 inch dia. seed plated under each exclosure and the number remaining after 7 to 14 days was recorded. Time lapse photography also was used to monitor removal of seeds by carabids and other invertebrates.

2007 W. Oregon. Activity density and seed predation were measured in four farm fields from July to September 2007 in the Willamette Valley. Stations were checked weekly. Corn was grown in three of the fields (Chambers, Grey, and Kenagy); golden delicious pumpkin was grown on the fourth (Chambers). Chambers, Gray, and Kenagy fields were strip-tilled corn, and the Horning field was conventionally tilled and planted with sweet corn.

Activity density (AD) was measured in two areas of each field with pitfall traps. The number and species of carabid beetles that were found in the pitfall traps was recorded weekly. The first part of the AD trial consisted of 5 pitfalls placed on a line that transversed the entire field. The pitfalls of the second part of the AD trial were contained within a smaller plot in the field that was 150 feet by 120 feet. Insecticide treatments (ethoprop for Kenagy, Gray, and Horning fields; bifenthrin for the Chambers field) were applied in this area on July 12-17. Pitfall stations were set up in the insecticide treated area along four radii (Figure 1). There was one pitfall in the center of the plot and four pitfalls along each radius. Seed stations were located within and bordering the insecticide treated areas. Seed stations were covered by exclosures that excluded all mammals (mice) and insects or that allowed insects but excluded mammals. Powell Amaranth seeds (30/station) were placed on a seed plate under each exclosure. Three seed stations were located in the middle of the insecticide plot and one station was located at the end of three of the plot's radii. The number of seeds predated was recorded weekly.

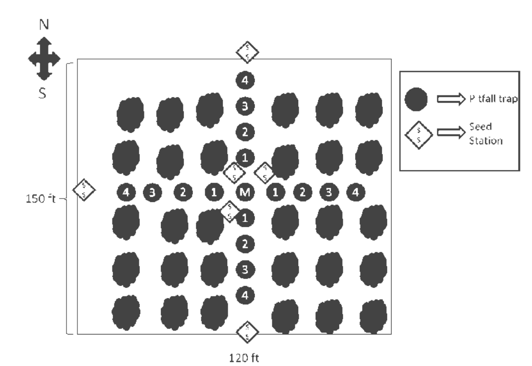


Figure 1. Layout of pitfalls and seed stations in grower fields in 2007.

2007 E. Washington. Activity density and seed predation were measured in two conventional fields and one organic field in July and August in the Columbia Basin at Mercer Farms. Corn was grown in all three of the fields. Activity density and seed predation were measured with pitfalls and seed stations set at 5 points along a line that transversed each field. The number and species of carabid beetles found in the pitfall traps were recorded every 7 to 10 days. Seed stations were covered with exclosure that excluded all mammals (mice) and insects or that allowed insects but excluded mammals. Fifty Powell Amaranth seeds were placed on a seed plate in each exclosure. The number of seeds removed from seed stations was recorded every 7 to 10 days.

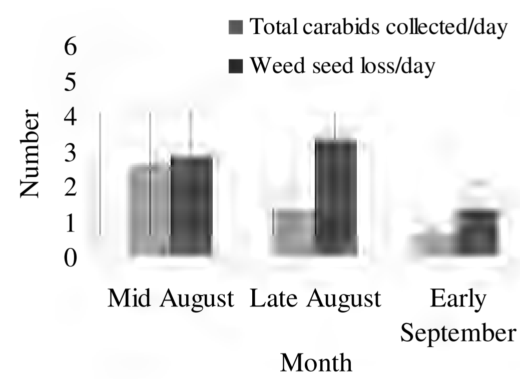


Figure 2. Effect of collection date on number of carabids trapped (potential seed predators) and weed seed loss per day averaged over both East and West sites in 2006. Error bars are standard deviation (n=40 to 50).

Results and Discussion

2006. The number of seeds removed per day and the number of seed predators trapped per day was greatest during August (Fig. 2), and more were trapped in the bean crop than in the corn or carrots. The most common species trapped in the fields included *Pterostichus melanarius, Harpalus pensylvanicus, Harpalus affinis, Amara aenea,* and *Agonum melanarium. P. melanarius* was the primary large carabid species on the west side and *H. pensylvanicus* was the primary large species in the eastern Washington fields.

Correlation analysis indicated that invertebrates were the cause of weed seed loss. Although seeds were removed from the seed stations by invertebrates as predicted, weed seeds also were removed from exclosures designed to exclude both invertebrates and mammals. Time lapse photography indicated that that the removal may have been due to seeds that stuck to earthworms and slugs that crawled across the seed plates. Future modifications to the exclosures will include a bottom barrier to prevent entry of earthworms and other soil dwelling and burrowing arthropods.

2007 West. *Activity Density. Pterostichus melanarius* and *Harpalus pensylvanicus* were the primary species in all fields. AD differed among the farms, and the strip-tilled Golden Delicious squash field (Chambers) had greater AD than the other sites (Fig. 3). AD tended to increase as summer progressed at the Chambers and Grey farms, but not at the other two sites. The number of beetles trapped decreased linearly toward the center of the insecticide plots (Fig. 4), suggesting that there was a detrimental effect of insecticide on beetle density. The increase in AD in the months following the insecticide application (August and September) in three of the four fields was likely due to the natural increase in density of *Pterostichus melanarius* and *Harpalus pensylvanicus* and recolonization of the insecticide treated area. The same increase in

AD was seen in other areas of the field in August and September in the Chambers and Horning fields. Beetle AD was greatest at the Kenagy site in July, likely because the primary species of beetle at that site were *Agonum muelleri* and *Agonum suteri*. *A. muelleri* and *A. suteri* are both spring breeding riparian species. The Kenagy site was positioned between two immediate riparian areas.

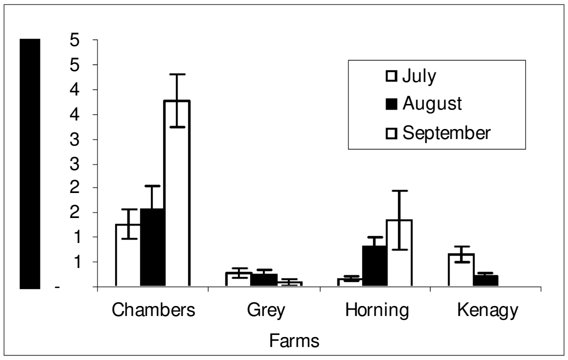


Fig 3. Effect of site and month on beetle activity/ density 2007, W OR(+ SE).

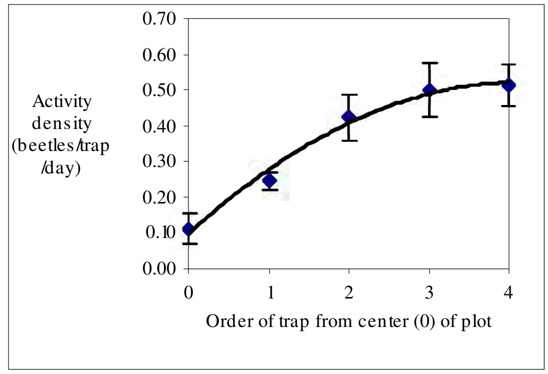


Figure 4. Carabid activity/density from the center of insecticide treated plot (0) to the edge of the plot (+ SE, 2007).

Seed Predation. Seed stations were placed at the center of the insecticide treated area or just outside the border of the insecticide treated area. The Chambers site had significantly greater seed predation in the 'outside' seed stations than the 'center' seed stations in all months, but predation did not follow this trend consistently at the other sites (Figure 5). Unexpectedly, seed predation at the Kenagy site was less than predation at all other sites, even though conservation tillage is commonly used and insecticides are used very sparingly on this farm. The data suggest, however, that insecticides may decrease both the activity density of the beetles and weed seed predation rates.

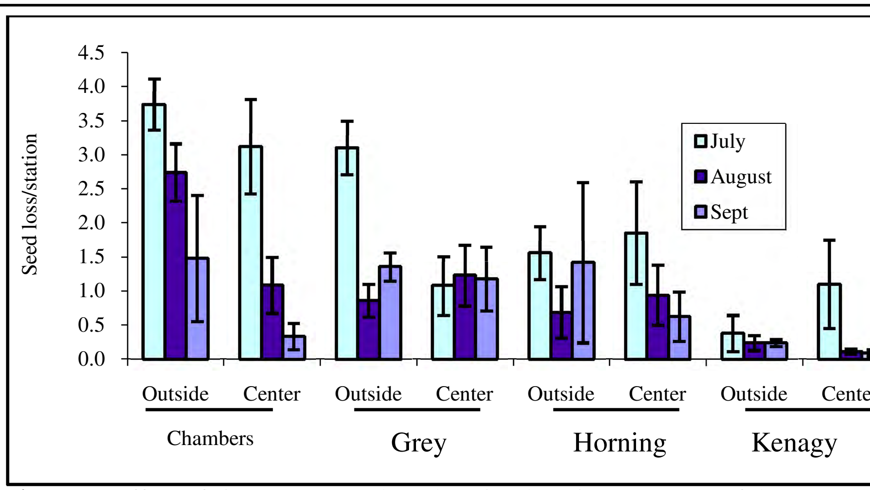


Figure 5. Effect of site, season, and seed station location ('Center' of the insecticide treated area/'Outside' the treated area) on weed seed loss, 2007 (+SE).

2007 East. There was no difference in AD between sites or between organic and conventional fields in the Columbia Basin. In general, seed predation was greater in July than August. Food resources for carabid beetles are typically scarce before weed seed shed in late summer, and this may have been the cause of the greater seed predation recorded in July.

Species diversity was similar to the results of 2006. The primary species in both the organic (37% of total species in organic) and conventional fields (36% of total species in conventional) was *Harpalus pensylvanicus*. The second most prevalent species was *Agonum melanarium* (23% of organic and 27% of conventional). *Pterostichus melanarius* was the third most abundant species (20% of organic and 12% of conventional). While conclusions cannot directly be drawn between pitfall and seed predation data of the Columbia Basin and the Willamette Valley, the data suggest that species diversity was greater in the Columbia Basin, but beetle activity density was lower.

Post-Dispersal Seed Predation in Annual Cropping Systems in the PNW
2008

Ed Peachey, Alysia Greco, Nicole Marshall, and Jess Green

Project I. Effects of Primary Tillage Sequence and Weed Seed Placement on Seed Predator Conservation, Efficacy, and Seedling Recruitment

Post-dispersal weed seed predation by carabid beetles may be a significant cause of weed seed mortality in some cropping systems. The potential to enhance carabid abundance and weed seed predation potential with tillage rotational systems and other cultural practices is poorly understood. Tillage increases carabid mortality, destroys habitat, and buries weed seeds so that carabids may not have access. *The objective of this project was to develop and test conservation tillage sequence strategies that increase weed seed mortality by enhancing in-field habitat for ground beetles that eat weed seeds.* The tillage-sequence treatments were designed to preserve habitat at critical life-stages for carabid populations, and synchronize weed seed availability with periods of high ground beetle activity.

Methods. A randomized split-plot design was used to test the main effects of primary tillage sequence and insecticide on seed predator activity density and seed predator efficacy at the OSU Horticulture Research Farm in Corvallis, OR. The crop rotation was tall fescue (2006)-snap beans (07)-winter squash (08). Tillage sequence treatments were strip-tillage or conventional tillage in the spring (2007) followed by direct-seeded or conventionally planted cover crops in the fall (also 2007), for a total of four tillage sequence treatments. Plots were 10 by 20 m surrounded by 15 cm landscape edging with plots separated by 6 m of bare soil. Each tillage plot included subplots with and without a midseason application of bifenthrin and ethoprop, insecticides typically used in commercial vegetable production. A pulse of weed seeds (500 wild proso millet, 1000 pigweed, and 250 hairy nightshade) was applied at cover crop planting in the fall in 2 m long rows in each plot to simulate weed seed rain. Weed seeds were sown on the soil surface or buried 1.5 cm deep. Activity-density of weed seed eating carabid beetles was monitored biweekly with 3 pitfall traps in each plot form 2007 through 2008.

2007 (snap beans). *Pterostichus melanarius*, *Amara* spp, and *Harpalus pensylvanicus* were the primary species found in pitfalls in the 2007 snap bean crop. Carabid beetle activity-density in the snap bean crop in 2007 was unaffected by the tillage level applied in the spring of 2007, but was reduced by 85% in plots treated with insecticide. Activity density was comparable to many fields in the Willamette Valley.

2008 (squash). There was a slight indication that carabid beetle activity-density in the squash crop (2008) was greater in plots that were strip-tilled before bean planting in 2007 and without insecticides (Fig. 1). The cover crop planting method in the fall of 2007 had no effect on carabid activity density. Weed density in the squash crop in 2008 was lowest in the strip till plot without insecticide applied (Fig. 3). Weed density was least when carabid density was greatest for all three species (Fig. 2).

I.

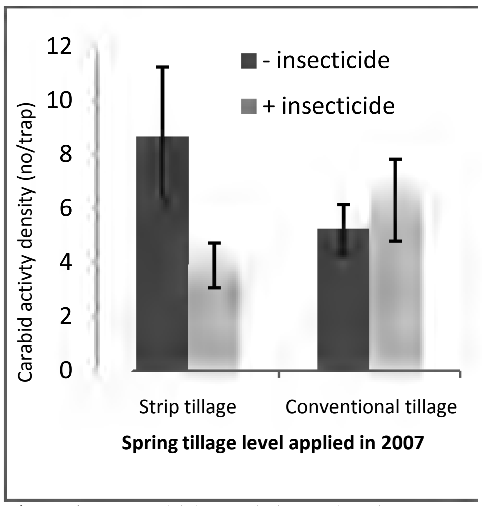


Fig. 1. Carabid activity density May through July, 2008. Tillage and insecticide treatments were applied in 2007.

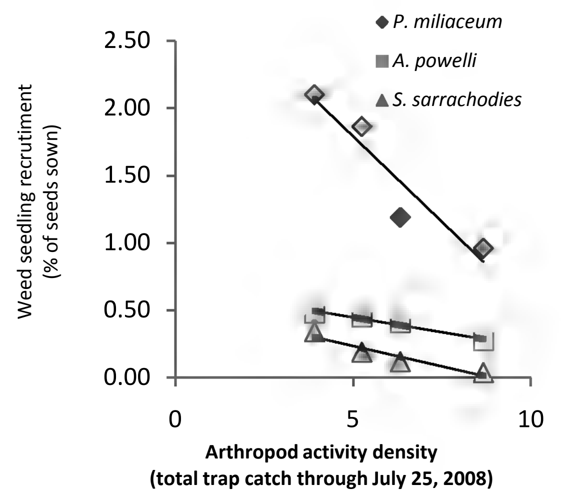


Fig. 2. Effect of arthropod activity-density in 2008 on weed seedling recruitment.

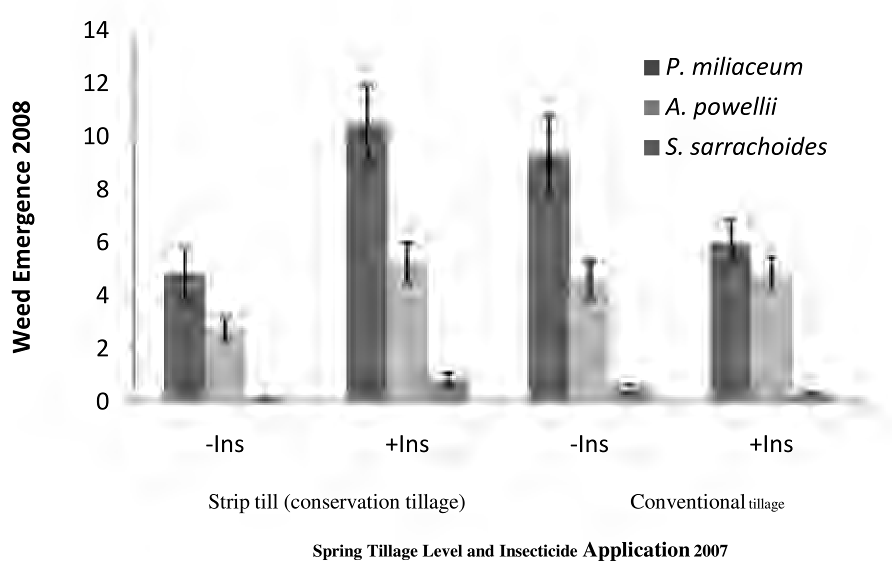


Fig. 3. Effect of spring tillage and insecticide (Ins) applied in 2007 on weed emergence in 2008.

Project II. Activity Density and Weed Seed Predation Potential of Ground Beetles in Annual Row Crops of the Pacific Northwest (2008).

The objective of this study is to assess the impact of agricultural practices and crop rotation on the activity density of carabid beetles and associated weed seed predation in PNW vegetable crop systems. Field sites chosen had a diversity of agronomic practices and crops including conventional tillage, strip tillage, and three fields that growers are transitioning to organic production over the next three years.

Methods. Ground beetle activity-density was measured from May through September 2008 in six farm fields of Western Oregon and two fields in the Columbia Basin. Pitfall traps were placed at six to eight sites in a transect across each field and beetles collected at 14 day intervals (Figure 4). Seed predation potential was measured during expected periods of summer annual weed seed rain by placing weed seed stations next to pitfall traps from June through September. Seed stations included a plaster-filled 10 cm Petri dish set flush with the soil surface with 30 pigweed (*Amaranthus retroflexus)* seeds. Missing seed were counted at 14 day intervals and seeds replenished to 30 per seed station. The dish was surrounded by 1.2 cm mesh screen to exclude rodents and birds and covered by a Plexiglas rain guard (not shown in figure).

Fig. 4. Example of seed station with 5 cm seed platter.

Soil samples were taken from near each seed station in July, composited, and frozen until processing. Variables measures were organic matter, bulk density, texture class, respiration, available N, mineralizable N, CEC and pH (Table 2, Figure 5, 6). Soil respiration was analyzed using the Drager tube method.

Table 1. List of 2008 fields, crops, primary tillage, and management practices

Farm	Crop	Primary tillage	Org/ Conventional
Chambers	Early Pea/ Late Corn	Conv/ Strip till	Conventional/Sustainable
Christianson	Fallow	Conv till multiple times	Org Transitional 1^{st} year
Hendricks	Corn	Strip-till	Conventional
Kenagy	Early Pea/ Late Bean	No-till/ Conv till	Conventional/Sustainable
Koch	Sugar Beet Seed	Conv till	Org Transitional 1^{st} yr
Pearmine	Winter Wheat	Conv till	Org Transitional 1^{st} yr
Watts Conv	Potato	Conv till	Conventional
Watts Org	Potato	Conv till	Organic

Results. In the majority of fields visited in spring and early summer of 2008 in the Willamette Valley, spring breeding species such as *Harpalus affinis, Agonum suterali* and *Amara spp.* were the most prevalent adult species. However, in the Kenagy field, which had a spring pea-summer snap bean rotation, *Pterostichus melanarius* (a fall-breeding species) was the most common species trapped. This field was no-till planted to peas in February and this may be the partial cause of the high number of *P. melanarius*. Conventional spring tillage is reported to be detrimental to fall breeding species such as *P. melanarius* because they are in their larval stage in spring and unable to escape the destructive effects of tillage.

The activity-density of *P. melanarius*, the most prevalent summer carabid species of the Willamette Valley, and a significant weed seed predator, grew in early June and then declined in late July. *P. melanarius* populations began to rise again in mid-August and early September (Fig 7). This trend was seen in all other fields located in western Oregon and eastern Washington and could have been caused by the overlap in generational cohorts of *P. melanarius*. The greatest carabid activity-density and seed predation was in a corn field (Hendricks) that was strip/conservation tilled for last two years. This field had the highest OM% (Fig. 5) and mineralizable nitrogen and NO_3-N (Table 2) but soil microbial activity was similar to other fields (Fig. 6). High activity density of *P. melanarius* was noted in the Hendricks' neighboring perennial ryegrass field, suggesting migration from areas of higher concentrations of carabid activity densities to areas of lower concentrations.

Seed predation in all fields also followed trends over time comparable to *P. melanarius* activity-density. Seed predation rates increased in early June and then declined in late July. Seed predation began to rise again in mid-August and early September and fall in late September and October (Fig 8). The Hendricks field had the most seed predation of the Willamette Valley fields (Fig 7, 8), and seed loss appeared to follow the activity density trends of of *P. melanarius* populations in that field (Fig 4, 6).

Christianson's field had the second highest early-season peak level of *P. melanarius* activity density and the highest initial seed predation of the sites in the Willamette Valley. However, this high level of activity-density and seed predation were not sustained; later in the season activity density dropped below most other sites. The decrease may have been due to the repeated tillage events in this fallow field to keep the field free of weeds as it is transitioned to organic production.

In eastern Washington potato fields there was more seed predation and carabid beetle populations in the conventional field than the organic field. The low number of carabids and seed predation in the organic field may have been due to its relatively new age and the extreme soil disturbance that occurred during its recent construction.

In six of the eight fields (Hendricks, Christianson, Chambers, Kenagy, Koch and Watts conventional) the activity-density of *Pterostichus melanarius* and pigweed seed (*Amaranthus retroflexus*) loss followed similar trends (Figure 4, 5, 6) with AD and seed predation peaking in early July and late August. There was no signficant correlation between soil properties and activity-density (Table 3).

These results, in conjunction with the results from last year's on-farm field experiments, suggest a positive relationship between *P. melanarius* populations and seed predation, and the detrimental effects that conventional tillage and insecticide use may have on carabid beetle populations.

Table 2. Soil Properties of on-farm sites. Soil samples were collected at each of 6 sites within the field and composited before analysis.

Field	pH	NO_3-N	NH_4-N	Incubation N	Mineral-izable N	% OM	CEC	Soil respiration	Carabid Activity-Density
		ppm	*ppm*	*ppm*	*ppm*	*LOI*	*meq/100g*	*lb CO_2-C/acre/day*	*no./trap/day*
Chambers	5.5	50.1	3.8	30.0	26.2	3.25	22.6	213.6	0.39
Christianson	5.9	28.0	2.9	39.1	36.2	4.57	32.2	223.1	0.78
Hendricks	6.2	170.0	2.5	103.5	101.0	6.06	25.1	165.7	1.28
Kenagy	5.4	29.7	2.8	47.0	44.2	4.28	20.9	165.7	1.25
Koch	6.2	15.1	1.9	35.1	33.2	2.38	16.9	146.5	0.73
Pearmine	6.6	4.5	2.4	58.0	55.6	3.64	22.4	184.8	0.27
Watts Bro-Conv	7.3	60.3	1.4	41.4	40.0	1.65	10.3	280.6	2.15
Watts Bro-Org	7.7	64.1	1.2	35.0	33.8	1.71	10.3	280.6	1.07

Table 3. Pearson correlation coefficients for soil properties and carabid activity density across all sites (probability of significance in italics).

	NO_3N	NH_4N	Incubation N	Mineralizable N	% OM	CEC	Soil respiration	Carabid AD
pH	0.11	-0.89	-0.05	-0.02	-0.62	-0.72	0.70	0.41
	0.79	*0.003*	*0.90*	*0.96*	***0.10***	*0.04*	*0.06*	*0.32*
NO_3N	-	-0.05	0.76	0.77	0.47	0.03	0.02	0.41
		0.90	***0.03***	***0.03***	*0.25*	*0.94*	*0.96*	*0.31*
NH_4N	-	-	0.03	-0.01	0.58	0.76	-0.44	-0.55
			0.94	*0.99*	*0.13*	***0.03***	*0.28*	*0.16*
Incubation N	-	-	-	1.00	0.74	0.31	-0.40	0.16
				<.0001	***0.04***	*0.46*	*0.33*	*0.70*
Mineralizable N	-	-	-	-	0.72	0.28	-0.38	0.18
					0.04	*0.50*	*0.35*	*0.67*
% OM	-	-	-	-	-	0.83	-0.59	-0.19
						0.01	*0.12*	*0.65*
CEC	-	-	-	-	-	-	-0.49	-0.50
							0.21	*0.21*
Soil respiration	-	-	-	-	-	-	-	0.43
								0.29

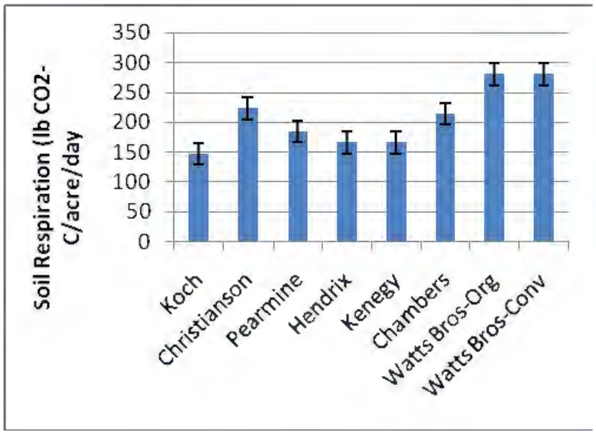


Fig. 5. Soil respiration (lbs CO_2-C/acre/day) in all on-farm study-fields

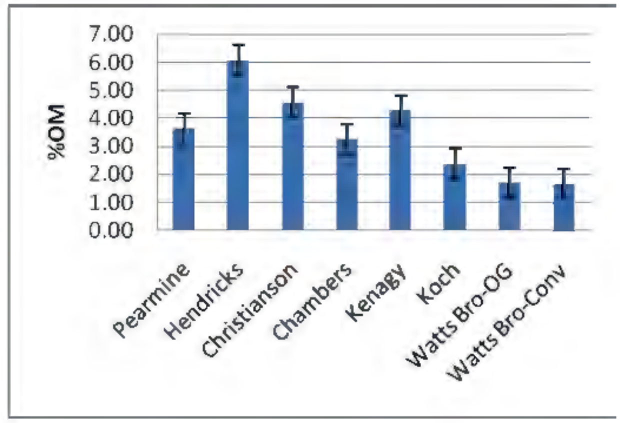


Fig. 6. Percent Organic Matter (OM) in all on-farm study fields.

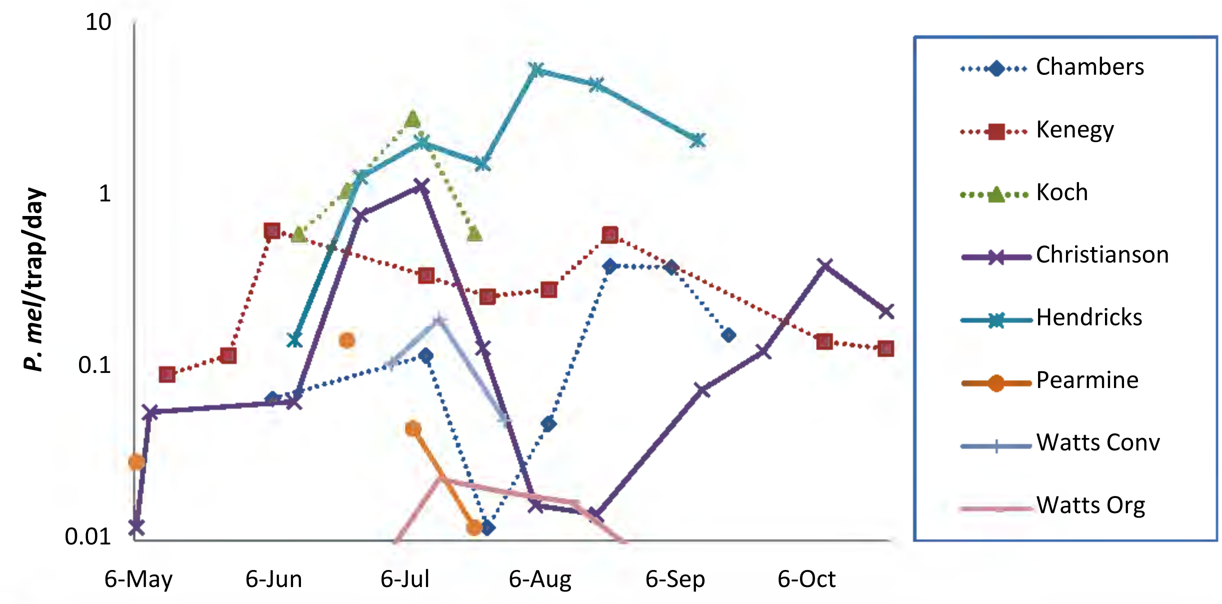


Fig. 7. *Pterostichus mealnarius* activity density in 2008 at all farms. Note logarithmic scale of y-axis

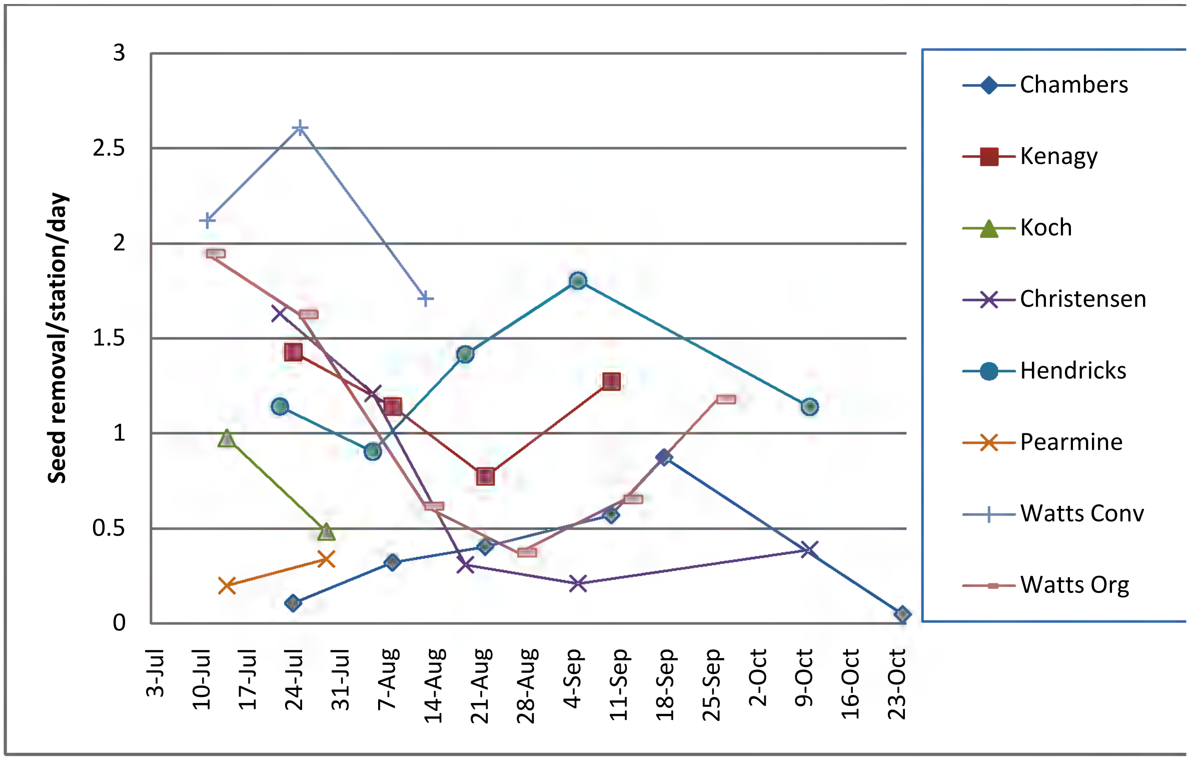


Fig. 8. Seed removal from seed stations during the summer of 2008 at all sites.

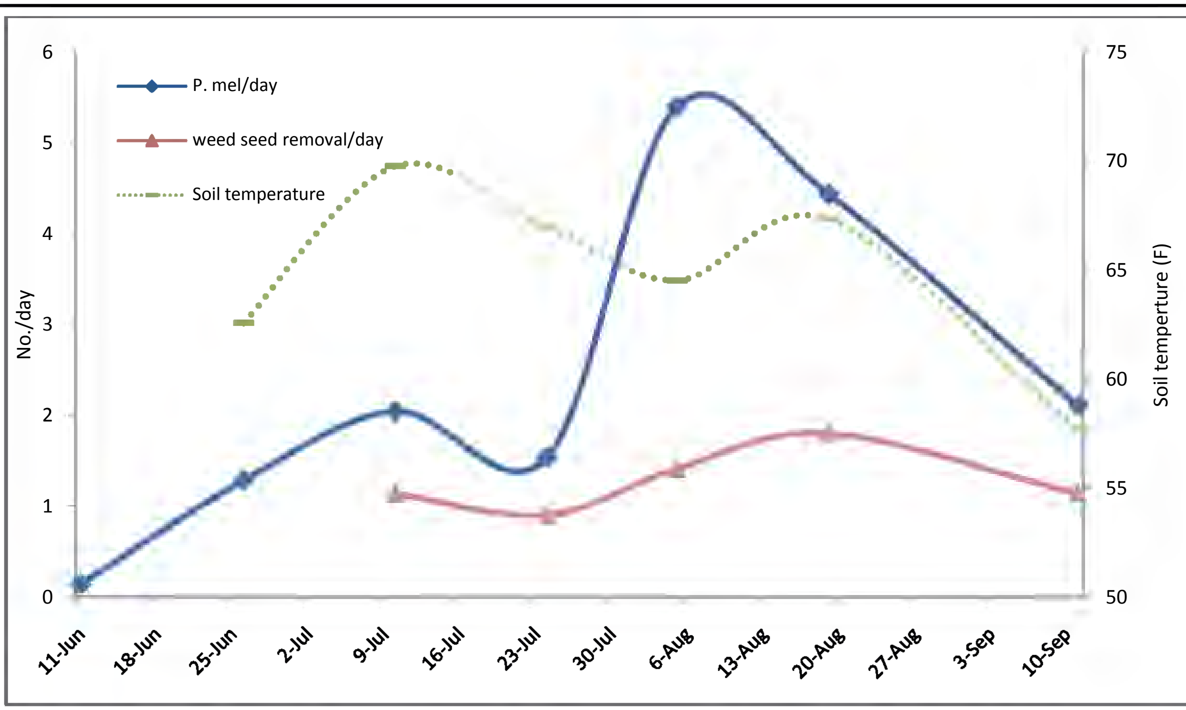


Fig. 9. Carabid activity-density and seed removal from seed stations in strip-tilled sweet corn, Stayton OR, 2008.

Project III. Effect of *P. melanarius* density on weed seed survival and recruitment.

The objective of these projects was to measure seed loss in response to three densities of *P. melanarius* in confined small plots under both field and greenhouse conditions.

Field Study

Methods. Snap beans were planted on June 20, 2008 on 30" rows after the soil was rototilled vigorously. Eighteen plots 0.97 m^2 were created on June 21 by installing 1.5 high galvanized metal fences around each plot (Fig 1). Metal was sunk into the field soil at least 2-3 inches, leaving the rest of the metal at least a foot above ground. There were 3 treatments replicated 6 times.

Beetles and weed seeds were added to plots on August 18th. *P. melanarius* were collected on the OSU Vegetable Research Farm in July, were sexed and placed in refrigerator for storage until needed. Beetles were added at 0, 6 (3 male; 3 female) or 20 (10 males; 10 females) to designated plots. Wild proso millet, Powell amaranth, and hairy nightshade were added to all plots at 50, 100, and 25 seeds, respectively. The seeds were scattered onto the soil surface in a one foot row approximately 4" wide between the bean rows.

Bird netting was placed over the plots to prevent beetle predation by birds. Six mouse bait stations placed around the edges outside experiment to reduce the mouse population to prevent beetle/seed predation. Low nibbling of the bait suggested there was not a large population of mice around the experiment.

From August through mid-September weed seedlings were counted and removed every two weeks. Final weed counts were made on 24-Sept and soil was collected from between each row to 1 inch in depth and stored in a freezer until analysis. Dead beetles were counted and removed and pitfalls were placed in each plot to determine seasonal activity density. Pitfall catches were collected until no more beetles appeared in the cups, then pitfall traps were removed.

Fig. 10. Plot construction and layout.

Soil was removed from the plot in the area between the bean rows in mid-September to a depth of one inch to recover the remaining seeds in the plot. Soil samples were homogenized in a cement mixer for 5 min and 1 liter of soil was taken as a representative sample for each plot. This liter of soil was mixed with a Calgon, Baking soda and Epson salt solution to float out the weed seeds. Seeds viability was determined by applying pressure to the seed coat. If the seed immediately shattered and revealed no endosperm, then it was determined as dead; seeds that remained intact were counted as viable.

Results & Discussion. A census of *P. melanarius* was taken in each plot at the end of the season by pitfall trapping and collection of dead beetles. Beetle density was 2.3, 2, and 3.3 in plots originally inoculated with 0, 6, and 20 ground beetles, respectively. Although the greatest number was found in plots that were inoculated with 20 *P. melanarius,* a few were found in plots that originally had no beetles. Beetles either immigrated into or between plots, possibly burrowing under the metal fences. Future efforts should be made to better contain the beetles. A fiberglass screen could be placed beneath the soil directly under the sheet metal dividers in order to prevent the beetles from escaping by burrowing, or the beetles could be marked to track their movement.

Seedling establishment in plots. There was no pigweed emergence in any treatment, probably because of primary dormancy in the seed and the late sowing date. Significantly more nightshade emerged in the plots with 0 beetles than in the plots with 6 or 20 beetles, but more nightshade also emerged in the plot with 20 beetles than in the plot with 6 beetles. There was a significant effect of beetle activity density on wild proso millet emergence or establishment; more millet established in the plots with 20 beetles than those without beetles, contrary to our hypothesis that increasing ground beetle density would reduce weed seedling establishment.

Seed recovery. The number of pigweed seeds surviving was greatest in the presence of 6 and 20 beetles per plot. Wild proso millet seed survival was greatest at 20 beetles. No effect was noted on hairy nightshade seed survival.

These results contradict our original hypothesis that increasing beetle density would reduce seed survival and seedling establishment. Several theories are proposed. *P. melanarius* may have cached the seeds and did not immediately eat them. We have observed in previous field and lab experiments that *P. melanarius* will cache seeds rather than immediately consume them. Caching seed may have moved seeds lower into the soil and into zones more favorable for germination. Interestingly, there was a positive correlation between beetle density and the number of weeds seeds surviving, suggesting that beetle survival may have been dependent on the density of seeds in the plots.

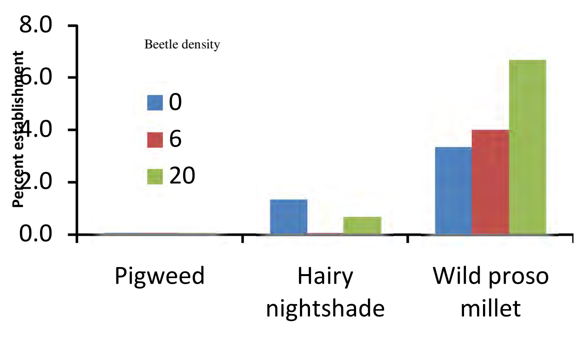


Fig. 11. Effect of *P. melanarius* density on percent weed seedling establishment in confined plots. Note scale of y-axis.

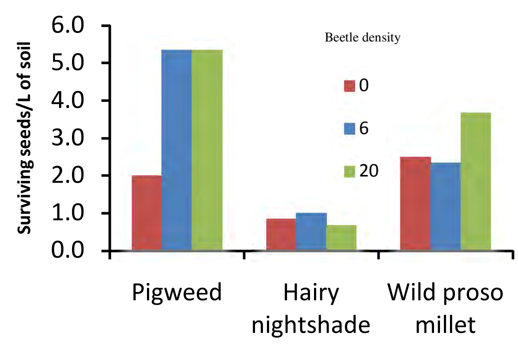


Fig. 12. Effect of *P. melanarius* density on survival of weed seeds in confined plots.

Greenhouse study

Methods. Eighteen rectangular Sterilite 6 qt clear plastic containers were filled with 3.5 L of soil collected from the OSU Vegetable Farm. The soil was collected from 12 in. under the soil surface to avoid weed seeds in the surface layers of soil. *P. melanarius* ground beetles were collected from the OSU Vegetable Farm from July to August 2008 and stored in a refrigerator until the project began.

One hundred seeds of nightshade, wild proso millet, and pigweed were counted and scattered on the surface of the soil. *P. melanarius* beetles were added at 0, 2, or 4 per container, with each treatment replicated 6 times in a completely randomized design. After ground beetles were added, containers were kept in the lab at 70 degrees F for two weeks, and then placed in the greenhouse for one month in order to promote germination of weed seeds. Soil moisture was monitored and adjusted daily to maximize survival of beetles and seed germination. Seedling establishment (recruitment) was monitored daily for the length of the project and seedlings removed after they were recorded. Seeds were counted as established if they produced a cotyledon and radical. *P. melanarius* beetles were replaced if they died.

Results and Discussion. Overall seedling establishment was 46, 9, and 0.4% of wild proso millet, pigweed, and hairy nightshade, respectively. Pigweed establishment was reduced from 17 to 4 seedlings at a density of 4 beetles per box (Fig 3). A similar but less significant trend was noted with wild proso millet. No effect was noted on hairy nightshade but the effect of carabid predation on hairy nightshade may have been masked by the extremely low establishment of this species. These results suggest that densities of 2 ground beetles per 1.5 ft^2 are sufficient to reduce establishment of some species, even when in the presence of weed seeds for a relatively short time. However, the only food source supplied in these experiments was weed seed; previous experiments have indicated that the ground beetle *P. melanarius* may easily be distracted by other food sources.

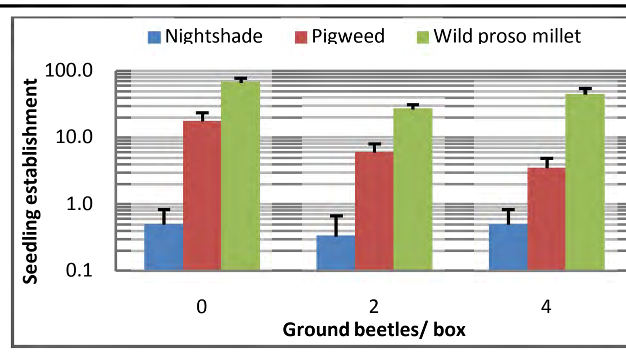


Fig. 13. Effect of *P. melanarius* ground beetles on weed seedling establishment (+SE). Note logarithmic scale.

Project IV. Effect of Petri Dish Surface Amendment on Removal of Weeds Seeds by *P. melanarius*

Pterostichus melanarius may be a significant predator of weed seeds in field settings. However, assessing seed predation rates by *P. melanarius* and other carabids is often confounded by earthworms that remove weed seeds from seed stations. Copper sheeting has been shown to interfere with earthworm mucous production, and we speculated that a ring of copper sheet placed around weed seeds would deter removal of the seeds by earthworms, but not effect carabid movement. The objective of this study was to determine what effect cooper sheet or other substrates might have on carabid seed predation.

Methods. Treatments included a 4 inch diameter Petri dish covered with one of the following: 30 GA copper sheet with a 2” by 2” square removed from the middle of the 4 inch circle; dark colored plastic less a 2 by 2 area in the middle, and plain Petri platters (Figure 14). The Petri platters were filled with Presto patch and the copper or plastic pressed into the plaster. The Petri dishes (with copper, plastic, or no amendment) were pushed flush into soil in the center of a square 4-cup Milan classic storage container that was filled with 3 cups unsterilized soil collected from the OSU Vegetable Research Farm near Corvallis. A total of 20 pigweed seeds was placed on the exposed plaster in each Petri dish and replaced (up to 20) as the seeds were removed by carabids. One male *P. melanarius* was placed in each container. All seeds pushed off Petri platters and/or germinated were removed and not included in the predation counts. Each treatment was replicated 2 times.

Results. The copper sheet that partially covered the Petri dish appeared to interfere with carabid seed predation (Figure 15). The differences in predation between the 3 surface amendments were not large, but sufficient to avoid this practice even though it may have potential to reduce seed removal by earthworms from seed stations.

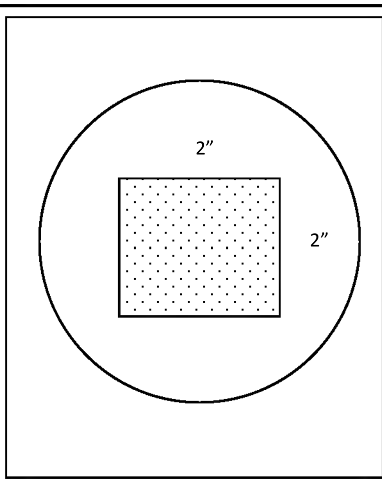


Figure 14. Diagram of seed plate with copper sheet. The dotted area indicates where seeds were placed without copper.

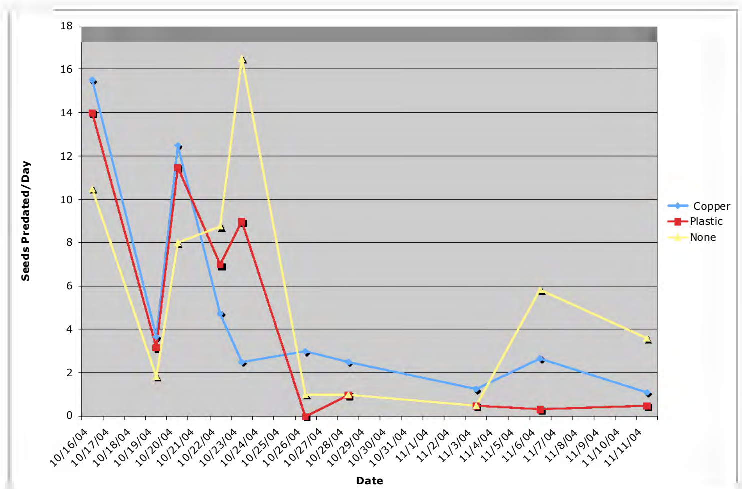


Figure 15. Effect of Petri dish surface amendment on seed removal rates by *P. melanarius.*

Project V. Predation Potential of Miscellaneous Ground Beetles

The objective of this study was to measure seed predation rates of the ground beetles *Amara spp., Harpalus pensylvanicus, Agonum spp., and Harpalus affinis*, carabids that are typically less common than *P. melanarius* in agricultural fields.

Methods. Approximately 3 cups of un-sterilized soil, collected from OSU Vegetable Research Farm, were added to the 15 Milan Classic storage containers. Petri dish platters 2" in diameter were filled with Presto patch pushed flush into soil. One carabid beetle was added to each container with the exception of the *Amara spp*, which had 3 per box. Species included in the study were male and female *Pterostichus melanarius*, *Amara spp*, male and female *Harpalus pensylvanicus*, male and female *Agonum spp*, and male *Harpalus affinis*. A total of 10 seeds (pigweed, nightshade, millet, and bittercress - A*mara* only) were placed on seed platters initially and replaced as they were removed. Seeds that were pushed off the seed platters and/or germinated were not included in predation estimates.

Results and discussion. Some substantial differences were observed in seed preference by carabids commonly found in the PNW. *Amara*, the smallest species, seemed to prefer smaller seeds that have soft seed coats, such as bittercress, nightshade, and also pigweed; they only consumed 0.074 pigweed, 0.001 wild proso millet, 0.16 hairy nightshade, and 0.25 bittercress seeds/day. Male and female *Harpalus pensylvanicus* provided the highest seed predation rate, consuming 1.32 and 0.90 pigweed, 0.59 and 0.78 millet, and 1.20 and 0.91 hairy nightshade seeds/day, respectively. Male *Harpalus affinis*, a smaller beetle than H. pensylvanicus, consumed 1.14 pigweed, 0.071 millet, and 0.59 hairy nightshade seeds/day. Male and female *P. melanarius* consumed 0.71 and 0.57 pigweed, 0.68 and 0.54 millet, and 0.72 and 0.64 hairy nightshade seeds/day, respectively.

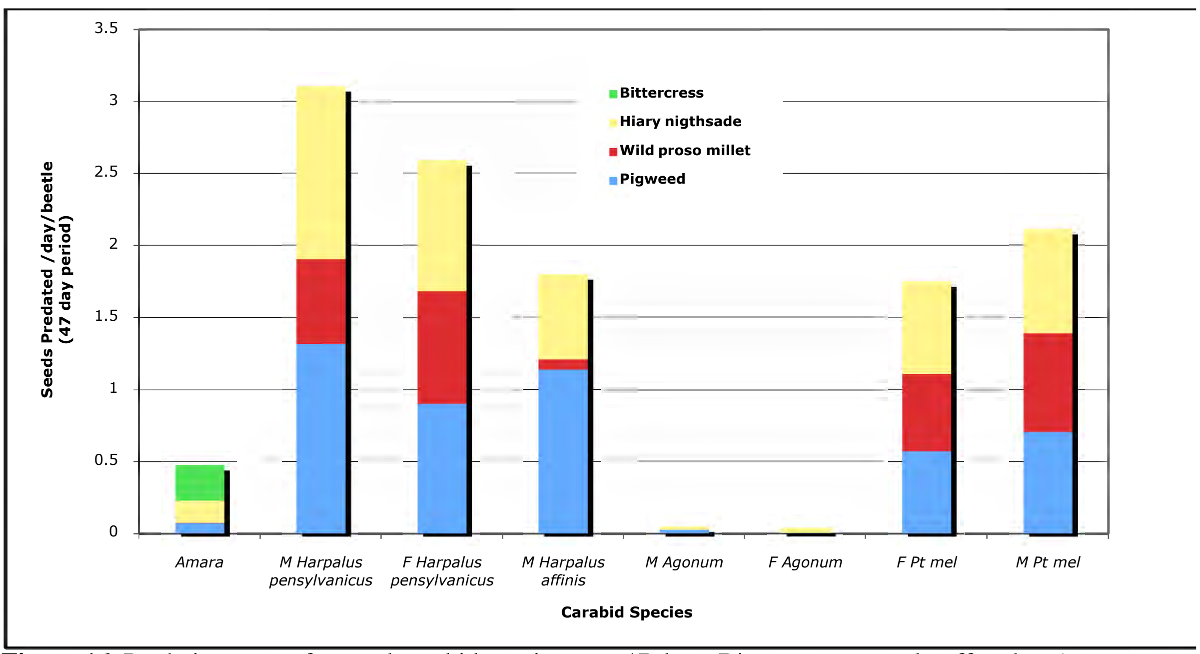


Figure 16. Predation rates of several carabid species over 47 days. Bittercress was only offered to *Amara* ground beetles.

Weed Control Efficacy with Nature's Avenger Herbicide

2008

Ed Peachey, Horticulture Department, OSU

A fallow field with silt loam soil at the Vegetable Research Farm near Corvallis, OR was tilled and a fine seed bed prepared. Rainfall was supplemented with irrigation to get a good sprout of weeds in mid-September. Nature's Avenger herbicide was applied on 27-Sept to 6.6 by 20 ft plots and on 7-Oct to 5 by 20 foot plots. The herbicide was diluted with water by factors of 3 to 11 for a total carrier volume of 170 gal/A. Weed control was rated on 9-Sept, 13-Oct, 30-Oct and 14-Nov.

Results

Weed control 3 to 6 DAT ranged from 79 to 98% and was dependent on dilution factor and date of application (Table 1). The later application had poorer weed control but only at the highest dilution rate. Common purslane was controlled with all rates and timings.

Weed control trends were similar at 7 weeks after treatment with composite ratings of 70% to 98%. Hairy nightshade control ratings improved as fall progressed, probably due to frost. Shepherds purse and annual bluegrass appeared to be more tolerant than the other species, but it is unclear whether the ratings may have been confounded by the additional emergence of seedlings after treatment. Common purslane succumbed to frost before the second evaluation.

Table 1. Weed control ratings at 4 and 7 weeks after the initial treatments.

	Date	Dilution	Obs	Weed control ratings					
				3 or 6 DAT [1]					*30-Oct*
				Hairy nightshade	Shepherds purse	Annual bluegrass	Speedwell	Common purslane	Composite rating [2]
		1 to-	*N*	*% control*					
1	27-Sep	3	4	100	100	100	100	100	98
2	27-Sep	6	4	100	99	100	98	100	97
3	27-Sep	7	4	100	98	100	98	100	93
4	27-Sep	11	3	95	95	99	77	98	85
5	7-Oct	3	4	100	100	100	100	100	99
6	7-Oct	6	4	95	97	100	98	100	93
7	7-Oct	7	4	91	86	100	97	100	93
8	7-Oct	11	4	81	88	88	93	100	79
FPLSD (0.05)				*7*	*5*	*5*	*11*	*1*	*11*
				7 weeks after initial treatment, 5 weeks after second treatment (14-Nov)					
1	27-Sep	3	4	100	100	99	96	-	98
2	27-Sep	6	4	100	96	89	95	-	89
3	27-Sep	7	4	100	97	92	91	-	89
4	27-Sep	11	3	100	67	73	82	-	82
5	7-Oct	3	4	100	100	98	99	-	99
6	7-Oct	6	4	100	91	89	99	-	93
7	7-Oct	7	4	100	84	88	95	-	86
8	7-Oct	11	4	99	63	60	89	-	70
FPLSD (0.05)				*1*	*16*	*17*	*8*		*6*

[1] Treatments 1 to 4 were rated on 30-Sept, 3 DAT; treatments 5-8 were rated on 13-Oct, 7 DAT.
[2] The composite rating was made on 30-Oct.

Table 2. Site and application data.

Date	Saturday, September 27, 2008	Tuesday, October 7, 2008
Weeds and growth stage		
Hairy nightshade (*Solanum sarrachoides*)	coty-2, 1" dia	2 in tall, 4 dia
Annual bluegrass (*Poa annua*)	1-2 lf	2 in tall, 6-8 lf
Shepherdspurse (*Capsella bursa-pastoris*)	2-4 lf, 1" dia	1/2 in tall, 3 dia
Speedwell (*Veronica persica*)	2-4 lf, ½ in dia	2-6 lf, 1 in dia
Common purslane (*Portulaca oleracea*)	2 lf, ¼ dia	2-4 lf, ½ to 1 in dia
Herbicide/treatment	EPOST	LPOST
Start/end time	8:30-9:30	9-10 AM
Air temp/soil temp (2")/surface	55/56/58	56 (36 last night)
Rel humidity	85%	80%
Wind direction/velocity	0-1 SW	0-1 NE
Cloud cover	Fog, sun breaking	0%, bright sun
Soil moisture	Damp	Dry
Plant moisture	Dew	Dew
Sprayer/PSI	BP 40PSI	BP 40PSI
Mix size	2100/plot	2100/plot
Gallons H20/acre	170	
Nozzle type	4-XR8003	3-8003 ceramics
Nozzle spacing and height	20/24	20/24

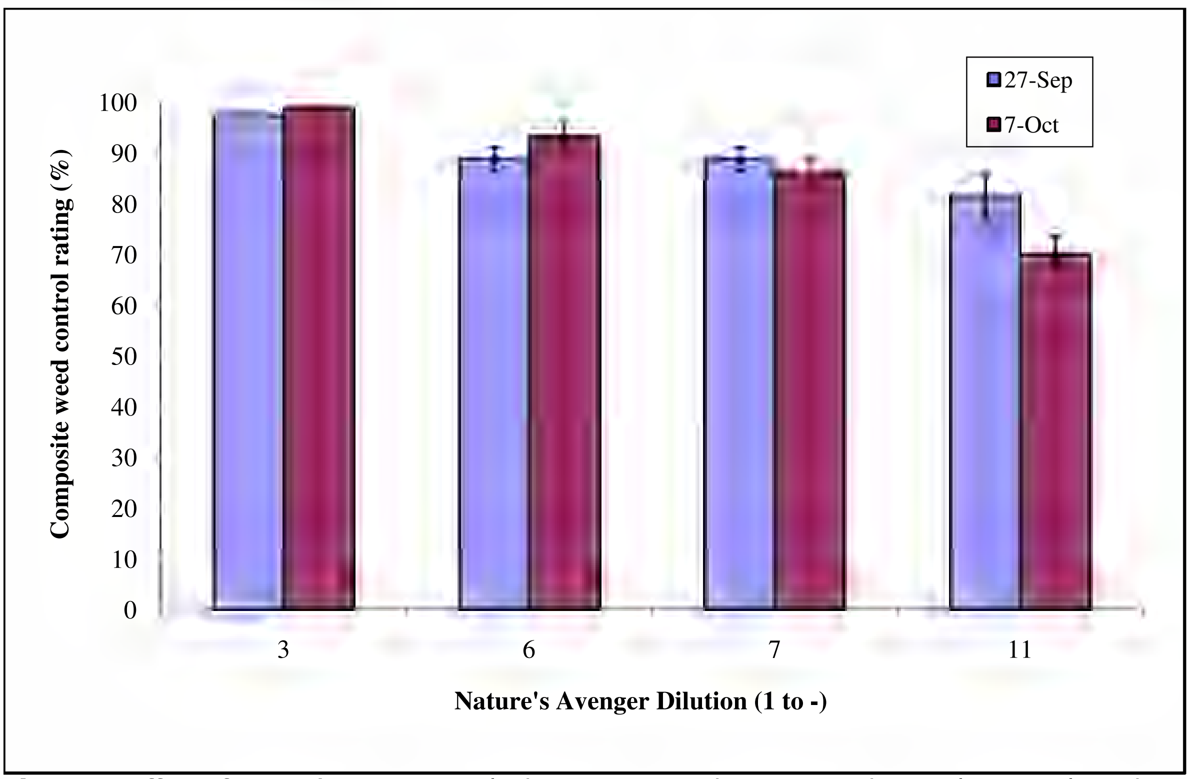


Figure 1. Effect of Nature's Avenger applied on 27-Sept and Oct 7. Weed control was evaluated on 14-Nov-08, 45 days after the experiment was initiated (N=4 for most treatments, $\pm$ SE).

Figure 2. Effect of treatment 1 (27-Sept, dilution 1-3) on weed control 2 days after application.

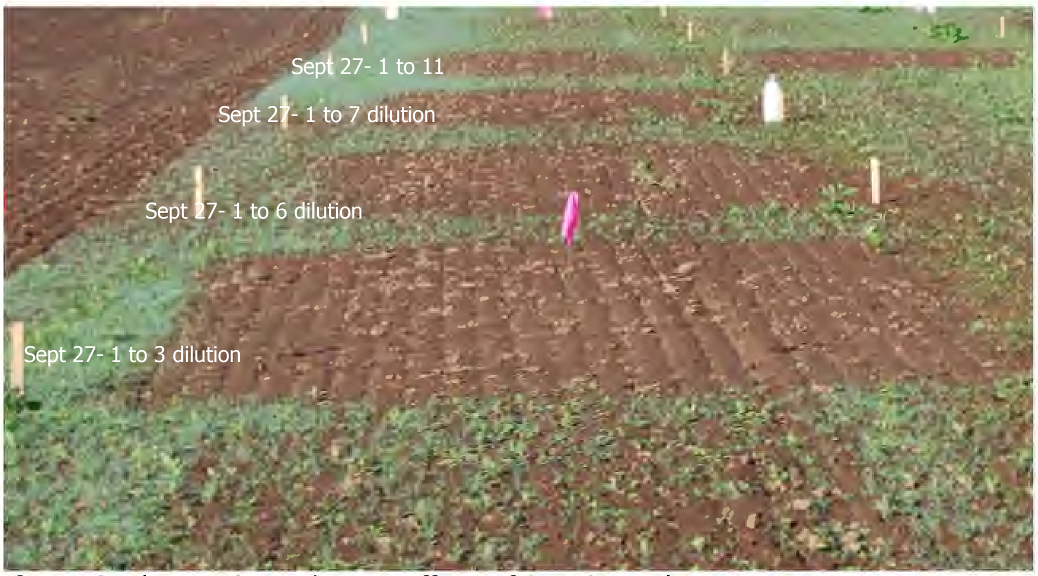


Figure 3. Plots on Oct 7 showing effects of Sept 27 application.

Figure 4. Weed growth stage before the Oct 7 treatment.

Effect of Trichoderma on Root Health and Yield of Snap Beans

2007

Ed Peachey, Horticulture Department, Oregon State University

Methods

Snap beans were planted at the Vegetable Research Farm near Corvallis on June 13 and at Kenagy Family Farms on June 22, 2007. The site at the research farm has had beans for more than 20 years and is the test site for root rot resistance of snap beans. The Albany site is typically a 3 year rotation of beans, sweet corn, and grass seed.

Snap beans seeds were treated with trichoderma just before planting by adding a small amount of water to the bean seed, adding the provided powder, mixing the beans and powder until the beans were uniformly covered, then air drying the beans. Four treatments were applied at each site: 1x and 2x rates of trichoderma, untreated seed, and commercial seed that was treated with fungicide (Thiram and Captan).

Beans were seeded with a John Deere Max emerge planter at both sites. Each treatment was applied to randomized one-row plots by switching planter boxes for each replication. Plots were 50 ft long and replicated 5 times at the research farm and 4 times in the growers field.

Snap beans were dug and roots evaluated at midseason (prior to first bloom) and at harvest. Beans were harvested from an 8 ft section of each plot and graded. Bean hypocotyls were rated for disease severity on a 1 to 10 scale with 10 designating roots that were severely damaged and without lateral roots. Lateral roots were counted at harvest and overall root quality rated on a 1-4 scale within each replication with a rating of 4 given to the treatment with the best roots.

Results

Slight differences were noted between the two sites for the measured variables and data are therefore presented separately for each site. Root rot was in general more severe at the research farm, but also surprisingly severe at the Albany on-farm site with a three year crop rotation (Figure 1).

Analysis of hypocotyl ratings at midseason found no treatment differences associated with the trichoderma treatments (Table 1). Hypocotyls were more diseased at the research farm than at the on-farm site. The only difference among hypocotyl ratings at harvest was found at the on-farm sites; the fungicide treated seed had a slightly lower disease rating than the check treatment.

Lateral root ratings at harvest indicated that the trichoderma treatments may have increased lateral root development or survival at the on-farm site, but not at the research farm. Bean plants from trichoderma treated seed had more lateral roots than bean plants of fungicide treated seed.

The overall root rating for size, lateral root development, and hypocotyl health suggested that the 2x trichoderma treatment improved overall root growth and development. At the on-farm site the 2x trichoderma treatment increased the overall root rating compared to the untreated check, and at research farm the 2x trichoderma treatment increased the overall root rating compared to the fungicide treated seed.

There were no differences in yield among treatments, with one exception. Plant stand and aerial biomass were significantly lower at the on-farm site with the fungicide treated seed than the other treatments. Pod yield may have been less as well, but the effect was probably due to beans that matured later in the fungicide treated plots. Seedling emergence was markedly slower in plots with this treatment, and may have caused a delay in maturity.

Discussion and Summary

The data suggest that the trichoderma treatments may have improved root health slightly but the data are highly variable among sites and treatments. The most surprising finding of the study was the extent of root rot at the on-farm site, which was similar to the root rot noted at the research farm. Clearly, root disease is impacting yield at the on-farm site. There were few temperature extremes this year, and split sets were not common in the Valley. If conditions had been warmer, the lack of root system at the on-farm site may have caused a split set, and significantly compromised yield. Future research should look at the relationship between root rot and bean yield under adverse soil (short rotation systems) and environmental conditions, and the effect that disease tolerant bean varieties, crop rotations, and disease suppressive treatments (eg trichoderma) might have on stabilizing snap bean yield.

Table 1. Trichoderma treatment effects on root rot and yield of OR91G snap beans.

Treatment	Bean Yield					Root ratings				
	Obs	Plant stand	Arial biomass	Pod wt	Grade	Obs	Hypocotyl rating at midseason	Hypocotyl rating at harvest	Lateral roots at harvest	Overall rating
	n	*2.5 m of row*	*tons/A*	*tons/A*	*%*	*n*	*0-10, 10=very diseased*	*0-10, 10=very diseased*	*no./plant*	*0 (very poor) to 4 (best)*
Albany On-farm Site										
Untreated seed	*4*	137000	17.9	8.1	77	*8*	4.8	7.6	3.0	2.3
Trichoderma (1x)	*4*	126000	17.2	7.6	77	*8*	5.4	7.8	2.8	2.5
Trichoderma (2x)	*4*	126000	17.4	7.9	77	*8*	4.2	7.7	3.1	3.1
Growers seed (treated with fungicide)	*4*	97000	15.4	6.8	82	*8*	4.5	7.5	3.4	2.9
ANOVA for treatment effect		0.006	0.06	0.26	0.16		0.39	0.59	0.14	0.07
FPLSD (0.05)		16,000	1.5	-	6		-	-	0.5	0.5
CV (%)		10	7	11	4		26	6	18	23
Vegetable Research Farm										
Untreated seed	*5*	129000	8.6	5.2	14	*5*	8.2	8.2	2.5	2.4
Trichoderma (1x)	*5*	121000	7.4	4.3	10	*5*	7.9	7.9	3.4	3.4
Trichoderma (2x)	*5*	138000	8.8	5.3	11	*5*	7.5	7.5	3.1	3.0
Seed treated with fungicide	*5*	154000	8.2	4.9	15	*5*	7.2	7.2	2.2	1.8
ANOVA for treatment effect		0.010	0.72	0.60	-		0.63	0.13	0.07	0.10
FPLSD (0.05)		17600	-	-	-		-	0.9	0.9	1.3
CV (%)		11	22	25	-		29	9	24	36

Figure 1. Bean root rot severity at 3 sites. Beans had not been planted at the '10 year rotation' site for more than 10 years.