Horticultural Weed Control Report

2012

Web downloads

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Not intended or authorized for publication

Data contained in this report are compiled annually as an aide to complete minor crop registrations for horticultural crops and to communicate our results to colleagues and funding sources. Data are neither intended nor authorized for publication. Information and interpretation cannot be construed as recommendations for application of any herbicide or weed control practice mentioned in this report.

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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
POST	Postemergence surface
PPI	Preplant incorporated herbicide application
lb. ai/A	Pounds of active ingredient per acre
no./A	Number per acre

Weather and Climate Data

Average daily minimum, maximum, and daily precipitation data were gathered from the Pacific Northwest Cooperative Agricultural Weather Network (AgriMet), a satellite-based network of weather stations operated and maintained by the Bureau of Reclamation. All AgriMet stations are located in an irrigated, agricultural area in order to provide relevant, accurate estimates for agricultural research and crop production purposes. Data points for 2012 (Fig. 1) are from the AgriMet station CRVO, located at 44° 38' 03"N / 123° 11' 24"W, elev. 230 feet above sea level.

Other sources of weather and climate information for this report include the following agencies:

National Climatic Data Center (NCDC, http://www.ncdc.noaa.gov/oa/ncdc.html)

Western Regional Climate Center (WRCC, http://www.wrcc.dri.edu)

Oregon Climate Service (OCS, http://www.ocs.orst.edu/)

Drought was widespread throughout the nation in 2012 and the PNW experienced a drier than average winter. However, spring precipitation was among the ten wettest historical averages in Oregon and Washington due to numerous storms during the spring season. This active storm pattern resulted in above-average snowpack for the Cascades. Regional summer temperatures were slightly above historical averages, and fall precipitation was normal.

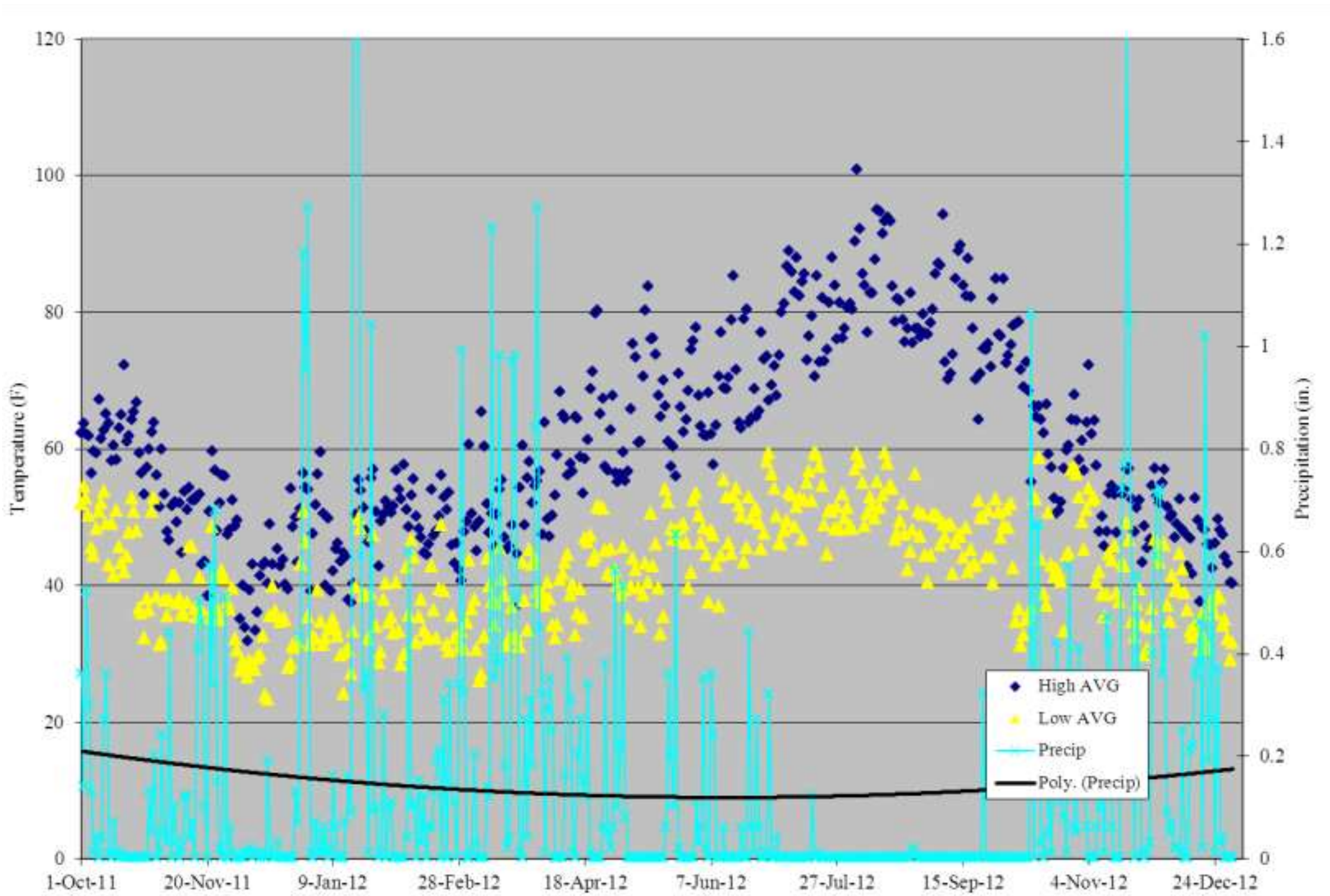

Figure 1. Daily average high and low temps and daily precipitation recorded at Corvallis, OR. from Oct 1, 2011 to Dec 31, 2012.

Efficacy and Crop Safety of Herbicides on Garden Beets

Ed Peachey, Horticulture Department, Oregon State University

Methods

The experiment was located on an experimental farm near Corvallis, OR on a silt loam soil (pH 6.0, OM 4.77%, CEC 29.7 mew/100g soil). Table beets (var. Red Ace) were planted 3 rows per plot with 26 in between rows and in plots 25 ft long, with 4 replications of each herbicide treatment. Treatments were applied with a CO_2 powered back-pack sprayer with 4 nozzles on an 18” spacing. One of the untreated check plots was hand hoed. Table beets were pulled from 10 ft of the middle row in each plot and weighed and graded according to industry standards on August 8.

Results and Discussion

S-metolachlor caused the least injury to the beets with reasonable but insufficient weed control by seasons end, even though the plots were cultivated. Yield was not improved by the combination of amicarbazone plus s-metolachlor (Trt. 14). Pendimethalin caused excessive injury at both rates and application timings. The combination of s-metolachlor (0.48 lb ai/A) plus ethofumesate (0.5 lb ai/A) gave the best yield, even though weed control was poor. Triflusulfuron (Upbeet) EPOST following s-metolachlor had the greatest yield, and weed control averaged 90% at harvest.

Amicarbazone at the low rate (Trt. 4) improved hairy nightshade control slightly but also caused more injury than s-metolachlor (Table 3). Pyroxasulfone improved weed control compared to s-metolachlor but caused more injury than s-metolachlor. Increasing the rate of s-metolachlor to (0.63 lb ai/A) in combination with ethofumesate improved weed control but not yield.

Table 1. Herbicide application data.

Date	May 19	May 25	June 08	June 09
Crop stage		Beets: all radicles emerged about ¾ in., ~10% poking through soil	2 true leaf	2 true leaf
Weeds and growth stage	-	-		
Hairy nightshade	-	-	2 leaf up to 4 cm	2 leaf up to 4 cm
Lambsquarters	-	-	coty to 2 lf	coty to 2 lf
Pigweed	-	-	coty to 2 lf	coty to 2 lf
Common purslane	-	-	coty	coty
Herbicide/treatments	All PRE treatments	16, 17, 25	13 DM, EPOST	18,19,20
Application timing	PRE	Delayed PRE	EPOST 2-leaf	EPOST 2-leaf
Start/end time	7-12:05	2:30-3 PM	4-4:15PM	9:15-9:45
Air temp/soil temp (2")/surface	73/75/75	72/76/82	59/- /-	59/- /-
Rel humidity	43%	40%	71%	78%

Wind direction/velocity	0-1 SE	2-5 NW	2-5 W	0-2 SW
Cloud cover (%)	100	50	100	0
Soil moisture	dry on surface	very wet from 4 days of rain	very wet	very wet from rain overnight
Plant moisture	-	-	possibly wet from showers	damp
Sprayer/PSI	BP 30	BP 25	BP30	BP30
Mix size	2100 mls	2100 mls	2100 mls	3 gal
Gallons H20/acre	20	20	20	20
Nozzle type	5-XR8003	5-XR8003	4--XR8003	4--XR8003
Nozzle spacing and height	20/20	20/20	20/20	20/20
Soil inc. method/implement	1 hr of irrigation starting at 12:10; more rain to follow	Showered at night	Light rain off and on after app; 0.05in or less fell during night	

Table 2. Table beet response to herbicide near Corvallis, 2012.

	Herbicide	*Timing*	Date	Rate	Crop stand June 4	Crop injury				Beet harvest							
						June 4	June 11	June 26	July 13	Roots/ plot	Yield	Grade					Avg. beet wt
						Chlorosis	*stunting*					*1*	*2*	*3*	*Over*	*%1-2*	
				lbs ai/A	*no/3 ft*	*0-10*	------ *%*------				*t/A*		*kg*				*g*
1	**Unweeded**	-	-	-	10	0	15	0	11	18	4.8	4.8	0.1	0.3	1.1	35	199
2	S-metolachlor	PPS	19-May	0.63	21	0	0	0	4	55	15.2	15.2	0.1	0.8	2.6	15	412
3	S-metolachlor	PPS	19-May	1.26	25	0	10	10	14	53	16.8	16.8	0.1	0.6	2.7	12	360
4	Amicarbazone	PPS	19-May	0.056	16	0	18	23	19	28	5.8	5.8	0.1	0.4	1.1	34	195
5	Amicarbazone	PPS	19-May	0.111	9	0	43	45	49	20	8.9	8.9	0.0	0.2	1.4	5	541
6	Amicarbazone	PPS	19-May	0.223	5	0	75	73	84	7	5.0	5.0	0.0	0.1	0.3	4	666
7	Clomazone	PPS	19-May	0.5	16	2	53	18	40	25	16.1	16.1	0.0	0.3	1.2	4	978
8	Clomazone	PPS	19-May	1.0	17	2	63	53	41	29	14.3	14.3	0.1	0.3	1.6	6	505
9	Pendimethalin	PPS	19-May	1.0	13	0	63	99	99	0	0.4	0.4	0.0	0.0	0.0	0	378
10	Pendimethalin	PPS	19-May	2.0	11	0	80	100	100	0	0.0	0.0	0.0	0.0	0.0	0	0
11	Pyroxasulfone	PPS	19-May	0.015	18	0	23	18	24	33	10.9	10.9	0.0	0.3	2.2	7	551
12	Pyroxasulfone	PPS	19-May	0.031	19	0	20	15	8	35	15.7	15.7	0.1	0.3	2.3	6	582
13	S-metolachlor + S-metolachlor	PPS EPOST	19-May 8-Jun	0.63 0.63	15	0	8	15	9	48	16.1	16.1	0.1	0.6	2.8	10	403
14	Amicarbazone + S-metolachlor	PPS PPS	19-May 19-May	0.056 0.63	13	0	18	23	23	31	14.5	14.5	0.1	0.2	2.0	5	484
15	Clomazone +`` S-metolachlor	PPS PPS	19-May 19-May	0.25 0.63	19	1	55	35	34	31	12.6	12.6	0.1	0.3	1.8	8	516
16	Pendimethalin	Delayed PRE	25-May	1.0	13	0	70	100	100	0	0.0	0.0	0.0	0.0	0.0	0	0

	Herbicide	Timing	Date	Rate	Crop stand June 4	Crop injury				Beet harvest							
						June 4	June 11	June 26	July 13	Roots/ plot	Yield	Grade					Avg. beet wt
						Chlorosis	*stunting*					*1*	*2*	*3*	*Over*	*%1-2*	
				lbs ai/A	*no/3 ft*	*0-10*	------ *%*------				*t/A*	*kg*					*g*
17	Pendimethalin +	PPS	19-May	0.5	17	0	65	100	100	0	0.0	0.0	0.0	0.0	0.0	0	0
	Pendimethalin	Delayed PRE	25-May	0.5													
18	Triflusulfuron + COC 1%	EPOST	9-Jun	0.031	20	0	10	10	8	35	9.1	9.1	0.2	0.3	2.3	11	260
19	S-metolachlor	PPS	19-May	0.63	17	0	20	23	21	33	16.7	16.7	0.1	0.3	2.1	5	824
	Triflusulfuron + COC 1%	EPOST	9-Jun	0.031													
20	Pyroxasulfone+	PPS	19-May	0.015	18	0	18	33	25	30	10.2	10.2	0.1	0.4	1.9	8	734
	Triflusulfuron + COC 1%	EPOST	9-Jun	0.031													
21	Pyroxasulfone +	PPS	19-May	0.015	16	0	25	15	35	29	14.9	14.9	0.1	0.2	1.4	4	905
	Ethofumesate	PPS	19-May	0.5													
22	S-metolachlor +	PPS	19-May	0.48	12	0	23	23	25	25	16.8	16.8	0.0	0.2	1.4	3	1053
	Ethofumesate	PPS	19-May	0.5													
23	S-metolachlor +	PPS	19-May	0.64	12	0	30	5	38	35	14.8	14.8	0.1	0.4	2.2	7	965
	Ethofumesate	PPS	19-May	0.5													
24	S-metolachlor +	PPS	19-May	0.64	10	0	50	50	50	19	14.0	14.0	0.0	0.3	1.0	4	809
	Ethofumesate	PPS	19-May	1													
25	S-metolachlor +	PPS	19-May	0.4775	12	0	55	90	95	2	0.7	0.7	0.0	0.1	0.2	13	115
	Pendimethalin	Delayed PRE	25-May	0.5													
26	**Weeded**				19	0	18	13	28	34	12.9	12.9	0.0	0.3	2.0	6	520
	FPLSD (0.05)				*12*	*0.7*	*25*	*21*	*24*	*21*	*4.9*	*0.1*	*0.4*	*1.3*	*2.0*	*17*	*589*

Table 3. Weed control with herbicides applied to table beets near Corvallis, 2012.

Plot	Herbicide	Timing	Date	Rate	Weed control 11-June-2012			Weed control 7-July-2012					At harvest
					Pigweed	Hairy nightshade	Composite rating	Pigweed	Hairy nightshade	Lambs-quarters	Purs-lane	Composite rating	Composite rating
				lbs ai/A	%								
2	S-metolachlor (1X)	PPS	19-May	0.63	94	73	91	88	75	100	68	69	83
3	S-metolachlor (2X)	PPS	19-May	1.26	81	75	81	98	93	95	100	95	92
4	Amicarbazone 75 WG	PPS	19-May	0.056	60	25	55	8	33	80	50	11	30
5	Amicarbazone 75 WG	PPS	19-May	0.111	96	24	91	24	88	100	65	68	33
6	Amicarbazone 75 WG	PPS	19-May	0.223	82	78	82	58	100	100	80	82	53
7	Clomazone (1X)	PPS	19-May	0.5	98	78	98	93	100	100	100	97	83
8	Clomazone (2X)	PPS	19-May	1.0	100	100	100	95	100	100	100	100	91
9	Pendimethalin (1X)	PPS	19-May	1.0	83	88	82	88	90	100	95	92	75
10	Pendimethalin (2X)	PPS	19-May	2.0	77	75	72	98	100	100	100	99	85
11	Pyroxasulfone (1X)	PPS	19-May	0.015	80	75	80	65	55	93	65	61	54
12	Pyroxasulfone (2X)	PPS	19-May	0.032	78	100	80	98	75	100	75	74	78
13	S-metolachlor + S-metolachlor	PPS EPOST	19-May 8-Jun	0.63 0.63	89	100	89	85	50	90	90	71	78
14	Amicarbazone + S-metolachlor	PPS PPS	19-May 19-May	0.056 0.63	97	96	96	90	75	100	78	76	84
15	Clomazone + S-metolachlor	PPS PPS	19-May 19-May	0.25 0.63	100	100	99	98	95	100	100	98	91
16	Pendimethalin	Delayed PRE	25-May	1.0	91	81	88	84	95	100	98	95	68

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Plot	Herbicide	Timing	Date	Rate	Weed control 11-June-2012			Weed control 7-July-2012					At harvest
					Pigweed	Hairy nightshade	Composite rating	Pigweed	Hairy nightshade	Lambs-quarters	Purs-lane	Composite rating	Composite rating
				lbs ai/A			---------- % ----------						
17	Pendimethalin + Pendimethalin	PPS Delayed PRE	19-May 25-May	0.5 0.5	93	88	89	95	98	100	93	98	81
18	Triflusulfuron + COC 1%	EPOST	9-Jun	0.031	17	7	17	20	57	100	63	15	43
19	S-metolachlor Triflusulfuron + COC 1%	PPS EPOST	19-May 9-Jun	0.63 0.031	85	100	85	90	73	100	80	83	90
20	Pyroxasulfone+ Triflusulfuron + COC 1%	PPS EPOST	19-May 9-Jun	0.015 0.031	83	66	80	80	80	100	63	80	80
21	Pyroxasulfone + Ethofumesate	PPS PPS	19-May 19-May	0.015 0.5	86	74	88	88	65	100	98	78	79
22	S-metolachlor + Ethofumesate	PPS PPS	19-May 19-May	0.48 0.5	90	100	90	93	73	100	98	66	73
23	S-metolachlor + Ethofumesate	PPS PPS	19-May 19-May	0.64 0.5	97	100	97	98	93	100	98	94	88
24	S-metolachlor + Ethofumesate	PPS PPS	19-May 19-May	0.64 1	98	100	98	93	98	100	98	98	68
25	S-metolachlor + Pendimethalin	PPS Delayed PRE	19-May 25-May	0.4775 0.5	98	78	98	95	85	100	95	94	75
26	**Weeded**				0	0	0	75	58	88	55	74	69
	FPLSD (0.05)				*25*	*44*	*26*	*22*	*30*	*14*	*32*	*26*	*23*

Treatment 2 (Dual Magnum) 19 (Dual Magnum + Upbeet) 20 (pyrox + Upbeet)

Figure 1. Weed control efficacy in table beets with combinations of S-metalochlor (Dual Magnum), triflusulfuron (UpBeet), and pyroxasulfone. See table 2 for rates and timings.

Integrated Strategies to Improve Weed Control in Table Beets

Ed Peachey and Aaron Heinrich, OSU Dept. of Horticulture

Methods

The trial was conducted at OSU's Vegetable Research Farm in Linn County, OR on Chehalis silty clay loam soil. Variety 'Detroit Dark Red' table beets were seeded at 12 seeds per ft on 10 July with a Gaspardo vacuum seeder. There were 15 treatments replicated 4 times in a factorial randomized complete block design. Each experimental plot was 10 ft. wide by 45 ft. long and contained 3 seedlines on 26 in. centers as well as an uncropped alley that served as a buffer between treatments.

Preemergent treatments and glyphosate were applied 11 July. Several applications of the fungicide Kocide (1 lb/A) were applied throughout the experiment to slow the spread of cercospora leaf spot. Cultivation was done on 16 July, 23 July, and 30 July using a spyder/torsion weeder system (Bezzerides Brothers, Inc. Orosi, CA) or a traditional sweep system. The spyders were attached to an electric converted Allis-Chalmers "G" cultivating tractor while the sweeps were attached to the gas powered version of the same tractor. The spyders were set at a 30 degree angle relative to the row and the gauge wheels adjusted so that the spyders penetrated the soils to a depth of 2.5-3 in. At this angle the rotating spyders shatter the crust next to the seedling and move it away from the crop. The spacing of the spyders was set so that there was a 3.5-4 in uncultivated band around the seedlings. The torsion weeder complements the spyders by moving and mixing the loosened soil in and around the crop seedling. Cultivation speed for the spyder/torsion weeder system was approximately 1.3 mph (~1 A/hr). The sweeps were set at a 4 in spacing. Several days passed between cultivation and watering to allow for the soils to dry out and the uprooted weed seedlings to desiccate and die. Beets were harvested 14 September.

Results and Discussion

There was no statistically significant effect of cultivation method on weed control, but that may have been due to uneven weed populations within plots. Herbicide treatments effectively controlled all weeds, with pigweed and purslane control close to 100%. Cultivation by the spyders (based on a contrast) increased control of hairy nightshade relative to the uncultivated check. For the spyders, timing did not appear to have a significant influence on weed control with the exception of Spyder 15+120, which had less weed control. The sweeps also increased weed control, though they appeared less effective than the spyders at the end of summer. Beet yield was not affected by herbicide or cultivation treatments.

The benefit of the spyder/torsion system is that it allows for closer cultivation of the seedline with minimal crop injury relative to the traditional cultivation by sweeps. In our study, when the sweeps were set up to cultivate a 4 in. band around the crop, they would compress and shatter the surface crust causing the crop seedlings to visibly move during cultivation. This movement can damage the roots of very small seedlings. The action of the rotating spyders shears and mixes the soil in such a way that crop seedling did not move.

Another benefit of the spyder/torsion system is the mixing of the soil around the seedline. The sweeps undercut weeds, but do not mix the soil. As a result, if mild, moist conditions follow a cultivation, some weeds may be able to reroot. The mixing of the soil by the spyders may eliminate this. Also, the torsion weeders can be set to be aggressive, pushing soil into the seedline potentially burying weeds in the seedline. However, this aggressive setting can only be used when the crop is larger (1st true leaf for beets in our study) and can handle being partially buried.

Table 1. Weed control ratings (±SE) for cultivation treatments that received herbicide, 18 Sept 2012.

Treatment		Rate		Weed control (0-100%)				
		Nightshade	*SE*	Lambsquarter	*SE*	Purslane	*SE*	Composite rating
1	Spyders 15	87.5	*12.5*	99.0	*1.0*	97.5	*2.5*	95.0
2	Spyders 60	92.5	*4.6*	87.5	*10.6*	95.8	*3.1*	99.0
3	Spyders 15 + 60	95.0	*6.1*	99.3	*0.8*	100	*0*	98.3
4	Spyders 15 + 120	70.0	*17.3*	77.0	*19.9*	99.5	*0.7*	85.0
5	Sweeps 15	80.0	*20.0*	94.0	*4.0*	100	*0*	95.0
6	Sweeps 60	77.5	*15.7*	85.0	*9.1*	100	*0*	95.0
7	Uncultivated check	52.5	*29.5*	81.3	*19.7*	75.0	*35.4*	82.5

Figure 1. Spyder/torsion weeder system by Bezzerides Brothers, Inc.

Evaluating New Strategies for Weed Control in Chenopodiaceous Crops

Ed Peachey, Horticulture Department, Oregon State University

Due to the introduction of glyphosate resistant sugar beets, the need for products such as cycloate (Ro-Neet), phenmedipham (SpinAid), phenmedipham + desmedipham (Betamix), and pyrazon (Pyramin) will diminish. Moreover, soil applied herbicides must be used at low rates because of potential crop injury; but most soil-applied herbicides are short lived and do not provide season long control.

Methods

The experiment was located on an experimental farm near Corvallis, OR on a silt loam soil (pH 6.0, OM 4.77%, CEC 29.7 mew/100g soil). Female line spinach and swiss chard were planted 3 rows per plot with 26 in between rows and in plots 25 ft long, with 4 replications of each herbicide treatment. Treatments were applied with a CO_2 powered back-pack sprayer with 4 nozzles on an 18" spacing. One of the untreated check plots was hand hoed. Spinach and swiss chard were harvested by hand (10 ft of row) on July 27.

Results and Discussion

Clomazone (Trts. 7 and 15) caused whitening early in the season for both crops, and severe stunting in swiss chard. Yet, clomazone provided weed control that brought yields up to the level of the weeded check plots. Pendimethalin caused excessive injury, regardless of application timing (Table 2). Swiss chard was tolerant of triflusulfuron applied alone EPOST (Trt. 18), but injury increased when combined with pyroxasulfone (Trt. 20). For spinach, the best weed control was achieved with 0.63 lb ai/A *s*-metolachlor in combination with either amicarbazone (Trt. 14) or clomazone (Trt.15), but both treatments had moderate stunting.

Table 1. Herbicide application data.

Date	May 19	May 25	June 09
Crop stage			2 true leaf
Weeds and growth stage	-	-	
Hairy nightshade	-	-	2 leaf up to 4 cm
Lambsquarters	-	-	coty to 2 lf
Pigweed	-	-	coty to 2 lf
Common purslane	-	-	coty
Herbicide/treatments	All PRE treatments	16	18, 20
Application timing	PRE	Delayed PRE	EPOST 2-leaf
Start/end time	7-12:05	2:30-3 PM	9:15-9:45
Air temp/soil temp (2")/surface	73/75/75	72/76/82	59/- /-
Rel humidity	43%	40%	78%
Wind direction/velocity	0-1 SE	2-5 NW	0-2 SW
Cloud cover (%)	100	50	0
Soil moisture	dry on surface	very wet from 4 days of rain	very wet from rain overnight
Plant moisture	-	-	damp
Sprayer/PSI	BP 30	BP 25	BP30
Mix size	2100 mls	2100 mls	3 gal
Gallons H20/acre	20	20	20
Nozzle type	5-XR8003	5-XR8003	4--XR8003
Nozzle spacing and height	20/20	20/20	20/20
Soil inc. method	1 hr irrigation; rain follow	Showered at night	

Table 2. Swiss chard and spinach tolerance to select herbicide treatments.

	Herbicide	Timing	Date	Rate	Chard						Spinach					
					Emergence (June 4)	Phytotoxicity (June 4)	Stunting (June 11)	Plants harvested	Biomass	Weed control at harvest	Emergence (June 4)	Phytotoxicity (June 4)	Stunting (June 11)	Plants harvested	Biomass	Weed control at harvest
				lbs ai/A	*no/3 ft*	*0-10*	*%*	*no/10 ft*	*t/A*	*%*	*no/3 ft*	*0-10*	*%*	*no/10 ft*	*t/A*	*%*
1	Unweeded				37	0	0	74	11.8	0	16	0	0	38	5.3	0
2	S-metolachlor (1X)	PPS	19-May	0.63	33	0	13	74	20.6	83	17	0	8	35	11.7	73
4	Amicarbazone 75 WG	PPS	19-May	0.056	38	0	18	70	15.1	40	17	0	5	32	10.2	18
7	Clomazone (1X)	PPS	19-May	0.5	32	2.8	80	31	14.6	90	16	3.0	15	31	11.5	96
9	Pendimethalin (1X)	PPS	19-May	1.0	31	0	48	0	0.0	86	18	0	63	0	0.0	81
11	Pyroxasulfone (1X)	PPS	19-May	0.015	39	0	8	85	17.0	83	19	0	10	33	9.0	60
14	Amicarbazone + S-metolachlor	PPS PPS	19-May 19-May	0.056 0.63	35	0	18	61	21.2	92	16	0	13	33	10.7	90
15	Clomazone + S-metolachlor	PPS PPS	19-May 19-May	0.25 0.63	28	1.3	78	44	17.4	95	18	1.0	23	35	9.8	97
16	Pendimethalin	Delayed PRE	25-May	1.0	41	0	55	0	0.0	89	18	0.3	65	0	0.0	79
18	Triflusulfuron + COC 1%	EPOST	9-Jun	0.031	40	0	5	70	16.0	60	18	0	20	5	0.7	23
19	*S*-metolachlor	PPS	19-May	0.63	31	0	23	70	20.0	93	19	0	30	14	9.6	81
20	Pyroxasulfone+ Triflusulfuron + COC 1%	PPS EPOST	19-May 9-Jun	0.015 0.031	30	0	20	48	17.0	91	20	0	18	11	4.6	63
22	*S*-metolachlor + Ethofumesate	PPS PPS	19-May 19-May	0.48 0.5	37	0	13	74	18.7	91	18	0	15	37	9.9	85
	FPLSD (0.05)				*ns*	*0.3*	*13*	*25*	*5.7*	*14*	*ns*	*0.4*	*11*	*11*	*6.7*	*13*

Figure 1. Plot design and layout of spinach and swiss chard trial near Corvallis, 2012.

Figure 2. Treatment effects of a.) amicarbazone (0.056 lb ai/A); b.) clomazone (0.5 lb ai/A); and c.) *S*-metolachlor (0.63 lb ai/A) on swiss chard at harvest, July 27.

Efficacy and Crop Safety of Pendimethalin on Green Onions

Ed Peachey, Horticulture Department, Oregon State University

Methods

The experiment was located on silt loam soil (pH 6.9, OM 3%, CEC 8.5.mew/100g soil). Pendimethalin (Prowl) was applied at two rates and two timings with a backpack sprayer (30psi) with 4 XR-8003 nozzles spaced 20" apart on a spray boom. The delayed-PRE treatments (0.95 lb ai/A and 1.90 lb ai/A) were applied on 22 Aug 2012. Loop-to-flag treatments were applied on 30 Aug 2012 at the same rates. Onion emergence was evaluated 8DAT and 15DAT following the delayed-PRE application. Weed density in each plot was evaluated on 6 Sept 2012. Growth reduction and weed control were evaluated at 6WAT and 11WAT.

Results and Discussion

Treatments did not significantly affect green onion emergence. Pendimethalin applied at the delayed-PRE timing did reduce the percent of seedlings with a flag leaf 8DAT compared to check plots (Tbl. 2). However, no crop injury was noted 15DAT for any of the treatments. Weed control was excellent (>95%), even at 6WAT (Fig. 1). By 11WAT, weed control in plots treated with the lower rate of pendimethalin applied EPOST (trt. 3) was reduced to 86%.

Table 1. Herbicide application data.

Date	August 22, 2012	August 30, 2012
Crop stage	coytledon looping under soil 1 "	
Herbicide/treatment	delayed-PRE	loop to flag
Start/end time	12:30-12:45PM	8:45-9:15AM
Air temp	74/78/82	60/62/62
Rel humidity	41%	64%
Wind direction/velocity	0-1.5 E	0-1.7 N
Cloud cover	50%	100% coastal cover
Soil moisture	dry	dry, wet underneath
Plant moisture	-	dry
Sprayer/PSI	BP CO2 30	BP CO2 30
Mix size	1000	2100
Gallons H20/acre	20	20
Nozzle type	4 XR-8003	4 XR-8003
Nozzle spacing and height	20/20	20/20
Incorporation	irrigation	irrigation

Table 2. Emergence of green onions, crop injury, and weed control near Lane County, 2012.

Treatment	Prowl rate	Timing	Obs	8 DAT (30 Aug)		15 DAT (6 Sept)			6 WAT (2 Oct)		11 WAT (7 Nov)	
				Onion emergence	seedlings with flag leaf	Onion emergence	Weed density	Crop injury	Growth reduction	Weed control	Growth reduction	Weed control
				(2 ft of 2 rows)	*% flag leaf*	*(2 ft of 2 rows)*	*no/plot*		-------------------- % ---------------------			
1	2 pts	DelayedPre	4	38	36	37	0.3	0	0	98	0	96
2	4 pts	DelayedPre	4	33	38	38	0.5	0	6	99	0	94
3	2 pts	EPOST	4	-	-	39	55	0	3	97	0	86
4	4 pts	EPOST	4	-	-	36	38	0	3	100	1	95
5	check		4	38	63	36	119	-	-	-	-	-
	FPLSD (0.05)			ns	20	ns	47	ns	ns	2	ns	13

Figure 1. Emerged green onions and near complete weed control in treated plots compared to the untreated check (front of photo), October 2012.

Sweet Corn Tolerance to Anthem™

Ed Peachey, Horticulture Department, Oregon State University

Methods

Anthem™ and Anthem ATZ™ were tested for tolerance and efficacy on six varieties of sweet corn commonly grown in this region (1477, Basin, Captain, Coho, Jubilee, and SC1263). The experiment was conducted on the OSU Vegetable research farm, Lane County, OR. Sweet corn was planted on 1 June in 30 in. rows, and seeded to a depth of 1.5 in. The most abundant weeds at the site were pigweed, purslane, hairy nightshade, and crabgrass. Anthem™ was applied 2 June (PPS) at 0.17 lb ai/A total (0.163 lb ai/A pyroxasulfone and 0.005 lb ai/A fluthiacet-methyl). Anthem ATZ™ was applied at crop stage V2-3 (21 June) at 1.126 lb ai/A total (1.002 lb ai/A atrazine, 0.121 lb ai/A pyroxasulfone, and 0.004 lb ai/A fluthiacet-methyl) with a methylated seed oil surfactant at 1% v/v. All treatments were applied at 20 GPA with a backpack sprayer. Phytotoxicity was evaluated at 4, 8, and 22DAT.

Results and Discussion

Varieties 1477 and Basin had very poor emergence (3 and 11 seedlings per 25 ft. of row, respectively), but was not significantly different from the untreated check, indicating that low emergence was not a treatment effect. Phytotoxicity ratings were very low for all varieties at all evaluation dates (Table 2.). Anthem controlled crabgrass poorly, particularly when applied POST (Figure 1).

Table 1. Herbicide application data.

Date		Saturday, June 02, 2012	Thursday, June 21, 2012
Crop stage (var.)			max ht and growth stage
	1477		3" V2 very poor (no) emergence
	Basin R		4" V3 poor emergence
	Captain		5" V3
	Coho		6" V2
	SC1263		8" V3
	Jubilee		6" V2
Weeds and growth stage			
	Pigweed		4-6 lvs
	Purslane		5-6
	Hairy nightshade		3-4
	Crabgrass		3-4
Herbicide/treatment		Anthem	EPOST
Application timing		PPS	V2-3
Start/end time		7:45-8:15	7:30-9:15
Air temp		59	60
Rel humidity		82%	79%
Wind direction/velocity		0-3 SW	0-1 NE
Cloud cover		100	0
Soil moisture		Damp to wet, 0.15 in over night	Dry
Plant moisture		None	None
Sprayer/PSI		BP 25 PSI	BP 25 PSI
Mix size		2100/2 plots	5000 mls
Gallons H20/acre		20	20
Nozzle type		3 XR-8003	3 XR-8003
Nozzle spacing and height		20/20	20/20
Soil inc. method/implement		rainfall incorporated	rainfall followed at night

Table 2. Herbicide effects on sweet corn growth.

Variety	Herbicide	Obs	Phytotoxicity		
			4 DAT	8 DAT	22 DAT
			------------------- *% injury (0-100)* -----------		
1477	Anthem	4	0	0	1
1477	Anthem ATZ	3	7	7	0
Basin	Anthem	4	0	4	3
Basin	Anthem ATZ	4	15	9	0
Captain	Anthem	4	0	1	0
Captain	Anthem ATZ	4	13	18	4
Coho	Anthem	4	0	0	0
Coho	Anthem ATZ	4	16	10	0
Jubilee	Anthem	4	0	3	1
Jubilee	Anthem ATZ	4	14	10	0
SC1263	Anthem	4	0	3	0
SC1263	Anthem ATZ	4	14	13	1

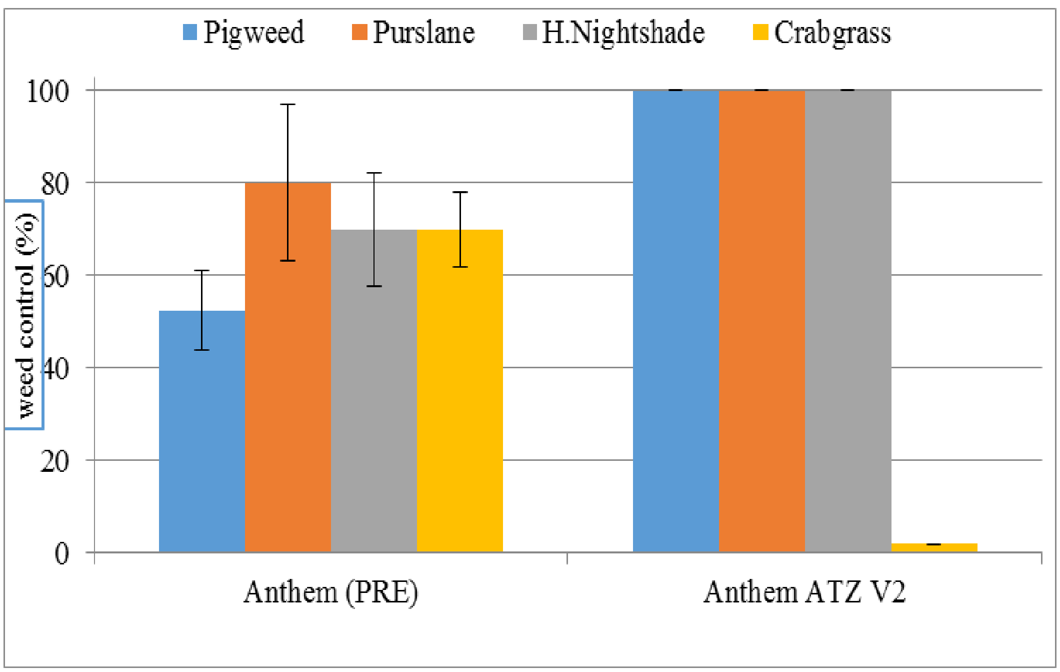

Figure 1. Weed control of pigweed, purslane, hairy nightshade, and crabgrass at 22DAT near Corvallis, OR 2012.

Captain, Coho, Devotion, and SC1263 Sweet Corn Tolerance to Herbicides

Ed Peachey, Horticulture Department, Oregon State University

Methods

The experiment was conducted on the OSU Vegetable research farm, Lane County, OR. Four varieties of sweet corn (Captain, Coho, Devotion, and SC1263) were planted on 15 June with 325 lbs/A 12-29-10 fertilizer at a rate of 24,000 seeds/A. The experiment was a RCBD with 4 reps, and included 4 rows per plot (30 in. spacing), and each row was a different variety. Herbicide combinations (Table 2) were applied at two timings: EPOST treatments were applied 5 July and LPOST on 16 July. Injury ratings were assessed at approximately 5DAT and 15DAT. A mid-season application of urea (80 lb N/A) was applied on 2 August to all plots. Coho var. corn was harvested from 20 ft. of row on 24 September.

Results and Discussion

Overall, the variety Coho appeared to more sensitive to the herbicides applied than the variety Devotion when averaged across all treatments. Crop injury was greatest for treatments that included Dual Magnum, particularly when applied at V2. The data also indicate that injury may have been greatest on the varieties Coho and Captain. Anthem ATZ applied post (treatment 13) provided 100% weed control but yield may have been reduced by crop injury to Coho early in the season (Table 4).

Table 1. Herbicide application data.

Date	Thursday, July 05, 2012	Monday, July 16, 2012
Crop stage for sweet corn varieties		
SC1263 (su)	v2-3, mostly v2, 3-6 in 3-4 lf	v5-6
Coho (se)	v2, 3-5 3 lf	v5-6
Captain (su)	v2-3 5-8 4 lf	v5-6
Devotion (Sh2 white)	v2-3 4-7" 4 lf	v5-6
Weeds and growth stage		v5-6
Common purslane	1- 2 dia	6-8” dia
Pigweed	4 lf	2-6 in tall
Lambsquarters	4 lf	2-6 in tall
Hairy nightshade	4 lf	2-4 in tall
Herbicide/treatment	EPOST V2-3	LPOST V5-6
Start/end time	9-11:30 AM	6:30-7 AM
Air temp	75	58
Rel humidity	48%	84%
Wind direction/velocity	0-3 SW	0-1 NE
Cloud cover	0 bright sun	100 %
Soil moisture	Dry	Dry
Plant moisture	None	Dew
Sprayer/PSI	BP 30 PSI	BP 30 PSI
Mix size	2100 4 plots	2100 4 plots
Gallons H20/acre	20	20
Nozzle type	6 XR-8002	6 XR-8002
Nozzle spacing and height	20/20	20/20
Soil inc. method/implement	none	none

Table 2. Herbicide treatments applied to 4 varieties of sweet corn.

	Treatment code	Exp herbicide treatments	Timing	Product rate		Active ingredient Rate
				vol. or wt/A		*lbs ai/A*
1	ImDA v2	**Impact**	v2	0.75	oz	0.0164
		Dual Magnum		24	oz	1.43
		Atrazine		1	pt	0.5
		MSO		1	%	1.00
		UAN		2.5	%	2.50
2	ImDA v6	**Impact**	v6	0.75	oz	0.016
		Dual Magnum		24	oz	1.43
		Atrazine		1	pt	0.5
		MSO		1	%	1.00
		UAN		2.5	%	2.50
3	ImA v2	**Impact**	v2	0.75	oz	0.016
		Atrazine		1	pt	0.5
		MSO		1	%	1.00
		UAN		2.5	%	2.50
4	ImA v6	**Impact**	V6	0.75	oz	0.016
		Atrazine		1	pt	0.5
		MSO		1	%	1.00
		UAN		2.5	%	2.50
5	ImA(0.1) V2	**Impact**	v2	0.75	oz	0.016
		Atrazine		0.20	pt	0.1
		MSO		1	%	1.00
		UAN		2.5	%	2.50
6	ImDA v2	**Impact**	v2	0.75	oz	0.016
		Dual Magnum		24	oz	1.43
		Atrazine		0.2	pt	0.1
		MSO		1	%	1.00
		UAN		2.5	%	2.50
7	Im V2	**Impact**	v2	0.75	oz	0.016
		MSO		1	%	1.00
		UAN		2.5	%	2.50
8	LDA v2	**Laudis**	v2	3	oz	0.082
		Dual Magnum		24	oz	1.43
		Atrazine		1	pt	0.5
		MSO		1	%	1.00
		UAN		2.5	%	2.50
9	LASK v2	Laudis	v2	3	oz	0.082
		Super Kix		28	oz	
		Atrazine		0.50	pt	0.5
10	LAR v2	Laudis	v2	3	oz	0.082
		Renegade		28		
		Atrazine		0.50	pt	0.5
11	IASKv2	Impact	v2	0.75	oz	0.016
		Super Kix		28		0.1
		Atrazine		0.50	pt	0.5
12	IAR v2	Impact	v2	0.75	oz	0.016
		Renegade		28		0.1
		Atrazine		0.50	pt	0.5
13	Anth+Atz v2	Anthem ATZ -	v2	32	oz	2.50
		MSO		1	%	
14	Anth v2	Anthem	v2	10	oz	-
		MSO		1	%	

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Table 2. Herbicide treatments applied to 4 varieties of sweet corn.

	Treatment code	Exp herbicide treatments	Timing	Product rate		Active ingredient Rate
				vol. or wt/A		*lbs ai/A*
15	Cal	Callisto	v2	3	oz	0.094
		COC		1	%	
16	Imv2+Lv6	**Impact**	v2	0.75	oz	0.016
		MSO		1	%	1.00
		UAN		2.5	%	2.50
		Laudis	**v6**	3	oz	0.082
		MSO		1	%	
		UAN		2.5	%	
17	Untreated check	---------				

Table 3. Main effect of sweet corn variety tolerance to herbicides.

Variety	Stunting (5 DA EPOST)	Phytotoxicity (5 DA EPOST)		Stunting (4 DA LPOST)		Phytotoxicity (4 DA LPOST)	
	%	*0-10*		*%*		*0-10*	
SC1263	8.5 a	0.65	b	8.0	ab	0.27	a
Coho	8.7 a	0.98	a	9.1	a	0.37	a
Captain	8.9 a	0.99	a	6.7	ab	0.34	a
Devotion	7.3 a	0.84	ab	5.8	b	0.33	a

Table 4. Response of Coho sweet corn yield to herbicides, 24 Sept. 2012.

Treatment		Ears/A	Tons/A	Avg. ear wt.	Weed control at harvest
				kg	*%*
1	ImDA v2	40656	18.7	0.42	100
2	ImDA v6	44649	19.4	0.40	100
3	ImA v2	41382	18.6	0.41	99
4	ImA v6	40729	16.8	0.38	91
5	ImA(0.1)V2	43125	19.3	0.41	83
7	Im V6	40946	18.9	0.42	84
8	LDA v2	42907	18.9	0.40	98
9	LASK v2	45520	20.7	0.41	100
10	LAR v2	41164	19.1	0.43	100
11	IASKv2	39204	19.1	0.45	100
12	IAR v2	42689	18.4	0.40	99
13	Anth+Atz v2	40075	17.8	0.40	100
14	Anth v2	40729	18.1	0.40	89
15	Cal	45883	20.2	0.40	94
16	Imv2+Lv6	42689	19.0	0.41	100
17	Chk	35429	14.9	0.38	0
FPLSD		ns	2.8	0.04	6

Figure 1. Weed control in treatment 9 (Laudis, Super Kix, and Atrazine applied V2, left) versus the untreated check (right).

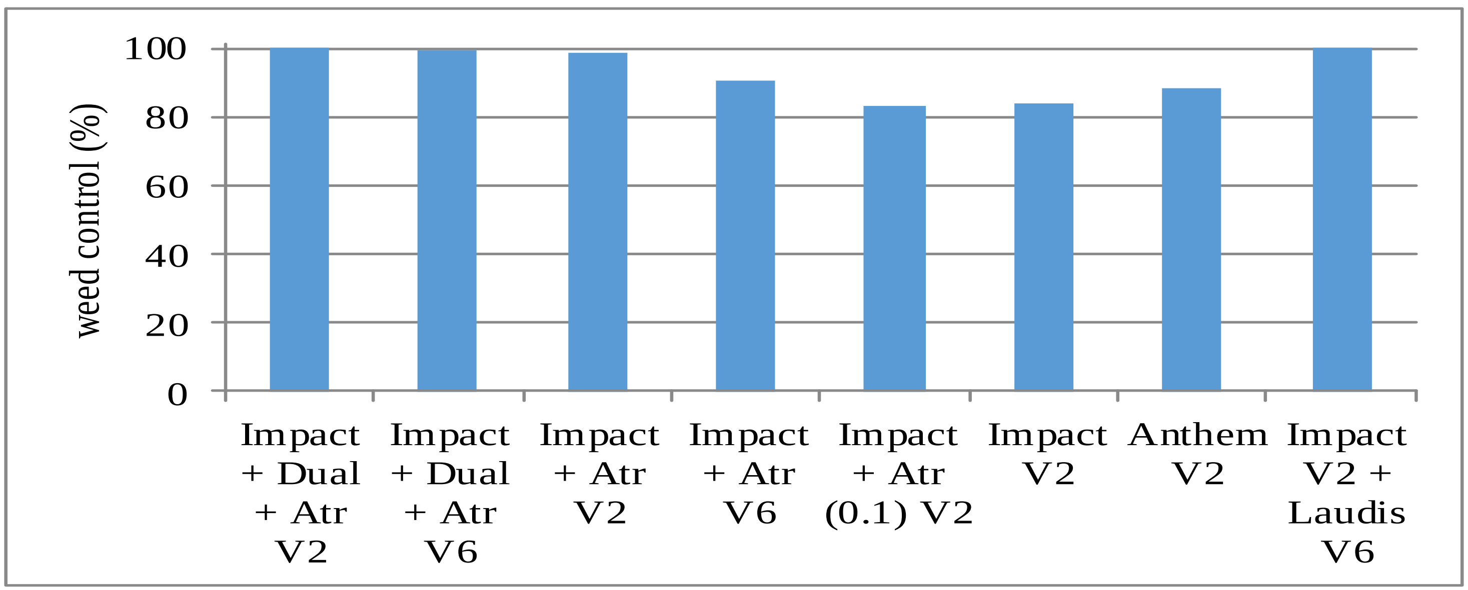

Figure 2. Composite weed control at harvest in treatments containing Impact applied at different timings near Corvallis, 2012.

Seasonal Applications of Herbicides on Blackberry Tolerance and Yield

Ed Peachey, Horticulture Department, Oregon State University

Methods

The experiment was located on an experimental farm near Corvallis, OR on a silt loam soil in alternate-year var. 'Marion' blackberries. Blackberry trellis rows were 14 ft apart with a spacing of 6 feet between plants (hills). Plots were 12 ft in length with 2 hills per plot, and with 5 replications of the quinclorac treatments and 4 replications of the remainder. The plots were overhead irrigated with one inch of water every week, beginning 15 May and continuing until after early October.

Herbicides were applied with a CO2 powered back-pack sprayer with a single nozzle, and herbicides applied to both sides of the row at two different timings (Table 1). The nozzle was positioned 10 inches from the center of the row and 20 inches above the soil to create a treatment zone 3.3 ft wide over the row. Maintenance herbicides of simazine and glufosinate were applied on 3 April. Hand hoeing was used to cleanup surviving weeds. Fungicides were applied in May 2012 to manage foliar diseases. Blackberries were harvested three times and average weight of 25 berries determined.

Results and Discussion

Overall cane vigor was very good at this site. The yield estimated from this trial averaged 8,660 lbs/A. Two plots were removed from the analysis because of unusually low (Treatment 1, Block 1) or high yield (Treatment 3, Block 3) compared to other plots of the same treatment. Mesotrione at 0.188 lb ai/A applied in the fall caused slight injury (whitening of leaves) to foliage in the spray zone at 2 WAT and to a few leaves in the upper canopy at 5 WAT. Injury was noted with the spring application of mesotrione as well, at both rates, but symptoms dissipated by 4 WAT.

No phytotoxicity symptoms were noted with quinclorac or clopyralid whether applied in the fall or spring. None of the treatments yielded less than the nontreated check. Mesotrione applied at 0.094 lbs ai/A in the fall and quinclorac applied at 0.375 lbs ai/A in both the spring and fall were the only two treatments that yielded statistically more than the nontreated check. The cause of this is unclear, as weed control was not expected to influence the outcome of this experiment.

Table 1. Herbicide application data.

Date	October 8, 2011	June 3, 2012
Crop stage	Canes trained before spraying	Near flowering
Herbicide/treatment	Mesotrione, quinclorac, clopyralid	Mesotrione, quinclorac, clopyralid, s-metolachlor
Application timing	Fall '11	Spring '12
Start/end time	8-9:30 AM	7-7:45 AM
Air temp/soil temp (2")/surface	60 F	52 F
Rel humidity	67%	87%
Wind direction/velocity	0-1 SW	0-1 SW
Cloud cover	50 %	100 %
Soil moisture	wet	wet
Plant moisture	damp	damp
Sprayer/PSI	BP CO_2/30 PSI	BP CO_2/30 PSI
Mix size	2100 mls	2100 mls
Gallons H20/acre	20	20
Nozzle type	1-XR-8002	1-XR-8003
Nozzle spacing and height	20/ 18 above ground, 3.3ft band	24 above ground, 3.3ft band
Soil inc. method/implement	Rainfall in afternoon	Rainfall expected in next 2 to 6 days

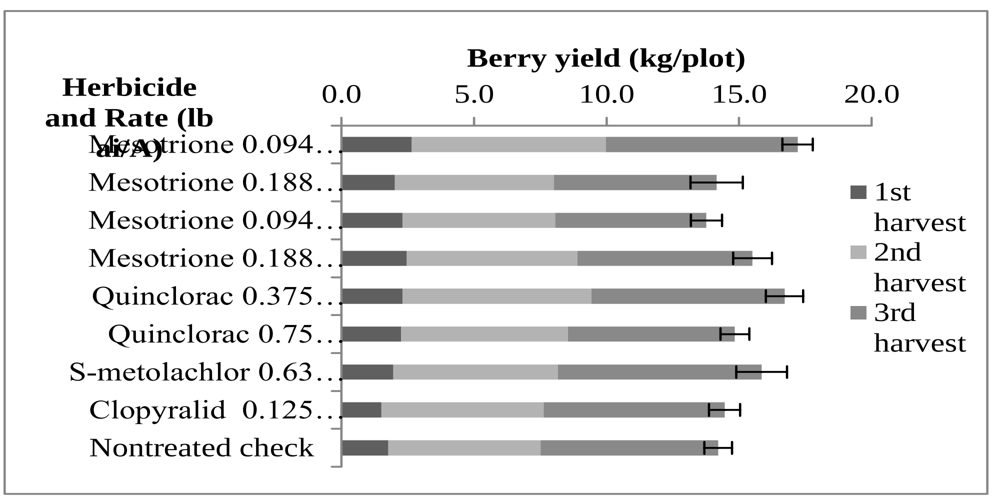

Figure 1. Cumulative yield of 'Marion' blackberries in 2012 (+SE for the total yield).

Table 2. ‘Marion’ blackberry response to herbicides near Corvallis, 2011-2012.

Herbicide and Timing	Obs	Phytotoxicity ratings 2011				Phytotoxicity ratings 2012					Yield and primocane length 2012								
		21-Oct		12-Nov		11-Jun		18-Jun	2-Jul	16-Jul	Harvest 1		Harvest 2		Harvest 3		Total yield	Avg. berry yield	Primo-cane length
		spray zone	above spray zone	spray zone	above spray zone	spray zone	above spray zone				berry wt	avg. berry wt	berry wt	avg. berry wt	berry wt	avg. berry wt			
lbs ai/A		*0-10 (10 =complete desiccation, 0=no effect)*									*kg*	*g*	*kg*	*g*	*kg*	*g*	*kg /plot*	*g*	*cm*
1 Mesotrione 0.094 Fall'11	3	0	0	0	0	0	0	0	0	0	2.7	132	7.3	113	7.2	115	17.2	118	204
2 Mesotrione 0.188 Fall'11	4	1.0	0	0	1.3	0	0	0	0	0	2.0	110	6.0	104	6.1	104	14.2	106	169
3 Mesotrione 0.094 Spr'12	3	-	-	-	-	2.3	0	0	0	0	2.3	125	5.8	115	5.7	109	13.8	117	213
4 Mesotrione 0.188 Spr'12	4	-	-	-	-	2.5	0	0	0	0	2.5	121	6.4	112	6.6	108	15.5	114	213
5 Quinclorac 0.375 (Fall+Spr)	5	0	0	0	0	0	0	0	0	0	2.3	110	7.1	113	7.3	107	16.7	110	178
6 Quinclorac 0.75 (Fall+Spr)	5	0	0	0	0	0	0	0	0	0	2.2	109	6.3	105	6.3	105	14.8	107	214
7 S-metolachlor 0.63 (Spr)	4	-	-	-	-	0	0	0	0	0	2.0	124	6.2	109	7.7	112	15.8	115	184
8 Clopyralid 0.125 (Fall+Spr)	4	0	0	0	0	0	0	0	0	0	1.5	123	6.1	115	6.8	116	14.5	118	204
9 Nontreated check	8	-	-	-	-	-	-	-	-	-	1.8	119	5.7	112	6.7	115	14.2	115	181
FPLSD (0.05)		*0.7*	*ns*	*ns*	*0.8*	*0.9*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*2.1*	*ns*	*ns*

Pendimethalin Performance on Commercial Caneberries

Ed Peachey, Horticulture Department, Oregon State University

Methods

The experiment was located on property farmed and managed by Stahlbush Island Farms, Corvallis OR, on a silt loam soil. 'Marion' variety blackberries were planted in 2004 and managed commercially as every-year blackberries. Blackberry rows were 10 ft apart with a spacing of 5 feet between plants (hills). Plots were 20 ft in length with 4 hills per plot, and with 4 replications of each treatment. The plots were drip irrigated per grower practice.

Herbicides were applied a CO2 powered back-pack sprayer with a single nozzle, and herbicides applied to both sides of the row. The nozzle was positioned 10 inches from the center of the row and 20 inches above the soil to create a treatment zone 3.3 ft wide over the row. Maintenance simazine herbicide (0.5 lb ai/A in fall and spring) was applied by the grower to minimize winter weed growth. Carfentrazone was applied in May of both years by the grower to burn vegetation from canes near the soil surface and suppress primocane growth. We applied glyphosate with a shielded sprayer to control several large and vigorous patches of Canada thistle, at the request of the grower in May 2012. Fungicides and insecticides were applied in both 2011 and 2012 to manage foliar diseases and spotted wing drosophila. Blackberries were harvested three times in 2011 and twice in 2012 from a length of row equivalent to 2 hills (10 ft) in both years.

Results and Discussion

This field of Marion blackberries was managed for production every year, and cane health was poor. The overall yield estimated from this trial averaged only 7400 lbs/A in 2011. One plot was removed from the analysis because of very low yield compared to other plots of the same treatment over both years (plot 301, Tr. 1).None of the herbicide treatments caused symptoms of phytotoxicity or reduction in plant growth. Total yield over the two year period was comparable to the yield of canes in the remainder of the field that were mechanically harvested by the grower. Pendimethalin did not influence yield over the 2 years of the trial (Table 1), but there was a slight indication that pendimethalin at 6 lbs ai/A may have suppressed yield in the first year of the project. A detail of weed control is not reported because results were confounded by the herbicides used to suppress primocane growth and perennial weeds such as Canada thistle.

Table 1. Herbicide application data.

Date	Saturday, April 02, 2011	Friday, October 14, 2011	Wednesday, March 28, 2012
Crop stage	Buds breaking dormancy, no primocanes visible	Trained vines on wires, still growing	Buds breaking dormancy, no primocanes visible
Herbicide/treatment	Prowl, Dual Mag	Prowl 1 and 2	Prowl, Dual Magnum
Application timing	Pre-Bud	Fall	Just budding
Start/end time	10-11 AM	2-2:45	3-3:45
Air temp/soil temp (2")	51/54	72/62	59/62
Rel humidity	60%	51%	63%
Wind direction/velocity	SSW 1-5	N 1-3.7	SE 1-3
Cloud cover	50%	70%	100%
Soil moisture	Wet	Damp	Standing water from just prior downpour
Plant moisture	Damp	Dry	Wet
Sprayer/PSI	BP 25 PSI	BP30PSI	BP30PSI
Mix size	2100	1600	2100
Gallons H20/acre	20	20	20
Nozzle type	2-XR8003	1-11003	1-XR8003
Nozzle spacing and height	20/ 18 above ground	24 above ground, 3ft band	24 above ground, 3ft band
Soil inc. method/implement	Rainfall in afternoon	Rainfall expected in next 2 to 6 days that should sufficiently incorporate product	Rain coming in 30-60 min

Table 2. Response of Marion blackberries to herbicides over 2 years near Corvallis, OR.

Herbicide	Timing	Rate	Obs	2011						2012			
				1st harvest		2nd harvest		3rd harvest		1st harvest		2nd harvest	
				Yield	*Avg. berry wt*	*Yield*	*Avg. berry wt*	*Yield*	*Avg. berry wt*	*Yield*	*Avg. berry wt*	*Yield*	*Avg. berry wt*
		lbs ai/A		*kg/plot*	*g*	*kg/plot*	*g*	*kg/plot*	*g*	*kg/plot*	*g*	*kg/plot*	*g*
1. Pendimethalin	prebud + post-harvest (2011-12)	3	3	3.1	126	4.3	110	2.6	99	1.9	109	3.4	126
2. Pendimethalin	prebud + post-harvest (2011-12)	6	4	2.9	128	3.2	106	2.3	103	2.1	111	4.3	130
3. S-metolachlor	prebud (2011-12)	1.26	4	2.1	119	2.7	106	1.7	101	1.4	113	4.9	131
4. Untreated			4	2.6	125	3.2	113	2.3	96	1.3	110	3.8	124
FPLSD(0.15)				*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*0.9*	*ns*

Red Raspberry Tolerance to Mesotrione

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Two field experiments were conducted to evaluate the effects of mesotrione (Callisto) at different rates alone and in combination with s-metolachlor (Dual Magnum) and fomesafen (Reflex).

Methods

Experiment 1 - was conducted on a young stand of privately-owned raspberries near Talbot, OR. Raspberry rows were 10 ft apart with a spacing of 24 inches between plants (hills). Plots were 10 ft in length with 5 hills per plot, and with 4 replications of each treatment in a randomized block design. A maintenance herbicide tankmix of paraquat + simazine was applied by the grower on March 1. All other treatments were applied to both sides of the row, creating a treatment zone approximately 3.3 ft wide, on 28 March. Phytotoxicity (necrosis, chlorosis) and floricane damage was evaluated at 1 and 2 WAT. The grower mistakenly burned the primocanes to the ground shortly after the evaluation at 2 WAT, as is typically done, which eliminated further evaluations of primocane injury. Due to low overall production, raspberries were only harvested once (22 June) from all hills within each plot and 25-berry subsamples were taken to determine average berry weight.

Experiment 2 - was conducted in a field of 10-year-old raspberry plants (var. 'Willamette') at OSU's North Willamette Research and Extension Center in Aurora, OR. Plots were 10 ft long with 8 hills per treatment, and with 4 replications of each treatment arranged in a randomized block design. An in-row, pre-emergence herbicide was applied by the grower to the entire raspberry planting about two months prior to the experimental treatments. Herbicide treatments were applied on 7 May in a 3 ft wide swath on each side of the plant row. Plots were irrigated with overhead sprinklers 3DAT to incorporate the herbicides, and otherwise were drip irrigated throughout the growing season. Phytotoxicity was evaluated 1, 2, and 4 WAT. Fruit yield and berry weight were determined from one hill per plot on 21 June. Primocane length and diameter were measured on 6 Aug.

Results and Discussion

Experiment 1 - Mesotrione applied alone or with s-metolachlor caused very little damage to at 1 WAT. At 2WAT, slight and moderate necrosis was noted on primocanes and floricanes, respectively (Table 2). The tankmix of mesotrione plus fomesafen was particularly injurious to raspberry primocanes. Damage recorded to floricanes at harvest was likely symptomatic of root rot and dieback due to the unusually long wet spring. Similarly, yields were so low at harvest that data were insignificant, and this plot was abandoned after the 2012 season.

Experiment 2 – All mesotrione treatments had higher incidence and greater severity of necrosis and chlorosis than did the untreated plots (Table 3*)*, but only those primocane leaves that came in direct contact with the spray solution were affected. Symptoms of phytotoxicity increased from 1WAT to 4WAT. Herbicide treatment did not appear to have an effect on yield, berry weight, or number of primocanes (Table 3). Neither were length and diameter of primocanes significantly different between treatments (data not shown).

Table 1. Herbicide application data.

	TALBOT	AURORA
Date	March 28, 2012	May 7, 2012
Crop stage	Leafing out, some primocanes visible	Primocanes 8-12", floricanes just prior to bloom
Herbicide/treatment	Callisto, Dual Magnum, Reflex	Callisto, Dual Magnum, Reflex
Application timing	PRE, leafout	POST, pre-bloom
Start/end time	11:45AM-12:15PM	09:30AM-11:00AM
Air temp/soil temp (2")/surface	51	76
Rel humidity	69%	42%
Wind direction/velocity	SSW 7-10	NW 2-3
Cloud cover	100%	None
Soil moisture	Very wet	Moist
Plant moisture	Damp	Dry
Sprayer/PSI	BP/30 PSI	BP/40 PSI
Mix size	2100 mls	1250 mls
Gallons H20/acre	20	30
Nozzle type	1-XR8003	1-9503EVS
Nozzle spacing and height	24" above ground	18" above ground
Soil inc. method/implement	Light rain, overhead 2DAT	Overhead 3DAT

Table 2. Effect of mesotrione and tankmixes on raspberry injury and yield near Talbot, 2012. Means followed by same letter do not differ (P≤0.05).

	Herbicide	Rate	1 WAT			2 WAT			Harvest		
			Necrosis (primocanes)	Chlorosis (primocanes)	Floricane damage	Necrosis (primocanes)	Chlorosis (primocanes)	Floricane damage	Vines /10 ft of row	Yield /plot	Avg. berry wt
		lbs ai/A	*-----scale of 0-10*					*-----*	*no.*	*---- g ----*	
1	mesotrione	0.094	0.0 a	0.8 a	0.0 a	1.0 a	2.9 b	3.1 b	7.0 a	390 a	2.8 a
2	mesotrione	0.188	0.4 a	0.6 a	1.0 a	1.5 a	3.5 b	5.8 c	5.8 a	371 a	2.4 a
3	mesotrione+ s-metolachlor	0.094 1.91	0.3 a	0.9 a	0.0 a	2.4 ab	3.4 b	4.3 bc	5.8 a	133 a	2.6 a
4	mesotrione+ fomesafen	0.094 0.5	3.0 b	0.0 a	4.0 b	3.5 b	0.4 a	4.1 bc	5.8 a	98 a	1.9 a
5	nontreated[a]		0.0	1.1 a	0.0 a	0.0 a	0.0 a	0.4 a	6.0 a	153 a	2.8 a

[a] Grower applied paraquat + simazine applied prior to experiment and well before primocanes emerged on 1 March.

Table 3. Effect of treatments on injury[a] to raspberries and yield near Aurora, 2012. Means followed by same letter do not differ (P≤0.05).

	Herbicide	Rate	1 WAT Necrosis	1 WAT Chlorosis	2 WAT Necrosis	2 WAT Chlorosis	4 WAT Necrosis	4 WAT Chlorosis	Harvest Primocanes/ hill	Harvest Yield /plant	Harvest Avg. berry wt
		lbs ai/A	*scale of 0-10*						*no.*	*g*	
1	mesotrione	0.094	1.0 b	8.8 c	7.8 b	8.5 c	7.5 bc	8.0 d	9.0 a	585 a	3.3 a
2	mesotrione	0.188	2.0 b	9.5 c	8.8 bc	8.8 c	8.2 cd	7.8 cd	8.8 a	1082 a	3.1 a
3	mesotrione+ s-metolachlor	0.094 1.91	1.8 b	9.0 c	9.0 c	8.0 c	8.8 d	6.0 bc	8.2 a	788 a	3.2 a
4	mesotrione+ fomesafen	0.094 0.5	5.2 b	3.5 b	8.0 bc	4.8 b	7.0 b	5.0 b	9.0 a	595 a	3.3 a
5	nontreated[b]		0.0 a	0.0 a	0.5 a	0.0 a	0.5 a	0.5 a	10.2 a	597 a	3.1 a

[a] Incidence = percentage of plants showing symptoms.

[b] Grower applied an in-row pre-emergent herbicide applied approximately 2 months prior to experiment.

Figure 1. Chlorosis on emerged primocanes 1WAT (left) and 4WAT (right) from treatment with 0.094 lb ai/A Callisto at the Aurora site. **Figure 2.** Chlorosis 2WAT (white line) from 0.094 lb ai/A Callisto plus 1.91 lb ai/A Dual Magnum versus untreated plot at the Talbot site.

Summary

Mesotrione is known to have both pre- and post-emergence activity and causes either loss of chlorophyll (chlorosis) or death (necrosis). In Experiment 2, the primocanes were 8-12 inches tall and leafed out at the time of application and, hence, susceptible to the postemergence activity of the herbicide. The current registered label for Callisto gives use directions for caneberries (raspberry and blackberry) that state to make a directed, pre-bloom application. Yet, given the symptoms seen in Experiment 2, caneberry growers may want to consider making a directed application of Callisto prior to primocane emergence instead.

Weed Control in Hazelnuts

Ed Peachey, Horticulture Department, Oregon State University

Methods

The experiment was located on a privately-owned hazelnut orchard in Lane County, OR on woodburn silt loam soil (pH 6.1, OM 3.8%, CEC 20.8 mew/100g soil). Plots were 20 ft long and 10 ft wide with one tree at the center of each plot. Weeds present at the site included annual bluegrass (mainly), toad rush, hare barley, groundsel, mallow, chickweed, and annual ryegrass. Herbicides were applied 1 May and weed control was evaluated at 3WAT and 5WAT. Glyphosate was applied by the grower after the final evaluation.

Results and Discussion

Hare barley and annual ryegrass density were highly variable between plots and therefore initial control estimates were not possible for these species. Hare barley density was much greater at the second rating. Glyphosate alone provided good to exceptional weed control for all species. Glyphosate/paraquat plus simazine provided nearly complete control of all weedy vegetation. Indaziflam +glyphosate provided excellent control as recorded in past trials. Neither oxyflourfen at 1.5 lb ai/A nor saflufenacil at 0.04 lb ai/A provided adequate weed control. No injury to the hazelnut trees was observed for any treatment.

A secondary objective of this trial was to evaluate potential resistance of annual ryegrass to glyphosate. The annual ryegrass density was very low overall, with only one or two individuals per plot, but there was no evidence of glyphosate resistance in the annual ryegrass that was present. Had annual ryegrass been resistant to glyphosate, we could predict that glufosinate plus indaziflam would have provided the best weed control.

Table 1. Herbicide application data.

Date	Tuesday, May 01, 2012
Crop stage	Completely leafed out
Herbicide/treatment	All
Start/end time	10:15-11:45AM
Air temp	58
Rel humidity	57%
Wind direction/velocity	1.5 to 7.6 SE
Cloud cover	50%
Soil moisture	Wet from night rain
Plant moisture	Damp
Sprayer/PSI	CO_2 BP 30 PSI
Mix size	2100 4 plots
Gallons H20/acre	20
Nozzle type	3-XR8003 on both sides of tree row (10 ft band)
Nozzle spacing and height	20/24
Incorporation/rainfall events	Light drizzle began 30 min after the last treatment was applied. All glyphosate treatments had $\geq$1 hr before drizzle began. Substantial rainfall occurred the week following application to incorporate the herbicide.

Table 2. Weed control in hazelnuts in Lane County, OR 2012.

	Product	Herbicide	Rate			May 24, 2012				July 4, 2012					
						Composite	Ann. blue.	Toad rush	Groundsel	Composite	Ann. blue.	Toad rush	Groundsel	Hare barley	Ann. rye.
			product/a		*lbs ai/A*	%									
1	Roundup[a]	glyphosate	1.5	qt	1.125	**99**	100	100	100	**97**	88	93	96	100	100
	Rely 280	glufosinate	64	oz	1.165										
2	Alion [a]	indaziflam	5	oz	0.065	**99**	98	100	100	**99**	97	100	100	100	100
	Rely 280	glufosinate	64	oz	1.165										
	Roundup	glyphosate	1.5	qt	1.125										
3	Matrix [a]	rimsulfuron	4	qt	0.063	**87**	100	100	100	**86**	95	99	100	97	73
	Prowl H20	pendimethalin	4	pt	3.800										
	Rely	glufosinate	64	oz	1.165										
4	Chateau [a]	flumioxazin	12	pt	0.383	**96**	100	100	100	**90**	85	88	100	88	65
	Prowl H20	pendimethalin	4	qt	3.800										
	Rely	glufosinate	64	oz	1.165										
	Roundup	glyphosate	1.5	qt	1.125										
5	Pindar [a]	pen+ oxy[b]	3	oz	1.505	**100**	100	75	100	**98**	99	100	100	98	77
	Rely	glufosinate	64	oz	1.165										
	Roundup	glyphosate	1.5	qt	1.125										
6	Goal [a]	oxyfluorfen	4	oz	1.000	**98**	100	100	100	**91**	93	90	100	90	100
	Prowl H20	pendimethalin	4	qts	3.800										
	Rely	glufosinate	64	oz	1.165										
	Roundup	glyphosate	1.5	qts	1.125										
7	Prowl H20 [a]	pendimethalin	4	qts	3.800	**99**	100	100	100	**96**	98	91	99	69	100
	Treevix	saflufenacil	1	oz	0.044										
	Rely	glufosinate	64	oz	1.165										
	Roundup	glyphosate	1.5	qts	1.125										
8	Rely	glufosinate	64	oz	1.165	**96**	100	100	100	**95**	98	95	100	97	99
	Alion	indaziflam	2.5	oz	0.033										
9	Glyphosate [a]	glyphosate	1.5	qts	1.125	**95**	98	100	100	**96**	99	99	94	99	100
10	Glyphosate [a]	glyphosate	1.5	qt	1.125	**85**	75	100	100	**100**	100	100	99	100	100
	Simazine	simazine	2	qts	2.000										
11	Goal 2 XL	oxyfluorfen	6	pts	1.500	**22**	13	25	84	**43**	33	0	100	27	33
12	Gramoxone	paraquat	3	pts	0.938	**96**	100	93	100	**92**	70	83	95	87	100
	Surflan	oryzalin	2	qts	2.000										
13	Gramoxone	paraquat	3	pts	0.938	**96**	100	100	100	**99**	100	100	100	100	100
	Simazine	simazine	2	qts	2.000										
14	Pindar	pen + oxy[b]	3	pts	1.505	**99**	100	100	100	**92**	100	99	100	86	100
	Rely	glufosinate	64	oz	1.165										
15	Treevix [a]	saflufenacil	1	oz	0.044	**18**	18	5	100	**10**	25	0	75	23	0
16	Matrix [a]	rimsulfuron	4	oz	0.063	**94**	98	100	100	**89**	78	91	100	91	99
	Rely	glufosinate	64	oz	1.165										
17	Alion [a]	indaziflam	2.5	oz	0.033	**97**	98	100	100	**97**	100	97	100	100	100
	Glyphosate	glyphosate	1.5	qt	1.125										
FPLSD (0.05)						10	14	27	9	13	34	11	19	28	32

Hazelnut orchard at time of herbicide application (left) and on May 24 (right).

Weed Control in Grapes

Ed Peachey, Horticulture Department, Oregon State University

Methods

The site was located at the Oregon State University Woodhall Vineyard near Alpine, OR (44.351, -123.407, 700 ft elev). The soil type at this site is a Bellpine silty clay loam with a pH of 5.8, OM of 5.29% (LOI), and CEC of 9.3 meq/100g soil at the beginning of the experiment. Glyphosate (1 lb ae/A) was applied with a tractor mounted sprayer on April 28 before vines broke dormancy after an extended wet and cold spring. The first PRE herbicide application was made on May 15 (A) and the second application (B) made on July 4. Weed control was evaluated 2 and 4 weeks after treatments. Grapes were harvested from all plots on October 18.

Table 1. Predominant weeds at the site.

Common name	Latin name	Bayer code[1]
Dovefoot geranium	*Geranium molle* L.	GERMO
Chaparral willowherb	*Epilobium minutum* Lindl ex. Lehm	EPMI
Spotted cat's-ear	*Hypochaeris radicata* L.	HYRA3

[1] Classification code used by Weed Sci. Soc. of America

Results and Discussion

The primary species surviving the April 28 glyphosate application was dove foot geranium. Flazasulfuron provided 68 to 79% weed control when applied at the A and B timings, respectively. Tankmixing flazasulfuron with saflufenacil and indaziflam for the A timing, and saflufenacil at the B timing raised weed control to 97 and 100% respectively. Little willowherb control with pendimethalin and mesotrione was poor. There was slight specking on shoots emerging from the base of plants that were treated by saflufenacil. There was no evidence that crop yield was influenced by weed control (R-sq <0.1).

Table 2. Herbicide application data.

Date		April 28, 2012	May 15, 2012	July 04, 2012
Crop stage		Dormant	Shoots 6 in	Shoots up to 4 ft; suckers 24 in
Weeds and growth stage				
	1		Dove foot geranium (predominate weed that survived glyphosate)	Dove foot geranium
	2		Little willowherb (*Epilobium minutum*)	Little willowherb
	3		Spotted cat's-ear	Spotted cat's-ear
Herbicide/treatment		Glyphosate to control existing vegetation	PRE	POST 2-4 in weeds
Application timing			A	B
Start/end time			5 to 6:30 PM	9:45-10:20 AM
Air temp			75	73
Rel humidity			60%	45%
Wind direction/velocity			0,0,0	0-1 SE
Cloud cover			5%	0
Soil moisture			Dry	Dry
Plant moisture			Dry	Dry
Sprayer/PSI		Tractor driven	BP 30 PSI	BP 30 PSI
Mix size			2100	2100
Gallons H20/acre			20	20
Nozzle type			1-XR 8003	XR 8003
Nozzle spacing and height			10 inch from center of vine row/20 inches high	10 inch from center of vine row/20 inches high
Soil inc. method/implement			Hoping for rain on Sunday	Last rain was 7-2

Table 3. Weed control and yield in grapes, Woodhall Vineyard, 2012. See Table 1 for weed species codes.

	Herbicide	Product rate		Active ingredient	Timing	Obs.	Weed control 1-Jun GERMO	1-Jun HYRA3	1-Jun EPMI	1-Jun Composite rating	12-Jun GERMO	12-Jun HYRA3	12-Jun EPMI	12-Jun Composite rating	18-Jul GERMO	18-Jul HYRA3	18-Jul EPMI	18-Jul Composite rating	Harvest Cluster yield	Yield	Avg. cluster wt
				lbs ai/A			%												*no/plot*	*kg/plot*	*kg*
1	Untreated						-	-	-	-	-	-	-	-	-	-	-	-	72	7.90	0.11
2	Flazasulfuron	2.85	oz	0.045	A	4	90	91	93	93	99	90	99	97	100	93	77	79	73	8.65	0.12
3	Flazasulfuron NIS	2.85 0.25	oz %	0.045	B		-	-	-	-	-	-	-	-	77	88	65	68	85	9.05	0.11
4	Flazasulfuron Oxyfluorfen 4F	2.85 3	oz pt/a	0.045 1.500	A	4	95	100	95	95	98	99	100	98	100	98	91	92	79	8.77	0.11
5	Flazasulfuron Oxyfluorfen4F NIS	2.85 3 0.25	oz pt/a %	0.045 1.500	B		-	-	-	-	-	-	-	-	78	86	59	60	72	7.60	0.11
6	Flazasulfuron Pendimethalin H2O	2.85 6.3	oz qt/a	0.045 5.985	A	4	88	95	86	86	94	69	89	93	100	98	59	90	75	7.84	0.10
7	Flumioxazin	12	oz	0.3825	A	4	95	100	97	97	87	99	100	93	61	98	95	81	77	8.70	0.11
8	Rimsulfuron	4	oz	0.0625	A	4	70	95	81	81	61	95	95	89	69	90	83	81	71	9.13	0.13
9	Indaziflam	6	fl	0.0783	A	4	29	38	64	64	96	74	99	92	95	99	100	96	70	8.95	0.13
10	Saflufenacil MSO	1 1	oz %	0.0438	B	4	-	-	-	-	-	-	-	-	99	99	100	97	71	7.88	0.11
11	Flazasulfuron Indaziflam	2.85 6	oz fl	0.0445 0.0783	A	4	89	100	91	91	96	91	100	97	100	93	99	97	74	8.29	0.11
12	Flazasulfuron Saflufenacil MSO	2.85 1 1	oz oz %	0.0445 0.0438	B	4	-	-	-	-	-	-	-	-	100	100	100	100	70	7.73	0.11
13	Pendimethalin H2O	6.3	qts	2.8500	A	4	38	61	46	46	30	5	0	50	100	99	43	61	69	8.13	0.12
14	Mesotrione COC	6 1	oz %	0.19	A	4	76	95	85	85	36	90	73	45	50	95	80	85	71	7.15	0.10
	FPLSD						39	37	ns	27	42	37	21	27	37	ns	32	20	ns	ns	ns

Figure 1. Field site conditions 2WAT glyphosate application.

Figure 2. Weed control 4WAT of ‘A’ timing herbicides in a.) untreated check and b.) flazasulfuron 0.045 lbs ai/A (0.056 lb ai/A).

Flower Regulation of Invasive Blackberry with Ethephon

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Himalayan blackberry (*Rubus armeniacus* F.) is widespread and invasive. Structurally, it serves an important role for birds and other wildlife. However, recent research has suggested that an invasive fruit fly (*Drosophila suzukii*) utilizes wild blackberry as an alternate host, and may be contributing to pest pressure in commercial berry fields. Persistent effort is required to remove Himalayan blackberry. Even the best herbicides, when applied at the optimum time, seldom kill the entire thicket, and small patches will often survive and produce non-fruiting primocanes. This preliminary study was conducted to determine if arresting flower development, and therefore fruit, may aid in integrated management of spotted wing drosophila.

Methods
A patch of unmanaged Himalayan blackberry was identified at OSU's Vegetable Research Farm. Plots were 30 ft long by 6 ft tall, with 3 replications of each herbicide rate. Ethephon, a systemic plant growth regulator, was applied on 1 June (pre-bloom) and 12 July (at bloom). Individual stems were marked and evaluated for number of flowers and green fruit 4DAT. Photos of each plot were taken for comparison.

Results and Discussion
Ethephon applied pre-bloom did not seem to effect subsequent flowering in the plots based on photos. For the application at-bloom, developing fruit counts of marked stems were reduced 59 and 64%, respectively, for the 8 pt/A and 16 pt/A rates (Table 2). All flowers present at time of application had withered or dropped by 4DAT. When ethephon was applied at 16 pt/A at bloom to a branch with 20+ developing fruits, symptoms of ripening were evident (Treament 2c, Fig. 2). Ethylene is the intended by-product of this formulation, and it is used in many production systems to hasten fruit development. By using the product early in the season, it appears that Himalayan blackberry flower development can be arrested.

Table 1. Herbicide application data.

Date	June 1, 2012	July 12, 2012
Crop stage	Buds developing but not flowering	At bloom (>70% of canes had flowers)
Herbicide/treatment	Ethephon 25L	Ethephon 25L
Rates	8 pt/A and 16 pt/A	Spray until wet
Application timing	Pre-bloom	At-bloom
Start/end time	2-3PM	12-1PM
Wind direction/velocity	0-1 SE	NA
Cloud cover	30	20
Soil moisture	Dry on surface	Dry
Plant moisture	Dry	Dry
Sprayer/PSI	BP	Mister bottle
Mix size	3 gal	250 ml
Gallons H20/acre	20	NA
Nozzle type	1-XR8003	NA
Nozzle spacing and height	20" away from foliage	20" away from foliage
Soil inc. method/implement	Showers tonight	No rain expected

Table 2. Changes in fruit and flower development of Himalayan blackberry after treatment with ehtophon, a growth regulator.

Plot	Rate	FRUIT			FLOWER		
		Initial (6 Jun)	4DAT (Jul 16)	Change	Initial (6 Jun)	4DAT (Jul 16)	Change
	pints/A	*no.*	*no.*	*%*	*no.*	*no.*	*%*
1a	8	8	5	38	4	1	75
1b	8	4	1	75	4	0	100
1c	8	26	9	65	6	0	100
2a	16	5	2	60	8	0	100
2b	16	11	4	64	4	0	100
2c	16	24	7	71	3	0	100

Figure 1. Patch of unmanaged Himalayan blackberry just prior to second application of ethephon.
Figure 2. Arrested fruit development 4DAT treatment with 16 pt/A ethephon and darkening of clusters (white circle) due to ethylene expression.

Preliminary Screen for Herbicide Resistance in Marestail

Ed Peachey and Jessica Green, Horticulture Department, Oregon State University
Rick Boydston, USDA-ARS, Prosser, WA

Methods

Seeds of horseweed (*Conyza canadensis*) were collected from sites in the Willamette Valley, OR (sites 1-12) and throughout the Columbia Basin of OR and WA (sites 13-18). Seeds from a known susceptible biotype from Davis, CA (site 19) also were included. Seeds were planted in 4 in pots on 11 Feb and thinned to 4 plants per plot on 28 Feb. Pots were placed in a temperature and daylight-controlled greenhouse (Figure 1). Glyphosate was applied at 2 rates when plants had 6-8 leaves. Each treatment was replicated 4 times.

Results and Discussion

At 1WAT there appeared to be differences among the sites in tolerance to glyphosate (Figure 2) but by 2WAT, all sites were similar and eventually all treated plants died. Differences in response to glyphosate may have been due to differences in growth stage at application as there were very visible differences among the biotypes collected both in plant form and vigor. Overall, there appeared to be very little evidence that horseweed is strongly resistant to glyphosate. However, in the first test run of this trial, a very low application rate (probably < 0.1 lb ae/A) of glyphosate was applied in error. Several individual plants completely survived the low application rate and there appeared to be differences among sites, even though the data were highly variable and statistically we could not sort out differences among treatments.

Figure 1. Completely randomized arrangement of horseweed seed pots in greenhouse, Corvallis, 2012.

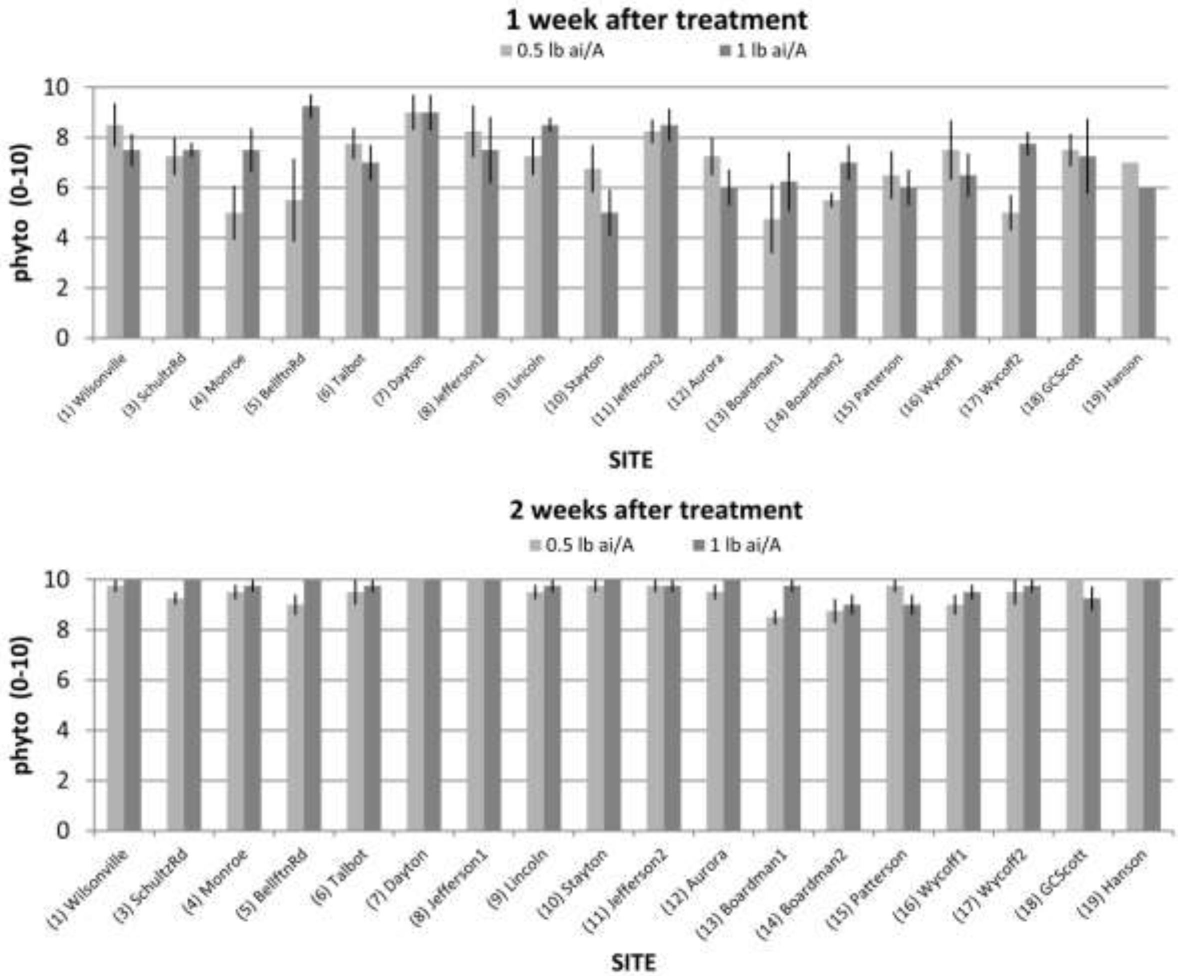

Figure 2. Horseweed tolerance to 0.5 lb ai/A and 1 lb ai/A glyphosate at 1WAT and 2WAT in a preliminary screening trial. Seed from site 19 was collected in CA and was included as the 'known glyphosate susceptible' reference.

Detection and Establishment of a Biological Control Agent for Field Bindweed

Jessica Green and Ed Peachey, OSU Horticulture
and Eric Coombs, Oregon Dept. of Ag. Noxious Weeds Program, Salem, OR

This project focused on the introduction and recovery of a biological control agent (BCA) of field bindweed (*Convolvulus arvensis*) throughout the Willamette Valley, OR. *Tyta luctuosa* is a host-specific noctuid moth that defoliates field bindweed in its larval stage, overwinters in the soil as pupae, and emerges the following summer. The BCA has been released in Western states for many years. However, inability to recover adult moths following release has limited widespread adoption of this integrated weed management tactic. Objectives of this research were to a.) field-test a pheromone monitoring approach and b.) determine if past larval releases in varying cropping systems were successful.

Methods

Pheromone traps were baited with blends of a previously identified sex-attractant used alone or in combination with other semiochemicals. Lures were place in paperboard wing traps and hung 1.5m above the soil surface. There were four traps at each site and location was randomized each time traps were checked. Additionally, traps were placed in 3 locations that did not have larvae released the year prior. These traps (north, middle, south Willamette Valley) were intended to serve as a baseline control.

Results and Discussion

Within the Willamette Valley, adult moths were detected at each of four locations where larvae had been released the year prior (Table 1). Although total trap catch numbers were low in proportion to the number of larvae released, these data suggest that *T. luctuosa* can be sampled using pheromone traps and that releases made by our research team were successful. Detection of moths at control sites may indicate that the moth has established in the Willamette Valley, or that adults are able to disperse more than 5 miles from release sites. We are currently evaluating dispersal capacity of *T. luctuosa* and how semiochemicals can be utilized to better estimate the success of biological weed control efforts.

Table 1. . Release sites of larval *Tyta luctuosa* (2011) and number of recovered moths from pheromone traps (Jun-Sept. 2012). For each location, mean values within a row followed by the same letter do not differ (α=0.1).

Trap location	Site	Trap type		Crop[a]
		Baited	Unbaited	
		----------- *no. adult moths*	-------------	
Prior release site	Dayton	5 a	0 b	Blackberries
	Jefferson	12 a	0 b	Blueberries
	Junction City	7 a	0 b	Organic vegetables
	Philomath	15 a	0 b	Home landscape
Control	North	8 a	0 b	Raspberries
	Middle	6 a	0 b	Wildlife refuge
	South	1 a	0 a	Hazelnuts
Total		54	0	

[a] Cropping system or land use when larvae were released (prior release sites) or when traps were placed (controls).

Seed Predation and Caching Behavior by Ground Beetles; Consequences for Wild-Proso Millet (*Panicum miliaceum*) Recruitment

Jessica Green, Alysia Greco, and Ed Peachey, OSU

Post-dispersal weed seed predation by ground beetles and other invertebrates may reduce seed banks and possibly weed recruitment in annual cropping systems. However, studies that evaluate removal of weed seeds from experimental feeding platters rarely correlate seedloss to weed recruitment. *Pterostichus melanarius* is a common carabid beetle in the PNW. It is a generalist feeder that scavenges for weed seeds on the soil surface and also preys on invertebrates such as slugs. This study examined seed removal and subsequent emergence of wild-proso millet when exposed to *P.melanarius* in a confined environment.

Methods

Metal bins ($1m^2$) were planted to snap beans (year 1) or spinach (year 2) and randomly assigned a level of 0, 10, or 20 *P.melanarius* beetles. Wire mesh screening (1mm opening) was installed under each bin and netting was placed over the bins to minimize interference by earthworms and birds. Seed platters containing 50 wild proso millet seeds were placed at the center of each bin. Removal from seed platters was assessed from late August through September each year and platters were reset to 50 seeds at each sampling period. Bins were left undisturbed throughout the winter and recruitment of wild-proso millet was evaluated the following spring[b]. The experiment was conducted over 2 years within the same metal bins.

Results and Discussion

Seed removal over two years averaged 3, 28, and 41% in bins with 0, 10, and 20 beetles, respectively. When corrected for density, "per beetle seedloss" was greatest in bins with 10 beetles (Fig.1). The greater average loss from bins with 10 beetles may suggest that *P. melanarius* has a 'finite density', and it has been noted that these beetles become cannibalistic under crowded conditions. In both years, recruitment of wild-proso millet was greatest in bins that had 20 *P. melanarius* beetles. This suggests that while removal increases with increased beetle density, so does recruitment the following year. Most seedlings emerged from a visible clump of seeds, indicating intentional seed caching. It is possible that *P. melanarius* beetles are caching seeds to provide an overwintering food source for developing larvae.

Table 1. Removal and subsequent emergence of wild-proso millet seeds when exposed to varying densities of *Pterostichus melanarius* carabid beetles. Per year, mean values within a column followed by the same letter do not differ (α=0.1).

Year	Treatment	n	Seedloss[a]	Recruitment[b]
			--- % ---	--- *no. seeds*1m$^{2/-1}$* ---
Year 1	0 beetles	6	4 a	0.5 b
	10 beetles	6	22 a	2.3 ab
	20 beetles	6	35 a	5.5 a
Year 2	0 beetles	6	3 b	1.3 b
	10 beetles	6	34 a	22 a
	20 beetles	6	47 a	23 a

[a] Percent removal of wild-proso millet, averaged across the season (Aug-Sept 2011 and Sept-Oct 2012).
[b] Values listed for recruitment of year 2 is an interim measurement, final values TBD in June 2013.

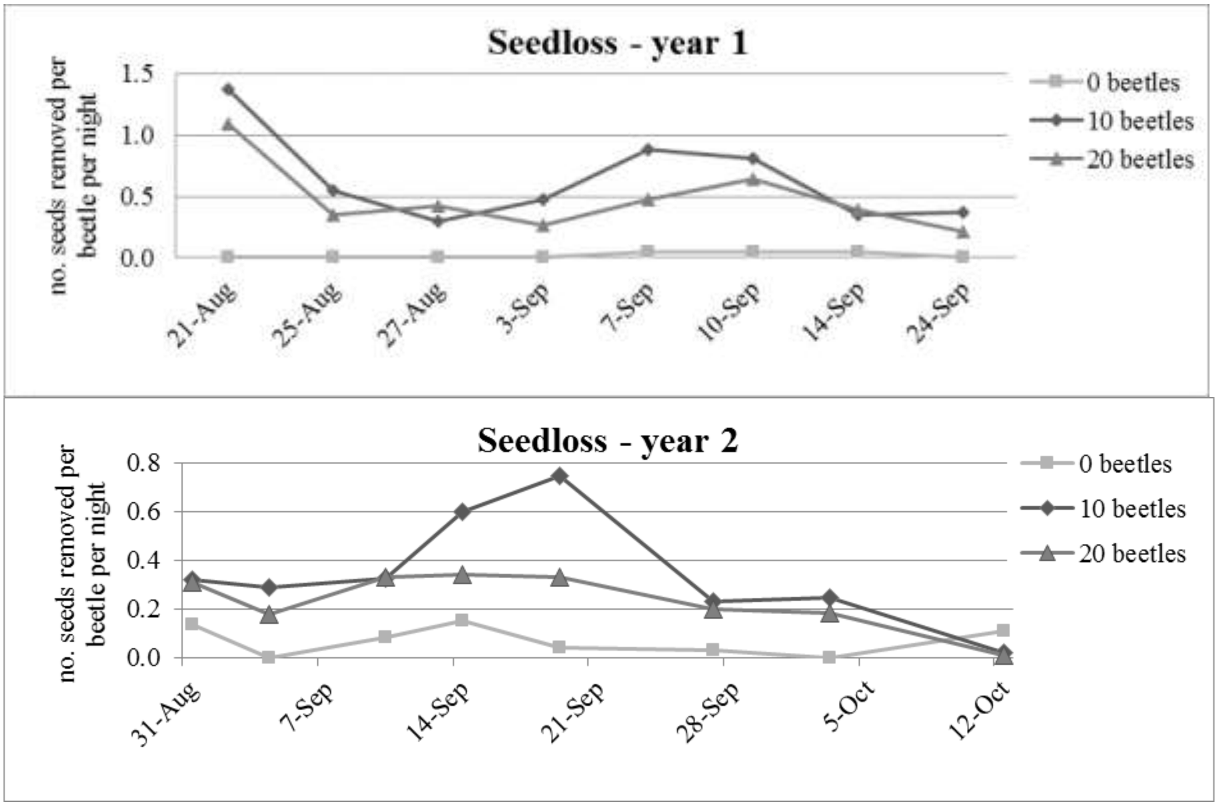

Figure 1. Removal of wild-proso millet over time in each treatment. *P. melanarius* can be cannibalistic under high densities, which may account for greater seed removal rates in bins with 10 beetles/m^2 versus bins with 20 beetles/m^2.

Figure 2. Metal arenas were filled with varying densities of carabid beetles and examined for removal of weed seeds. Bins remained in place over the winter, and recruitment was evaluated the following year. Corvallis, 2010-2012.

Assessing Weed Control Options in a Commercial Conifer Nursery

Ed Peachey and Jessica Green, Horticulture Department, Oregon State University

Methods

The experiment was located on land managed by IFA nurseries near Canby, OR. Hemlock seedlings were planted by the grower on 21 May. Plots (4 ft wide by 10 ft long) were established in a randomized complete block design throughout the western half of the field. Preemergence surface herbicides were applied 31 May using a backpack sprayer with CO2 tank delivering 30psi. The spray boom was equipped with 3 XR8003 flat fan nozzles. Postemergence treatments (treatments 3, 15 and 16) were applied 29 June with a 25% NIS surfactant using the same equipment. At 4WAT and 8WAT growth reduction and phytotoxicity was evaluated in each plot. Height of 10 trees per plot was evaluated 8WAT. A final injury rating was conducted on 8 November and trees were harvested by hand. A 10 tree subsample from each plot was returned to the lab, washed, weighed, and evaluated for abnormal growth.

Results and Discussion

Callisto (trts. 2, 3, and 4) caused moderate bleaching to hemlock tips, but did not significantly reduce tree growth (Tbl. 2). Alion at both rates (trts. 1 and 5) caused significant injury to hemlocks and negatively affected tree height mid-season (Tbl. 2). Mortality at harvest averaged 60% for indaziflam treatments. Freehand (trt. 8) also caused injury and significantly reduced tree height mid-season as well as shoot and root weight at harvest, compared to the weeded check (Tbl. 2). All treatments provided optimum weed control 4WAT, but by 8WAT control was greatly reduced in treatments 9, 10, 11, and 16. The field site was located downwind of an established cottonwood stand, which reduced the overall weed control rating in certain treatments. Katana (trts. 7 and 17) and Fierce (trt. 14) provided excellent season-long weed control with very little to no damage to hemlocks.

Table 1. Herbicide application data.

Date	Thursday, May 31, 2012	Friday, June 29, 2012
Crop stage	planted on May 21, about to break dormancy	
Weeds and growth stage	none	
LQ		6 in
Cottonwood		2-4 leaf
Spurry?		6 in dia
Herbicide/treatment	PES	3,15,16
Application timing	PES	POST
Start/end time	8-9:30 AM	9:45-10 AM
Air temp/soil temp (2")/surface	55/59/61	72/-/-
Rel humidity	55%	58%
Wind direction/velocity	0-3 NE very still mostly	0-0.5 S very still
Cloud cover	100%, sun breaking through	100% sun visible
Soil moisture	Very wet	Very wet
Plant moisture	Dew	Light dew
Sprayer/PSI	BPCO2 30	BPCO2 25
Mix size	2100	2100
Gallons H20/acre	20	20
Nozzle type	3-XR8003	3-XR8003
Nozzle spacing and height	20/18	20/18
Soil inc. method/implement	irrigation immediately after	irrigation next week

Table 2. Hemlock seedling (1-1) tolerance to herbicides at IFA Nursery, Canby, OR, 2013.

	Herbicide	Product	Rate		Timing	Injury			Tree ht.	Harvest (8-Nov)					
			Product	Active ingredient		16-Jun	24-Jul	18-Nov	29-Jul	Shoot wt.	Root wt	Shoot to Root ratio	Mortality	Shoot length	Stem dia.
				lbs ai/A		---------------- % ------------------			*cm*	*g*	*g*	*S:R*	*%*	*cm*	*cm*
1	indaziflam	Alion	5 oz/A	0.065	PES	11	79	73	2.8	61	56	1.1	62.5	33.7	6.4
2	mesotrione	Callisto	6 oz/A	0.188	PES	18	21	10	16.0	108	68	1.7	2.5	32.2	4.6
3	mesotrione+ mesotrione	Callisto	6 oz/A+ 6 oz/A	0.188 0.188	PES EPOST	-	63	38	17.8	75	59	1.3	2.5	28.0	4.0
4	mesotrione	Callisto	8 oz/A	0.250	PES	16	20	18	18.0	79	51	1.6	0.0	30.0	4.0
5	indaziflam	Alion	2.5 oz/A	0.033	PES	6	39	24	8.3	62	34	1.9	57.5	35.3	5.9
6	dithiopyr	Dimension	0.47 lb/A	0.188	PES	1	5	0	16.0	116	66	1.8	0.0	37.2	4.7
7	flazasulfuron	Katana	2 oz/A	0.031	PES	3	0	0	17.3	156	100	1.5	2.5	37.2	5.1
8	pendimethalin + dimethenamid-P	Freehand	200 lbs/A	2 1.5	PES PES	6	38	38	11.0	45	25	4.2	57.8	28.2	6.5
9	isoxaben	Gallery	11 oz/A	0.516	PES	3	3	0	16.8	116	36	3.5	0.0	37.6	4.5
10	oxyfluorfen	Goal Tender	1 pt/A	0.500	PES	3	0	0	18.0	130	71	1.9	0.0	38.4	4.4
11	saflufenacil	Treevix	1 oz/A	0.044	PES	6	5	0	18.0	95	41	2.4	0.0	33.0	3.9
12	trifluralin+ isoxaben	Snapshot	100 lbs/A	2 0.5	PES PES	3	1	8	17.5	149	75	2.0	5.0	41.0	5.2
13	flumioxazin	SureGuard	8 oz/A	0.250	PES	1	0	0	16.8	119	66	6.7	0.0	42.7	4.9
14	flumioxazin+ pyroxsulam	Fierce	8 oz/A	0.168 0.213	PES	8	13	0	17.8	157	99	1.6	0.0	40.6	5.3
15	imazamox	Raptor	5 fl. oz/A	0.039	POST	0	20	23	16.5	72	53	1.4	0.0	23.6	4.6
16	fluroxypyr	Starane Ultra	1/3pt	0.125	POST	0	33	18	14.0	76	40	1.9	0.0	32.8	3.8
17	flazasulfuron+ oxyfluorfen	Katana	2 oz/A 1 pt/A	0.031 0.500	PES PES	5	0	0	18.3	158	94	1.9	0.0	38.4	5.3
18	Nontreated	-	-	-	-	0	3	0	18.8	91	32	2.9	5.0	34.0	3.8
19	Nontreated	Weeded check	-	-	-	1	0	25	16.8	154	65	2.4	0.0	39.7	4.8
	FPLSD (0.05)					*5*	*14*	*25*	*3.6*	*46*	*35*	*ns*	*13.7*	*8.1*	*1.3*

Table 3. Weed control in hemlock seedlings (1-1) at IFA Nursery, Canby, OR, 2013.

	Herbicide	Rate	Weed control estimate 28-Jun				Weed control estimate 24-Jul					Weed control estimate at harvest			
			Cottonwood	Groundsel	N. willowherb	Composite rating	Cottonwood	Groundsel	N. willowherb	Horseweed	Composite rating	Horseweed	Cottonwood	N. willowherb	Composite rating
		lb ai/A	-- % --												
1	indaziflam	0.065	100	100	100	100	100	100	100	100	100	100	100	100	100
2	mesotrione	0.188	100	100	100	100	96	100	100	100	93	100	83	73	76
3	mesotrione+ mesotrione	0.188 0.188	75	100	100	100	100	100	100	100	100	100	75	95	81
4	mesotrione	0.250	100	100	100	100	96	100	100	100	90	100	93	73	65
5	indaziflam	0.033	100	100	100	100	100	100	100	95	99	88	88	90	85
6	dithiopyr	0.188	100	100	100	100	85	75	100	81	83	85	50	48	54
7	flazasulfuron	0.031	100	100	100	100	100	100	100	100	100	100	100	94	93
8	pendimethalin + dimethenamid-P	2 1.5	100	98	100	100	100	100	100	100	98	98	95	91	84
9	isoxaben	0.516	98	98	97	96	23	73	97	94	48	71	0	38	53
10	oxyfluorfen	0.500	100	100	98	98	43	100	98	56	64	88	25	86	57
11	saflufenacil	0.044	98	100	100	100	55	100	58	92	60	88	23	20	34
12	trifluralin+ isoxaben	2 0.5	99	98	99	99	83	98	99	81	79	85	40	90	58
13	flumioxazin	0.250	100	100	100	100	100	85	100	100	97	88	88	100	85
14	flumioxazin+ pyroxsulam	0.168 0.213	100	100	100	100	100	100	100	100	100	100	100	89	90
15	imazamox	0.039	0	0	0	0	89	25	75	31	84	8	100	90	53
16	fluroxypyr	0.125	0	0	0	0	93	25	20	63	59	68	83	20	45
17	flazasulfuron+ oxyfluorfen	0.031 0.500	100	100	100	100	100	100	100	100	100	97	100	97	96
	FPLSD (0.05)		*17*	*3*	*2*	*2*	*16*	*35*	*27*	*28*	*17*	*37*	*33*	*34*	*28*

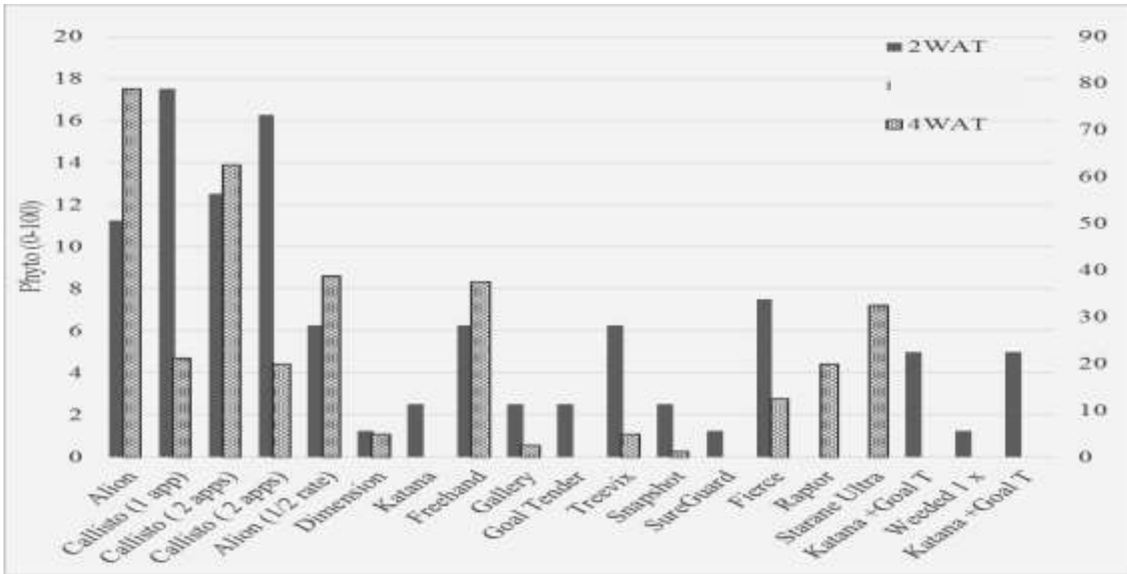

Figure 1. Tolerance of young hemlocks to varying treatments applied PES and POST (see Table 2 for rates and timings). Symptoms were evaluated 2WAT (left axis, 0-20%) and 4WAT (right axis, 0-90%).

Figure 2. Weed control just prior to harvest in plots treated with a.) saflufenacil (0.044 lb ai/A) and b.) flazasulfuron (0.031 lb ai/A) near Canby, 2012.

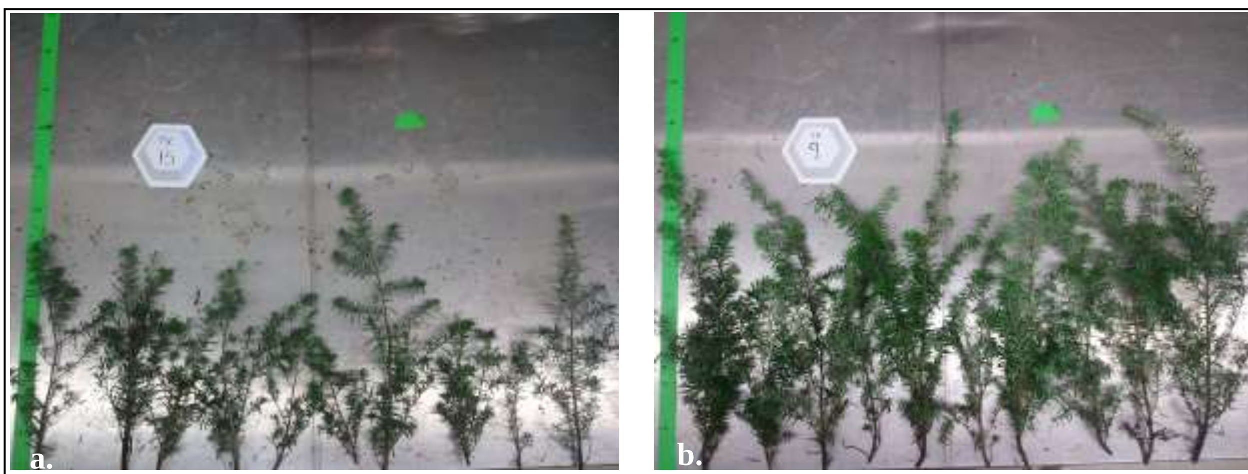

Figure 3. Effects of treatment on hemlock shoot length at harvest for a.) imazamox (0.039 lb ai/A) and b.) isoxaben (0.516 lb ai/A). 10-tree subsamples were collected from each plot and evaluated for shoot and root growth and abnormalities (twisting, etc.).

Herbicide Efficacy and Selectivity on Native Tree and Shrub Seedlings

Ed Peachey, OSU Horticulture Extension, and Brad Withrow-Robinson, OSU Forestry and Natural Resources Extension

Successful establishment of native tree and shrub seedlings is a critical first step towards restoration of bottomland and riparian forests. Invasive weeds must be controlled before and after planting or seedling survival will suffer. Many approaches can be used, but herbicides are an efficient and cost-effective approach to control weeds and limit competition. Best results come from a combination of foliar herbicide to kill growing weeds, and a soil-active herbicide to prevent re-establishment of weeds. While there are a number of soil-active herbicides safe and labeled for use on conifers in forests, there are no soil-active herbicides for use on hardwoods. This causes repeated and costly hand applications of foliar herbicides such as glyphosate or hand weeding to maintain effective control. The objective of this study was to evaluate common preemergent herbicides with low environmental impact to determine which might be suitable for restoration applications with hardwood species.

Methods

Products of interest were selected based on predicted efficacy as a preemergence herbicide in restoration sites and potential impact on non-target organisms. Products were then evaluated for crop safety and efficacy at two sites. Plots were established on irrigated (OSU Research Farm) and nonirrigated sites (Half Moon Bend). Glyphosate (2 lb ae/A) was applied to control surviving winter weeds before planting trees and shrubs. Cottonwood (*Populus balsamifera* L. *trichocarpa*, POBAT), ninebark (*Physocarpus capitatus* (Pursh) Kuntze, PHCA11), redosier dogwood (*Cornus sericea* L., COSES), ash (*Fraxinus latifolia* Benth., FRLA), and snowberry (*Symphoricarpos albus* (L.) Blake, SYAL) were acquired from local native plant nurseries.

Bareroot trees and seedlings (18 to 36 in tall) were planted by hand on May 8, 2012 in rows 5 ft apart and in plots 15 ft long within a randomized split-plot design with 4 replications. After trees and shrubs were planted, water was applied to settle the soil around each plant using irrigation (at OSU research farm) and a hose (1 gal/plant) at the nonirrigated site (Half Moon Bend). Preemergence herbicides were applied as a directed-application to plots after watering. Plots were mowed mid-July (at both sites) and rototilled between rows (at the irrigated site; OSU Research Farm) to reduce competition from weeds. Tree growth, survival, and weed control were monitored throughout the summer. Electric fence was installed but did not eliminate all grazing by deer at Half Moon Bend.

Results and Discussion

Flumioxazin provided excellent preemergence weed control with low risk of injury to transplants at both sites (Tbls. 2 and 3). Weed competition in the untreated plots at Half Moon Bend curtailed tree and shrub growth (Fig. 1) and caused on average 41% mortality of trees and shrubs (65% of redosier dogwood 17% of snowberry). Initial results indicate that of eight herbicides screened, flumioxazin is the best fit based on efficacy, crop safety and environmental toxicology. Flumioxazin provided near complete suppression of emerging weed seedlings, and significantly improved tree survival by the end of summer.

Table 1. Herbicide application data.

	OSU RESEARCH FARM	HALF MOON BEND
Date	May 10, 2012	May 20, 2012
Crop stage	2DAP	10DAP
Herbicide/treatment	PRE	PRE
Start/end time	6:15-7:30 AM	7:30-8:30 AM
Air temp/soil temp (2")/surface	59/48/48	60/-/-
Rel humidity	48%	90%
Wind direction/velocity	0-1 NE	0
Cloud cover	0	100
Soil moisture	Dry except where holes were dug	Damp
Plant moisture	Dry	Damp, few sprinkles of rain
Sprayer/PSI	BP30	BP30
Mix size	2100 ml/ 2 plots	6000 mls
Gallons H20/acre	20	20
Nozzle type	2-XR-8003	3-XR-8003
Nozzle spacing and height	20/20	20/20
Soil inc. method/implement	Irrigated next day with 0.5 in of water	Rain coming, expect more than 0.5 in in next 3 days

Table 2. Mean phytotoxicity ratings (0-10, 10=dead) for herbicide effects on five native species planted at the irrigated site (OSU Research Farm).

Treatment		Rate	Phytotoxicity ratings 29 May 2012					Weed control 31 Jul
		lbs ai/A	Ave. composite rating (0-100)	Pacific ninebark (PHCA11)	Oregon ash (FRLA)	Redosier dogwood (COSES)	Snowberry (SYAL)	Ave. composite rating (0-100)
1	flumioxazin	0.3825	0.1	0.1	0.0	0.1	0.0	88.8
2	indaziflam	0.065	0.1	0.0	0.0	0.5	0.0	90.0
3	prodiamine	1.5	0.0	0.3	0.0	0.1	0.3	67.5
4	rimsulfuron	0.0625	0.0	0.3	0.0	0.1	0.0	55.0
5	saflufenacil	0.044	5.3	3.0	0.0	0.6	0.3	57.5
6	mesotrione	0.1875	0.0	2.5	0.3	0.8	0.5	46.3
7	isoxaben	1.0	0.0	0.0	0.0	0.4	0.0	25.0

Table 3. Mean phytotoxicity ratings (0-10, 10=dead) for herbicide effects on five native species planted at the non-irrigated site (Half Moon Bend).

Treatment		Rate	Phytotoxicity ratings 29 May 2012					Weed control 17 Jul
		lbs ai/A	Black cottonwood (POBAT)	Pacific ninebark (PHCA11)	Oregon ash (FRLA)	Redosier dogwood (COSES)	Snowberry (SYAL)	Ave. composite rating (0-100)
1	flumioxazin	0.3825	1.5	2.0	0.5	0.3	2.0	96.5
2	indaziflam	0.051	0.8	2.8	1.8	0.5	0.1	83.8
3	prodiamine	0.0	0.0	0.0	0.0	0.3	0.3	68.8
4	isoxaben	0.5	0.5	0.5	0.3	0.0	0.0	57.5

Figure 1. Untreated check on left and flumioxazin on right. Note difference in tree growth and survival.