Research report to the

Oregon Processed Vegetable Commission 2007

Title: *Weed management in sweet corn and other rotational crops*

I. Wild proso millet and broadleaf control with HPPD inhibitor herbicides.
II. Carryover Potential of Impact Herbicide.
III. Tillage and rotational effects on weed seed predation by ground beetles in the PNW.

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SUMMARY

- Impact and Laudis herbicides were evaluated for wild proso millet and broadleaf weed control in sweet corn.
- The most effective treatments were Impact and Laudis applied with Outlook and atrazine at V2-3.
- 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).
- Impact + Outlook + atrazine (Tr. 14) provided yields above 11 t/A with exceptional wild proso millet control (Table 2).
- 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/A or none will give the same yield of sweet corn when there is a high density of both wild proso millet and broadleaves.
- The symptoms normally associated with Impact injury (bleaching) have not been observed on crops planted in the fall or spring following sweet corn. Crop stand and yield may have been reduced in a few sensitive crops such as table beets. However, this only occurred at the 2x rate. There is very little risk of crop injury caused by Impact herbicide carryover.
- Insecticides reduced the activity and density of the ground beetle *P. melanarius* from 2.0 beetles to 0.3 in the strip-till plots and from 1.5 to 0.2 beetles in conventional tillage. There was no effect of the tillage systems on beetle activity-density.
- Seed loss due to predation by ground beetles averaged 20% during the month of August. Predation of wild proso millet seeds was influenced by the tillage-insecticide treatments. Insecticide use was the most important factor regulating predation of wild proso millet.

PROJECTS

Ia. Impact and Laudis weed control efficacy in sweet corn.

Impact (topramezone) was used for the first time in 2006 with great success. This is the first significant registration to impact wild proso millet since Accent was labeled in 1996. Topramezone is an HPPD inhibitor like Callisto and Balance herbicides, but with less injury potential to sweet corn than Callisto and Accent. Plus it can be used with any insecticide. Laudis (tembotrione) will be registered for use by Bayer in the near future. Challenge is to develop use patterns for topramezone that control weeds with a single application when the corn is small, and that eliminate the need for atrazine. The label currently encourages tankmixing with 1 pt or more atrazine to enhance control of broadleaves.

The 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 (V4-5) 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 on Sept. 5. Field day participants helped to evaluate the plots on July 19, 9 WAP.

Results

- Bleaching and burning of corn leaves was noted in a few cases, most prominently when Impact and Laudis were tankmixes 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.
- Average evaluation scores from the field day participants were closely correlated with crop yield (R=0.90), even though only one replication was evaluated and the ratings were made 7 weeks before harvest (Table 3). The best rating was given to Tr 14 (Impact + Outlook + atrazine applied at V2-3).
- 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	%						

	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		----------------%----------------		
13	Impact	V4-5	18-Jun	0.75	oz	0.016	0.3	0.0	21	15	85
	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	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	%						

	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		----------------%----------------		
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	%						
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	%									

	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*
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	%									
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	%									

	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*
Surfactant and nitrogen effects														
22	Impact MSO	V4-5	19-Jun	0.75 0.25	oz %	0.016	84	49	75	65	53	-	-	-
23	Laudis MSO	V4-5	19-Jun	3 0.25	oz %	0.082	86	15	91	80	45	-	-	-
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 19, 2007. Treatments were evaluated in only one replication of the four in the experiment. Values for Trs. 16 and 32 are not presented because of overspray from the commercial application that may have confounded interpretation in this replication. Lines highlighted in gray were given an average overall treatment rating ≥ 8.0. The data are based on an average of twelve observations (participants).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
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
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 6in, most 4"	v4-5, max 6in, 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

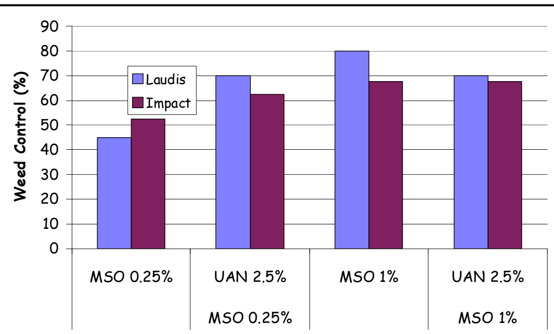

Figure 1. Effect of surfactant on weed control with Laudis and Impact herbicides.

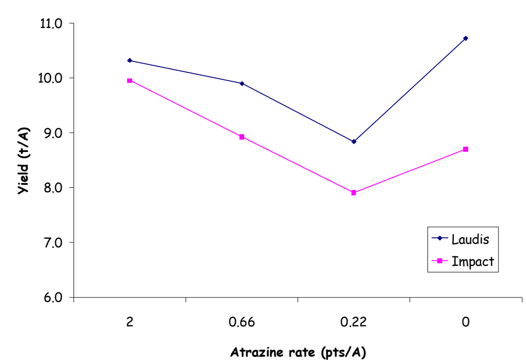

Figure 2. Effect of atrazine tankmixes with Laudis and Impact on corn yield. Note scale of y-axis.

I-b. Effect of Atrazine on Laudis Activity

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 in 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

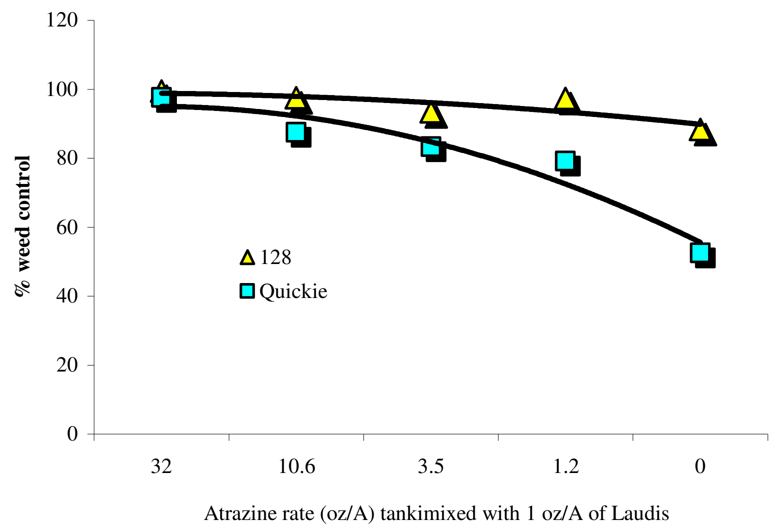

Figure . Effect of atrazine rate (oz/A) on weed control when applied with 1 oz/A of Laudis.

II. Carryover Potential of Impact Herbicide, Corvallis, OR

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 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	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			

Planting Season and Crop	Planting date	Herbicide rate	Emergence/ stand	Phyto	Stunting	Biomass/ yield
		1=0.75 oz; 2=1.5 oz/A	*% of check in the fall of 2006*	*0-10*	*%*	#/unit area
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*
			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).

III. Tillage and rotational effects on weed seed predation by ground beetles in the PNW.

Regulation of weed seed banks in agricultural systems involves management of seed input from seed rain, and seed removal from mortality and germination. While seed rain, germination, and emergence are managed using a number of methods such as tillage and herbicides, management of seed mortality is frequently overlooked. Seed predation by invertebrates such as carabid beetles is a key source of mortality in many cropping systems. The influence of ground beetles on weed seed density in the soil, and the potential to increase the abundance of these seed predators in agricultural systems has not been determined in commercial vegetable production sites in the Pacific Northwest, and is poorly understood in many cropping systems. Objectives were to determine the impact of select agronomic practices on seed predator activity density and seed predation efficacy.

Methods. We measured activity density of seed predator ground beetles and weed seed consumption rates in farm fields in western Oregon and eastern Washington. Pitfalls were placed: 1) along a line that transversed the entire field; and 2) within a 0.4 acre plot that was treated with an insecticide appropriate to the crop.

At the OSU Vegetable Research Farm, pitfall traps and seed stations were placed in 33 x 66 ft plots that were surrounded by 6 inch tall landscape edging. Four tillage-insecticide treatments were applied to 24 plots, with 6 replications of each treatment. Half of the plots were disked and roto-tilled in the spring, and the other half were strip-tilled twice. Snap beans were planted on 76 cm rows. Bifenthrin was applied at 52 g ai/ha over first trifoliate beans, and ethoprop was banded between rows on at 3.4 kg ai/ha at first bloom.

Results and Discussion. *Pterostichus melanarius* and *Harpalus pensylvanicus* were the primary species trapped in fields in the Willamette Valley. Activity density (AD) tended to increase as summer progressed but inconsistently among sites. Insecticide treatments applied to plots in farm fields reduced seed predator activity-density most at the center of the plot, and beetles slowly recolonized the insecticide treated areas. In the Columbia basin, species diversity was similar in both years. 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 and third most prevalent species were *Agonum melanarium* (23% of organic and 27% of conventional) and *Pterostichus melanarius* (20% of organic and 12% of conventional), respectively.

At the research farm in Corvallis in 2007, the insecticide applications reduced *P. melanarius* mean densities from 2.0 beetles to 0.3 in the strip-till plots and from 1.5 to 0.2 beetles in conventional tillage (Fig. 1). There was no effect of the tillage systems on beetle activity-density. Seed loss averaged 20% during the month of August (Fig. 2). Predation of wild proso millet seeds was influenced by the tillage-insecticide treatments. Contrast analysis indicated that insecticide use was the most important factor regulating predation of wild proso millet ($F=6.4$, $P=0.02$), but that tillage system also may have been important ($F=2.0$, $P=0.16$).

The crop rotation will continue in 2008 with the objective to determine which agronomic practices will inflate carabid numbers the most. Wild proso millet, hairy nightshade and Powell amaranth seeds were planted in plots in the fall of 2007 to determine the impact that tillage and other applied treatments will have on seed survival and recruitment. The weeds seeds were either broadcast on the surface or seeded at 4 cm deep. Sweet corn will be planted in the spring and weed seedling recruitment measured.

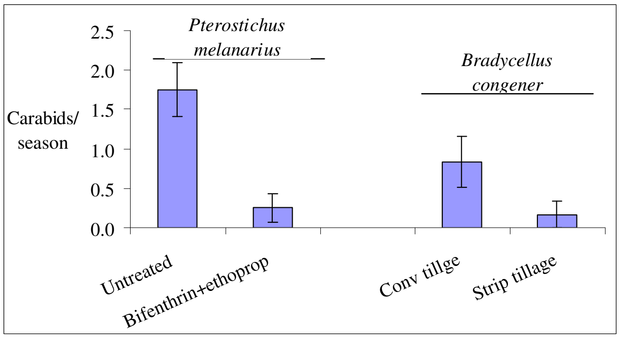

Figure 1. Contrast analysis indicating effects of insecticide and tillage system on ground beetle activity density.

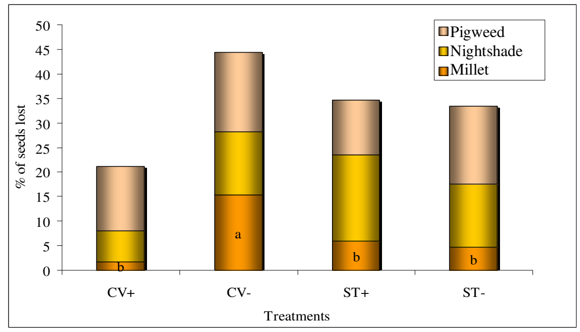

Figure 2. Effect of tillage and insecticide treatment on percent of weed seeds lost from seed stations, August, 2007. Column segments followed by the same letter do not differ (P=0.05). CV = conventional tillage; ST = Strip tillage; ± insecticide.