Research report to the

Agricultural Research Foundation

and the

Oregon Processed Vegetable Commission

2006

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

Project Leader

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1. Impact herbicide efficacy, crop tolerance, and carryover studies

Stayton

The experiment was located on a Newberg silt loam soil with a pH of 5.9, OM of 2.5 %, and CEC of 20 meq/100 g soil. Preplant herbicides and Lorsban (on designated plots) were broadcast prior to final rototilling. Plots were 10 by 30 ft with four replications of each treatment. Sweet corn (var. Bonus) was planted on June 15, and PES herbicides applied on June 16, EPOST herbicides applied on July 3, and POST herbicides applied on July 13. Corn growth and weed control were evaluated throughout the season, corn height measured at mid-season, and yield measured by picking 2- 8 ft rows of corn from selected plots.

Results. Wild proso millet (WPM) density was low at this site, possibly because of late planting that caused a large flush of millet before final soil tillage (rain forced planting in late June rather than late May as originally planned).

Impact provided exceptional control of wild proso millet (Table 1) whether applied as a tankmix or alone. Impact controlled plants that were up to 12 in. tall. Crop tolerance to Impact also was very good. However, the data suggest that Impact may have caused more injury to corn when applied in a tankmix with Outlook and a modified seed oil (MSO) rather than a non-ionic surfactant (NIS) (comparison of Trs. 7 and 8). Additionally, significant crop injury was noted when Outlook was tankmixed with atrazine and applied EPOST; adding Impact to this tankmix reduced corn height by 1/3 ft. but did not significantly reduce yield (Table 3). Outlook is known to occasionally damage corn leaves when applied POST, particularly if the weather is hot.

The registration of Impact herbicide on sweet corn will significantly reduce the impact of wild proso millet on corn production. However, because Impact does not provide residual control of wild proso millet, future research should test one-pass programs that will deliver burndown and residual control while minimizing the number of trips across the field. Outlook, Dual Magnum, and Prowl are potential tank mix partners. Prowl should be avoided as a tank mix with Impact because of its propensity to increase lodging of corn. As in years past, **all** of the corn at this site that was treated with Prowl lodged. Tankmixes of Prowl with Impact herbicide should be discouraged.

Dayton

Sweet corn (var. Punch) was strip-till planted and Dual Magnum and atrazine applied by the grower after planting. Significant rainfall shortly after planting eliminated the efficacy of Dual Magnum and provided a good flush of wild proso millet seedlings. All treatments were applied on July 14. Crop growth and weed control were evaluated throughout the season and corn harvested from 2- 8 ft sections of one row. Only treatments that had 3 replications remaining were harvested, because the grower inadvertently harvested some of the plots on one side of the experiment.

Results. WPM density at this site was great enough to reduce sweet corn yield. However, corn growth was highly variable within the experiment and treatment effects on corn yield were difficult to ascertain. The Check treatment only yielded 5.3 t/A, even though the plots of this treatment had Dual Magnum and atrazine applied to them after planting (Table 4). Impact controlled WPM very well in all treatments, and in some cases controlled millet that was 14 inches tall. Tank mixing Impact and Accent did not significantly improve weed control, but did significantly increase crop injury. Lowering the rate of MSO that was applied with Impact (from 1% to 0.25%) may have reduced WPM control and yield compared to Impact applied with 1% MSO. The addition of UAN did not improve WPM control. Impact killed WPM and reduced competition with the corn crop, but did not stop WPM seed production. Whether this will result in a decline in seed density in the soil over time is unknown. Strategies should be developed that provide residual control of WPM as well as the burndown provided by Impact herbicide.

Lebanon *(Puncturevine control)*

The experiment was located on a Chehalis silty clay loam with a pH of 6.0, OM of 3.8% and CEC of 31.2 meq/100 g of soil. The soil was pre-irrigated before planting because of very dry conditions in May. Eradicane was sprayed on selected plots and incorporated within a dynadrive within 10 minutes. Rain promptly began to fall and created a less than perfect seed-bed. Sweet corn was planted on May 19 into very wet soil and PES herbicides applied on May 20. On June 16, all of the emerged puncturevine seedlings were flagged, and POST treatments were applied on June 20 to puncturevine that had 4-6 true leaves. Puncturevine survival was recorded on June 30, and seedlings counted, recorded and removed from the plot the remainder of the season.

Results. Puncturevine was not evenly distributed at this site, thus weed control evaluations were difficult to make. Nearly all of the puncturevine seedlings died after application of Impact and Callisto herbicides, but puncturevine continued to emerge and many began to produce seeds later in the season (Table 6). The low number of puncturevine recorded in the untreated plots was either do to the location of the plots (randomly assigned to areas with a low density of seeds), or possibly due to the other weeds that emerged faster and kept the soil temperatures low. Prowl +atrazine and Eradicane + Outlook produced the greatest number of seedlings, but once again it is unclear whether this was a plot placement or treatment effect. These plots were nearly devoid of other weeds, which may have encouraged puncturevine emergence. Another possibility, but unlikely, is that these herbicides stimulated puncturevine emergence. This will be tested in the lab.

Corvallis *(carryover study)*

The experimental design for the experiment was a strip plot, with herbicide rate, follow-crop, and planting season as the subplots. Four varieties of sweet corn were planted on May 19 in rows 2.5 ft apart. All plots were replicated 4 times. 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. Soil analysis is in process.

Following corn harvest on September 11, 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 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 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.

Results. There was no evidence of growth reduction or phytotoxicity for any of the crops at 6 WAP (Figure 1) or to date (Dec 22) that indicate Impact herbicide is affecting crop growth. Snap bean and sugar beet emergence counts were slightly reduced in plots with the 2X rate of Impact. Additional crops will be planted in the spring including broccoli, peas, peppermint, perennial ryegrass, snap beans, squash, sugarbeets, and turf-type tall fescue. All crops will be harvested next summer.

Table 1. Weed control and sweet corn response to Impact herbicide, Stayton, OR, 2006.

No.	Product	Rate	Timing	Phytotoxicity		Stunting		Corn height	WPM density	WPM control
				7-13-06 10 DA EPOST	*7-15-06 12 DA EPOST*	*7-13-06 10 DA EPOST*	*7-15-06 12 DA EPOST*	*8-9-06 4 WA POST*	*7-27-06*	*8-9-06*
		lbs ai/A or %		*0-10*		*% (0-100)*		*Ft.*	*No/240 ft^2*	*%*
1	Untreated			0	0	0	0	5.4	7.5	-
SEQUENTIAL										
2	Eradicane Outlook	4.2 0.84	PPI PRE	0	0	0	0	5.1	2.0	84
3	Eradicane Lorsban Outlook	4.2 2.0 0.84	PPI PPI PRE	0	0	0	0	5.4	0.5	98
4	Outlook Impact MSO UAN 28%	0.84 016 1 % 2.5 %	PRE V2-3 V2-3 V2-3	0	0.5	3	10	4.7	0	100
5	Outlook Impact Atrazine MSO	0.84 0.016 0.5 1 %	PRE V2-3 V2-3 V2-3	0.8	0	1	8	4.7	0	100
EARLY POSTEMERGENCE										
6	Outlook Atrazine MSO UAN 32%	0.84 0.5 1 % 2.5 %	V2-3 V2-3 V2-3 V2-3	1.5	0	1	15	5.2	14.5	55
7	Impact Outlook Atrazine NIS UAN 28%	0.016 0.84 0.5 0.25 % 2.5 %	V2-3 V2-3 V2-3 V2-3 V2-3	0.6	0	0	0	5.2	0.5	100
8	Impact Outlook Atrazine MSO UAN 32%	0.016 0.84 0.5 1 % 2.5 %	V2-3 V2-3 V2-3 V2-3 V2-3	1.8	0	4	5	4.8	0.5	100
9	Callisto Outlook Atrazine UAN 32%	0.094 0.84 0.5 2.5 %	V2-3 V2-3 V2-3 V2-3	1.8	0.3	0	8	5.1	0.3	98
10	Prowl H2O Atrazine MSO UAN 32%	1.66 0.5 1 % 2.5 %	V2-3 V2-3 V2-3 V2-3	0.9	0	0	3	5.2	6.3	83
11	Impact Prowl H2O Atrazine MSO UAN 32%	016 1.66 0.5 1 % 2.5 %	V2-3 V2-3 V2-3 V2-3 V2-3	0.8	0	0	0	5.4	0	100

Table 1, cont'd

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No.	Product	Rate	Timing	Phytotoxicity		Stunting		Corn height	WPM density	WPM control
				7-13-06 10 DA EPOST	*7-15-06 12 DA EPOST*	*7-13-06 10 DA EPOST*	*7-15-06 12 DA EPOST*	*8-9-06 4 WA POST*	*7-27-06*	*8-9-06*
		lbs ai/A or %		*0-10*		*% (0-100)*		*Ft.*	*No/240 ft^2*	*%*
POSTEMERGENCE										
12	Impact	0.016	V4-5	3.3	1.0	18	15	5.5	0	100
	Accent	031	V4-5							
	Atrazine	0.5	V4-5							
	MSO	1 %	V4-5							
	UAN 32%	2.5 %	V4-5							
13	Impact	0.016	V4-5	3.0	1.5	28	12	5.3	0.3	100
	Option	0.033	V4-5							
	Atrazine	0.5	V4-5							
	MSO	1.000	V4-5							
	UAN 32%	2.5 %	V4-5							
14	Impact	0.016	V4-5	0	0.8	0	0	5.3	0.8	98
	Atrazine	0.5	V4-5							
	MSO	1 %	V4-5							
	UAN 32%	2.5	V4-5							
15	Impact	0.016	V4-5	0	0	0	0	5.4	0.5	100
	Atrazine	0.5	V4-5							
	Renegade	1.75	V4-5							
16	Impact	0.016	V4-5	0.3	0	3	2	5.3	0.5	100
	Atrazine	0.5	V4-5							
	Renegade	1.75	V4-5							
	Inplace	0.75	V4-5							
17	Impact	0.016	V4-5	0	0	0	0	5.5	1.0	100
	MSO	1	V4-5							
	UAN 32%	2.5 %	V4-5							
18	Accent	0.032	V4-5	2.5	1.3	15	20	5.2	2.0	99
	Atrazine	0.5	V4-5							
	COC	1%	V4-5							
19	Accent	0.032	V4-5	5.0	2.8	28	32	4.9	0.8	100
	Aim	0.008	V4-5							
	COC	1%	V4-5							
LSD (0.05)				0.7	1.5	9	12	0.5	3.8	25

Table 2. Herbicide and weed control effects on sweet corn yields, Stayton, OR, 2006.

No.	Product	Rate	Timing	Corn yield			
				Ear number	Fresh wt yield	Avg. ear wt.	Husked ear avg. wt
		lbs ai/A or %		*No./A*	*t/A*	*kg*	*kg*
1	Untreated			27446	12.4	0.43	0.26
SEQUENTIAL							
2	Eradicane	4.2	PPI	28553	11.9	0.38	0.27
	Outlook	0.84	PRE				
3	Eradicane	4.2	PPI	30545	12.2	0.37	0.26
	Lorsban	2.0	PPI				
	Outlook	0.84	PRE				
4	Outlook	0.84	PRE	26561	11.1	0.38	0.26
	Impact	016	V2-3				
	MSO	1 %	V2-3				
	UAN 28%	2.5 %	V2-3				
5	Outlook	0.84	PRE	26893	11.2	0.38	0.21
	Impact	0.016	V2-3				
	Atrazine	0.5	V2-3				
	MSO	1 %	V2-3				
EARLY POSTEMERGENCE							
6	Outlook	0.84	V2-3	26561	11.3	0.38	0.26
	Atrazine	0.5	V2-3				
	MSO	1 %	V2-3				
	UAN 32%	2.5 %	V2-3				
8	Impact	0.016	V2-3	28221	10.9	0.36	0.24
	Outlook	0.84	V2-3				
	Atrazine	0.5	V2-3				
	MSO	1 %	V2-3				
	UAN 32%	2.5 %	V2-3				
9	Callisto	0.094	V2-3	29549	11.7	0.36	0.27
	Outlook	0.84	V2-3				
	Atrazine	0.5	V2-3				
	UAN 32%	2.5 %	V2-3				
POSTEMERGENCE							
12	Impact	0.016	V4-5	28221	11.5	0.37	0.26
	Accent	031	V4-5				
	Atrazine	0.5	V4-5				
	MSO	1 %	V4-5				
	UAN 32%	2.5 %	V4-5				
14	Impact	0.016	V4-5	29549	12.3	0.38	0.27
	Atrazine	0.5	V4-5				
	MSO	1 %	V4-5				
	UAN 32%	2.5	V4-5				
15	Impact	0.016	V4-5	27889	12.1	0.40	0.26
	Atrazine	0.5	V4-5				
	Renegade	1.75	V4-5				

Table 2, cont'd

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No.	Product	Rate	Timing	Corn yield			
				Ear number	Fresh wt yield	Avg. ear wt.	Husked ear avg. wt
		lbs ai/A or %		*No./A*	*t/A*	*kg*	*kg*
16	Impact	0.016	V4-5	26229	11.1	0.38	0.27
	Atrazine	0.5	V4-5				
	Renegade	1.75	V4-5				
	Inplace	0.75	V4-5				
17	Impact	0.016	V4-5	30213	12.7	0.38	0.27
	MSO	1	V4-5				
	UAN 32%	2.5 %	V4-5				
18	Accent	0.032	V4-5	30102	12.1	0.36	0.26
	Atrazine	0.5	V4-5				
	COC	1%	V4-5				
19	Accent	0.032	V4-5	23462	9.6	0.37	026
	Aim	0.008	V4-5				
	COC	1%	V4-5				
LSD (0.05)				4061	ns	ns	ns

Table 3. Herbicide application data for Stayton site, 2006.

Date	June 14, 2006	June 24, 2006	July 03, 2006	July 13, 2006
Crop stage		Planted 6/20/2006	V 2-3	V4- some V5, up to 14 inches tall
Weeds and growth stage				
Millet		Few millet have emerged	Very few millet, cotyledon to1-2 inches tall	4-leaf to 12 inch diameter plants with 6 leaves or more
Pigweed				12 inches tall
Application timing	PPI	PES	EPOST (V2-3)	POST (V4-5)
Start/end time	10-10:15	6-7 AM	7-8 AM	6:30-8:00 AM
Air temp/soil temp (2")/surface	64/69/71	62/64/62	62/56/59	63/65/67
Relative humidity (%)	100	80	82	88
Dew point	-	-	-	59
Wind direction/velocity	3-6 SE	0-0.5 SE	0-2.8 SW	0-1.2 NW
Cloud cover	100	0	0	100
Soil moisture	Damp	Dry	Dry	Very wet - just irrigated day prior
Plant moisture	-	-	Light dew	Plants very wet - some collars filled with water
Sprayer/PSI	BP 30	BP40	BP40	BP40
Mix size	2100	2100	2100	2100
Gallons H20/acre	20	20	20	20
Nozzle type	8003	8003	8003	8003
Nozzle spacing and height	20/18	20/18	20/18	20/18
Soil inc. method/implement	Field cultivator and leveler within 15 min.	Plan to irrigate next morning		Irrigated yesterday
	Rototilled on 6-16 before planting			

Table 4. Weed control with Impact herbicide, Dayton, OR, 2006.

	Herbicides[1]/surfactants	Rate	*Obs.*	Phytotoxicity rating			Stunting			WPM control		*Obs*	Harvest			
		lbs ai/A or %		21-Jul	26-Jul	9-Aug	21-Jul	26-Jul	9-Aug	26-Jul	9-Aug		Ear count	Fresh wt.	Avg. ear wt.	WPM control
				----------*0-10* ----------			-----------*%*-----------			-------*%*--------			*no/A*	*t/A*	*kg*	*%*
1	Check		*4*	0	0	0	0	0	10	0	0	*3*	13458	5.3	0.36	0
2	Impact	0.016	*4*	1.5	3.8	3.0	13	43	40	93	88		-	-	-	-
	Accent	0.031														
	Atrazine	0.500														
	MSO	1%														
	UAN 28%	2.5%														
3	Impact	0.016	*4*	0	0	0	0	0	15	95	88	*3*	17353	7.9	0.42	82
	Atrazine	0.500														
	MSO	1%														
	UAN 32%	2.5%														
4	Impact	0.016	*4*	0.3	0	0	3	0	0	95	86	*3*	16645	7.8	0.43	78
	Atrazine	0.500														
	Renegade[2]	1.75 pts/A														
	Inplace	0.75 oz/A														
5	Impact (0.5 oz)	0.011	*4*	0	0	0	0	3	10	96	81	*2*	21780	9.2	0.38	83
	MSO	1%														
	UAN 32%	2.5%														
6	Impact	0.016	*4*	0	0	0	0	0	9	86	78	*3*	12041	5.5	0.44	67
	MSO	0.25%														
7	Impact	0.016	*4*	0	0	0	0	0	3	93	85	*4*	20983	9.3	0.40	74
	MSO	1%														
8	Impact	0.016	*4*	0	0	0	0	0	8	97	90	*3*	19832	8.8	0.40	80
	MSO	1%														
	UAN 32%	2.5%														
9	Accent	0.032	*4*	3.0	3.0	2.5	25	30	35	89	91	-	-	-	-	-
	Atrazine	0.500														
	MSO	1%														
	UAN 32%	2.5%														
10	Accent	0.032	*4*	3.5	3.5	3.0	30	35	19	90	93	-	-	-	-	-
	MSO + UAN (32%)															
FPLSD (0.05)				0.7	0.7	0.7	9	9	22	6	11		6210	2.4	ns	28

[1] Dual Magnum and atrazine were applied to the entire field at planting.
[2] MSO = Super Spread (Wilbur Ellis); NIS = Preference (Agriliance); Renegade = modified vegetable oil and nitrogen blend (Wilbur Ellis); Inplace=deposition and drift management agent (Wilbur Ellis).

Table 5. Schedule and herbicide application data, Dayton, 2006.

Date	Friday, July 14, 2006
Crop stage	v5; 6-14 tall, irregular on this edge of field
Weeds and growth stage	
Millet	2-4" tall; up to 8" in dia.
Lambsquarters	4-6 lf, very few
Application timing	POST
Start/end time	7-8 AM
Air temp/soil temp (2")/surface	70/72/72
Relative humidity	65%
Dew point	52%
Wind direction/velocity	0
Cloud cover	0
Soil moisture	Very dry, plans to irrigate within 12 hrs
Plant moisture	Light dew
Sprayer/PSI	BP/40
Mix size	2100 mls/4.8 plots
Gallons H20/acre	20
Nozzle type	New 8002 and 50 screens
Nozzle spacing and height	20/24” above soil to avoid high conc. on corn whorls

Table 6. Puncturevine control with Impact herbicide, Lebanon, 2006.

	Herbicide	Rate		Timing	Date	Puncturevine density before EPOST app. (17-June)		EPOST control 2 WAT (30-June)	Cumulative puncturevine density (through 10-Aug)
						# plots	*no./plot*	*%*	*no./plot*
1	Untreated					*1*	0.5	-	1.5
2	Eradicane	5	pts	PPI	19-May	*0*	0	-	0.3
3	Outlook	1	pt	PRE	20-May	*0*	0	-	1.5
4	Dual Magnum	2	pts	PRE	20-May	*0*	0	-	1.8
5	Eradicane	5.0	pts	PPI	19-May	*2*	10.5	-	14.8
	Outlook	16	oz	PES	20-May				
6	Outlook	16	oz	PRE	20-May	*1*	0.3	-	1.0
	Atrazine	10	oz	PRE	20-May				
7	Prowl H2O	2.0	pts	PRE	20-May	*3*	7.8	-	31.3
	Atrazine	0.6	pt	PRE	20-May				
8	Outlook	16	oz	PRE	20-May	*1*	0.8	100	1.8
	Impact	0.75	oz	EPOST	17-Jun				
	NIS	0.25	%	EPOST	17-Jun				
	UAN 32%	2.5	%	EPOST	17-Jun				
9	Outlook	16	oz	PRE	20-May	*2*	1.5	100	1.5
	Impact	0.75	oz	EPOST	17-Jun				
	Atrazine	10	oz	EPOST	17-Jun				
	NIS	0.25	%	EPOST	17-Jun				
	UAN 32%	2.5	%	EPOST	17-Jun				
10	Impact	0.75	oz	EPOST	17-Jun	*0*	0	-	0.5
	Outlook	12.0	oz	EPOST	17-Jun				
	Atrazine	10	oz	EPOST	17-Jun				
	NIS	0.25	%	EPOST	17-Jun				
	UAN 32%	2.5	%	EPOST	17-Jun				
11	Callisto	3	oz	EPOST	17-Jun	*2*	0.8	100	2.0
	Outlook	12.0	oz	EPOST	17-Jun				
	Atrazine	10	oz	EPOST	17-Jun				
	UAN 32%	2.5	%	EPOST	17-Jun				
12	Impact	0.75	oz	EPOST	17-Jun	*2*	1.3	75	3.0
	MSO	1.0	%	EPOST	17-Jun				
	UAN 32%	2.5	%	EPOST	17-Jun				
13	Accent	0.67	oz	EPOST	17-Jun	*1*	2.0	88	1.3
	Atrazine	10	oz	EPOST	17-Jun				
	COC	1	%	EPOST	17-Jun				
14	Atrazine			PRE	20-May	*2*	6.8	-	10.5
	FPLSD (0.05)						ns	47	17.0

Table 7. Application data for Lebanon site, 2006.

Date	Friday, May 19, 2006	Saturday, May 20, 2006	Saturday, June 17, 2006
Crop stage		Planted 5-19 into very wet pre-irrigated soil with rainfall following during the night	8" max, v3, 5-6 leaf
Weeds and growth stage			
Puncturevine			4-6 lf
Pigweed			4-6 lf
Nightshade			4-6 lf
Lambsquarters			4-8 lf
Application timing	PPI Eradicane	PES	EPOST
Start/end time	8:30-10:00	7-7:45	7:20-8 ~~am~~AM
Air temp/soil temp (2")/surface	68.5/70.5/80.1	56/60/59	62/64/65
Rel humidity	86%	92%	82%
Wind direction/velocity	1	0-1 W	0-2 NW
Cloud cover	Partly cloudy	Partly cloudy	90
Soil moisture	Damp	Very, very, wet	Dry crusted
Plant moisture			Dry
Sprayer/PSI	BP 30	BP 30	BP 40
Mix size	2100	2100	2100
Gallons H20/acre	20	20	20
Nozzle type	5, 8003	5, 8003	5, 8003
Nozzle spacing and height	20/18	20/18	20/18
Soil inc. method/implement	Dynadrive within 10 minutes		

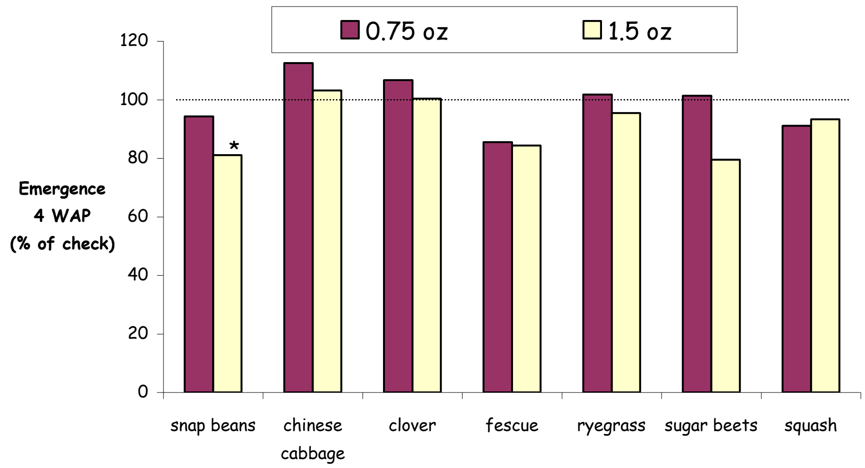

Figure 1. Effect of Impact herbicide on rotational crops planted 82 days after Impact herbicide was applied to sweet corn, Corvallis, 2006. The asterisk (*) indicates that snap bean emergence may have been lower compared to the untreated check when Impact was applied at 1.5 oz in June.

2. Seed predation potential in field crops

Background. Regulation of weed seed banks in agricultural systems primarily 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.

Methods. During the summer and fall of 2006 we began to measure the seed predation potential of carabid beetles, and the use of crop and tillage rotational strategies to promote the establishment of seed predators in vegetable cropping systems. Sites were located both in western Oregon (5) and eastern Washington (4). Western Oregon sites were primarily conventional corn, beans and grass fields. Eastern Washington sites consisted of both organic and conventional corn and carrot fields. Seed predation stations were placed in several areas of the field, along edges and in the middle. Each station included a pitfall trap to determine species in the field, and three types of exclosures over weed seed trays to calculate seed predation. The exclosures included one designed to exclude all mammals (mice) and insects, one that allowed insects but excluded mammals, and one that allowed entry of both mammals and insects. Fifty pigweed seeds were placed on 2 inch dia. Petri dishes under each exclosure and the number remaining after 7 to 14 days was recorded. Time lapse photography also was used to monitor removal of seeds by carabids and other invertebrates.

Results. Seeds were removed from both the mammal exclosures (allow arthropod entry) and the total exclosures, although the number of seeds removed from the mammal exclosures was higher than the total exclosures. The number of seeds removed per day and the number of seed predators caught per day was greatest during August (Figure 2). The number of seeds removed and number of seed predators caught per day was greater in the bean crop than in the corn or carrots. The most prevalent species caught in the fields included *Pterosticus melanarius, Harpalus pennsylvanicus, Harpalus affinius, Amara aenea,* and *Agonum melanarium*. *P. melanarius* was the primary large carabid species on the west side and *H. pennsylvanicus* was the primary large species in the eastern Washington fields.

Discussion. Regression analysis suggests a correlation between number of insects and seeds removed from the total exclosures. Although seeds were removed from the seed stations by invertebrates as predicted, they were also removed from exclosures designed to exclude both insects and mammals. Time lapse photography suggests that the removal may be due to seed sticking to earthworms and slugs that crawl across the seed plates. Modifications to the exclosures will include a bottom barrier to prevent both earthworms and soil dwelling and burrowing arthropods entry by emerging through the soil surface.

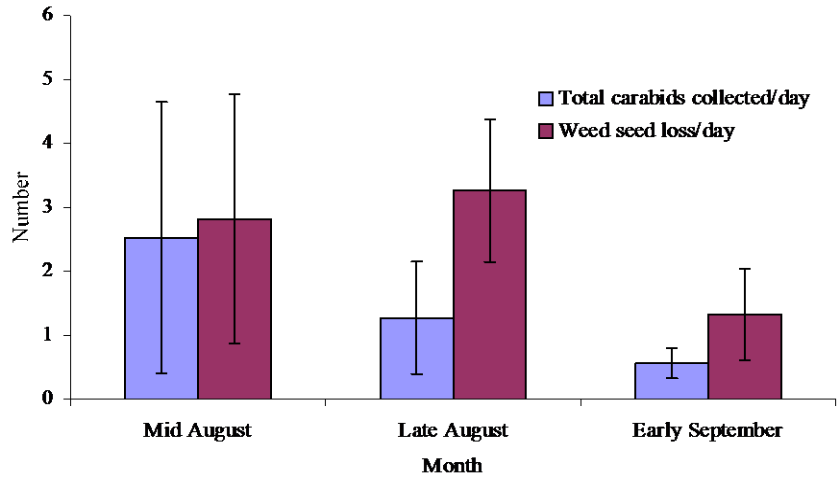

Figure 2. Effect of collection date on number of carabids (potential seed predators) trapped and weed seed loss per day averaged over both East and West sites. Error bars are standard deviation (n=40 to 50).