Research report to the

Agricultural Research Foundation

and the

Oregon Processed Vegetable Commission

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Title: Pest Management in Sweet Corn

1. *Irrigation level effects on sweet corn growth, yield, and root rot*
2. *Wild Proso Millet (WPM) control*
3. *Survival and emergence of WPM*

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Summary

- Reducing the irrigation level during the first 6 weeks after planting reduced root rot and firing of Jubilee sweet corn but did not affect corn yield.
- The rating used to quantify lesions on the radicle was a good predictor of root rot when corn was harvested.
- Combinations of preplant (PPI) and post-plant surface (PPS) herbicides were needed to control WPM in an on-farm demonstration project.
- WPM seeds emerged over a greater temperature range when buried at 10 inches during the winter than when buried at 5 or 0.5 inches.
- WPM seeds buried near the surface emerged much better when rainfall was prevented from striking the soil surface.

1. Irrigation and soil applied herbicide effects on corn root rot.

Data from the last two years indicates that irrigation amount and timing can influence corn growth and the onset of root rot. In trials in 2001, sweet corn growth was significantly greater when sweet corn was planted into moist soil than when planted into dry soil and irrigated up. In 2002 in field-scale trials, Jubilee sweet corn yielded as much or more when the amount of irrigation applied during the first 8 weeks was reduced by 25%. Greenhouse studies have indicated a link between root rot severity and herbicide. The objective of this study was to determine the effect of irrigation level and herbicide on root rot severity in sweet corn.

Methods

Plots were located at the Vegetable Research Farm near Corvallis with a silt loam soil. The field had a history of root rot. There were four irrigation levels applied to plots. Plots were either pre-irrigated and Jubilee sweet corn (2 seeds/ft) planted (plant to moisture treatment), or the corn was planted into dry soil and irrigated (irrigated-up treatment). These two initial irrigation levels were followed by either a low or high irrigation rate until the 6th leaf stage of corn when roots were dug and radicles evaluated for disease. Thereafter, irrigation rates were the same for all treatments (see Table 1.1). Dual Magnum (16 oz/A), Outlook (24 oz/A), and Atrazine (2 qts/A) were all applied preemergence shortly after the corn was planted. Hand hoeing augmented herbicides to minimize weed competition. The check plot was untreated until July 25, when Distinct herbicide (4 oz/A) was applied to control purselane.

Results

Corn emergence was best when the soil was pre-irrigated and corn was planted one week later (Table 1.2). Corn height was greatest under the high irrigation regime, particularly when planted to moisture and followed by the high irrigation level. Corn height was severely restricted by the application of Distinct herbicide in the check plots to control purselane, but also reduced by a lesser degree with Dual Magnum and Outlook, depending on irrigation level.

Weed emergence was primarily related to herbicide (Table 1.2). There was very little indication that irrigation level was influencing herbicide efficacy, with the exception of purselane.

Radicle root rot ratings at midseason were significantly greater under the high irrigation regimes (Table 1.2). Mesocotyl and nodal root rot ratings also were influenced by irrigation, but the effect was much less. There was very little indication statistically that herbicides were influencing lesions on the radicle. However, as other experiments have indicated, Dual Magnum may have caused more lesions to form on the radicle than atrazine or Outlook at the low irrigation level (Figure 1.1).

Root rot evaluation at harvest indicated similar trends; root rot was greatest in treatments with higher irrigation rates through mid-season (Figure 1.2). Additionally, the radicle ratings taken at mid-season were partially correlated with the root rot ratings at the end of the season (Figure 1.3), demonstrating the utility of radicle evaluation to predict root rot potential.

Significant firing was observed in treatments with the higher irrigation levels at harvest (Table 1.3). A second evaluation 2 weeks later found that firing had significantly advanced in the high irrigation plots. Firing was also observed in the low irrigation plots, but at much lower levels.

Sweet corn yield was greatest when irrigation was restricted during the first six weeks after planting (Table 1.3). The check treatments yielded very poorly because of injury from Distinct herbicide (possibly due to high temperatures after application). Treatment with Dual Magnum and Outlook also tended to yield less than the atrazine treatment under both irrigation regimes. In the end, treatments with very low irrigation levels during the 6 weeks after planting yielded as good as or better than comparative herbicide treatments under high irrigation. This data is contrary to emergence and growth measurements made up to 8 weeks after planting, in which corn height was greater under the higher irrigation levels.

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

Table 1.1. Irrigation and activity schedule.

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

Table 1.2. Effect of irrigation on early and midseason corn growth, root disease rating, and weed control.

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

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

Table 1.3. Effect of irrigation level on sweet corn yield, root rot and firing.

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

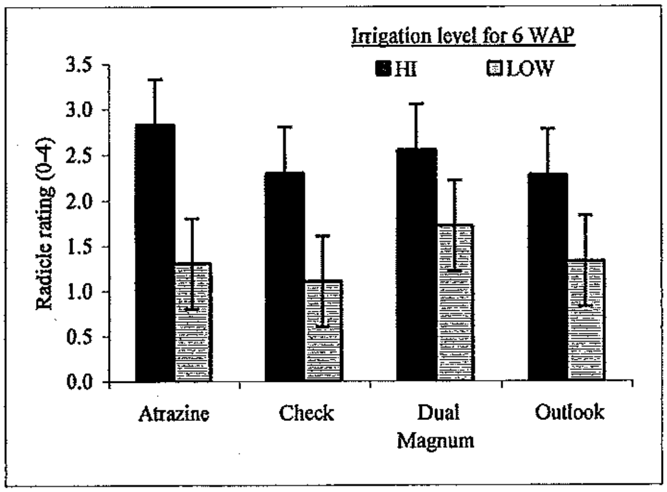


Figure 1.1. Effect of herbicide and irrigation level for 6 weeks after planting on radicle lesion evaluation (±SE).

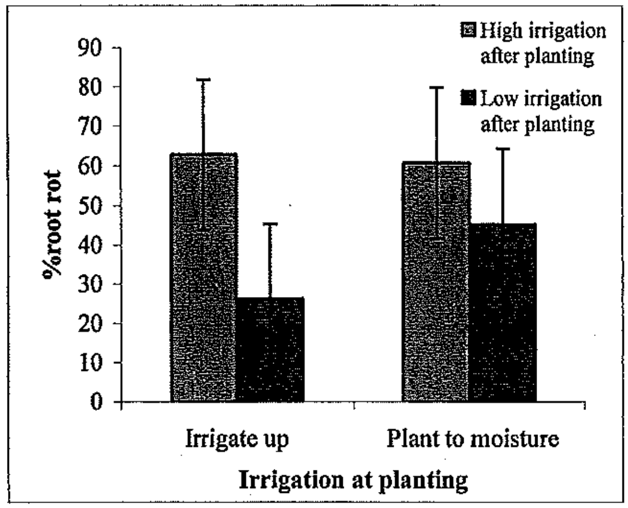


Figure 1.2. Effect of irrigation level at planting and 6 weeks after planting on root rot at harvest (±SE)

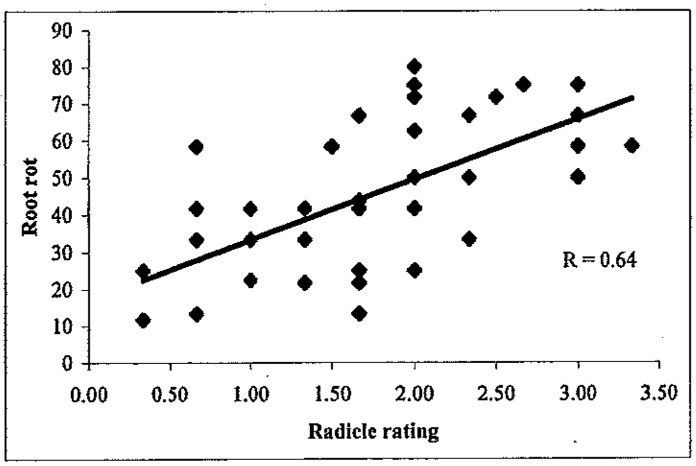


Figure 1.3. Relationship between radicle lesion rating at 6 WAP and percent root rot at harvest.

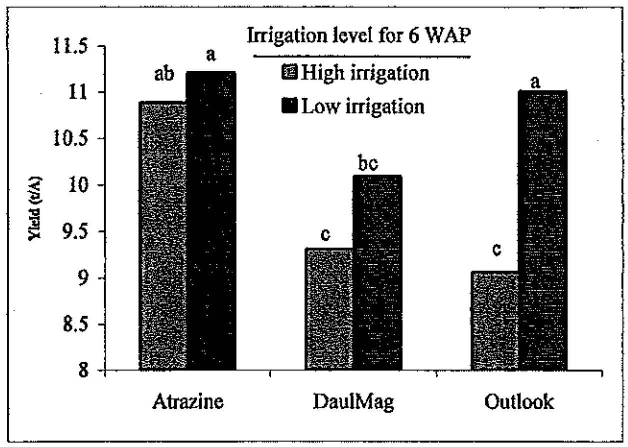
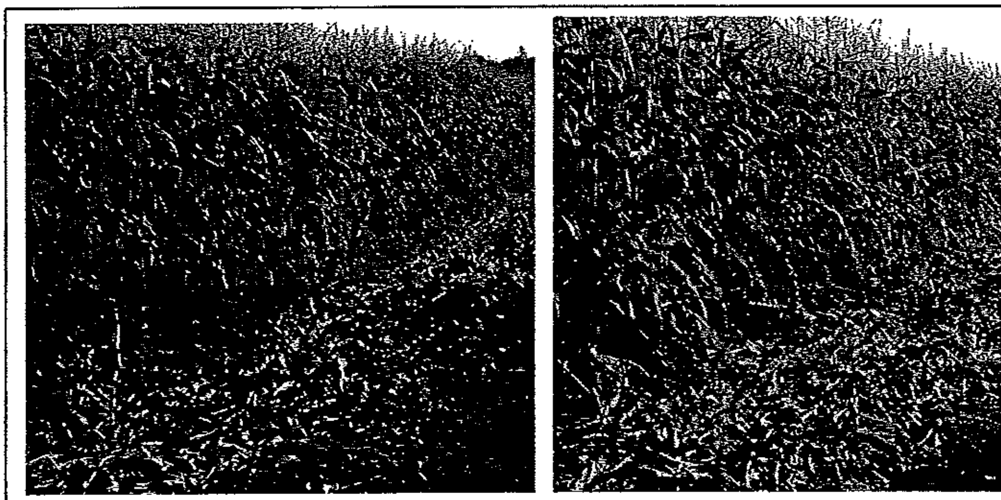


Figure 1.4. Effect of herbicide and irrigation level on corn yield.



High irrigation Low irrigation

Figure 1.5. Effect of irrigation level on firing.

2. Controlling Wild Proso Millet

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

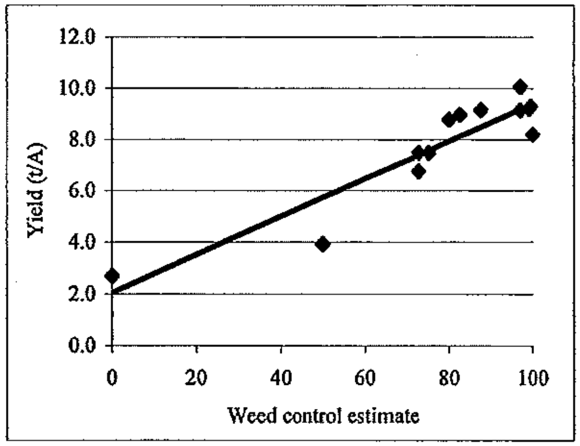


Figure 2.1. Effect of weed control on yield.

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

Table 2.2. Effect of soil-applied herbicides on millet control and corn yield, Monroe, 2003.

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

3. Factors controlling emergence potential of Wild Proso Millet

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

Emergence of seeds in April approached 30 % of the seeds that were buried at 10 inches, but was less for seeds buried at 5 and 0.5 inches (Figure 3.3). Emergence was less when seeds were tested in July, with one exception. Seeds that were covered during the winter had a high level of emergence even though they were buried near the soil surface during winter. There were no significant differences in the number of seeds that remained viable during the winter.

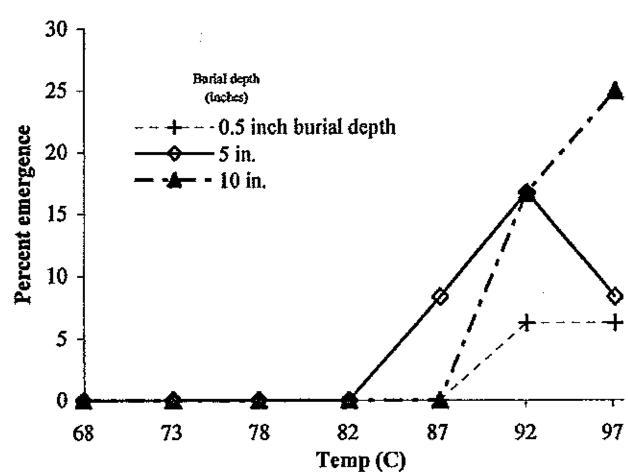


Figure 3.1. Effect of burial depth on emergence of wild proso millet after 14 days at specified temperature. Seeds tubes were excavated on April 25, 2003.

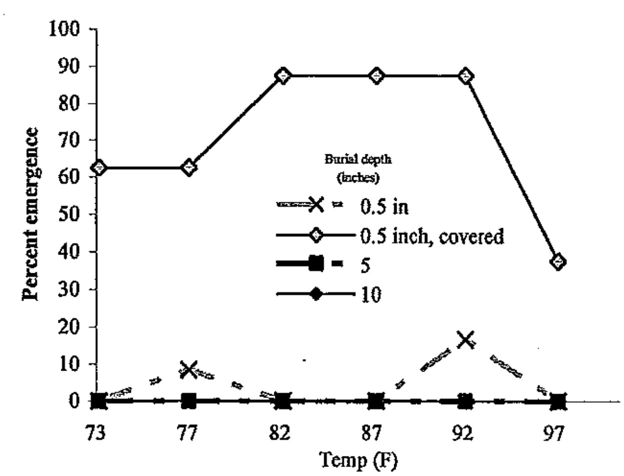


Figure 3.2. Effect of burial depth on emergence of wild proso millet after 14 days at specified temperatures. Seeds tubes were excavated on July 15, 2003. 'Covered' seeds were buried at the soil surface but a Plexiglas tent prevented rainfall from striking the soil surface. Note difference in scale to Fig. 3.1.