Project Number: 13K 3419 7228

Title: Weed control in vegetable seed crops.

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Reporting Period: 2010-11

Accomplishments: Four weed control trials in vegetable seed were conducted in 2010: one study each in cabbage seed and table beet seed and two studies in spinach seed.

Results:

Cabbage seed trial. Eight cabbage seed lines were transplanted at WSU Mount Vernon NWREC September 16, 2009. All plots received simazine treatment October 20 for general weed control prior to the spring applications of interest. Postemergence (POST) applications of Goal, GoalTender, Starane, and UpBeet were made over-the-top of cabbage plants February 9, 2010. Crop injury and weed control were estimated March 6 and April 16. All plants were pulled from the soil April 14-15 and plant population and fresh weight from each plot were recorded. The trial was a split-block, randomized complete block with three replicates.

Cabbage treated with Goal showed 22% injury in March, while the combination of Goal + UpBeet resulted in a similar 23% injury (Table 1). Both treatments caused significantly more injury than a mixture of GoalTender + UpBeet (15%); injury from the other treatments did not exceed 10%. By mid-April, crop injury from all treatments was uniformly low and statistically equal to non-treated cabbage (data not shown).

For the most part, weed control from these products (following fall-applied simazine) was similar (Table 1). Products did not significantly improve weed control from simazine alone in early March, but by mid-April, all were providing enhanced control. There was no difference between treatments at any time, with weed control from these products in April ranging from 92 to 98%.

Herbicides did not affect cabbage stand, but cabbage fresh weight was reduced by all treatments except Starane alone as compared to nontreated cabbage. Cabbage fresh weight and was reduced by Goal and Goal + UpBeet (38 and 43% reduction, respectively), by GoalTender and GoalTender + UpBeet (12 and 31% reduction, respectively), by Starane + UpBeet (11% reduction) and UpBeet alone (21% reduction). Not every cabbage line responded similarly, however, so further spring testing of these products is warranted.

Spinach seed.

Herbicide trial. Due to extremely wet spring conditions at WSU Mount Vernon NWREC, spinach wasn't seeded until June 18, 2010. Preplant-incorporated (PPI) treatments were applied June 18, preemergence (PRE) June 19, and POST July 9. Weed control and crop injury were estimated July 6, July 29, and September 15. All plants in each plot were counted and pulled from the soil September 11 and plants placed in the greenhouse and drying ovens to dry. Plant biomass will be determined, then seed will be threshed, cleaned, and weighed. This trial was midway between two commercial spinach seed fields, so no male spinach lines were used in this trial. Because of this, and because of the lateness of the planting, no seed germination will be determined. The trial was a randomized complete block with four replicates.

Crop injury was generally low for all these treatments, with the exception of 20% damage to spinach from Ro-Neet + Eptam applied PPI (Table 2). Command applied at 10.7 (PPI) or 6.4 fl.oz/a (PRE) caused slight (6%) initial injury compared to nontreated spinach. No treatments were causing significant crop injury by July 29 (data not shown).

Weed control at the July 6 evaluation represented PPI and PRE treatments only, since POST treatments were not applied until July 9 (Table 2). Ro-Neet applied with Dual Magnum, Define, or Eptam, Nortron + Eptam, or either rate of Command applied PPI were providing the best weed control by early July, ranging from 88 to 98% control. By late July, all Ro-Neet combinations, Nortron + Spin Aid, Dual Magnum + Spin Aid, and both Command (PPI) treatments were giving weed control ratings from 86 to 95%. By harvest, however, the best

herbicide treatments were providing only 75 to 90% weed control. These treatments were Ro-Neet + Asulox, Nortron + Command or Asulox, Dual Magnum + Asulox, both rates of Command applied PPI, and Command at 6.4 fl.oz/a applied PRE. Until crop biomass is determined and applications made at a more conventional time of year, however, rates of these herbicides are not considered to definitive, as crop injury may have been higher than acceptable.

Micro-rate trial. Spinach was seeded as in the herbicide trial. Herbicides were also applied the same day as in the herbicide trial. Two POST treatments were used in this trial, however, so the first, P7, was applied 7 days after spinach emergence (July 9) and the second, P14, was applied 14 days after spinach emergence (July 16). Crop injury and weed control estimates and plant harvest was conducted as in the herbicide trial. The trial was a randomized complete block with four replicates.

Crop injury was not significantly greater from any treatment than in nontreated spinach (data not shown). Weed control at the July 6 evaluation represented PPI and PRE treatments only, since POST treatments were not applied until July 9 (Table 3).

All four Ro-Neet applications and half of the Nortron applications were providing the best weed control by early July, ranging from 86 to 95% control (Table 3). By late July, Ro-Neet combinations with one or two Spin Aid + Asulox micro-rate applications or two Stinger + Asulox micro-rate applications, and the Nortron or Dual Magnum with two Spin Aid + Asulox microrate applications were giving weed control ratings from 90 to 98%. By harvest, however, the best herbicide treatments were providing only 75 to 86% weed control. These treatments were Ro-Neet or Dual Magnum with two micro-rate applications (either Spin Aid or Stinger +Asulox) or Nortron with two micro-rate applications of Spin Aid + Asulox. As in the herbicide trial, however, until crop biomass is determined and applications made at a more conventional time of year, rates of these herbicides are not considered to definitive, as crop injury may have been higher than acceptable.

Table beet herbicide screen. Red beet stecklings were transplanted May 11 at WSU Mount Vernon NWREC. PPI treatments were applied May 10, PRE treatments were applied May 14 and POST treatments were applied June 22, June 29, and July 6. Crop injury and weed control were estimated July 29. Because of severe stand reduction due to flooding in the field, the trial was destroyed at the end of July. Early season weed control was poor to excellent, with three micro-rate applications achieving the best weed control (Table 4). Based on these results, additional testing is warranted in 2010.

Table 1. Crop injury and weed control from spring herbicide application to eleven overwintered cabbage seed lines (2009-10).

		Crop injury	Weed control			
Treatment[a]	Rate	Mar 6	Mar 6	Apr 16	Fresh weight[b]	Cabbage stand[b]
	product/a	%	%	%	lb/plant	plants/plot
Goal (2 lb/gal product)	2.0 pt	22 a	97	96 a	1.54 de	8.1
Goal (2 lb/gal product) + UpBeet	2.0 pt + 0.5 oz	23 a	95	98 a	1.41 e	7.4
Goaltender (4 lb/gal product)	1.0 pt	6 c	95	98 a	2.18 b	7.8
Goaltender (4 lb/gal product) + UpBeet	1.0 pt + 0.5 oz	15 b	93	95 a	1.73 d	8.1
Starane	0.67 pt	5 cd	93	92 a	2.33 ab	7.4
Starane + UpBeet	0.67 pt	5 c	95	95 a	2.21 b	8.3
UpBeet	0.5 oz	5 c	93	93 a	1.96 c	8.0
Non-treated check	---	2 d	92	80 b	2.49 a	8.1

Means within a column followed by the same letter (or without letters) are not statistically different ($P < 0.05$).
Cabbage was transplanted September 16, 2009; simazine applied October 20, 2009; EPOST herbicides were applied February 9, 2010.
[a]The active ingredient in both Goal and GoalTender is oxyfluorfen.
[b]Cabbage fresh weight and stand count were determined April 14-15, 2010.

Table 2. Crop injury and weed control in spinach seed after treatment with several herbicides (2010).

Treatment[a]	Rate	Timing[b]	Crop injury	Weed control		
			Jul 6	Jul 6	Jul 29	Sep 15
	product/a		%	%	%	%
Ro-Neet + Pyramin	1.3 pt + 1.5 lb	PPI + PRE	1 c	86 bcd	86 abc	40 g
Ro-Neet + Dual Magnum	1.3 pt + 8.4 fl.oz	PPI + PRE	3 bc	94 ab	88 abc	69 cde
Ro-Neet + Define	1.3 pt + 1 pt	PPI + PRE	2 c	88 a-d	87 abc	58 ef
Ro-Neet + Spin Aid	1.3 pt + 1.8 pt	PPI + POST	1 c	83 cde	95 a	71 b-e
Ro-Neet + Eptam	1.3 pt + 3.6 pt	PPI + PPI	20 a	98 a	95 a	73 b-e
Ro-Neet + Asulox	1.3 pt + 3 pt	PPI + POST	0 c	73 ef	95 a	86 ab
Nortron + Pyramin	4.6 fl.oz + 1.1 lb	PRE + PRE	0 c	58 gh	66 f	44 fg
Nortron + Dual Magnum	4.6 fl.oz + 5.9 fl.oz	PRE + PRE	0 c	58 gh	66 f	51 fg
Nortron + Command	4.6 fl.oz + 3.4 fl.oz	PRE + PRE	0 c	68 fg	71 ef	84 abc
Nortron + Spin Aid	4.6 fl.oz + 1.8 pt	PRE + POST	0 c	53 h	90 abc	70 cde
Nortron + Eptam	4.6 fl.oz + 3.6 pt	PRE + PRE	0 c	89 a-d	84 bcd	59 ef
Nortron + Asulox	4.6 fl.oz + 3 pt	PRE + POST	1 c	53 h	76 de	75 a-d
Dual Magnum + Command	8.4 fl.oz + 3.4 fl.oz	PRE + PRE	1 c	79 de	76 de	79 a-d
Dual Magnum + Spin Aid	8.4 fl.oz + 1.8 pt	PRE + POST	0 c	58 gh	93 ab	68 de
Dual Magnum + Eptam	8.4 fl.oz + 3.6 pt	PRE + PRE	0 c	73 ef	76 de	41 g
Dual Magnum + Asulox	8.4 fl.oz + 3 pt	PRE + POST	0 c	54 h	84 bcd	80 a-d
Command	6.4 fl.oz	PPI	4 bc	88 a-d	88 abc	80 a-d
Command	10.7 fl.oz	PPI	6 b	90 abc	95 a	90 a
Command	3.4 fl.oz	PRE	0 c	84 bcd	81 cd	58 ef
Command	6.4 fl.oz	PRE	6 b	81 cde	83 cd	75 a-d
Hand weeded	---	---	0 c	53 h	64 f	90 a

Means within a column followed by the same letter are not statistically different ($P < 0.05$).
Spinach was seeded June 18, 2010.
[a]MSO = methylated seed oil.
[b]PPI = pre-plant incorporated (June 18); PRE = preemergence (June 19); P7 = postemergence (July 9).

Table 3. Crop injury and weed control in spinach seed after treatment with several herbicides (2010).

Treatment[a]	Rate	Timing[b]	Weed control		
			Jul 6	Jul 29	Sep 15
	product/a		%	%	%
Ro-Neet +	1.3 pt +	PPI +	95 a	90 abc	55 c
(Spin Aid + Asulox + MSO)	(2 fl.oz + 1.8 pt + 1.5%)	(P7)			
Ro-Neet +	1.3 pt + 3 pt +	PPI +	90 ab	94 ab	76 ab
(Spin Aid + Asulox + MSO)	(2 fl.oz + 1.8 pt + 1.5%)	(P7 + P14)			
Ro-Neet +	1.3 pt +	PPI +	90 ab	88 bcd	56 c
(Stinger + Asulox + MSO)	(2.7 fl.oz + 1.8 pt + 1.5%)	(P7)			
Ro-Neet +	1.3 pt +	PPI +	90 ab	98 a	86 ab
(Stinger + Asulox + MSO)	(2.7 fl.oz + 1.8 pt + 1.5%)	(P7 + P14)			
Nortron +	6.1 fl.oz +	PRE +	83 bcd	81 de	56 c
(Spin Aid + Asulox + MSO)	(2 fl.oz + 1.8 pt + 1.5%)	(P7)			
Nortron +	6.1 fl.oz +	PRE +	86 abc	91 ab	76 ab
(Spin Aid + Asulox + MSO)	(2 fl.oz + 1.8 pt + 1.5%)	(P7 + P14)			
Nortron +	6.1 fl.oz +	PRE +	88 abc	75 ef	48 c
(Stinger + Asulox + MSO)	(2.7 fl.oz + 1.8 pt + 1.5%)	(P7)			
Nortron +	6.1 fl.oz +	PRE +	79 cd	83 cde	74 b
(Stinger + Asulox + MSO)	(2.7 fl.oz + 1.8 pt + 1.5%)	(P7 + P14)			
Dual Magnum +	10.8 fl.oz +	PRE +	80 cd	73 f	53 c
(Spin Aid + Asulox + MSO)	(2 fl.oz + 1.8 pt + 1.5%)	(P7)			
Dual Magnum +	10.8 fl.oz +	PRE +	80 cd	91 ab	75 ab
(Spin Aid + Asulox + MSO)	(2 fl.oz + 1.8 pt + 1.5%)	(P7 + P14)			
Dual Magnum +	10.8 fl.oz +	PRE +	85 bc	81 de	50 c
(Stinger + Asulox + MSO)	(2.7 fl.oz + 1.8 pt + 1.5%)	(P7)			
Dual Magnum +	10.8 fl.oz +	PRE +	84 bcd	88 bcd	85 ab
(Stinger + Asulox + MSO)	(2.7 fl.oz + 1.8 pt + 1.5%)	(P7 + P14)			
Hand weeded	---	---	75 d	60 g	88 a

Means within a column followed by the same letter are not statistically different ($P < 0.05$).
Spinach was seeded June 18, 2010. Spinach was harvested September 22.
[a]MSO = methylated seed oil.
[b]PPI = pre-plant incorporated (June 18); PRE = preemergence (June 19); P7 = postemergence (July 9), 7 days after spinach emergence; P14 = postemergence (July 16), 14 days after spinach emergence.

Table 4. Weed control in table beet seed after treatment with several herbicides (2010).

Treatment[a]	Rate product/a	Timing[b]	Weed control %	Crop density plants/plot
Hand weeded	---	---	98 a	3.5
Ro-Neet + Asulox	2.7 pt + 3 pt	PPI + P21	23 hi	3.3
Ro-Neet + (Asulox + UpBeet + Stinger + MSO)	2.7 pt + (1.5 pt + 0.1 oz + 1.3 fl.oz + 1.5%)	PPI + (P7)	70 cde	2.0
Ro-Neet + (Asulox + UpBeet + Stinger + MSO)	2.7 pt + (1.5 pt + 0.1 oz + 1.3 fl.oz + 1.5%)	PPI + (P7, P14)	85 abc	3.3
Ro-Neet + (Asulox + UpBeet + Stinger + MSO)	2.7 pt + (1.5 pt + 0.1 oz + 1.3 fl.oz + 1.5%)	PPI + (P7, P14, P21)	95 ab	4.3
Nortron + (Asulox + UpBeet + Stinger + MSO)	2 fl.oz + (1.5 pt + 0.1 oz + 1.3 fl.oz + 1.5%)	PRE + (P7)	53 efg	5.0
Nortron + (Asulox + UpBeet + Stinger + MSO)	2 fl.oz + (1.5 pt + 0.1 oz + 1.3 fl.oz + 1.5%)	PRE + (P7, P14)	71 b-e	4.8
Nortron + (Asulox + UpBeet + Stinger + MSO)	2 fl.oz + (1.5 pt + 0.1 oz + 1.3 fl.oz + 1.5%)	PRE + (P7, P14, P21)	96 a	4.3
Dual Magnum + (Asulox + UpBeet + Stinger + MSO)	2 fl.oz + (1.5 pt + 0.1 oz + 1.3 fl.oz + 1.5%)	PRE + (P7)	39 fgh	5.8
Dual Magnum + (Asulox + UpBeet + Stinger + MSO)	2 fl.oz + (1.5 pt + 0.1 oz + 1.3 fl.oz + 1.5%)	PRE + (P7, P14)	80 a-d	3.8
Dual Magnum + (Asulox + UpBeet + Stinger + MSO)	2 fl.oz + (1.5 pt + 0.1 oz + 1.3 fl.oz + 1.5%)	PRE + (P7, P14, P21)	83 a-d	5.5
Command	6.4 fl.oz	PPI	18 hi	2.5
Command	10.7 fl.oz	PPI	29 ghi	2.3
Command	3.4 fl.oz	PRE	40 fgh	2.0
Command	6.4 fl.oz	PRE	49 efg	2.8
EPTC	3.5 pt	PPI	39 fgh	2.3
EPTC	3.5 pt	PRE	23 hi	1.5
Callisto	3 fl.oz	PRE	88 abc	0.3
Chateau	2 oz	PRE	100 a	4.3
Prowl H2O	2.5 pt	PRE	83 a-d	3.5
Goal	2 pt	PRE	95 ab	0.3
Lorox	1 lb	PRE	81 a-d	5.3
Diuron	1 lb	PRE	85 abc	4.3
Kerb	2 lb	PRE	59 def	3.3
Kerb	2 lb	P7	9 i	3.3

Means within a column and followed by the same letter (or with no letters) are not statistically different ($P < 0.05$).
Table beet stecklings were transplanted May 11, 2010. Weed control was estimated and beets counted June 29.
[a]MSO = methylated seed oil.
[b]PPI = pre-plant incorporated (May 10); PRE = preemergence (May 14); P7 = postemergence (June 22), 7 days after beet leaf emergence; P14 = postemergence (June 29), 14 days after beet leaf emergence; P21 = postemergence (July 6), 21 days after beet leaf emergence.