

**Project Number:** 13K 3419 7228

**Title:** Weed control in vegetable seed crops.

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**Reporting Period:** 2009-10

**Accomplishments:** Four weed control trials in vegetable seed were conducted in 2009: one study each in cabbage seed and table beet seed and two studies in spinach seed.

**Results:**

*Cabbage seed trial.* Eleven cabbage seed lines were transplanted at WSU Mount Vernon NWREC September 18, 2008. All plots received simazine treatment October 28 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 27, 2009. Crop injury and weed control were estimated March 31 and April 24. All plants were pulled from the soil April 27 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 at either rate showed 19 and 20% crop injury in late March for the 2 and 3 pt/a rates, respectively; significantly higher than the 12 and 14% crop injury caused by 1 and 1.5 pt/a of Goaltender (Table 1). By mid-April, crop injury with Goal was visually about the same as for the high rate of Goaltender (7 to 10%), while Goaltender at the low rate was equal to non-treated cabbage. Starane at 1.3 pt/a caused slightly more injury than when applied at 0.67 pt/a (11 and 8% in March, respectively, and 6 and 3%, respectively, in April). Cabbage treated with UpBeet was similar in appearance to non-treated cabbage. For the most part, weed control from these products (following fall-applied simazine) was similar. Goal and Goaltender gave similar levels of control (ranging from 87 to 99% in March and 93 to 98% in April; Table 1). Weed control with Starane was statistically similar to Goal and Goaltender in March, and not much reduced in April. Weed control with UpBeet did not differ from plots not receiving spring herbicide, at least at this 0.5 oz/a rate. Herbicides did not affect cabbage stand, but cabbage fresh weight was reduced by some 55% by Goal, by some 45% by Goaltender, by some 25% by Starane, and by 13% with UpBeet. Not every cabbage line responded similarly, however, so further spring testing of these products is warranted.

*Spinach seed. Herbicide trial.* Spinach was seeded April 30, 2009 at WSU Mount Vernon NWREC. Preplant-incorporated (PPI) treatments were applied April 30, preemergence (PRE) May 6, and POST June 5. Weed control and crop injury were estimated May 23 and July 27. All plants in each plot were counted and pulled from the soil September 11. Seed has been threshed, but not yet cleaned nor germinability tested. The trial was a randomized complete block with four replicates. Weed control was 80% or greater in late July with 11 treatments; unfortunately, crop injury was excessive for six of these, all of which were combinations with Lorox or Define (Table 2). Rainfall following herbicide application but prior to spinach emergence was apparently high enough to move these herbicides into the seed zone. These conditions also contributed to moderate injury from Nortron and Dual Magnum. Only Lorox in combination with Dual Magnum or Ro-Neet significantly reduced spinach stand, however.

*Micro-rate trial.* Spinach was seeded May 9, 2009 at WSU Mount Vernon NWREC. Preplant-incorporated (PPI) treatments were applied May 8, preemergence (PRE) May 15, and POST June 12 and 20. Weed control and crop injury were estimated July 27. All plants in each plot were counted and pulled from the soil September 11. Seed has been threshed, but not yet cleaned nor germinability tested. The trial was a randomized complete block with four replicates. Crop injury was generally low for all these treatments, with the exception of 24% damage to spinach from Ro-Neet + Eptam applied PPI (Table 3).

*Observations on Command and Asulox from both spinach trials.* Command (PPI) at these rates (Table 3) was generally not effective by July, but injury was low (Table 3). When applied PRE (Table 2), weed control was much improved, but although labeled for PRE applications, drift is a concern with Command (PRE). Combinations with Command applied PPI at higher rates seems appropriate for further testing. Asulox treatments were better than expected. Applied after Dual Magnum (PRE), Asulox gave 93% weed control by July; Asulox was not as effective when sequentially used with Ro-Neet or Nortron (73 and 79% weed control, respectively). When used as a micro-rate (combined at low use rate with Spin-Aid and mso) weed control was good to excellent, especially when the micro-rates were applied twice one week apart. (83 to 93% control).

*Table beet herbicide screen.* Beet seedlings were transplanted April 24 at WSU Mount Vernon NWREC. PPI treatments were applied April 24, PRE treatments were applied April 28 and POST treatments were applied May 30 and June 5 and 12. The lay-by treatments were applied June 12, but were applied only between rows using a shielded sprayer. Crop injury and weed control were estimated June 26. Plants were pulled from the soil September 17 and seed has been threshed, but not yet cleaned nor germinability tested. The trial was a randomized complete block with four replicates. There was no significant crop injury resulting from herbicide applications (data not shown). Weed control was poor to excellent, with three micro-rate applications generally being necessary to achieve acceptable weed control (Table 4). The lay-by treatments did not provide adequate weed control. Based on these results, additional testing is warranted in 2009.

Table 1. Crop injury and weed control from spring herbicide application to eleven overwintered cabbage seed lines (2008-09).

Treatment	Rate product/a	Crop injury		Weed control		Fresh weight lb/plant	Stand plants/plot
		Mar 31 %	Apr 24 %	Mar 31 %	Apr 24 %		
Goal (2 lb/gal product)	2.0 pt	20 a	10 a	99 a	96 a	0.50 e	13.0
Goal (2 lb/gal product)	3.0 pt	19 a	7 bc	98 a	98 a	0.62 d	13.0
Goaltender (4 lb/gal product)	1.0 pt	12 bc	4 cde	95 a	98 a	0.79 c	16.3
Goaltender (4 lb/gal product)	1.5 pt	14 b	7 ab	87 a	93 ab	0.76 c	12.1
Starane	0.67 pt	8 d	3 de	85 a	87 abc	1.02 b	14.3
Starane	1.3 pt	11 c	6 bcd	83 ab	82 bc	1.01 b	14.4
UpBeet	0.5 oz	5 e	1 e	65 b	75 cd	1.10 b	13.9
Non-treated check	---	4 e	1 e	65 b	68 d	1.21 a	14.4

Means followed the same letter are not statistically different ( $P < 0.05$ ). The active ingredient in both Goal and Goaltender is oxyfluorfen. Cabbage was transplanted September 18, 2008; simazine applied October 28, 2008; EPOST herbicides were applied February 18, 2009. Cabbage fresh weight and stand count were determined April 27, 2009.

Table 2. Crop injury and weed control in spinach seed after treatment with several herbicides (2008).

Treatment <sup>a</sup>	Rate product/a	Timing <sup>b</sup>	Crop injury		Weed control		Stand plants/plot
			May 23 %	Jul 27 %	May 23 %	Jul 27 %	
Eptam	3.6 pt	PPI	24 c-f	9 c	94 cd	46 ij	18 ab
Ro-Neet + Pyramin	1.3 pt + 1.5 lb	PPI + PRE	5 i	4 c	98 abc	89 a-d	17 ab
Ro-Neet + Dual Magnum	1.3 pt + 8.4 fl.oz	PPI + PRE	25 cde	10 bc	98 abc	70 e-h	19 ab
Ro-Neet + Define	1.3 pt + 1 pt	PPI + PRE	50 b	9 c	100 a	88 a-d	14 ab
Ro-Neet + Lorox	1.3 pt + 1.3 pt + 1 lb	PPI + PRE	100 a	100 a	100 a	95 ab	5 cd
Ro-Neet + Spin Aid	1.3 pt + 1.8 pt	PRE + POST	4 i	5 c	86 e	59 ghi	19 ab
Nortron + Pyramin	4.6 fl.oz + 1.1 lb	PRE + PRE	9 hi	3 c	95 bc	81 a-f	13 abc
Nortron + Dual Magnum	4.6 fl.oz + 5.9 fl.oz	PRE + PRE	23 c-g	1 c	96 abc	60 ghi	18 ab
Nortron + Define	4.6 fl.oz + 1 pt	PRE + PRE	61 b	11 bc	100 a	93 abc	20 a
Nortron + Spin Aid	6.1 fl.oz + 1.8 pt	PRE + POST	6 i	0 c	90 de	54 hi	16 ab
Nortron + Lorox	4.6 fl.oz + 1 lb	PRE + PRE	100 a	100 a	100 a	95 ab	10 bcd
Nortron + Eptam	4.6 fl.oz + 3.4 pt	PRE + PRE	33 c	9 c	95 bc	35 j	19 ab
Nortron + Asulox	4.6 fl.oz + 3 pt	PRE + POST	11 ghi	5 c	90 de	79 b-f	15 ab
Dual Magnum + Define	8.4 fl.oz + 1 pt	PRE + PRE	58 b	6 c	100 a	91 abc	11 a-d
Dual Magnum + Spin Aid	10.8 fl.oz + 1.8 pt	PRE + POST	14 e-i	6 c	98 abc	73 d-g	19 ab
Dual Magnum + Lorox	8.4 fl.oz + 1.0 lb	PRE + PRE	100 a	100 a	98 abc	98 a	3 d
Dual Magnum + Eptam	8.4 fl.oz + 3.4 pt	PRE + PRE	28 cd	6 c	99 ab	65 fgh	17 ab
Dual Magnum + Asulox	8.4 fl.oz + 3 pt	PRE + POST	13 f-i	4 c	100 a	93 abc	13 a-c
Command	3.4 fl.oz	PRE	8 hi	1 c	95 bc	78 c-f	20 a
Command	6.4 fl.oz	PRE	19 d-h	1 c	96 abc	89 a-d	12 a-d
Hand weeded	---	---	10 hi	25 b	86 e	98 a	19 ab
Asulox	3.0 pt	POST	9 hi	0 c	88 e	85 a-e	15 ab

Means followed the same letter are not statistically different ( $P < 0.05$ ).

<sup>a</sup>MSO = methylated seed oil.

<sup>b</sup>PPI = pre-plant incorporated; PRE = preemergence; POST = postemergence.

Spinach was seeded April 30. PPI herbicides were applied April 30; PRE was applied May 6; POST was applied June 5. Spinach was harvested September 11.

Table 3. Crop injury and weed control in spinach seed after treatment with several herbicides (2008).

Treatment <sup>a</sup>	Rate	Timing <sup>b</sup>	Crop injury <sup>c</sup>	Weed control <sup>c</sup>
	product/a		%	%
Ro-Neet + Eptam	1.3 pt + 3.4 pt	PPI + PPI	24 a	30 f
Ro-Neet + Asulox	1.3 pt + 3 pt	PPI + P7	8 b	73 b-e
Command	6.4 fl.oz	PPI	10 b	61 de
Command	10.7 fl.oz	PPI	6 b	70 cde
Ro-Neet + (Spin Aid + asulox + mso)	1.3 pt + (2 fl.oz + 1.8 pt + 1.5%)	PRE + (P7)	6 b	75 a-e
Ro-Neet + (Spin Aid + asulox + mso)	1.3 pt + (2 fl.oz + 1.8 pt + 1.5%)	PRE + (P7, P14)	6 b	88 abc
Nortron + (Spin Aid + asulox + mso)	6.1 fl.oz + (2 fl.oz + 1.8 pt + 1.5%)	PRE + (P7)	11 b	55 e
Nortron + (Spin Aid + asulox + mso)	6.1 fl.oz + (2 fl.oz + 1.8 pt + 1.5%)	PRE + (P7, P14)	4 b	83 abc
Dual Magnum + (Spin Aid + asulox + mso)	10.8 fl.oz + (2 fl.oz + 1.8 pt + 1.5%)	PRE + (P7)	5 b	81 a-d
Dual Magnum + (Spin Aid + asulox + mso)	10.8 fl.oz + (2 fl.oz + 1.8 pt + 1.5%)	PRE + (P7, P14)	6 b	93 ab
Pyramin + (Spin Aid + asulox + mso)	1.5 lb + (2 fl.oz + 1.8 pt + 1.5%)	PRE + (P7)	6 b	71 cde
Pyramin + (Spin Aid + asulox + mso)	1.5 lb + (2 fl.oz + 1.8 pt + 1.5%)	PRE + (P7, P14)	6 b	85 abc
Hand weeded	---	---	5 b	95 a

Means followed the same letter are not statistically different ( $P < 0.05$ ).

<sup>a</sup>MSO = methylated seed oil.

<sup>b</sup>PPI = pre-plant incorporated; PRE = preemergence; P7 = postemergence, 7 DAE; P14 = postemergence, 14 DAE.

<sup>c</sup>Crop injury and weed control were estimated July 27.

Spinach was seeded May 9. PPI herbicides were applied May 8; PRE was applied May 15; POST June 12 and 20. Spinach was harvested September 11.

Table 4. Weed control in table beets after treatment with several herbicides (2008).

Treatment <sup>a</sup>	Rate product/a	Timing <sup>b</sup>	Weed control %
Hand weeded	---	---	98 ab
Ro-Neet + Betamix	2.7 pt + 3.1 pt	PPI + P21	41 j
Pyramin + (Progress + UpBeet + Stinger + MSO)	3.7 lb + (5.7 fl.oz + 0.1 oz + 1.3 fl.oz + 1.5%)	PRE + (P7)	84 a-d
Pyramin + (Progress + UpBeet + Stinger + MSO)	3.7 lb + (5.7 fl.oz + 0.1 oz + 1.3 fl.oz + 1.5%)	PRE + (P7, P14)	99 a
Pyramin + (Progress + UpBeet + Stinger + MSO)	3.7 lb + (5.7 fl.oz + 0.1 oz + 1.3 fl.oz + 1.5%)	PRE + (P7, P14, P21)	93 abc
Ro-Neet + (Progress + UpBeet + Stinger + MSO)	2.7 pt + (5.7 fl.oz + 0.1 oz + 1.3 fl.oz + 1.5%)	PPI + (P7)	73 b-g
Ro-Neet + (Progress + UpBeet + Stinger + MSO)	2.7 pt + (5.7 fl.oz + 0.1 oz + 1.3 fl.oz + 1.5%)	PPI + (P7, P14)	70 c-h
Ro-Neet + (Progress + UpBeet + Stinger + MSO)	2.7 pt + (5.7 fl.oz + 0.1 oz + 1.3 fl.oz + 1.5%)	PPI + (P7, P14, P21)	89 a-d
Nortron + (Progress + UpBeet + Stinger + MSO)	2 fl.oz + (5.7 fl.oz + 0.2 oz + 1.3 fl.oz + 1.5%)	PRE + (P7)	68 c-i
Nortron + (Progress + UpBeet + Stinger + MSO)	2 fl.oz + (5.7 fl.oz + 0.2 oz + 1.3 fl.oz + 1.5%)	PRE + (P7, P14)	65 d-j
Nortron + (Progress + UpBeet + Stinger + MSO)	2 fl.oz + (5.7 fl.oz + 0.2 oz + 1.3 fl.oz + 1.5%)	PRE + (P7, P14, P21)	83 a-e
Dual Magnum + (Progress + UpBeet + Stinger + MSO)	2 fl.oz + (5.7 fl.oz + 0.2 oz + 1.3 fl.oz + 1.5%)	PRE + (P7)	58 e-j
Dual Magnum + (Progress + UpBeet + Stinger + MSO)	2 fl.oz + (5.7 fl.oz + 0.2 oz + 1.3 fl.oz + 1.5%)	PRE + (P7, P14)	79 a-f
Dual Magnum + (Progress + UpBeet + Stinger + MSO)	2 fl.oz + (5.7 fl.oz + 0.2 oz + 1.3 fl.oz + 1.5%)	PRE + (P7, P14, P21)	84 a-d
Outlook + (Progress + UpBeet + Stinger + MSO)	1.75 fl.oz + (5.7 fl.oz + 0.2 oz + 1.3 fl.oz + 1.5%)	PRE + (P7)	71 c-h
Outlook + (Progress + UpBeet + Stinger + MSO)	1.75 fl.oz + (5.7 fl.oz + 0.2 oz + 1.3 fl.oz + 1.5%)	PRE + (P7, P14)	80 a-f
Outlook + (Progress + UpBeet + Stinger + MSO)	1.75 fl.oz + (5.7 fl.oz + 0.2 oz + 1.3 fl.oz + 1.5%)	PRE + (P7, P14, P21)	90 a-d
Ro-Neet + Betamix + Prowl	2.7 pt + 3.1 pt + 2 pt	PPI + P21 + P21L	44 ij
Ro-Neet + Betamix + Dual Magnum	2.7 pt + 3.1 pt + 2 pt	PPI + P21 + P21L	43 ij
Ro-Neet + Betamix + Outlook	2.7 pt + 3.1 pt + 1.75 pt	PPI + P21 + P21L	46 hij
Ro-Neet + Betamix + Nortron	2.7 pt + 3.1 pt + 2 pt	PPI + P21 + P21L	51 g-j
Ro-Neet + Betamix + Pyramin	2.7 pt + 3.1 pt + 3.7 lb	PPI + P21 + P21L	44 ij
Ro-Neet + Betamix + diuron	2.7 pt + 3.1 pt + 2 lb	PPI + P21 + P21L	56 f-j

Means followed the same letter are not statistically different ( $P < 0.05$ ).

<sup>a</sup>MSO = methylated seed oil.

<sup>b</sup>PPI = pre-plant incorporated; PRE = preemergence; P7 = postemergence, 7 DAE; P14 = postemergence, 14 DAE; P21 = postemergence, 21 DAE; P21(L) = postemergence, 21 DAE, lay-by.

Table beets were transplanted April 24. PPI herbicides were applied April 24; PRE were applied April 28; POST were applied May 30, June 5 and 12; Lay-by's were applied June 17, between rows using a shielded sprayer. Weed control was estimated June 26 and beets were harvested September 17.