

Project Number: 13K 3419 7228

Title: Weed control in vegetable seed crops

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Accomplishments: Six vegetable seed studies were conducted in 2002: two studies each in table beet seed and spinach seed, one in cabbage seed, and one greenhouse trial in Umbelliferae crops. A second cabbage seed trial is currently underway. Weed control and/or crop injury was measured in each study.

1. Eleven herbicides were tested for weed control in table beet seed (a total of thirty-nine treatments).
2. Eleven herbicides were tested for crop safety and weed control in spinach seed (a total of thirty treatments).
3. Nine herbicides are being tested for crop safety and weed control in cabbage seed (a total of fifty-six treatments).
4. Fourteen herbicides at two postemergence application timings were tested for crop safety in seven Umbelliferae crops (a total of twenty-eight treatments)

Results:

Table Beets. Table beet roots were transplanted at WSU Mount Vernon April 24 and 25 for both the herbicide trial and the split application trial. PPI treatments were applied April 24, PRE on April 26 and May 2, and POST on May 31. Weed control and crop injury for both trials were estimated May 28 and June 17, and beet stand counts were made June 21 for the split application trial and June 28 for the herbicide trial. Three representative beet plants per plot were cut September 24 through October 1 then dried in the greenhouse. Seed has not yet been threshed nor germination percentage determined. The herbicide trial was a randomized complete block with four replicates; the split application trial was a split block randomized complete block with four replicates. Results are presented in Tables 1 and 2.

No treatments in either trial significantly injured beets or reduced stand counts. Treatments in the herbicide trial providing > 85% weed control by June 17 included Ro-Neet + Outlook or Dual Magnum (PPI + PRE), Ro-Neet + Outlook

or Betamix (PPI + POST), Nortron or Pyramin + Outlook (PRE), and Outlook + Pyramin (PRE + POST). Treatments in the split application trial providing > 85% weed control by June 17 included Spartan + Betamix or UpBeet (PRE + POST), Milestone + Betamix, UpBeet, or Visor (PRE + POST), and all split applications with Visor (PRE).

Spinach. Spinach was seeded April for the Select trial and April 25 for the herbicide trial at WSU Mount Vernon. PPI, PRE, and POST herbicides were applied April 24, May 8, and May 31, respectively, and Select was applied June 25. Weed control and spinach injury were estimated May 29 and June 17. Stand counts were made June 14 for the herbicide trial and at August 15 for the Select trial. All spinach plants were stripped of seed by hand August 15 in the Select trial and August 19 in the herbicide trial. Seed has not yet been threshed nor germination percentage determined. Both trials were randomized complete blocks with four replicates. Results are presented in Table 3.

Although no treatments in the Select trial significantly injured spinach, sixteen treatments in the herbicide trial significantly injured spinach at the May 29 evaluation. By June 17, however, spinach had recovered except when treated with Ro-Neet or Pyramin + Outlook (PPI or PRE + PRE), all Nortron (PRE) combinations, Pyramin + Outlook (PRE), Valor, or Devrinol. Stand counts were reduced in the herbicide trial by Ro-Neet + Outlook (PPI + PRE), Nortron + Outlook (PRE), Nortron + Spin-Aid or Visor (POST), Pyramin + Visor (PRE + POST), Kerb, and Valor.

Sixteen treatments in the herbicide trial were still providing > 85% weed control by June 17. Of these, only Ro-Neet + Pyramin or Dual Magnum (PPI + PRE), Ro-Neet + Outlook, Dual Magnum, Visor, or Spin-Aid (PPI + POST), Pyramin + Dual Magnum (PRE), Pyramin, Dual Magnum, or Outlook + Spin-Aid (PRE + POST), Outlook + Visor (PRE + POST) also were safe for spinach as based on crop injury ratings or stand counts.

Umbelliferae seed crops. Early-flowering and long-standing cilantro, coriander, carrot, dill, parsnip, and parsley were seeded May 13 and August 8 in the greenhouse at WSU Mount Vernon. Plants were thinned to approximately ten per cultivar at about ten days after seeding then sprayed POST with one of 14 herbicides at two growth stages: early (cotyledon to 3 inches, approx. three weeks after seeding) and late (3 to 5 inches, approx. four weeks after seeding). Early applications were made May 31 and August 26, late applications June 10 and September 4, respectively for the two iterations. Visible crop injury was

evaluated at 3 and 10 DAT. Plants were then grown until 7 weeks after seeding (July 1 and September 30), at which time plants were counted, cut at the soil surface, and dry weights measured. Results are presented in Tables 4-7.

Products causing excessive or variable injury to cilantro/coriander were Caparol, Goal, Cobra, Axiom, Valor, Spartan, Balance, Milestone, and Reflex. Five POST treatments displayed some selectivity in these crops, however, including Lorox, Prefar, Devrinol early, Visor, and Prowl early. Based on these results, field testing with these five products is warranted.

Cabbage. Cabbage seedlings (2- to 3-leaf) were transplanted at WSU Mount Vernon September 6, 2002 and at-transplant treatments applied September 6 and 9. Split-plot, POST herbicides were applied to all plots September 27, and crop injury/weed control were estimated October 11. Stand count, weed control, and plant biomass at flowering will be determined during 2003. The trial is a split-plot, randomized complete block with three replicates. Results are presented in Table 8.

Most herbicide combinations were providing excellent weed control in cabbage about 1 month after transplanting. Combinations with Devrinol (POTR) were generally the poorest, except when followed by Spartan, Lentagran, or Simazine. Simazine followed by Devrinol or hand weeding followed by Devrinol, Stinger, Command, or Simazine also were performing poorly by October 11.

Table 1. Weed control, stand counts, and weeding times from several herbicide combinations used in beet seed.

Treatment	Timing ^a	Rate	Weed control ^b		Stand count ^c	Weeding times ^d
			5/28	6/17		
		product/a	----- % -----		no./plot	hrs/a
Ro-Neet + Outlook	PPI + PRE	2.67 pt + 1.33 pt	99	85	7	57
Ro-Neet + Outlook	PPI + POST	2.67 pt + 1.33 pt	97	89	8	45
Ro-Neet + Dual Magnum	PPI + PRE	2.67 pt + 1.05 pt	99	86	8	43
Ro-Neet + Dual Magnum	PPI + POST	2.67 pt + 1.05 pt	87	53	5	97
Ro-Neet + Betamix	PPI + POST	2.67 pt + 3.1 pt	93	89	5	59
Nortron + Outlook	PRE	1.92 pt + 1.33 pt	98	95	6	24
Nortron + Outlook	PRE + POST	1.92 pt + 1.33 pt	72	74	10	64
Nortron + Dual Magnum	PRE	1.92 pt + 1.05 pt	81	73	9	74
Nortron + Dual Magnum	PRE + POST	1.92 pt + 1.05 pt	77	50	7	107
Nortron + Betamix	PRE + POST	1.92 pt + 3.1 pt	73	81	11	78
Pyramin + Outlook	PRE	3.7 lbs + 1.33 pt	97	82	9	70
Pyramin + Outlook	PRE + POST	3.7 lbs + 1.33 pt	64	64	10	91
Pyramin + Betamix	PRE + POST	3.7 lbs + 3.1 pt	72	83	9	61
Outlook + Pyramin	PRE	2 pt + 2.22 lbs	99	89	8	45
Outlook + Pyramin	PRE + POST	2 pt + 2.22 lbs	99	95	9	33
Pyramin + Dual Magnum	PRE	3.7 lbs + 1.05 pt	86	55	7	105
Pyramin + Dual Magnum	PRE + POST	3.7 lbs + 1.05 pt	67	23	6	125
Dual Magnum + Pyramin	PRE	1.57 pt + 2.22 lbs	92	69	8	87
Dual Magnum + Pyramin	PRE + POST	1.57 pt + 2.22 lbs	90	84	8	61
handweeded	—	—	100	100	7	86
LSD _{0.05}	—	—	20	24	ns	52

^aPPI = preplant incorporated; PRE = preemergence; POST = postemergence.

^bPOST treatments not yet applied at 5/28 evaluation.

^cStand counts done June 21

^dHand weeding done July 11-12. Times are adjusted to hours per acre for one person.

Table 2. Crop injury, weed control, stand counts, and weeding times from split-applications of several herbicides in beet seed.

Treatment	Weed control		Stand count ^c	Weeding times ^d
	5/28	6/17		
	----- % -----		no./plot	hrs/a
Spartan (0.33 lb, PRE)	85	–	–	–
Betamix (3.1 pt, POST)	–	94	9	47
UpBeet + nis (0.5 oz + 0.25%, POST)	–	93	9	55
Stinger (0.25 pt, POST)	–	80	9	38
Visor (1.52 pt, POST)	–	81	9	34
Milestone (0.25 lb, PRE)	97	–	–	–
Betamix (3.1 pt, POST)	–	98	7	13
UpBeet + nis (0.5 oz + 0.25%, POST)	–	93	9	24
Stinger (0.25 pt, POST)	–	84	9	35
Visor (1.52 pt, POST)	–	95	7	26
Visor (1.52 pt, PRE)	97	–	–	–
Betamix (3.1 pt, POST)	–	91	9	35
UpBeet + nis (0.5 oz + 0.25%, POST)	–	90	7	36
Stinger (0.25 pt, POST)	–	89	8	36
Visor (1.52 pt, POST)	–	90	8	33
No PRE treatment	0	–	–	–
Betamix (3.1 pt, POST)	–	68	8	92
UpBeet + nis (0.5 oz + 0.25%, POST)	–	44	8	119
Stinger (0.25 pt, POST)	–	19	8	114
Visor (1.52 pt, POST)	–	31	7	124
LSD _{0.05}		19	15	ns

^aPRE = preemergence; POST = postemergence.

^bPOST treatments not yet applied at 5/28 evaluation.

^cStand counts done June 28

^dHand weeding done July 16-17. Times are adjusted to hours per acre for one person.

Table 3. Crop injury and weed control from several herbicide combinations used in spinach seed.

Treatment	Timing ^a	Rate	Crop injury ^b		Weed control ^b		Stand count ^c
			5/29	6/17	5/29	6/17	
		product/a	----- % -----		----- % -----		no./plot
Ro-Neet + Pyramin	PPI + PRE	1.33 pt + 1.5 lb	13	1	98	89	88
Ro-Neet + Outlook	PPI + PRE	1.33 pt + 0.4 pt	44	13	99	92	84
Ro-Neet + Outlook	PPI + POST	1.33 pt + 0.67 pt	1	0	94	85	92
Ro-Neet + Dual Magnum	PPI + PRE	1.33 pt + 0.52 pt	19	4	99	89	105
Ro-Neet + Dual Magnum	PPI + POST	1.33 pt + 0.79 pt	0	0	95	81	96
Ro-Neet + Visor	PPI + POST	1.33 pt + 1 pt	0	0	95	94	105
Ro-Neet + Spin-Aid	PPI + POST	1.33 pt + 1.8 pt	0	4	95	98	93
Nortron + Pyramin	PRE	0.38 pt + 1.5 lb	26	13	86	60	99
Nortron + Outlook	PRE	0.38 pt + 0.33 pt	80	48	88	61	64
Nortron + Dual Magnum	PRE	0.38 pt + 0.37 pt	35	18	69	51	98
Nortron + Spin-Aid	PRE + POST	0.38 pt + 1.8 pt	28	19	68	89	85
Nortron + Visor	PRE + POST	1.92 pt + 1 pt	88	88	89	88	14
Pyramin + Outlook	PRE	1.5 lb + 0.4 pt	48	23	97	90	92
Pyramin + Outlook	PRE + POST	1.5 lb + 0.67 pt	5	3	75	50	96
Pyramin + Dual Magnum	PRE	1.5 lb + 0.52 pt	21	8	96	90	105
Pyramin + Dual Magnum	PRE + POST	1.5 lb + 0.79 pt	5	5	73	50	107
Pyramin + Visor	PRE + POST	1.5 pt + 1 pt	19	4	80	83	81
Pyramin + Spin-Aid	PRE + POST	1.5 pt + 1.8 pt	6	6	58	90	92
Dual Magnum + Visor	PRE + POST	0.52 pt + 1 pt	5	3	76	76	103
Dual Magnum + Spin-Aid	PRE + POST	0.52 pt + 1.8 pt	5	5	90	95	103
Outlook + Visor	PRE + POST	0.4 pt + 1 pt	18	8	94	90	97
Outlook + Spin-Aid	PRE + POST	0.4 pt + 1.8 pt	18	10	93	97	96
Valor	PRE	2.25 oz	100	100	100	97	1
Kerb	PRE	2 lbs	54	9	96	88	76
Devrinol	PRE	2 lbs	21	35	63	35	91
handweeded	—	—	0	0	100	100	106
LSD _{0.05}	—	—	16	12	20	17	19

^aPPI = preplant incorporated; PRE = preemergence; POST = postemergence.

^bPOST treatments not yet applied at 5/29 evaluation.

^cStand counts done June 14.

Table 4. Crop injury from several herbicides applied postemergence to Umbelliferae seed crops in the greenhouse.

Crop	Injury from Caparol (3 pt/a) ^a				Injury from Lorox (2.25 lbs/a) ^a				Injury from Goal (1 pt/a) ^a				Injury from Cobra (1 pt/a) ^a			
	cotyledon to 3 in.		3 to 5 in.		cotyledon to 3 in.		3 to 5 in.		cotyledon to 3 in.		3 to 5 in.		cotyledon to 3 in.		3 to 5 in.	
	3 DAT	10 DAT	3 DAT	10 DAT	3 DAT	10 DAT	3 DAT	10 DAT	3 DAT	10 DAT	3 DAT	10 DAT	3 DAT	10 DAT	3 DAT	10 DAT
	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----
First iteration																
Early cilantro	0	24	1	61	1	8	0	16	65	53	35	35	79	83	55	96
Long-stand. cilantro	1	34	0	51	4	15	0	11	65	53	33	36	83	78	50	93
Coriander	3	29	1	53	3	8	0	5	66	38	30	25	83	70	50	93
Carrot	0	4	0	16	0	0	0	0	60	50	23	12	79	80	73	89
Dill	9	15	2	33	9	34	0	20	63	45	48	48	88	88	60	86
Parsnip	15	55	0	45	10	5	0	4	81	60	33	28	93	93	53	90
Parsley	18	69	0	51	11	45	0	26	76	63	35	33	94	93	48	93
Second iteration																
Early cilantro	5	88	6	11	3	16	8	11	70	83	50	69	70	100	50	88
Long-stand. cilantro	5	84	4	10	3	11	5	10	68	65	49	63	78	99	48	85
Coriander	4	82	3	3	4	8	6	5	64	60	45	59	75	96	49	89
Carrot	1	61	0	10	0	0	3	0	71	63	74	58	88	100	74	86
Dill	3	35	1	11	6	34	4	3	75	75	75	75	90	100	63	83
Parsnip	6	85	0	3	3	30	8	4	78	83	74	64	85	100	63	80
Parsley	4	96	3	21	6	64	8	3	86	90	43	68	90	100	50	86

^aPercent crop injury visually estimated at 3 and 10 days after treatment (DAT).

Table 5. Crop injury from several herbicides applied postemergence to Umbelliferae seed crops in the greenhouse.

Crop	Injury from Prefar (1.25 gal/a) ^a				Injury from Axiom (12 oz/a) ^a				Injury from Devrinol (4 lbs/a) ^a				Injury from Visor (1 pt/a) ^a			
	cotyledon to 3 in.		3 to 5 in.		cotyledon to 3 in.		3 to 5 in.		cotyledon to 3 in.		3 to 5 in.		cotyledon to 3 in.		3 to 5 in.	
	3 DAT	10 DAT	3 DAT	10 DAT	3 DAT	10 DAT	3 DAT	10 DAT	3 DAT	10 DAT	3 DAT	10 DAT	3 DAT	10 DAT	3 DAT	10 DAT
	-----	%	-----	%	-----	%	-----	%	-----	%	-----	%	-----	%	-----	%
First iteration																
Early cilantro	8	3	8	1	18	78	13	59	3	8	13	16	1	5	9	5
Long-stand. cilantro	10	3	5	1	21	85	6	54	1	11	9	10	0	1	6	1
Coriander	11	4	5	1	34	80	1	41	0	8	4	3	3	3	3	3
Carrot	3	3	3	0	3	19	1	5	0	4	1	1	0	1	0	3
Dill	15	4	3	3	36	85	1	55	1	3	1	0	0	1	1	1
Parsnip	3	3	3	3	53	100	4	76	1	8	1	1	0	1	0	3
Parsley	10	3	3	1	53	98	1	53	3	6	4	1	1	3	1	3
Second iteration																
Early cilantro	0	1	0	5	11	85	0	29	3	0	18	36	1	0	13	16
Long-stand. cilantro	0	0	0	1	15	76	0	14	3	1	5	5	1	0	9	8
Coriander	3	0	0	0	8	69	0	19	3	0	0	0	1	0	5	0
Carrot	0	0	0	0	8	14	0	3	0	3	0	0	1	3	3	0
Dill	4	1	0	1	11	70	0	19	0	0	0	1	0	0	4	1
Parsnip	1	0	0	0	23	100	1	49	1	1	1	0	1	1	4	1
Parsley	4	0	1	1	16	88	0	34	1	3	0	0	1	1	6	0

^aPercent crop injury visually estimated at 3 and 10 days after treatment (DAT).

Table 6. Crop injury from several herbicides applied postemergence to Umbelliferae seed crops in the greenhouse.

Crop	Injury from Valor (2.24 oz/a) ^a				Injury from Spartan (5.33 oz/a) ^a				Injury from Balance (2.56 oz/a) ^a				Injury from Milestone (3 oz/a) ^a			
	cotyledon to 3 in.		3 to 5 in.		cotyledon to 3 in.		3 to 5 in.		cotyledon to 3 in.		3 to 5 in.		cotyledon to 3 in.		3 to 5 in.	
	3 DAT	10 DAT	3 DAT	10 DAT	3 DAT	10 DAT	3 DAT	10 DAT	3 DAT	10 DAT	3 DAT	10 DAT	3 DAT	10 DAT	3 DAT	10 DAT
	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----
First iteration																
Early cilantro	55	58	45	75	66	85	28	80	18	70	13	70	50	75	33	84
Long-stand. cilantro	56	55	40	71	63	85	30	76	18	75	15	69	65	73	30	81
Coriander	53	43	43	55	68	83	28	73	20	70	9	65	65	73	30	83
Carrot	48	60	19	53	50	63	15	24	8	78	0	68	55	78	30	70
Dill	28	11	6	21	50	45	11	15	20	75	1	66	46	68	13	51
Parsnip	60	50	30	53	60	63	18	33	14	80	1	65	50	70	33	69
Parsley	80	79	38	60	73	81	25	61	43	93	0	59	70	85	40	76
Second iteration																
Early cilantro	34	50	40	74	36	68	34	66	9	89	23	40	–	–	–	–
Long-stand. cilantro	41	48	36	65	34	66	33	61	8	92	13	30	–	–	–	–
Coriander	31	41	35	59	33	66	33	63	8	94	10	46	–	–	–	–
Carrot	25	56	43	59	26	48	35	45	10	96	1	61	–	–	–	–
Dill	11	11	30	36	34	25	40	50	16	96	10	55	–	–	–	–
Parsnip	53	86	44	58	28	60	29	51	5	100	8	51	–	–	–	–
Parsley	59	79	39	65	55	79	39	78	6	100	16	70	–	–	–	–

^aPercent crop injury visually estimated at 3 and 10 days after treatment (DAT).

Table 7. Crop injury from several herbicides applied postemergence to Umbelliferae seed crops in the greenhouse.

Crop	Injury from Reflex (12.8 fl.oz/a) ^a				Injury from Prowl (2.4 pt/a) ^a			
	cotyledon to 3 in.		3 to 5 in.		cotyledon to 3 in.		3 to 5 in.	
	3 DAT	10 DAT	3 DAT	10 DAT	3 DAT	10 DAT	3 DAT	10 DAT
	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----	----- % -----
First iteration								
Early cilantro	76	88	45	90	–	–	–	–
Long-stand. cilantro	70	90	43	84	–	–	–	–
Coriander	70	85	40	83	–	–	–	–
Carrot	58	73	9	53	–	–	–	–
Dill	58	48	10	43	–	–	–	–
Parsnip	63	80	18	60	–	–	–	–
Parsley	73	75	25	66	–	–	–	–
Second iteration								
Early cilantro	66	99	50	88	5	4	14	14
Long-stand. cilantro	61	96	46	84	5	4	11	11
Coriander	63	90	44	86	5	4	11	11
Carrot	53	69	50	71	6	0	10	4
Dill	50	50	53	74	6	4	13	6
Parsnip	55	79	48	76	10	10	16	11
Parsley	78	89	48	74	10	9	16	14

^aPercent crop injury visually estimated at 3 and 10 days after treatment (DAT).

Table 8. Crop injury and weed control from split applications of several herbicides in cabbage seed (transplanted September 6, 2002).

Treatment	Crop injury ^b	Weed control ^b
	%	%
Goal (3 pt, PRETR)	0	95
Spartan (4.3 oz, POST)	0	100
Devrinol (2 lbs, POST)	0	99
Lentagran (1.4 pts, POST)	0	100
Stinger (5.3 fl.oz, POST)	0	98
Command (10.7 fl.oz, POST)	8	100
Simazine (14.2 oz, POST)	0	100
Spartan (5.3 oz, POTR)	0	95
Spartan (4.3 oz, POST)	0	100
Devrinol (2 lbs, POST)	0	93
Lentagran (1.4 pts, POST)	0	100
Stinger (5.3 fl.oz, POST)	0	98
Command (10.7 fl.oz, POST)	5	100
Simazine (14.2 oz, POST)	0	100
Devrinol (2 lbs, POTR)	0	53
Spartan (4.3 oz, POST)	0	100
Devrinol (2 lbs, POST)	0	57
Lentagran (1.4 pts, POST)	0	93
Stinger (5.3 fl.oz, POST)	0	68
Command (10.7 fl.oz, POST)	3	78
Simazine (14.2 oz, POST)	0	85
Dual Magnum (1 pt, POTR)	0	93
Spartan (4.3 oz, POST)	0	100
Devrinol (2 lbs, POST)	0	98
Lentagran (1.4 pts, POST)	0	100
Stinger (5.3 fl.oz, POST)	0	95
Command (10.7 fl.oz, POST)	5	96
Simazine (14.2 oz, POST)	0	100
Outlook (1.27 pt, POTR)	0	99
Spartan (4.3 oz, POST)	0	100
Devrinol (2 lbs, POST)	0	100
Lentagran (1.4 pts, POST)	0	100
Stinger (5.3 fl.oz, POST)	0	100
Command (10.7 fl.oz, POST)	7	100
Simazine (14.2 oz, POST)	0	100
Command (10.7 fl.oz, POTR)	2	93
Spartan (4.3 oz, POST)	2	100
Devrinol (2 lbs, POST)	2	98
Lentagran (1.4 pts, POST)	3	100
Stinger (5.3 fl.oz, POST)	0	96
Command (10.7 fl.oz, POST)	3	98
Simazine (14.2 oz, POST)	3	99

Simazine (6.8 oz, POTR)	0	73
Spartan (4.3 oz, POST)	0	100
Devrinol (2 lbs, POST)	0	82
Lentagran (1.4 pts, POST)	0	98
Stinger (5.3 fl.oz, POST)	0	88
Command (10.7 fl.oz, POST)	5	95
Simazine (14.2 oz, POST)	0	90
Handweeded	0	0
Spartan (4.3 oz, POST)	0	99
Devrinol (2 lbs, POST)	0	20
Lentagran (1.4 pts, POST)	0	98
Stinger (5.3 fl.oz, POST)	0	28
Command (10.7 fl.oz, POST)	7	77
Simazine (14.2 oz, POST)	0	73

^aPRETR = pre-transplant; POTR = post-transplant; POST = postemergence.

^bCrop injury and weed control evaluated October 11, 2002.