Volunteer Potato Control in Field and Sweet Corn 2002

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Volunteer potato control in field corn is difficult due to the vigorous growth of potato shoots and the ability of potatoes to sprout numerous times from the mother tuber. Atrazine suppresses volunteer potatoes and is currently labeled for use in corn, but its long persistence in soil limits rotations to corn and a few other tolerant crops. Dicamba (Clarity, Distinct, Banvel) and fluroxypyr (Starane) are labeled for postemergence use in field corn but volunteer potato control is seldom complete and numerous small tubers continued to be produced following dicamba or fluroxypyr application.

Mesotrione (Callisto) and carfentrazone (Aim) were recently registered for use in field corn and both have activity on volunteer potato. Mesotrione can be applied preemergence (PRE) or postemergence (POST) and inhibits chlorophyll synthesis in susceptible plants. Carfentrazone is applied POST and has contact burn-down activity with little or no translocation within the plant.

The three major objectives of volunteer potato control are to 1) prevent yield loss of the rotation crop; 2) eliminate potato plants that can host potato diseases, insects, and nematodes; and 3) prevent new tuber production that can lead to volunteer potato infestation in future years. This trial was conducted to compare volunteer potato control, tuber production, and corn yield after treating with several available herbicides and herbicide combinations.

Materials and Methods.

Trials were conducted in field corn grown under center pivot irrigation near Paterson, WA on a Quincy sand. Potato tubers, var. 'Russet Burbank' were planted on April 3, 2002 to simulate volunteer potatoes. Potatoes were planted in two rows spaced 34 in. to obtain a final density of 1.7 plants/ft row near the two center rows of corn in each four-row plot. Corn was planted on April 16, 2002 to obtain a final density of 32,000 plants/a in rows spaced 30 in. Dimethenamid (Outlook), which does not affect potato, was applied PRE at 0.7 kg/ha to the entire trial to control annual weeds both years. Trials were kept free of additional weeds by hand weeding.

Plots were 10 by 30 ft and treatments replicated three times in a randomized complete block design. Herbicides were applied with a bicycle sprayer equipped with flat fan nozzles and operated at pressure of 26 psi in a total volume if 20 gpa. Treatments are listed in Tables 1-4. PRE treatments were applied April 18, 2002.

POST applied treatments containing mesotrione included crop oil at 1% (v/v) and UN32 at 2.5% (v/v). All other treatments included R-11 nonionic surfactant at 0.25% (v/v). POST herbicide treatments were applied May 8 (EPOST), May 15

(MPOST), and May 24 (LPOST) when field corn was in the 2.5-, 3.5-, and 5.5-leaf stage, respectively. Most potato shoots were 7- to 11- cm tall at the EPOST application date both years and 15- to 18- cm tall at the time of the MPOST applications. Potato tuber initiation was just beginning at the time of the MPOST application date both years with some plants having 4 mm diameter tubers. All applications made at the LPOST stage were repeat applications, so potato height varied depending on the effectiveness of the initial treatment.

Volunteer potato control was visually rated on a scale of 0 = no control to 100 = complete control in early June. Corn injury was rated visually on a scale of 0 = no injury to 100 = dead in early June. Potato tubers were dug from 10 ft of row in September. Corn was machine harvested and shelled from 20 ft of the two center rows in each plot and weighed.

Data was subjected to ANOVA and treatment means were separated by Fisher's Protected LSD procedure at $\alpha = 0.05$. In early July plots became infested with Colorado potato beetle, which severely defoliated most remaining potato plants by early August.

Results

Corn Injury. Field corn was not injured greatly by any herbicide treatments tested (Tables 1 & 3). Mesotrione did not injure corn significantly at either evaluation date (Table 1). Corn injury May 21, 2002 was greatest when carfentrazone was tank mixed with fluroxypyr, averaging 10 to 13% (Table 3). By early June, field corn injury was greatest with fluroxypyr applied alone at 0.24 lb ai/a, averaging 14%, followed by carfentrazone plus fluroxypyr, and two treatments containing carfentrazone applied LPOST, all averaging 11%. Carfentrazone injury consisted of necrotic speckling on upper surfaces of leaves exposed at the time of herbicide application. Fluroxypyr injury consisted of bent corn shoots. Field corn grew normally and no injury symptoms persisted beyond mid June.

Potato control. Initial potato control on May 21, 2002 was greatest with carfentrazone plus mesotrione applied MPOST, treatments containing mesotrione applied EPOST, and carfentrazone plus fluroxypyr (0.0082 + 0.24 lb ai/a) applied MPOST, averaging 97, 91, and 89% control, respectively (Tables 1 & 3). Potatoes treated with mesotrione appeared white and chlorotic, whereas potatoes treated with fluroxypyr exhibited epinasty and malformed and stunted growth. Initial potato control was least with mesotrione applied PRE, averaging only 37% control and carfentrazone applied once EPOST averaging only 23% control on May 21, 2002 (Tables 1 & 3).

Treatments of dicamba, Distinct (dicamba + diflufenzopyr) or fluroxypyr alone or in combinations with carfentrazone controlled potatoes ranging from 65 to 89% on May 21, 2002 (Table 3). Dicamba and Distinct stunted potato growth and caused epinastic, twisted growth of potatoes. Carfentrazone added with dicamba improved early control of potato compared to dicamba alone, but by July 1, control with the combination was similar to dicamba alone. Carfentrazone added to fluroxypyr did not improve early potato control ratings and decreased potato control with fluroxypyr at the later July rating date (Table 3).

Potato control in early July was greater than 90% with all treatments containing mesotrione (Table 1). By early July, fluroxypyr, dicamba, or Distinct (dicamba + diflufenzopyr) applied alone controlled potato similarly, averaging from 89 to 94% (Table 3). Dicamba applied alone or with carfentrazone controlled potato from 87 to 89% in early July. Potatoes treated with one or more applications of carfentrazone alone resprouted from the mother tuber and continued to grow.

Corn Yield. Corn yield averaged 6.4 T/acre in hand-weeded checks and 2.5 T/acre in plots where potatoes were not controlled (Table 2 & 4). All herbicide-treated plots yielded greater than nontreated checks (Tables 2 & 4). All herbicide-treated plots yielded equal to hand-weeded checks except plots treated with fluroxypyr alone at the lower rate of 0.188 lb ai/a and plots treated with only one or two applications of carfentrazone alone (Tables 2 & 4). If the producer's primary objective of applying an herbicide is to prevent corn yield loss due to competition from volunteer potato, the majority of these treatments could accomplish that objective.

Plots receiving treatments that included mesotrione applied MPOST or PRE were among the highest yielding ranging from 6.2 to 7.1 T/acre (Table 2). Three applications of carfentrazone were required to prevent corn yield loss from potato competition (Table 4).

Potato Tuber Production. Potatoes in nontreated checks produced 51 tubers/m2 weighing 4,226 (equivalent to 19 T/a) (Table 2 & 4). Potatoes treated with mesotrione alone or combined with another herbicide produced less than 3 tubers/m2 and were statistically equal to the hand-weeded checks (Table 2). Mesotrione at 0.094 lb ai/a applied at MPOST or split applied at EPOST and LPOST eliminated new tuber production.

Fluroxypyr alone and Distinct alone reduced the number of new tubers produced by 40 to 64% and tuber mass by 82 to 93% compared to nontreated checks (Table 4).

Carfentrazone applied once EPOST or MPOST or applied twice EPOST and MPOST did not reduce the number of tubers formed, but reduced the tuber mass by 11 to 52% compared to nontreated checks. Carfentrazone tank mixed with dicamba or with fluroxypyr did not reduce the number of tubers produced, but reduced tuber mass by 68 to 76% compared to nontreated checks. Dicamba alone failed to reduce tuber number, but reduced tuber mass by 67% (Table 4). Either two applications of carfentrazone at EPOST and LPOST or three applications of carfentrazone reduced the number of new tubers produced by half and reduced mass of tubers by 78 to 85%.

The greater reduction in tuber mass than tuber number when treating with POST herbicides agrees with previous results reported by Boydston (2001). In previous trials, cultivation 7 to 10 days after POST applied herbicides, greatly reduced tuber number compared to herbicides alone.

Mesotrione is unique in that tuber number was greatly reduced with PRE or POST applications and may provide a valuable new tool for volunteer potato control in corn.

Table 1. Field corn injury and volunteer potato control with mesotrione alone or tank-mixed with other herbicides at Paterson, WA in 2002. (Mesotrione=Callisto; Carfentrazone=Aim; 79406= 1:1 ratio of nicosulfuron:rimsulfuron)

			Field Corn Injury		Potato Control	
Treatment	Rate[a]	Timing[a]	May 21	June 2	May 21	July 1
	(lb ai/a)		------- (%) -------		------ (%) -------	
Mesotrione	0.188	PRE	0	0	37	95
Mesotrione	0.188 + 0.063	PRE + MPOST	0	1	77	99
Mesotrione	0.094	EPOST	0	0	91	91
Mesotrione	0.063	MPOST	0	0	52	97
Mesotrione	0.094	MPOST	0	0	58	99
Mesotrione + 79406	0.094 + 0.023	MPOST	2	1	65	95
Mesotrione + carfentrazone	0.063 + .0082	MPOST	10	4	97	94
Mesotrione	0.094 + 0.094	EPOST + LPOST	0	2	92	99
Nontreated CK			0	0	0	0
Hand weeded CK			0	0	100	100
	$LSD_{(0.05)}$		2.6	2.2	10.7	5.4

[a] PRE=April 18, EPOST=May 8, MPOST=May 15, and LPOST=May 24
All POST treatments included Moract COC @ 1% and UN32@ 2.5% (v/v) spray solution.

Table 2. Effect of mesotrione treatments on field corn yield and volunteer potato tuber production at Paterson, WA in 2002. (Mesotrione=Callisto; Carfentrazone=Aim;79406= 1:1 ratio of nicosulfuron:rimsulfuron).

				Potato	
Treatment	Rate	Timing[a]	Field Corn Yield	Number tubers	Weight tubers
	(lb ai/a)		(T/A)	(no./m^2)	(g/m^2)
Mesotrione	0.188	PRE	6.2	0.6	0.6
Mesotrione	0.188 + 0.063	PRE + MPOST	7.1	0.1	5.6
Mesotrione	0.094	EPOST	5.7	2.3	29.8
Mesotrione	0.063	MPOST	6.4	2.4	5.6
Mesotrione	0.094	MPOST	6.4	0	0
Mesotrione + 79406	0.094 + 0.023	MPOST	6.3	0.9	4.0
Mesotrione + carfentrazone	0.063 + .0082	MPOST	6.4	2.5	6.8
Mesotrione	0.094 + 0.094	EPOST + LPOST	6.6	0	0
Nontreated CK			2.5	51.2	4225.7
Hand weeded CK			6.4	0.5	1.4
	$LSD_{(0.05)}$		1.07	2.8	28.8

[a] PRE=April 18, EPOST=May 8, MPOST=May 15, and LPOST=May 24
All POST treatments included Moract COC @ 1% and UN32@ 2.5% (v/v) spray solution.

Table 3. Field corn injury and volunteer potato control with twelve herbicide treatments at Paterson, WA in 2002. (Carfentrazone=Aim; Fluroxypyr=Starane; Dicamba=Clarity; Dicamba+diflufenzopyr=Distinct)

			Field Corn Injury		Potato Control	
Treatment	Rate	Timing[a]	May 21	June 2	May 21	July 1
	(lb ai/a)		----- (%) ----		------ (%) -------	
Carfentrazone	0.0082	EPOST	2	2	23	12
Carfentrazone	0.0082	MPOST	5	4	78	33
Carfentrazone	0.0082 + 0.0082	EPOST + MPOST	8	5	84	33
Carfentrazone	0.0082 + 0.0082	EPOST + LPOST	3	11	18	47
Carfentrazone	0.0082 + 0.0082 + 0.0082	EPOST + MPOST + LPOST	6	11	82	52
Fluroxypyr	0.19	MPOST	5	6	87	89
Fluroxypyr	0.24	MPOST	7	14	88	92
Fluroxypyr + carfentrazone	0.19 + 0.0082	MPOST	10	5	85	65
Fluroxypyr + carfentrazone	0.24 + 0.0082	MPOST	13	11	89	74
Dicamba	0.25	MPOST	5	0	65	89
Dicamba + carfentrazone	0.25 + 0.0082	MPOST	7	4	85	87
Dicamba + diflufenzopyr	0.263	MPOST	7	3	87	94
Nontreated check			0	0	0	0
Hand weeded check			0	0	100	100
	$LSD_{(0.05)}$		3.0	1.9	4.9	6.8

[a] EPOST=May 8, MPOST=May 15, and LPOST=May 24

All treatments included R-11 nonionic surfactant @ 0.5% (v/v) spray solution.

Table 4. Effect of twelve herbicide treatments on field corn yield and volunteer potato tuber production at Paterson, WA in 2002. (Carfentrazone=Aim; Fluroxypyr=Starane; Dicamba=Clarity; Dicamba+diflufenzopyr=Distinct)

				Potato	
Treatment	Rate	Timing[a]	Field Corn Yield	Number tubers	Weight tubers
	(lb ai/a)		(T/A)	(no./m^2)	(g/m^2)
Carfentrazone	0.0082	EPOST	3.9	49.8	3770
Carfentrazone	0.0082	MPOST	4.7	53.3	2520
Carfentrazone	0.0082 + 0.0082	EPOST + MPOST	5.4	45.5	2020
Carfentrazone	0.0082 + 0.0082	EPOST + LPOST	6.2	28.2	910
Carfentrazone	0.0082 + 0.0082 + 0.0082	EPOST + MPOST + LPOST	6.3	24.3	640
Fluroxypyr	0.19	MPOST	4.9	24.6	460
Fluroxypyr	0.24	MPOST	5.4	18.5	310
Fluroxypyr + carfentrazone	0.19 + 0.0082	MPOST	5.7	42.4	1360
Fluroxypyr + carfentrazone	0.24 + 0.0082	MPOST	6.0	47.0	1270
Dicamba	0.25	MPOST	5.5	45.9	1380
Dicamba + carfentrazone	0.25 + 0.0082	MPOST	5.8	49.1	1030
Dicamba + diflufenzopyr	0.263	MPOST	6.4	31.1	780
Nontreated check			2.5	51.2	4230
Hand weeded check			6.4	0.5	1.4
	$LSD_{(0.05)}$		1.0	10.2	419

[a] EPOST=May 8, MPOST=May 15, and LPOST=May 24
All POST treatments included Moract COC @ 1% and UN32@ 2.5% (v/v) spray solution.

Volunteer Potato Control in Sweet Corn 2002

Volunteer potato control in sweet corn is difficult due to the vigorous growth of potatoes, relatively low early vigor and growth of sweet corn, and few registered effective herbicides. Atrazine is currently labeled for use in sweet corn, but its long persistence in soil limits rotations to corn and a few other tolerant crops. Fluroxypyr (Starane) has had Section 18 emergency exemptions for use in sweet corn for volunteer potato control, but can injure corn at rates that control potatoes well.

Dicamba plus diflufenzopyr (Distinct) and mesotrione (Callisto) are currently being tested for volunteer potato control in sweet corn. Both herbicides have been shown to have good activity on volunteer potatoes in field corn. Sweet corn variety trials are underway to determine susceptibility of currently used varieties.

In this trial mesotrione was tested alone and with nicosulfuron, Distinct was tested alone and with atrazine or bentazon, and atrazine and bentazon were included alone for volunteer potato control in sweet corn.

Materials and Methods

The trial was located on a Quincy sand soil containing 0.5% organic matter near Paterson, WA. Volunteer potatoes were present from a natural population that developed in the previous winter wheat crop in 2001. Plots contained an average of 8.5 potatoes/m^2 on May 30, 2002. Sweet corn (var. Super Sweet Jubilee) was planted in 30-inch rows May 8, 2002 to obtain a population of 32,000 plants/acre. The entire trial was treated with glyphosate plus pendimethalin (1 + 1 lb ai/a, respectively) on May 15, 2002 prior to sweet corn emergence. In early July plots became infested with Colorado potato beetle, which severely defoliated most remaining potato plants by early August.

Plots were 10 by 30 feet and treatments were replicated three times. Herbicide treatments were applied POST on May 30, 2002 when sweet corn had 3 ½ to 4 leaves and was 4 to 6 inches tall. Potatoes were from 2-8 inches tall with most plants containing stolons without tubers and a few larger plants with small 0.5 cm diameter tubers. Herbicides were applied with a bike sprayer delivering 20 GPA. Treatments containing mesotrione included crop oil at 1% (v/v) and UN32 at 2.5% (v/v). Bentazon and atrazine applied alone included crop oil at 1% (v/v). All other treatments included R-11 nonionic surfactant at 0.25% (v/v).

Sweet corn injury was visually estimated June 2, June 5, and June 24, 2002. Potato control was visually estimated June 5, June 24, 2002. Sweet corn yield was harvested by hand on August 13, 2002. All ears greater than 8 inches in length were removed from 20 feet of the middle two rows in each plot and counted and weighed. A twenty ear subsampled was husked and ear diameter and length was determined. In early June, an area containing ten potato plants was marked between the middle two corn rows in each plot. Potato tubers were dug from this area on August 19, 2002 and counted and weighed.

Results

Early emerged volunteer potato foliage was killed by glyphosate application on May 15, 2002. New shoots continued to emerge and potatoes uniformly infested plots by late May.

<u>Sweet Corn Injury.</u> Sweet corn injury at 3 DAT was greatest with mesotrione and mesotrione plus nicosulfuron (Table 5). Sweet corn plants were almost completely white at 3 DAT with mesotrione alone, whereas plants treated with mesotrione plus nicosulfuron were less bleached and had a more yellow chlorotic appearance. Bentazon injured sweet corn about 20% at 3 DAT and all other treatments ranged from 10 to 16% injury.

On June 5, 2002 (6 DAT), sweet corn treated with mesotrione alone was still severely chlorotic but newly emerged leaves had more green color. On June 5, sweet corn treated with bentazon or Distinct alone or Distinct in combination with atrazine or bentazon was injured similarly ranging from 5 to 9%. Corn injury from Distinct appeared as bent stalks. Atrazine alone injured sweet corn the least. Injury from all herbicide treatments lessoned with time and by June 24, only sweet corn treated with mesotrione alone still had injury symptoms, which was minor bleaching of the lower leaves that were exposed at the time of herbicide application (Table 5).

Potato Control. At 6 DAT, potato control was greatest with mesotrione alone or in combination with nicosulfuron (Table 5). Potatoes treated with mesotrione appeared white and chlorotic. All treatments containing Distinct controlled potatoes similarly ranging from 86 to 92% control at 6 DAT. Distinct stunted potato growth and caused epinastic, twisted growth of potatoes. Atrazine alone controlled potatoes 90% at 6 DAT while bentazon controlled potatoes the least, causing some chlorosis and minor leaf necrosis.

Potato control in late June was 98% with mesotrione applied alone or in combination with nicosulfuron (Table 5). Atrazine alone or in combination with Distinct controlled potatoes from 91 to 94% by late June. Distinct applied alone or in combinations with bentazon controlled potatoes from 86 to 90%. Bentazon applied alone controlled potatoes only 41% by late June.

Sweet Corn Yield. Sweet corn yield averaged 13.4 T/acre in hand-weeded checks and 13.3 T/acre in plots where potatoes were not controlled. Apparently, the removal of early-emerged potatoes with glyphosate and the late season defoliation by Colorado potato beetle prevented potatoes from reducing corn yield. However, hand-weeded checks were not the greatest yielding treatments (Table 6). All plots treated with Distinct alone or in combination with bentazon or atrazine were among the highest yielding ranging from 14 to 15 T/acre (Table 6). Sweet corn treated with atrazine, mesotrione, or mesotrione plus nicosulfuron yielded 12.5 to 13.4 T/acre, equal to nontreated and hand-weeded checks.

Distinct may have promoted more secondary ears to form on sweet corn. Sweet corn treated with Distinct alone or in combinations with bentazon or atrazine was among the treatments that produced the greatest number of ears ranging from 91 to 101 ears/40 feet of row (Table 6). Sweet corn treated with atrazine alone or mesotrione plus nicosulfuron produced 81 to 83 ears/40 feet row, similar to nontreated and hand-weeded checks. Sweet corn treated with bentazon alone averaged 89 ears/40 feet of row (Table 6).

Potato Tuber Production. Potatoes in nontreated checks that were not controlled produced an average of 49 tubers/10 plants weighing 848 g (Table 2). Potatoes that were poorly controlled with bentazon alone produced 24 tubers/10 plants.

Potatoes treated with Distinct alone or in combination with bentazon produced 12 to 20 tubers/10 plants. The least amount of tubers were produced in plots treated with mesotrione alone or in combination with nicosulfuron, atrazine alone, or Distinct plus atrazine ranging from 3 to 7.7 tubers/10 plants. These five treatments greatly decreased tuber weight to 30 g or less/10 plants.

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Table 5. Sweet corn injury and volunteer potato control with ten herbicide treatments. (Mesotrione=Callisto; Bentazon=Basagran; Dicamba+Diflufenzopyr=Distinct)

		Sweet Corn Injury			Potato Control[a]	
Treatment	Rate	June 2	June 5	June 24	June 5	June 24
	(lb ai/a)	------------- (%) -------------			------- (%) -------	
Mesotrione	0.094	72	45	5	96	98 a
Mesotrione + nicosulfuron	0.094 + 0.031	50	17	0	95	98 a
Bentazon	1.0	20	6	0	57	41 d
Atrazine	1.0	10	2	0	90	94 b
Distinct	0.13	12	8	0	86	86 c
Distinct	0.175	17	9	0	88	87 c
Distinct + bentazon	0.13 + 1	10	8	0	89	88 c
Distinct + bentazon	0.175 + 1	10	6	0	90	90 bc
Distinct + atrazine	0.13 + 1	15	8	0	87	91 bc
Distinct + atrazine	0.175 + 1	15	5	0	92	93 b
Nontreated check		0	0	0	0	0
Hand-weeded check		0	0	0	100	100
$LSD_{(0.05)}$		2.1	5.3	0	3.6	(T)[b]

[a] Means within a column followed by the same letter are not significantly different according to Fishers least significant difference test at the $\alpha = 0.05$ level
[b] T = means separated after data transformed using arcsine square root to provide homogeneity of variance. Actual means are shown.

Table 6. Sweet corn yield and potato tuber production with ten herbicide treatments. (Mesotrione=Callisto; Bentazon=Basagran; Dicamba+Diflufenzopyr=Distinct)

Treatment	Rate	Sweet Corn Yield		Potato Tubers Produced	
		Number ears	Weight	Number tubers	Weight[a]
	(lb ai/a)	(no./40feet)	(T/acre)	(no./10 plants)	(g/10 plants)
Mesotrione	0.094	84	13.4	3.0	11 de
Mesotrione + nicosulfuron	0.094 + 0.031	81	12.5	7.7	10 e
Bentazon	1.0	89	13.9	24.3	256 ab
Atrazine	1.0	83	13.3	3.7	8 e
Distinct	0.13	91	14.9	17.0	120 bc
Distinct	0.175	92	14.3	20.0	117 bc
Distinct + bentazon	0.13 + 1	97	14.0	11.7	49 cd
Distinct + bentazon	0.175 + 1	91	14.5	17.3	106 bc
Distinct + atrazine	0.13 + 1	98	15.0	4.7	30 de
Distinct + atrazine	0.175 + 1	101	14.7	3.0	24 de
Nontreated check		82	13.3	49.0	848 a
Hand-weeded check		79	13.4	0.0	0 f
$LSD_{(0.05)}$		13.5	1.31	12.7	(T)[b]

[a]Means within a column followed by the same letter are not significantly different according to Fishers least significance difference test at the α = 0.05 level.
[b] T = means separated after data transformed using log (x+1) to provide homogeneity of variance. Actual means are shown.