

Evaluating Potential Herbicides for Row-Middles with Plasticulture
Final Report for 2014

Submitted to

Pennsylvania Vegetable Marketing and Research Program
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Introduction:

Producing fruiting vegetables (tomatoes, peppers, eggplant) and melons with plasticulture for fresh market has become the standard practice in Delaware and other regions of the Mid-Atlantic States. Based on the 2009 USDA Ag Statistics, there are over 16,000 A of fresh market tomatoes, peppers, and eggplant in the region, and an additional 9,000 A of melons. Plasticulture provides many benefits to the grower, including moisture conservation, cleaner produce, better diseases resistance, and better weed control in the crop row. Weed control between the rows of plasticulture vegetables and melon crops can be challenging due to the limitation of some options for weed control. For instance, the plastic does not allow for close cultivation, forming the beds prevents using cover crop and mulches for weed control, and wide rows limit the benefit of crop canopy for shading out late emerging weeds. As a result most growers have relied on chemical weed control. Herbicide options are limited for effective full-season weed control; furthermore due to herbicide resistance issues in the region, incorporating additional herbicide mode of action would be very beneficial.

Curbit, Sandea, Dual Magnum, Command, Devrinol, metribuzin, Prowl are labeled for providing residual control between the rows of plastic in melons and/or fruiting vegetables. But many of these products are limited in the spectrum of weeds that they will control. Also, many will limit which vegetables can be planted in the field the following year. These products are typically applied in combination with paraquat, using hooded (shielded) applicators. Two new herbicides may have potential for weed control in row middles, Chateau and Sharpen. Both are PPO-inhibiting herbicides (Group 14) which are not typically used in vegetables and can bring a different mode of action for resistance management. Both can be used at rates significantly higher than typically used in field crops, which will improve their performance and longevity in the soil. However, there are no crop rotational restrictions after six months if the soil is tilled prior to planting the rotational crop. Valent, the manufacturer of Chateau, has granted special local needs labeling (24c SLN) for use in fruiting vegetables and melons to some states. This project will examine Chateau for potential for labeling in PA and provide additional information on its benefits. Sharpen, is not labeled for the proposed uses, but this project is the first step to determine its appropriateness in this region. Additional research is needed to assess this potential damage and the level of weed control from the higher rates we are evaluating in this trial.

Objectives:

1. Evaluate effectiveness of various herbicides for weed control in row middles for plasticulture
2. Evaluate potential herbicides for use in plasticulture
3. Evaluate crop safety of various crops for herbicides that could be registered in PA

Methodology:

Experiments were conducted at two locations: the Russell E. Larson Agricultural Research Farm in Centre County and at the University of Delaware Research and Extension Center in Sussex County in 2014.

Two trials were conducted, the first focused on weed control, and the second examined crop safety. The first study was conducted with cantaloupes in PA ('Athena'), and cantaloupe ('Athena') and watermelon ('Super Seedless 7187') in DE and examined Chateau at 3 and 4 oz/A applied before transplanting, and Chateau, Sharpen, and Spartan Charge applied after transplanting. In addition, a standard treatment of Strategy (Curbit plus Command) plus Sandea was evaluated. See Tables 1, 2, and 3 for rates and application timings. In PA, pre-transplant applications were made June 24, transplanting occurred June 25, and post-transplant treatments were applied July 25. In DE, pre-transplant applications were made May 27, transplanting was done May 28, and post-transplant was done June 12.

The second study was only done in DE, and examined vegetable crop safety. Plots consisted of multiple crop species that were evaluated for response to Chateau or Sharpen. Tomatoes, peppers, and eggplant were planted in each plot. Two pepper varieties, 'Aristotle' and 'Snapper' were used. Chateau at 4 oz/A and Sharpen at 5 oz/A were applied prior to transplanting and after transplanting to examine crop safety. Spartan Charge was also included as a post-transplant option. Pre-transplant treatments were made May 19, transplanting occurred on May 20, and post-transplanting treatments were made June 4.

All applications will be made with a backpack, hooded (shielded) sprayer to minimize herbicide contact with crop foliage. Applications made pre-transplant were made with hooded sprayers as well, so spray only was applied to a narrow region (2 to 3 inches) on top edge of the plastic, not a broadcast application (not over the top of the plastic).

Results & Discussion – Larson Research Farm, Centre County: (Table 1):

- Watermelon were planted, but due to poor stand and growth, no data was collected.
- More cantaloupe injury was observed with post-transplant applications than pre-transplanting
- Chateau resulted in more injury than standard treatment of Strategy+Curbit+Sandea or Anthem. No difference among the other treatments
 - Due to late season disease pressure in the cantaloupes, no pre-harvest data was collected
- Weed control was excellent for all treatments
- Due to wet season, no yield data was collected.

UD Research and Education Center, Sussex County (Table 2 and 3)

- Weed populations were quite variable and as a result no significant differences were detected among the treatments
- Cantaloupe appeared to be more sensitive to treatments compared to watermelon; most of the injury was due to spray drift. There was direct movement of the spray from under the hoods unto crop foliage.
- Chateau applied post-transplant to watermelon resulted in the highest level of injury (29%), but the crop recovered quickly and this did not affect final yield
- Sharpen, Spartan Charge, and Chateau all caused more cantaloupe injury than other treatments at 3 weeks after post-transplant applications, and plants treated with Spartan Charge did not recover quite as quickly. However, treatments did not negatively impact yields.

UD Research and Education Center, Multiple Vegetable Screen (Table 4)

- Very little weed pressure was present

- Eggplant appears to be the most sensitive and tomato the most tolerant to the herbicides tested.
- There was more stunting associated with Chateau on eggplant, but this was not significantly different than the other treatments.
- There was no difference in yields for any of the crops tested (data not presented).

Other data (not presented)

- The multiple vegetable screen was also conducted in MD at the Wye Research Farm. Eggplant was the only crop to be affected by the treatments. Yield from the first harvest was reduced with Chateau, Sharpen, and Spartan Charge. However, total yield did not differ among the treatments.
- Melon3-14, cantaloupe was injured with Zidua, Chateau, Spartan Charge, and Sharpen shortly after the post-transplant applications. Cantaloupe recovery was quicker with Sharpen and Chateau than Zidua or Spartan Charge. Watermelon exhibited minimal injury (~10%) immediately after application with Zidua and Spartan Charge, but the crop recovered very quickly had showed no injury.

Two-year Summary:

- Chateau and Sharpen have potential for use in watermelon, peppers, and tomatoes as postemergence, hood spray. Drift unto the crop plant may cause some stunting and injury, but the crops outgrew the injury very rapidly.
- Cantaloupes and eggplant are more sensitive to these products and more work is needed to develop a more consistent use pattern
- Spartan Charge was used in only one year and additional work is needed to determine its potential for plasticulture.

Data will be shared with Valent, who markets Chateau, and we will discuss the potential for shield applications as a post-transplant application. Any labeling changes will take time to obtain.

Table 1. Cantaloupe injury and weed control at Russell Research Farm, Centre County, PA. Weed control ratings prior to harvest. Values followed by the same letter are not significantly different from one another.

TrtNo	Herbicide	Rate	Timing	Cantaloupe Injury (%)	Redroot pigweed	Common lambsquarters	Common purslane
1	Untreated			0	0	0	0
2	Strategy	3 pt/a	Pre-transplant	0 d	99 a	92 a	94 bc
	Curbit	8 fl oz/a					
	Sandea	0.75 oz/a					
3	Chateau	3 oz/a	Pre-transplant	1.5 cd	99 a	91 a	90 c
	Curbit	32 fl oz/a					
4	Chateau	4 oz/a		1.5 cd	99 a	93 a	95 ab
	Curbit	32 fl oz/a					
5	Strategy	3 pt/a	Post-transplant	7.5 bcd	98 a	92 a	98 ab
	Curbit	8 fl oz/a					
	Sandea	0.75 oz/a					
	Gramoxone	1.5 qt/a					
	NIS	0.25 % v/v					
6	Chateau	4 oz/a	Post-transplant	17.5 a	99 a	99 a	99 a
	Curbit	32 fl oz/a					
	Gramoxone	1.5 qt/a					
	NIS	0.25 % v/v					
7	Sharpen	5 fl oz/a	Post-transplant	9.5 abc	99 a	98 a	99 a
	Curbit	32 fl oz/a					
	Gramoxone	1.5 qt/a					
	NIS	0.25 % v/v					
8	Reflex	1.25 fl oz/a	Post-transplant	10 ab	99 a	97 a	99 a
	Curbit	32 fl oz/a					
	Gramoxone	1.5 qt/a					
	NIS	0.25 % v/v					
9	Spartan Charge	5 fl oz/a	Post-transplant	9.5 abc	94.5 a	99 a	99 a

Table 2. Weed control 3 weeks after post-transplant applications at UD Research and Education Center, Sussex County, DE. Values followed by the same letter are not significantly different from one another.

TrtNo	Herbicide	Rate	Timing	Palmer amaranth	Common lambsqrtr	Large crabgrs
1	Untreated			0	0	0
2	Chateau	3 oz wt/a	Pre-transplant	100 a	100 a	83 a
	Curbit	32 fl oz/a				
3	Chateau	4 oz wt/a	Pre-transplant	87 a	93 a	68 a
	Curbit	32 fl oz/a				
4	Strategy	3 pt/a	Pre-transplant	93 a	88 a	76 a
	Curbit	8 fl oz/a				
	Sandea	0.75 oz wt/a				
5	Spartan Charge	5 fl oz/a	Post-transplant	100 a	100 a	91 a
	Curbit	32 fl oz/a				
	Gramoxone SL	1.5 qt/a				
	NIS	0.25 % v/v				
6	Reflex	1.5 pt/a	Post-transplant	100 a	100 a	82 a
	Curbit	32 fl oz/a				
	Gramoxone SL	1.5 qt/a				
	NIS	0.25 % v/v				
7	Sharpen	3 fl oz/a	Post-transplant	100 a	100 a	85 a
	Curbit	32 fl oz/a				
	Gramoxone SL	1.5 qt/a				
	NIS	0.25 % v/v				
8	Sharpen	5 fl oz/a	Post-transplant	100 a	100 a	79 a
	Curbit	32 fl oz/a				
	Gramoxone SL	1.5 qt/a				
	NIS	0.25 % v/v				
9	Strategy	3 pt/a	Post-transplant	100 a	100 a	77 a
	Curbit	8 fl oz/a				

	Sandea	0.75	oz wt/a					
	Gramoxone SL	1.5	qt/a					
	NIS	0.25	% v/v					
10	Chateau	4	oz wt/a	Post-transplant	100	a	100	a
	Curbit	24	fl oz/a				87	a
	Gramoxone SL	1.5	qt/a					
	NIS	0.25	% v/v					

LSD		15.27	9.31	33.61
CV		9.02	5.5	24.01
Trt (F)		0.5696	0.1233	0.9238

Table 3. Cantaloupe and watermelon stunting and yield at UD Research and Education Center, Sussex County, DE. Stunting data was collected at 3 and 6 weeks after the post-transplant applications were made. Values followed by the same letter are not significantly different from one another.

TrtNo	Herbicide	Rate	Timing	Cantaloupe				Watermelon											
				Stunting		Yield / plot		Stunting		Yield / plot									
				3	WAT	6	WAT	Num	Wt	3	WAT	6	WAT	Num	Wt				
1	Untreated							6	a	17	a	0		0		8	a	242	a
2	Chateau Curbit	3 oz /a 32 fl oz/a	Pre-transplant	8	cd	3	cd	7	a	25	a	0	b	0	a	11	a	270	a
3	Chateau Curbit	4 oz /a 32 fl oz/a	Pre-transplant	1	d	6	bcd	9	a	27	a	0	b	0	a	10	a	251	a
4	Strategy Curbit Sandea	3 pt/a 8 fl oz/a 0.75 oz /a	Pre-transplant	14	c	3	cd	7	a	28	a	0	b	0	a	13	a	273	a
5	Spartan Charge Curbit Gramoxone NIS	5 fl oz/a 32 fl oz/a 1.5 qt/a 0.25 % v/v	Post-trnsplnt	37	ab	20	a	5	a	20	a	2	b	2	a	11	a	265	a
6	Reflex Curbit Gramoxone NIS	1.5 pt/a 32 fl oz/a 1.5 qt/a 0.25 % v/v	Post-trnsplnt	15	bc	9	bc	7	a	23	a	1	b	4	a	9	a	249	a
7	Sharpen Curbit Gramoxone NIS	3 fl oz/a 32 fl oz/a 1.5 qt/a 0.25 % v/v	Post-trnsplnt	24	abc	11	b	5	a	20	a	4	b	2	a	13	a	270	a
8	Sharpen Curbit Gramoxone NIS	5 fl oz/a 32 fl oz/a 1.5 qt/a 0.25 % v/v	Post-trnsplnt	20	bc	10	bc	6	a	23	a	6	b	0	a	7	a	247	a

9	Strategy	3	pt/a		12	cd	0	d	6	a	22	a	1	b	0	a	11	a	262	a
	Curbit	8	fl oz/a	Post-trnsplnt																
	Sandea	0.75	oz /a																	
	Gramoxone	1.5	qt/a																	
	NIS	0.25	% v/v																	
10	Chateau	4	oz /a	Post-trnsplnt	48	a	9	bc	1	a	3	a	29	a	3	a	10	a	258	a
	Curbit	24	fl oz/a																	
	Gramoxone	1.5	qt/a																	
	NIS	0.25	% v/v																	
LSD					15		7		5	18			17		6		4		29	
Trt (F)					0.01		0.01		0.21	0.3			0.02		0.8		0.11		0.30	

Table 4. Vegetable stunting 2 weeks after post-transplant applications. All treatments included Gramoxone to control weeds that were present at time of application. Values followed by the same letter are not significantly different from one another.

TrtNo	Herbicide	Rate	Timing	Peppers		Eggplant	Tomato
				Aristotle	Snapper		
1	Chateau Dual	4 oz/A 1.5 pt/A	Pre-trnsplnt	2.5 ab	4.3 a	6 a	1.8 a
2	Sharpen Dual	5 fl oz/A 1.5 pt/A	Pre-trnsplnt	3.8 ab	3 a	6.8 a	0 a
3	Chateau Dual	4 oz/A 1.5 pt/a	Post-trnplnt	8.5 a	5.5 a	18.8 a	1.8 a
4	Sharpen Dual	5 fl oz/A 1.5 pt/A	Post-trnplnt	7.8 a	6.3 a	6.3 a	2.5 a
5	Dual	1.5 pt/A	Pre-trnsplnt	0 b	0 a	0 a	0 a
6	Spartan Charge Dual	5 fl oz/A 1.5 pt/A	Post-trnplnt	0 b	2.5 a	8.8 a	0 a