Potential Herbicide Programs to Control Problem Weeds in Pumpkin
(2022 final research report)

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Introduction:
Weed control in pumpkins is challenging for many reasons, including the production practices of wide rows, no-till which excludes use of cultivation, long growing season, and limited number of herbicide options. These practices result in a greater reliance upon herbicides for weed control. Unfortunately, there are very few herbicides labeled for postemergence weed control in pumpkins. Since herbicides play an important role in pumpkin production, it is important that currently registered herbicides are used judiciously and new herbicides (i.e., ones with different active ingredients and modes of action than those currently labeled) are identified that fit into a pumpkin production system and provide effective weed control, minimal crop injury, and environmental safety.

We propose to evaluate preemergence and postemergence herbicide programs for control of typical annual weeds such as, giant foxtail, velvetleaf, pigweed, nightshade, ragweed, and any other weed species present in the study location. In addition to evaluating weed control, we will determine effect of the herbicides on pumpkin injury and any subsequent impacts on yield. We will compare labeled standards such as Command, Curbit, and Sandea to some recently labeled products and those that could potentially receive a label for use in pumpkins such as, Dual, Reflex, Zidua, bicyclopyrone, BroadStar, Tough, and others. The study will be conducted at the Penn State research farm near Rock Springs, Centre County. Benefits to state and regional pumpkin growers will include updated information in vegetable production guides and other educational resources on how to control weeds more effectively with existing and new products and how best to integrate other effective herbicide modes of action into the program to reduce the potential for resistance.

Objectives:
1. To examine various pre and post herbicide programs in pumpkin (i.e., novel concepts vs. standards) to determine their effectiveness on weed control.

2. To evaluate these herbicide programs on pumpkin injury and yield impact.

Work Statement:
An experiment was conducted at the Russell E. Larson Agricultural Research Farm in Centre County in 2022. Several herbicide-program approaches (Table 1) were evaluated in a randomized complete block design with three replications. Each plot was one row of pumpkin vines, 25 feet long and seeds were direct planted into a raised bed containing drip tape irrigation. A common face-pumpkin variety (EROS hybrid from Seedway) was planted on June 10. Preemergence treatments were applied the same day as planting and postemergence treatments were applied on July 13 but before vines started to run. Weed control for all species present and crop injury was evaluated on July 1, July 25, and August 17. In addition, crop yield (fruit size and number) was documented on September 16. Insect and disease management and irrigation was enacted when necessary, during the growing season.

Results

- Control data was collected for common lambsquarters (*Chenopodium album*), velvetleaf (*Abutilon theophrasti*), and redroot pigweed (*Amaranthus retroflexus*).
    - All treatments (Table 1) provided 91-99% control of these three broadleaf weeds.
    - Unfortunately, there were inconsistent grasses or nutsedge populations to evaluate control.
- In general, crop injury varied greatly across all treatments; some treatments caused significant injury while others minimal (Table 1 and images).
    - A16003 (bicyclopyrone-BIR) caused the most pumpkin damage with 57-87% injury
    - Zidua SC caused 15-22% injury
    - Tough 5EC caused 30-47% injury
    - Sandea + Select Max caused 21-25% injury
    - The other treatments caused minimal injury to pumpkin
- Pumpkin yields varied across treatments in both fruit size and number per plot (Figure 1).
    - All treatments produced 18-24 total fruits per 25-foot row except for treatments containing A16003 (bicyclopyrone-BIR) which only produced 8-11 fruits.
    - However, some treatments possibly caused a delay in fruit maturation.

Discussion and summary

Command and Curbit (or Strategy), Sandea, and a graminicide (e.g., clethodim) tend to be typical herbicides used in pumpkin production. The goal of this research was to hopefully find additional active ingredients with different modes of action that could potentially fit into pumpkin production systems. Most of the "different" herbicides were used in conjunction with Command and Curbit to determine if they could improve their weed control spectrum without impacting yield. Below are some comments about each of the products tested:

- Dual Magnum is an ideal candidate to be used as an overlapping residual treatment a few weeks after planting. This "overlapping residuals" approach improves overall weed control by applying a second residual herbicide over the top of the emerged crop, but before the weeds have begun to emerge. Previous research at Penn State and several other universities across the United States have shown effective weed control and minimal crop damage when applied in this manner. Currently, we are awaiting approval for this label change.
- Reflex, a Group 14 herbicide, was recently labeled for use in pumpkin as a PRE application at 8-10 fl oz/acre, and provides control of pigweeds, ragweed, and nightshade. It is a welcomed addition for various reasons; however, it needs to be used with caution since it can injure certain pumpkin varieties and its residual activity won't last the entire growing season, among other limitations.
- BroadStar (flumioxazin, same active ingredient in Valor), is a dry granular herbicide that is labeled for use in ornamentals, orchards, and other areas. It is a Group 14 residual herbicide that controls many annual broadleaf weeds (including Palmer amaranth and marestail) and provides some annual grass suppression. It must be applied before weeds germinate, so in a pumpkin setting, it might likely be used as an overlapping residual treatment a few weeks after planting. When applied as a broadcast liquid application (i.e., sprayed), flumioxazin causes severe pumpkin injury. However, since BroadStar is a granular product, it tends to cause less crop injury since the granules fall off dry pumpkin leaves. If it were applied to leaves that were damp from dew or rainfall, injury potential might be increased. Once the granules drop to the ground, the herbicide would need to be activated by irrigation or rainfall to get effective weed control. BroadStar is a candidate to include in future pumpkin research to optimize its use rate and further evaluate crop injury potential, as well as other use parameters.
- Initially, none of the other candidates, such as Zidua SC, Tough 5EC, and A16003 (bicyclopyrone-BIR) appear to be adequate options, mostly due to their potential to cause significant crop injury. However, further research on the utility of Zidua SC and A16003 as overlapping residuals might be warranted.

Pumpkin yield was taken on September 16. Pumpkins were evaluated by fruit size and numbers per plot. Size rankings were based on Small (7-9 inches in diameter), Medium (10-12 inches) and Large (13-15 inches) as well as maturity (fully ripe vs. still green). Those that were still immature during the evaluation process might likely ripen and be marketable fruits after a few weeks. The reason for fruit size differences and late maturity of some fruit could possibly be related to herbicide treatment. Further research would be needed to determine if herbicides caused this to occur. Refer to Figure 1 for information about pumpkin yield.

Table 1. Effect of herbicides on pumpkin injury and weed control at Centre Co., PA, 2022.

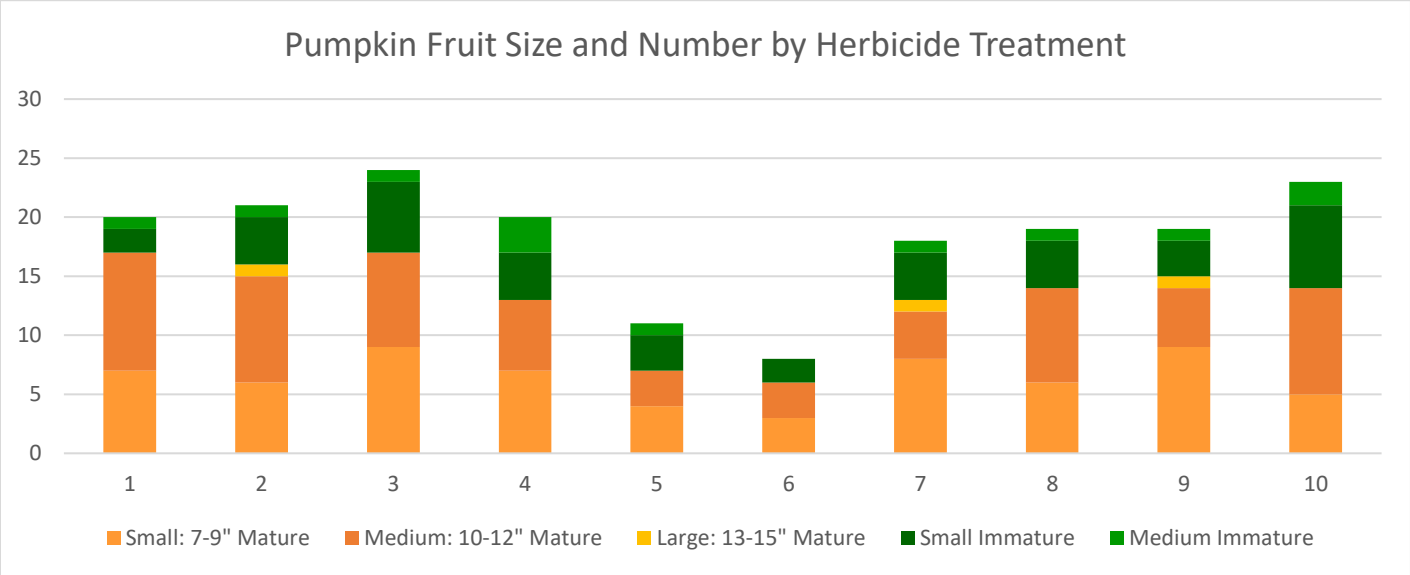
Treat-ment #	Herbicide(s)*	Rate/A	Applic. timing**	Pumpkin injury (7/1/22)	Pumpkin injury (7/25/22)	Pumpkin injury (8/17/22)	Lambs-quarters	Velvet-leaf	Rr pig-weed
				% injury			% control***		
1	Untreated	-	-	0	0	0	0	0	0
2	Command ME + Curbit	1 pint + 2 pints	PRE	3	1	0	91	95	95
3	Command ME + Curbit + Reflex	1 pint + 2 pints + 10 fl oz	PRE	2	1	1	95	96	96
4	Command ME + Zidua SC	1 pint + 4 fl oz	PRE	22	15	15	95	98	97
5	Command ME + Curbit + A16003 (bicyclopyrone-BIR)	1 pint + 2 pints + 3.4 fl oz	PRE	87	78	62	98	99	99
6	Sandea + A16003 (bicyclopyrone-BIR)	0.5 oz+ 3.4 fl oz	PRE	87	76	57	98	99	99
7	Command ME + Curbit fb Sandea + Select Max	1 pint + 2 pints fb 0.5 oz + 12 fl oz	PRE fb POST	3	25	22	92	96	96
8	Command ME + Curbit fb Dual Magnum	1 pint + 2 pints fb 1.33 pints	PRE fb POST	3	2	2	92	96	96
9	Command ME + Curbit fb Tough 5EC	1 pint + 2 pints fb 24 fl oz	PRE fb POST	2	47	30	99	99	99
10	Command ME + Curbit fb BroadStar G	1 pint + 2 pints fb 32 lb	PRE fb POST	4	3	6	93	99	98
	LSD (P=0.05)			4	10	15	4	3	4

* If necessary, rates could be adjusted depending on soil type; and appropriate adjuvants are included with the postemergence herbicide treatments

**abbreviations reference: fb – followed by; PRE – preemergence; POST – postemergence (3-4 weeks after planting)

*** Late season ratings taken 8/17/2022

Figure 1. Effect of herbicides on pumpkin fruit size and number at Centre Co., PA, 2022.



X axis = treatment number (refer to Table 1 for descriptions)
Y axis = Average number of pumpkins per 25 feet
Color codes = size and maturity of fruit (see legend)

Signature: 

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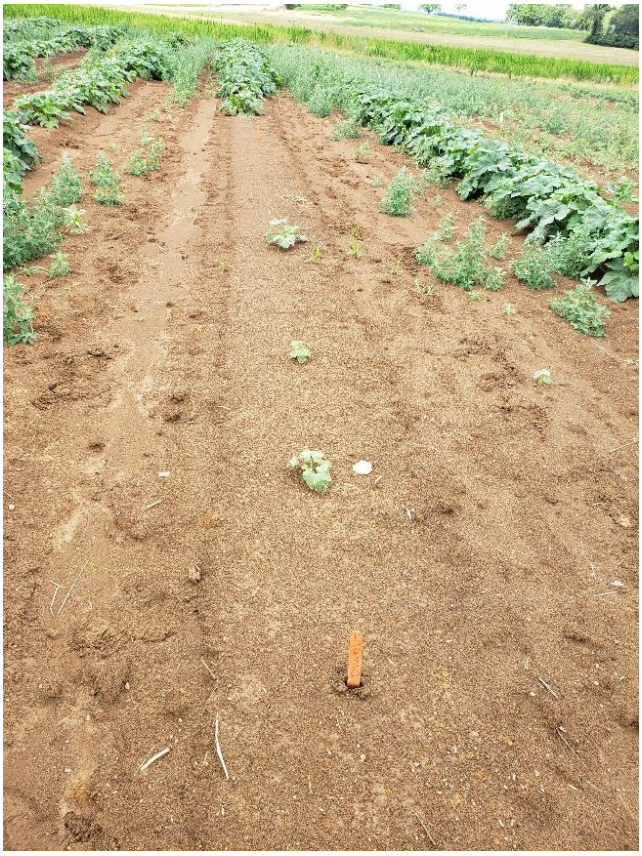
Pictures from the study at Rock Springs.

Untreated check plot (July 25)



Treatment with A16003 (bicyclopyrone-BIR)

Treatment with Tough 5EC (July 25)

Treatment with Sandea + Select Max (July 25)

BroadStar granule application (July 13)

Treatment with BroadStar (July 25)

Overview of study area (August 17)