Potential Herbicides to Control Problem Weeds in Snap Bean

Final Report for 2019

Submitted to:

Pennsylvania Vegetable Marketing and Research Program
Pennsylvania Vegetable Growers Association

Submitted by:

Dwight D. Lingenfelter
Penn State Dept. of Plant Science
116 Ag Sciences & Industries Bldg.
University Park, PA 16802
Ph: 814-865-2242
Email: DXL18@psu.edu

John M. Wallace
Penn State Dept. of Plant Science
116 Ag Sciences & Industries Bldg.
University Park, PA 16802
Ph: 814-863-1014
Email: jmw309@psu.edu

Mark J. VanGessel
University of Delaware, Carvel Center
16483 County Seat Highway
Georgetown, DE 19947
Ph: 302-856-2585 ext 510
Fax: 302-856-1845
Email: mjv@udel.edu

Kelly Nichols
Ag Agent Associate
University of Maryland Extension,
Frederick County
330 Montevue Lane
Frederick, MD 21702
301-600-3577
Email: kellyn@umd.edu

Introduction:

Pennsylvania, Delaware, Maryland, New Jersey, and New York combined produce over 46,000 acres of snap beans (NASS, 2017). Management of weeds is a major concern to snap bean producers and a critical component to provide optimal crop yield. Some major weeds of concern in snap bean production in the region include foxtail, crabgrass, lambsquarters, smooth pigweed, common ragweed, nightshade, velvetleaf, horsenettle, and yellow nutsedge. However, within the past five years, species such as Palmer amaranth, waterhemp, and annual morningglory are become more prevalent in the area and there are indications that these aggressive species will further spread in both agronomic and horticultural cropping systems. These new weeds can be especially difficult to manage with the current snap bean herbicide options available. Furthermore, only a limited number of herbicides are currently available for snap beans, with a heavy reliance on ALS-inhibiting herbicides (Pursuit, Raptor, and Sandea) for broadleaf weed control. Several herbicide-resistant biotypes have been selected due to the over reliance on ALS-inhibiting herbicides, not only in snap beans but in many rotational crops as well. The number of fields infested with herbicide-resistant biotypes is increasing in the Mid-Atlantic region.

PPO-inhibiting herbicide products such as Valor (flumioxazin), Spartan (sulfentrazone), Reflex (fomesafen), and Cobra (lactofen) have provided control of these weeds in soybean and there is potentially a fit to use them in snap bean production. Except for Reflex, only limited field data is available on the utility of the PPO-inhibiting herbicides in snap bean.

We propose to evaluate weed control, snap bean injury and yield following use of these potential PPO-herbicides and currently labeled products in snap bean production systems. Combinations of preemergence and/or pre & postemergence herbicides, including standard and new products will be evaluated. To obtain a wider range of weeds, soil types, and growing conditions, the studies will be conducted at the Penn State research farm in Centre County, at the University of Delaware, Georgetown research farm, and at the University of Maryland research farm in Washington County. Benefits to state and regional snap bean growers will include updated information in vegetable production guides and other educational resources on how to more effectively control weeds 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.

In addition, a successful trial will provide data to encourage the manufacturers of these products to consider a registration for use in snap beans. Snap bean growers could benefit from additional herbicide options to control troublesome weeds.

Objectives:

1. To evaluate herbicide effectiveness of these potential herbicides when used in combination with other herbicides as compared to current standards.
2. Determine the effect of these herbicide treatments on snap bean stand, injury, and yield.

Work Statement:

Experiments were conducted at three locations: the Russell E. Larson Agricultural Research Farm in Centre County; the University of Delaware Research and Extension Center in Sussex County; and at the Western Maryland Research and Education Center in Washington County. Trials were arranged as a randomized complete block design with three replications. Fields were conventionally tilled and 'Caprice' snap beans were planted on 30 inch rows at 6 seeds per ft-row. Snap beans were planted on June 20 on loamy sand in DE, June 6 on silt loam in PA, May 30 on silt loam in MD. PRE herbicides (*Table 1*) were applied one day after planting and POSTs applied at the second trifoliate at all locations. In DE, a POST application of bentazon was added to treatments 2-9 to control patches of common cocklebur. All POSTs had nonionic surfactant (NIS).

Treatments for field trial:

Table 1. Herbicide programs for weed control in snap bean.

Treatment	Herbicide(s)*	Rate/A**	Application timing***
1	Untreated		
2	Valor (flumioxazin) + Dual Magnum (s-metolachlor)	1 oz + 1.67 pt	PRE
3	Valor + Dual Magnum	2 oz + 1.67 pt	PRE
4	Spartan (sulfentrazone) + Dual Magnum	3 fl oz + 1.67 pt	PRE
5	Spartan + Dual Magnum	6 fl oz + 1.67 pt	PRE
6	Cobra (lactofen) + Dual Magnum	12 fl oz + 1.67 pt	PRE
7	Collide (oxyfluorfen) + Dual Magnum	1 pt + 1.67 pt	PRE
8	Reflex (fomesafen) + Dual Magnum	1.25 pt + 1.67 pt	PRE
9	Sandea (halosulfuron) + Dual Magnum	0.67 oz+ 1.67 pt	PRE
10	Valor + Dual Magnum fb Basagran (bentazon) + Reflex + NIS	2 oz + 1.67 pt 1.5 pt + 0.75 pt	PRE fb POST
11	Spartan + Dual Magnum fb Basagran + Reflex + NIS	6 fl oz + 1.67 pt 1.5 pt + 0.75 pt	PRE fb POST
12	Cobra + Dual Magnum fb Basagran + Reflex + NIS	12 fl oz + 1.67 pt 1.5 pt + 0.75 pt	PRE fb POST
13	Sandea+ Dual Magnum fb Basagran + Reflex + NIS	0.67 oz+ 1.67 pt 1.5 pt + 0.75 pt	PRE fb POST
14	Sandea+ Dual Magnum fb Basagran + Raptor (imazamox) + NIS	0.67 oz+ 1.67 pt 1.5 pt + 4 fl oz	PRE fb POST

*fb=followed by; NIS=nonionic surfactant

**PRE rates presented are for medium textured soils and will be adjusted appropriately for soil type at each location

***PRE – preemergence/soil-applied; POST – postemergence

Results:

Snap bean injury and weed control were evaluated visually at 4, 6 and 8 weeks after planting (WAP) based on a 0 to 100 scale. Snap beans were harvested, and weight was recorded. Data was analyzed and means were separated using Fisher's Protected LSD ($\alpha = 0.05$).

Figure 1. Snap bean injury at 6 weeks after planting (WAP). Both DE and PA observed minimal injury with fomesafen and halosulfuron alone and halosulfuron f/b fomesafen + bentazon or imazamox + bentazon. At MD, no treatment showed significant injury except oxyfluorfen (data not presented).

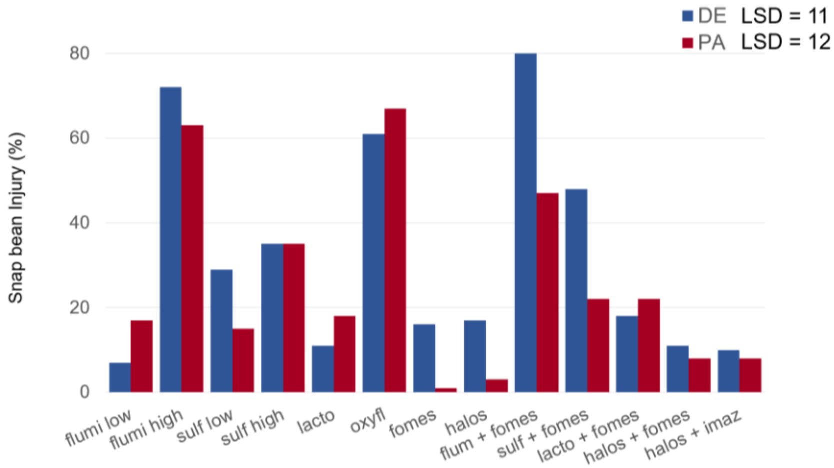


Figure 2. Snap bean yield (% of highest yield). Halosulfuron PRE f/b fomesafen or imazamox POST resulted in higher yields in both DE and PA. In DE these were the highest yielding treatments f/b the low rate of sulfentrazone alone. In PA halosulfuron alone produced the greatest yield but was not significantly different from fomesafen alone, halosulfuron + fomesafen and halosulfuron + imazamox. Significant differences were observed with MD yield at α = 0.10. Yield loss was observed with lactofen alone, the low rate of sulfentrazone and halosulfuron f/b imazamox compared to low rate of flumioxazin which produced the highest yield.

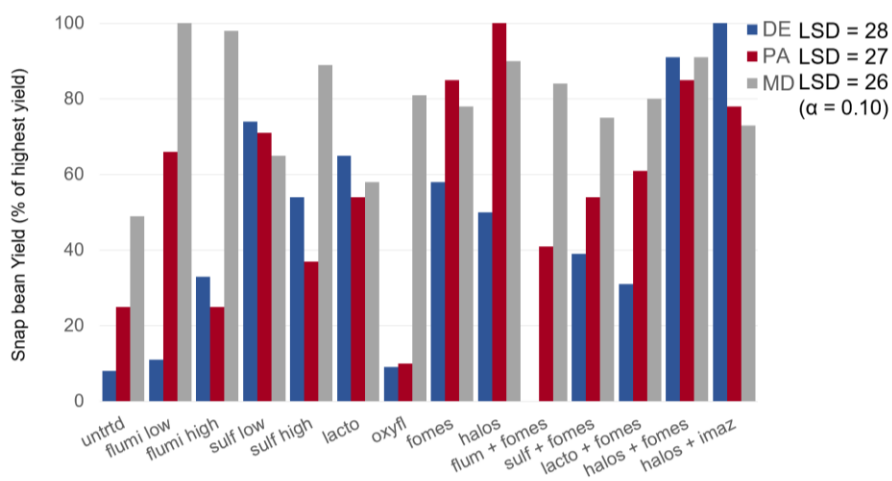


Figure 3. DE weed control at 8 weeks after planting (WAP). DE had two predominant weed species, Palmer amaranth (AMAPA) and morningglory (IPOSS). Good Palmer amaranth control was observed with 8 of the 13 treatments. 89-100% control was observed with high rate of flumioxazin, both rates of sulfentrazone, fomesafen alone and treatments with fomesafen as a POST. No treatment provided adequate full-season morningglory control.

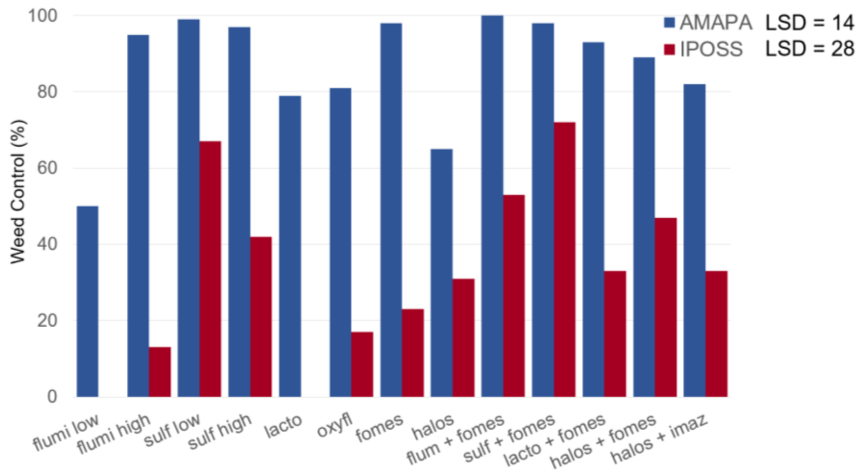
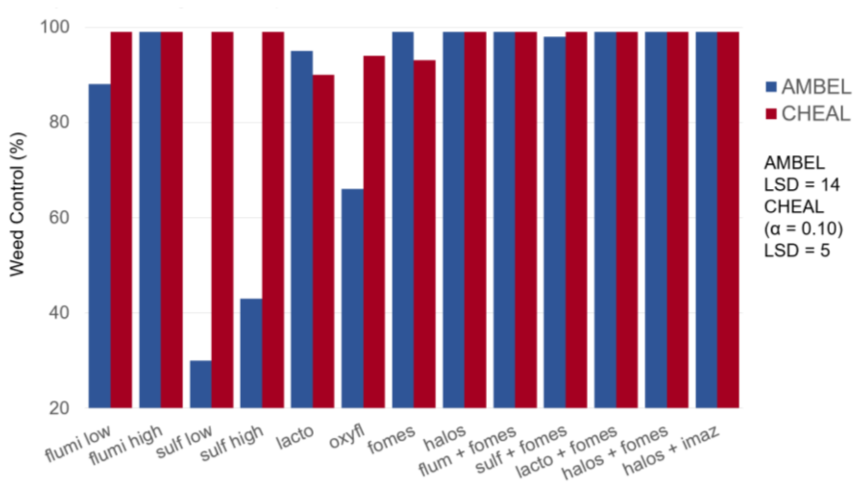


Figure 4. PA weed control at 8 WAP. PA had multiple weed species. All but three treatments provided >85% control of common ragweed (AMBEL). Oxyfluorfen and sulfentrazone resulted in less than 70% control. All treatments resulted in excellent common lambsquarter (CHEAL) control (90% or greater), with lactofen and fomesafen alone slightly less effective (α = 0.10). Excellent control was observed with three other weed species in PA (smooth pigweed, ladysthumb, and giant foxtail) and did not differ between treatments.



Summary

- At 6 WAP minimal crop injury was observed with halosulfuron alone, fomesafen alone, halosulfuron f/b fomesafen and halosulfuron f/b imazamox in both DE and PA (*Figure 1*). In MD, minimal injury was observed with all treatments except oxyfluorfen (55%) (data not presented).

- DE best yielding treatments were: halosulfuron f/b imazamox, halosulfuron f/b fomesafen, the low rate of sulfentrazone, respectively (*Figure 2*). PA best yielding treatments were: halosulfuron alone, fomesafen alone, halosulfuron f/b fomesafen and halosulfuron f/b imazamox, respectively. MD yields differed at the $\alpha = 0.10$. A yield loss was observed with lactofen alone, the low rate of sulfentrazone and halosulfuron f/b imazamox as compared to the low rate of flumioxazin; all other treatments resulted in similar yields.

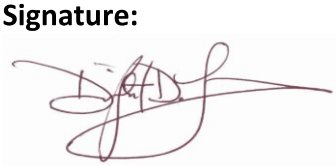
- In DE the high rate of flumioxazin, sulfentrazone and treatments with fomesafen provided good Palmer amaranth control (≥89%) (*Figure 3*). No treatment provided adequate season long morningglory control. In PA excellent weed control was observed with smooth pigweed, ladysthumb, giant foxtail (data not presented). Common lambsquarter control was slightly reduced with lactofen and fomesafen alone although control was still 90% or > (*Figure 4*). Good to excellent common ragweed control was observed with all treatments except sulfentrazone alone and oxyfluorfen. In MD excellent control was observed with smooth pigweed and good control of large crabgrass (data not presented).

- Across three states and two soil types one treatment resulted in minimal injury, higher yields and effective weed control for most species: halosulfuron + s-metolachlor f/b fomesafen + bentazon.

- From this preliminary data, it is unlikely that flumioxazin, sulfentrazone, lactofen, and oxyfluorfen will receive much consideration for a label from their manufacturer's due to the potential for snap bean injury. However, additional research is warranted.

Special thanks to Barb Scott, Univ. of Delaware for summarizing these results.

Signature:



Dwight Lingenfelter