New Herbicide Options for Weed Control in Sweet Corn

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Introduction:

Weed control continues to be a problem in sweet corn. However, over the past few years some newer herbicide products have been labeled for use in sweet corn that could provide effective control of problem weed species. Historically, weed control in sweet corn has primarily been limited to soil-applied materials. In addition to some newer preemergence herbicides, other postemergence products are also currently available. Products such as Acuron, Armezon PRO, Anthem, Liberty, Revulin Q, Solstice, Verdict, and Zidua now can be used in sweet corn production. These products have provided effective weed control and exhibited good crop safety in field corn, however there is limited research experience with them in sweet corn in Pennsylvania and the Mid-Atlantic region. It has been several years since an experiment evaluating competitive herbicide programs, especially those including newer products, has been conducted in our area. Also, with more weeds becoming herbicide resistant it is critical that growers use other effective modes of action to combat this problem. Some of these new products can help.

Newer GMO sweet corn varieties that are resistant to Roundup and Liberty are currently available for use. These varieties can be valuable since glyphosate and Liberty (glufosinate) provide broadspectrum weed control with no soil residual issues that could interfere with rotational crops. However, due to the increasing number of glyphosate resistant weed species we will not be using Roundup Ready sweet corn varieties in this study. There will be some treatments that include Liberty so a Liberty Link variety will be used.

We propose to evaluate grass and broadleaf weed control programs in sweet corn using combinations of preemergence and/or pre & postemergence herbicides, including standard and new products. In order 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 and at the University of Delaware, Georgetown research farm. Benefits to state and regional sweet corn 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.

Objectives:

1. To examine various new herbicides in sweet corn to determine their effectiveness on weed control.
2. To evaluate these herbicide programs on sweet corn injury and yield impact.

Work Statement:

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 2016. Several herbicide program approaches (Table 1) were evaluated in a randomized complete block design with three replications. The plots were four rows by 25-30 feet long, and a glufosinate-resistant ('BC0805', Liberty Link) sweet corn variety was used. Weed control for all species present was evaluated approximately 2, 4, and 8 weeks after planting. In addition, crop injury and yield were recorded. Preemergence treatments were applied within two days of planting and postemergence treatments were applied when sweet corn was at the mid-postemergence stage (8-10 inches tall). While a glufosinate-resistant variety was used, results are the same for all sweet corn types except for the treatments including Liberty.

Results

- At Rock Springs (Centre Co.), PA, all treatments provided (Table 1):
    - >85% giant foxtail (Setaria faberi) control
    - 95% large crabgrass (Digitaria sanguinalis) control except for the Accent Q + Impact tankmix (50%)
    - >90% common lambsquarters (Chenopodium album) control
    - >90% control of velvetleaf (Abutilon theophrasti) except for the Accent Q + Impact tankmix (79%)
    - >97% control of common ragweed (Ambrosia artemisiifolia)
    - >98% redroot pigweed (Amaranthus retroflexus) control and
    - >85% control of common cocklebur (Xanthium strumarium) except for Acuron, Verdict + atrazine and Zidua + atrazine (57-83%)
    - No yield was taken due to severe drought and crop damage from raccoons and deer

- In Delaware (Sussex Co.), all treatments provided (Table 2):
    - >93% control of Palmer amaranth (Amaranthus palmeri)
    - >95% control of large crabgrass (Digitaria sanguinalis) except for Armezon Pro (70%) and Accent Q + Impact tankmix (80%)
    - Annual morningglory (Ipomoea spp.) was variable across treatments; most provided 88 to 99% control however, Lumax EZ, Prowl H2O fb Liberty 280, and the Accent Q + Impact tankmix ranged from 31 to 68% control
- In general, crop injury was negligible for all treatments across both locations

Discussion and summary

There are some new herbicide products for sweet corn growers that can improve control of hard to control weeds. Although many are premixes of existing active ingredients labeled for corn, they have not been tested in this region for sweet corn safety. Another issue for mid-Atlantic farmers is getting the proper herbicide combinations and rates to not only provide effective weed control but also to account for potential carryover to rotation crops. For example, a lack of atrazine in the Impact treatments was evident with reduced grass and morningglory control in some cases. In addition, late season morningglory control was impacted by not including full rates of atrazine in the PRE programs. Herbicides such as atrazine, mesotrione (Callisto), topramezone (Impact/Armezon), and pyroxasulfone (Zidua) potentially can leave residues causing injury to rotational crops. However, these can vary depending on use rates, soil types, rainfall, and other environmental conditions. A proper understanding of herbicide characteristics, herbicide resistance management techniques, and management of rotational crops not only helps to obtain good weed control and improved crop yields but also it can help alleviate crop injury.

Atrazine does improve control of certain weed species (as is well documented through various research) and is still a very effective and economical herbicide for broadleaf weed control in sweet corn, including no-till systems. However, depending on weed species present, reducing the rate of atrazine or eliminating it could be possible if there are concerns about carryover to rotational crops, especially vegetables, and cover crops following field or sweet corn production. Problems with atrazine residues causing injury to rotational crops varies depending on use rates, soil types, rainfall, and other environmental conditions. *However, simply replacing atrazine with another product such as an HPPD- or PPO-inhibiting herbicide (Acuron, Zemax, Callisto, Impact/Armezon, Laudis, Verdict) will not necessarily eliminate the aforementioned concerns.* Several of these types of products have stringent crop rotation restrictions as well. Only a few herbicides have short rotations for a multitude of crops.

Liberty can have a good fit in sweet corn production in a LibertyLink sweet corn system. Roundup Ready varieties also can have a good fit as well. However, limited number of available hybrids, increased seed costs (e.g., seed tech fees), resistant weed species (esp. glyphosate), and customer acceptance may limit their widespread use.

Our treatments all included a soil-applied herbicide. Total-post weed control is not recommended because sweet corn seedlings are not very competitive with weeds, and weather conditions that prevent timely postemergence herbicide application may reduce weed control and result in yield loss. Having a soil-applied herbicide down improves overall weed control, can provide additional herbicide modes of action for resistance management, and provides some insurance in case postemergence herbicides cannot be sprayed in a timely fashion. In previous Penn State research a two-pass system provided more effective weed control overall compared to a single application timing especially in no-till systems. This is dependent on spraying when weeds are small (<3 inches tall). For best results, fields with heavy populations of annual grasses (foxtail, crabgrass, panicum) will require a PRE followed by POST herbicide program for consistent control. Depending on the program, common ragweed may require a two-pass program for adequate control. Also, control of annual morningglory and Palmer pigweed are two species that could be a problem depending on which herbicide program is used. Palmer pigweed and waterhemp are becoming a problem in PA. These troublesome pigweeds are very aggressive and can be difficult to control in certain cropping systems. There are certain herbicides in sweet corn that provide control of Palmer and waterhemp including atrazine, acetochlor-products, Acuron/Lumax, Zidua, Callisto, Impact/Armezon, Laudis, Liberty 280, 2,4-D and a few others. Again, two-pass systems work best with Palmer amaranth since it has a long germination period. And control of these weeds after sweet corn harvest may be necessary to stop seed production and additional spread.

Table 1. Effect of herbicides on weed control in sweet corn at Centre Co., PA, 2016***.

Herbicide(s)*	Rate/A	Applic. timing**	Gi. foxtail	L. crab-grass	Lambs-quarters	Velvet-leaf	C. rag-weed	Rr pig-weed	Cockle-bur
			% control						
Untreated	-	-	0	0	0	0	0	0	0
Lumax EZ	3 qt	PRE	98	95	99	99	98	99	86
Acuron	2.5 qt	PRE	96	95	99	99	99	99	83
Verdict + atrazine	15 oz + 1 qt	PRE	87	95	97	94	99	99	72
Zidua + atrazine	2.5 oz + 1 qt	PRE	86	95	99	94	99	99	57
Cinch ATZ fb Revulin Q	1 qt fb 4 oz	PRE fb MPOST	91	95	99	99	99	99	94
Bicep II Magnum fb Solstice + atrazine	1 qt fb 3 oz + 1 pt	PRE fb MPOST	85	95	99	99	99	99	99
Bicep II Magnum fb Impact + atrazine	1 qt fb 0.5 oz + 1 pt	PRE fb MPOST	90	95	98	96	99	98	94
Bicep II Magnum fb tolpyralate + atrzine	1 qt fb 1 oz + 1 pt	PRE fb MPOST	92	95	98	99	99	99	96
Bicep II Magnum fb Liberty	1 qt fb 20 fl oz	PRE fb MPOST	89	95	90	89	99	99	87
Prowl H2O fb Liberty	3 pt fb 20 fl oz	PRE fb MPOST	95	95	99	99	99	99	91
Zidua fb Armezon Pro	2 oz fb 16 fl oz	PRE fb MPOST	96	95	99	99	99	99	86
Anthem Maxx fb Solstice	3 fl oz fb 3 fl oz	PRE fb MPOST	90	95	99	99	99	98	92
Accent Q + Impact	0.5oz+0.75oz	MPOST	87	50	98	79	97	99	94
LSD (P=0.05)			7	-	4	7	2	1	21

* If necessary, rates will be adjusted depending on soil type at research location; and appropriate adjuvants will be included with the postemergence herbicide treatments

**abbreviations reference: fb – followed by; PRE – preemergence (; MPOST – mid postemergence

*** Late season ratings taken 8/5/2016

Table 2. Effect of herbicides on weed control and crop yield in sweet corn at Sussex Co., DE, 2016***.

Herbicide(s)*	Rate/A	Applic. timing**	L. crab-grass	Palmer amaranth	Annual morningglory	Yield (tons/A)

			% control			
Untreated	-	-	0	0	0	2.8
Lumax EZ	3 qt	PRE	98	100	53	3
Acuron	2.5 qt	PRE	99	100	90	3
Verdict + atrazine	15 oz + 1 qt	PRE	94	100	99	3.2
Zidua + atrazine	2.5 oz + 1 qt	PRE	97	100	0	2.6
Resicore + atrazine	2.25 qt + 1 qt		97	93	67	2.8
Cinch ATZ fb Revulin Q	1 qt fb 4 oz	PRE fb MPOST	98	100	98	3.1
Bicep II Magnum fb Solstice + atrazine	1 qt fb 3 oz + 1 pt	PRE fb MPOST	97	100	92	3.1
Bicep II Magnum fb Impact + atrazine	1 qt fb 0.5 oz + 1 pt	PRE fb MPOST	100	100	91	3.3
Bicep II Magnum fb Liberty	1 qt fb 20 fl oz	PRE fb MPOST	99	100	88	3.1
Prowl H2O fb Liberty	3 pt fb 20 fl oz	PRE fb MPOST	96	100	31	3.3
Zidua fb Armezon Pro	2 oz fb 16 fl oz	PRE fb MPOST	70	100	0	2.7
Anthem Maxx fb Solstice	3 fl oz fb 3 fl oz	PRE fb MPOST	99	100	92	2.4
Accent Q + Impact	0.5oz+0.75oz	MPOST	78	100	68	3
LSD (P=0.05)			30	5	45	0.6

* If necessary, rates will be adjusted depending on soil type at research location; and appropriate adjuvants will be included with the postemergence herbicide treatments

**abbreviations reference: fb – followed by; PRE – preemergence; MPOST – mid postemergence

*** Late season ratings taken 8/4/2016

Signature: 

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Pictures from the study at Rock Springs.

Untreated check (high weed population)

In general, good weed control from treatments

Accent + Impact: poor control of large crabgrass

Drought impacted crop growth

Crop damage from wildlife

Unmarketable yield: poor cob fill