Non-Atrazine Herbicide Programs for Weed Control in No-till Sweet Corn

(2011 final research report)

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Introduction:

Atrazine continues to be a very effective yet economical herbicide for broadleaf weed control in sweet corn. Over half of the herbicides labeled for use in sweet corn contain atrazine or recommend atrazine as a tank-mix partner. Pennsylvania producers grew about 15,000 acres of sweet corn (PDA Ag Statistics, 2009-10) and likely a high percentage of those acres had atrazine applied to them. Despite its wide acceptance by producers, atrazine use in crop production systems is a controversial issue for various reasons including environmental issues and resistant weeds. In addition to these concerns, atrazine can cause problems with rotational crops, especially vegetables, and cover crops after sweet corn production. Many growers have inquired about herbicide programs that do not contain atrazine to potentially alleviate carryover problems with successional crops. Furthermore, LibertyLink sweet corn varieties are expected to be registered by 2012, allowing Ignite herbicide to be applied over-the-top of some sweet corn hybrids. Ignite is a broadspectrum herbicide with limited residual and a short crop rotation interval. Also, as more producers are using no-till farming techniques for vegetable production, herbicide programs plays a key role in effective weed management. Research evaluating non-atrazine herbicide programs and Ignite in no-till sweet corn is very limited.

We examined various herbicide programs in no-till sweet corn that contained no atrazine to determine their effectiveness on weed control. We evaluated preemergence (PRE)and/or postemergence (POST) herbicide programs that contain non-atrazine alternatives such as, Dual, Camix, Verdict, Zidua (KIH-485) as PRE herbicides and POST herbicides such as Impact, Option, and Ignite on the control of annual broadleaves and grasses. (Note: Verdict and Zidua are experimental product and not yet labeled in sweet corn.) By comparing atrazine-based programs with non-atrazine treatments, we can evaluate if commercially acceptable weed control can be achieved with both soil-applied programs and with two-pass programs that do not include atrazine, especially in no-till systems. In order to obtain a wider range of weeds, soil types, and growing conditions, the studies were conducted at the Penn State research farm in Centre County and at the University of Delaware, Georgetown research farm. This research could benefit Pennsylvania and Mid-Atlantic sweet corn and vegetable growers by providing information on some herbicide options that could potentially replace atrazine yet provide effective weed control and allow more flexibility with rotational vegetable and cover crops.

Objectives:

1. To examine various herbicide programs in sweet corn that contain no atrazine to determine their effectiveness on weed control.
2. To compare the activity of these programs with industry standards and current herbicide programs that typically include atrazine (both >1 lb/acre and 0.5 lb/acre).
3. To evaluate these herbicide programs on sweet corn injury and yield impact.

Work Statement:
Field studies were conducted in 2011 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 to examine various herbicide programs in no-till sweet corn (*Zea mays succharata*, var. 'BC0805') that contain either atrazine or non-atrazine alternatives to determine their effectiveness on annual weed control. Preemergence and pre fb post programs were evaluated; see tables below for treatment listing. A broadcast, burndown herbicide program of glyphosate (1 qt/A) was applied prior to the other treatments. Preemergence treatments were applied soon after planting and postemergence treatments were applied when sweet corn is at the mid-postemergence stage (8-12 inches tall, V5 stage).Visual weed control evaluations were taken periodically throughout the growing period. Sweet corn yield data and crop injury ratings were also collected. Small-plot studies were arranged in a randomized complete block design with three replications.

Budget:

Summer hourly labor:	$1000
Farm supplies:	$1800
Travel:	$200
Total:	$3000

Results: (Tables 1 & 2):

- Evaluations just prior to the POST application revealed that pre-grass-only herbicide treatments provided approximately 83% control of common lambsquarters, velvetleaf, smooth pigweed, and ladysthumb smartweed; However in PRE treatments that included atrazine or an HPPD- or PPO-inhibitor (e.g., Lumax, Camix, Verdict), control of these same species was ≥95%
- Late season ratings show that control from PRE only treatments provided 63-92% control of giant foxtail and fall panicum, whereas the PRE fb POST treatments increased control of these species to 90-96%
- Common ragweed control ranged from 78-94% and 91-97% for the PRE only and the PRE fb POST treatments, respectively.
- All treatments provided 89-97% control of velvetleaf and smooth pigweed.
- At both locations, treatments provided 91-100% control of common lambsquarters. Large crabgrass control ranged from 58-92% for the total PRE treatments at both locations and the two-pass programs provided 92-96% control at Rock Springs and 83-97% control at Georgetown.
- Palmer amaranth control at Georgetown ranged from 78-100% across treatments whereas annual morningglory species control was 53-87%.
- With respect to yield of BC0805 at Rock Springs, some of the treatments were significantly different from one another and yields ranged from 3847 to 10065 lb/A in the treated areas. However, the differences are likely not due to injury from herbicides but from weed competition.
- Yields at Delaware ranged from 1.0 to 3.9 tons/A with some significant differences within the data, however, no definite trends could be suggested due to herbicide injury.

Summary:

In summary, atrazine does improve control of certain weed species (as is well documented through various research) and is still a very effective yet 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 (Camix, Callisto, Impact, Laudis, Verdict) will not necessarily eliminate the aforementioned concerns. Several of these types of products have stringent crop rotation restrictions as well. Once registered, glufosinate (Ignite) may have a good fit in sweet corn production in a LibertyLink sweet corn system. Also the experimental product, Zidua, provided adequate control of many weeds. Zidua will likely be labeled for use in sweet corn by early 2012. Many of these herbicide programs could provide effective weed control in no-till sweet corn. 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 is not yet a problem in PA, but it is expected to arrive soon, since it is in Delaware, Maryland and Virginia. It is a very aggressive weed and can be difficult to control in certain cropping systems.

Table 1a. Effect of herbicides on weed control (grassy), crop injury, and yield in sweet corn at Centre Co., PA, 2011*.

Herbicide(s)*	Rate/A	Giant foxtail %control	Large crabgrass %control	Fall panicum %control	Yellow nutsedge %control	BC0805 %Injury (7/13/11)	BC0805 %Injury (8/19/11)	BC0805 Yield (lb/A)
Untreated	-	0	0	0	0	0	0	93
Lumax	2.5 qt	87	87	81	80	0	0	8487
Bicep II Mag + Prowl H2O	2.1 qt + 3 pt	92	92	85	72	0	0	5605
Camix	2 qt	72	73	73	72	1	0	7533
Verdict	15 fl oz	63	60	65	60	2	1	3847
Bicep II Mag fb** Impact + atrazine (+MSO+UAN)	2.1 qt fb 0.75 fl oz + 1 pt	95	94	93	80	0	0	8269
Camix fb Impact (+MSO+UAN)	3 qt fb 0.75 fl oz	93	93	94	85	1	0	10065
Zidua fb Impact (+MSO+UAN)	2.5 oz fb 0.75 fl oz	92	94	94	57	3	1	9021
Dual II Mag fb Impact + atrazine (+MSO+UAN)	1.67 pt fb 0.75 fl oz + 1 pt	92	93	90	73	2	1	7382
Camix fb Ignite (+AMS)	2 qt fb 22 fl oz	96	96	92	82	0	0	9562
Zidua fb Ignite (+AMS)	2.5 oz fb 22 fl oz	94	96	95	77	3	1	8605
Dual II Mag fb Ignite + atrazine (+AMS)	1.67 pt fb 22 fl oz + 1 pt	96	96	95	86	1	1	8955
Verdict fb Ignite (+AMS)	13 fl oz fb 22 fl oz	92	92	92	77	3	1	8024
Dual II Mag fb Option + 2,4-D (+MSO+UAN)	1.67 pt fb 1.5 oz + 8 fl oz	94	93	94	80	20	11	7602
LSD (P=.05)		6	6	8	10	2	1	1938

* Late season ratings taken 8/19/2011; sweet corn harvested 8/19/2011

** fb = followed by; meaning PRE followed by a POST herbicide program

Table 1b. Effect of herbicides on weed control (broadleaves) in sweet corn at Centre Co., PA, 2011*.

Herbicide(s)*	Rate/A	Lambs-quarters %control	Common ragweed %control	Velvetleaf %control	Redroot pigweed %control	Smartweed %control	E. black nightshade %control
Untreated	-	0	0	0	0	0	0
Lumax	2.5 qt	97	94	97	97	97	99
Bicep II Mag + Prowl H2O	2.1 qt + 3 pt	96	78	89	96	96	99
Camix	2 qt	96	82	96	96	96	99
Verdict	15 fl oz	91	82	94	89	88	99
Bicep II Mag fb** Impact + atrazine (+MSO+UAN)	2.1 qt fb 0.75 fl oz + 1 pt	97	96	97	97	97	99
Camix fb Impact (+MSO+UAN)	3 qt fb 0.75 fl oz	97	97	97	97	97	99
Zidua fb Impact (+MSO+UAN)	2.5 oz fb 0.75 fl oz	96	96	94	96	83	99
Dual II Mag fb Impact + atrazine (+MSO+UAN)	1.67 pt fb 0.75 fl oz + 1 pt	96	96	96	96	92	83
Camix fb Ignite (+AMS)	2 qt fb 22 fl oz	97	96	97	97	97	98
Zidua fb Ignite (+AMS)	2.5 oz fb 22 fl oz	92	91	96	96	96	99
Dual II Mag fb Ignite + atrazine (+AMS)	1.67 pt fb 22 fl oz + 1 pt	96	95	96	97	97	83
Verdict fb Ignite (+AMS)	13 fl oz fb 22 fl oz	95	95	95	95	95	97
Dual II Mag fb Option + 2,4-D (+MSO+UAN)	1.67 pt fb 1.5 oz + 8 fl oz	94	87	94	96	87	84
LSD (P=.05)		4	8	4	3	6	8

* Late season ratings taken 8/19/2011; sweet corn harvested 8/19/2011

** fb = followed by; meaning PRE followed by a POST herbicide program

Table 2. Effect of herbicides on weed control, crop injury, and yield in sweet corn at Sussex Co., DE, 2011*.

Herbicide(s)*	Rate/A	Large crabgrass %control	Lambs-quarters %control	Palmer Pigweed %control	Annual morningglory %control	BC0805 %Injury (6/14/11)	BC0805 Yield (Ton/A)
Untreated	-	0	0	0	0	0	1.0
Lumax	2.5 qt	77	100	100	68	0	3.9
Bicep II Mag + Prowl H2O	2.1 qt + 3 pt	58	100	78	67	0	3.0
Camix	2 qt	89	100	87	77	0	2.9
Verdict	15 fl oz	62	100	97	87	0	2.3
Bicep II Mag fb** Impact + atrazine (+MSO+UAN)	2.1 qt fb 0.75 fl oz + 1 pt	86	93	84	53	4	2.5
Camix fb Impact (+MSO+UAN)	3 qt fb 0.75 fl oz	95	100	92	53	3	2.5
Zidua fb Impact (+MSO+UAN)	2.5 oz fb 0.75 fl oz	88	100	95	69	0	3.2
Dual II Mag fb Impact + atrazine (+MSO+UAN)	1.67 pt fb 0.75 fl oz + 1 pt	97	93	93	82	2	2.5
Camix fb Ignite (+AMS)	2 qt fb 22 fl oz	88	92	83	58	1	2.8
Zidua fb Ignite (+AMS)	2.5 oz fb 22 fl oz	95	97	97	85	1	2.3
Dual II Mag fb Ignite + atrazine (+AMS)	1.67 pt fb 22 fl oz + 1 pt	83	97	89	75	4	2.6
Verdict fb Ignite (+AMS)	13 fl oz fb 22 fl oz	83	100	85	86	0	3.1
Dual II Mag fb Option + 2,4-D (+MSO+UAN)	1.67 pt fb 1.5 oz + 8 fl oz	91	97	87	78	19	2.2
LSD (P=.05)		15	8	14	32	2	1.1

* Late season ratings taken 7/27/2011; sweet corn harvested 7/27/2011

** fb = followed by; meaning PRE followed by a POST herbicide program