

# ***Kixor® herbicide: a potentially new sweet corn herbicide*** (2010 final research report)

**Dwight D. Lingenfelter and Tim Elkner, Penn State University and Mark J. VanGessel, University of Delaware**

## **Introduction:**

Over the past several years, only one new herbicide mode of action has been labeled for use in sweet corn (HPPD-inhibiting herbicides [Callisto®, Impact®, and Laudis™]). These have met specific weed control needs such as postemergence grass control, improve herbicide resistance management, and provide good to excellent crop safety. However, their use has been limited due to restrictions or concerns about crop rotations. BASF Chemical Company has recently registered a new herbicide active ingredient (saflufenacil, trade name, Kixor®) for use in field corn, soybeans and wheat. This active ingredient provides a different mode of action from what is currently offered in the corn herbicide market and appears to have greater rotational flexibility. After this initial phase of registration for field crops, Kixor products will possibly be registered for use in sweet corn and other vegetable crops. Kixor provides foliar burndown and residual soil activity of broadleaf weeds which are very useful in no-till settings. Depending on its use, it potentially could serve as an alternative to atrazine and could help control various weeds, including triazine-, glyphosate-, and ALS-resistant weeds found across Pennsylvania and the Northeast. Other benefits of Kixor include its shorter crop rotation intervals of zero to six months and its favorable environmental profile. In an era when very few new herbicide modes of action are being registered, Kixor may provide an opportunity to increase the number of available herbicide choices for sweet corn. This could improve weed control options, provide excellent rotational flexibility, and furnish an additional means of managing resistant weeds.

We compared Kixor-based herbicide programs with some currently used herbicide systems to determine weed control and crop safety. These studies were conducted at three unique locations in order to get a diversity of environmental and soil conditions. Crop injury and yield data were collected from two sweet corn varieties planted at each site. By conducting this research we can accumulate important data about the utility of this herbicide in sweet corn and thus ultimately help Pennsylvania (and Northeast and Mid-Atlantic) sweet corn growers make informed weed management decisions about this product.

(Please note: Although Kixor is a BASF trademark, there are no products that have the tradename Kixor. The actual product tradename will be followed by the phrase "Powered by Kixor herbicide". Sharpen is the product that only contains the single active ingredient saflufenacil and currently can be used in field corn, soybeans or small grains. Verdict (formerly Integrity) contains Kixor plus Outlook for use in field corn and soybeans as a burndown or preemergence application)

## **Objectives:**

1. To examine various Kixor-containing herbicide programs in sweet corn to determine their effectiveness on weed control.
2. To compare the activity of these programs with different residual grass herbicides, with and without atrazine, and industry standards.

3. To evaluate these herbicide programs on sweet corn injury and yield impact.

### **Work Statement:**

Experiments were conducted at three locations: the Russell E. Larson Agricultural Research Farm in Centre County, the Penn State Southeast Research and Extension Center in Lancaster County, and at the University of Delaware Research and Extension Center in Sussex County in 2010. The soil type at the sites in Centre County and Lancaster County is silt loam, and in Sussex County, DE was loamy sand. Several herbicide treatments (Table 1) were evaluated in a randomized complete block design with three replications. The plots were four rows by 25-30 feet long, and two sweet corn varieties (BC0805 and Obsession, Silver King, or Silver Queen) were planted at each site that represent the common fresh market varieties used in each local area. The herbicide treatments were applied preemergence within two days of planting. Weed control for all species present was evaluated periodically after planting. In addition, crop injury and yield were documented. Refer to Tables 1-3 for summary of data. Data will be forwarded to BASF in hopes of potentially receiving registration of Kixor products for use in sweet corn in the near future.

### **Results:**

Centre Co., PA (Table 1):

- By the end of season, all treatments provided  $\geq 91\%$  control of smooth pigweed, common ragweed, and giant foxtail. While all treatments provided  $\geq 92\%$  control of common lambsquarters, except Bicep II Magnum (60%) and Integrity (89%).
- Most of the treatments only caused minimal, if any, crop injury to both varieties. The highest rate of Sharpen (6 fl oz/A) initially caused 13-15% injury to both varieties but by late season only 1% injury was evident.
- With respect to yield of BC0805, none of the treatments were significantly different from one another. Yields ranged from 10757 to 14985 lb/A. The same is true for Obsession, despite some slight differences between treatments, all yielded between 10849 and 12522 lb/A.

Lancaster Co., PA (Table 2):

- End of season results revealed that any treatment that included Dual II Magnum provided 92-95% control of giant foxtail while the treatments that included either Outlook or Prowl only provided 81-89% control of this species. However, all treatments provided 96-99% control of velvetleaf.
- If any injury was observed, it was minimal. The highest rate of Sharpen (6 fl oz/A) initially caused 5-6% injury to BC0805 and 9-13% injury to Silver King, but by late season only 2-4% injury was evident on both varieties.
- In general, there was no difference in yield for both varieties. However, yield ranged from 7272 to 13103 for BC0805 and 5808 to 10501 for Silver King. Some raccoon damage was evident in the plots, thus causing variation in the plot data.

Sussex Co., DE (Table 3):

- Late season rating showed that all treatments provided 92-100% control of large crabgrass except Integrity (82%). All treatments provided 90-100% control of pigweed except for Integrity (87%) and Sharpen (3 oz) + Outlook (89%). Annual morningglory control ranged from 81-92% for all treatments except Bicep (43%) and Lexar (47%).

- Initially up to 22% injury was observed with Sharpen + Outlook treatments. However by the later rating, that reduced to no more than 17% in BC0805 and 10% in Silver Queen. Since Dual II Magnum contains a corn safener, it seemed to reduce crop injury when combined with Sharpen. No more than 15% crop injury was noted in treatments that contained Dual II Magnum.
- There were some differences in yield, however, no definite trends could be suggested due to herbicide injury.

**Summary:**

In summary, Kixor-based herbicide can provide effective weed control in sweet corn and could potentially be an alternative to herbicides with longer rotational restrictions (e.g., atrazine). Crop response may be more of a concern with coarse-textured soils and more research is needed to determine how severe of an issue this may be. Based on other research, consistency of weed control might be an issue with Kixor herbicides especially in drought years or if weed populations are severe. The weed populations in the sweet corn studies were low to moderate. Other studies in field corn (data not included) revealed that Kixor-powered products will provide burndown and residual activity on various broadleaf weeds such as horseweed, pigweed, lambsquarters, and nightshade. Kixor will not control grasses and the current labeled rates are targeted to small seeded broadleaves so season-long residual control of weeds like ragweed and velvetleaf will typically not occur. Additional herbicides will need to be tank-mixed with Kixor or applied post to control escaped weeds or to increase the control spectrum. BASF has yet to determine if Kixor products will be labeled for use on sweet corn. These data sets will be provided to them to help in the process.

**Budget (divided across three locations):**

Summer hourly labor:	\$2000
Farm supplies:	\$2200
Travel:	<u>\$300</u>
Total:	\$4500

Table 1. Effect of herbicides on weed control, crop injury, and yield in sweet corn at Centre Co., PA, 2010\*.

Herbicide(s)*	Rate/A	Giant foxtail	Lambs- quarters	Common ragweed	Pigweed	BC0805 %Injury (6/7/10)	BC0805 %Injury (8/3/10)	BC0805 Yield (lb/A)	Obsess. %Injury (6/7/10)	Obsess. %Injury (8/3/10)	Obsess. Yield (lb/A)
Untreated	-	0	0	0	0	0	0	2068	0	0	1510
Sharpen + Outlook	2 oz + 16 oz	91	92	96	91	4	0	13776	4	0	12359
Sharpen + Outlook	3 oz + 16 oz	96	95	96	94	6	0	10757	7	0	11128
Sharpen + Outlook	6 oz + 16 oz	98	96	97	97	13	1	12545	15	1	11639
Sharpen + Dual II Magnum	2 oz + 1.67 pt	96	94	93	95	5	0	13219	6	0	11152
Sharpen + Dual II Magnum	3 oz + 1.67 pt	98	95	98	96	8	0	13335	8	0	14125
Sharpen + Dual II Magnum	6 oz + 1.67 pt	99	97	98	98	13	1	12452	14	1	11546
Sharpen + Dual II Magnum + atrazine	2.5 oz + 1.67 pt + 1 pt	98	96	96	97	5	0	12267	6	0	10849
Sharpen + Dual II Magnum + atrazine	2.5 oz + 1.67 pt + 1 qt	98	94	96	95	7	0	12987	9	0	11384
Sharpen + Dual II Magnum + Prowl H2O	2.5 oz + 1.67 pt + 3 pt	99	98	98	98	10	1	12662	11	1	11012
Sharpen + Prowl H2O	2.5 oz + 3 pt	95	97	95	96	7	1	12150	7	0	12081
Integrity	13 fl oz	93	89	92	92	7	0	12057	6	0	11151
Bicep II Magnum	2.1 qt	93	60	92	91	2	0	13730	2	0	12080
Lexar	3 qt	96	96	98	96	3	0	14985	3	0	12522
LSD (P=.05)		4	5	3	3	5	1	2929	6	1	1677

\* Late season ratings taken 8/3/2010; sweet corn harvested 8/9/2010

Table 2. Effect of herbicides on giant foxtail control, crop injury, and yield in sweet corn at Lancaster Co., PA, 2010\*.

Herbicide(s)*	Rate/A	Giant foxtail	Velvet-leaf	BC0805 %Injury (6/11/10)	BC0805 %Injury (6/22/10)	BC0805 Yield (lb/A)	Slv.King %Injury (6/11/10)	Slv.King %Injury (6/22/10)	Slv.King Yield (lb/A)
Untreated	-	0	0	0	0	7411	0	0	6505
Sharpen + Outlook	2 oz + 16 oz	88	98	3	0	6458	4	0	6156
Sharpen + Outlook	3 oz + 16 oz	88	99	4	1	8433	4	1	7039
Sharpen + Outlook	6 oz + 16 oz	89	98	6	4	9479	13	4	8550
Sharpen + Dual II Magnum	2 oz + 1.67 pt	92	99	1	0	8596	1	0	9130
Sharpen + Dual II Magnum	3 oz + 1.67 pt	92	99	2	0	12034	3	0	9920
Sharpen + Dual II Magnum	6 oz + 1.67 pt	97	98	5	1	11012	9	2	9316
Sharpen + Dual II Magnum + atrazine	2.5 oz + 1.67 pt + 1 pt	95	99	3	0	7806	4	0	8015
Sharpen + Dual II Magnum + atrazine	2.5 oz + 1.67 pt + 1 qt	95	99	2	0	9479	2	0	10083
Sharpen + Dual II Magnum + Prowl H2O	2.5 oz + 1.67 pt + 3 pt	94	99	6	2	6203	6	1	5808
Sharpen + Prowl H2O	2.5 oz + 3 pt	81	98	4	0	7272	4	0	6807
Integrity	13 fl oz	83	99	6	0	10524	11	1	8735
Bicep II Magnum	2.1 qt	96	96	0	0	12174	1	0	8782
Lexar	3 qt	96	99	0	0	13103	1	1	10501
LSD (P=.05)		6	3	3	2	4544	5	2	2475

\* Late season ratings taken 8/10/2010; sweet corn harvested 8/10/2010

Table 3. Effect of herbicides on weed control, crop injury, and yield in sweet corn at Sussex Co., DE, 2010\*.

Herbicide(s)*	Rate/A	Lrg. crabgrass	Pigweed	Annual Mornng-glory	BC0805 %Injury (6/2/10)	BC0805 %Injury (7/1/10)	BC0805 Yield (lb/A)	Slv.Que. %Injury (6/2/10)	Slv.Que. %Injury (7/1/10)	Slv.Que. Yield (lb/A)
Untreated	-	0	0	0	0	0	0	0	0	0
Sharpen + Outlook	2 oz + 16 oz	94	96	87	18	16	11550	17	8	11924
Sharpen + Outlook	3 oz + 16 oz	92	89	81	17	16	11227	20	10	11475
Sharpen + Outlook	6 oz + 16 oz	93	100	92	22	17	11657	17	9	13576
Sharpen + Dual II Magnum	2 oz + 1.67 pt	97	100	82	10	7	10964	11	0	14126
Sharpen + Dual II Magnum	3 oz + 1.67 pt	100	100	91	15	7	13348	9	3	10944
Sharpen + Dual II Magnum	6 oz + 1.67 pt	100	100	91	10	15	9727	6	10	10060
Sharpen + Dual II Magnum + atrazine	2.5 oz + 1.67 pt + 1 pt	100	100	92	12	8	12222	10	0	10929
Sharpen + Dual II Magnum + atrazine	2.5 oz + 1.67 pt + 1 qt	100	100	85	11	2	13459	0	0	11444
Sharpen + Dual II Magnum + Prowl H2O	2.5 oz + 1.67 pt + 3 pt	95	100	88	15	12	10944	10	6	10858
Sharpen + Prowl H2O	2.5 oz + 3 pt	92	90	88	4	0	14273	2	0	11060
Integrity	13 fl oz	82	87	81	14	16	11530	12	9	11793
Bicep II Magnum	2.1 qt	100	100	43	0	0	9873	0	0	11591
Lexar	3 qt	100	100	47	0	0	10611	0	0	11747
LSD (P=.05)		8	8	7	7	7		8	4	

\* Late season ratings taken 7/1/2010; sweet corn harvested 7/29/2010