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2008 / 2009 Indiana Weed Science Update

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Products are not considered to be labeled in Indiana if not marked so on the National Pesticide Retrieval System database for the Office of the Indiana State Chemist

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The following article is a tradition with your Purdue Weed Science Team. It is a companion article with the "Weed Science Updates" that we present around the State of Indiana during the winter meeting season. The Weed Science Update is a summary of the key points and issues seen around the state in 2008 and a collection of upcoming points of interest to do with weed management and the Agricultural Chemical Industry. It includes information about some of the new herbicides and changes to familiar herbicides in 2008. Not all of the herbicides mentioned in this article are currently labeled in Indiana. Labeling of a product will be indicated. Sections of the Weed Science Update will appear in the Pest & Crop Newsletter.

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Herbicide Update

Kixor [saflufenacil or BAS800] – **BASF:**

[Not labeled in Indiana] is a new herbicide from BASF that will be labeled for use in corn, soybean, small grains, and tree/nut/vine cropping systems. Saflufenacil is a PPO inhibitor, similar to flumioxazin [**Valor**] and sulfentrazone [**Authority**]. It has shown good foliar and residual activity on horseweed [marestail], giant and common ragweed, lambsquarter, velvetleaf, and pigweed/waterhemp species and thus would fit in both the no-till and conventional-till corn and soybean market. It is anticipated that **Kixor** and **Kixor** containing products will be labeled for use for the 2010 season. BASF has indicated that they will market saflufenacil alone [proposed trade is **Sharpen**] and as premixes with imazethapyr [**Pursuit**] [proposed trade name is **Optill**] and dimethenamid-P [**Outlook**] [proposed trade name is **Integrity**].

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Authority Assist [3.33 lb ai sulfentrazone + 0.67 lb ai imazethapyr / gal] **– FMC:**

[Labeled in Indiana] Last year we mentioned Authority Assist, a premix of Authority and Pursuit, but at that time it was not labeled. Authority Assist is now labeled for preemergence use in soybean. It can be applied from 45 days before planting to 3 days after planting. To avoid the potential of seedling injury do not apply at cracking. Rates are from 6 to 12 floz/A depending on soil texture and percent organic matter] [table 1].

Table 1. Authority Assist rate structure.

	Percent Organic Matter	
Soil Texture	1% to 2%	2% to 4%
	fl oz/A	
Coarse[1]	6 to 8 [4][2]	8 to 10 [4 to 5]
Medium	8 to 10 [4 to 5]	10 to 12 [5 to 6]
Fine	10 to 12 [5 to 6]	12 [6]

Use higher rates for soils with pH less than 7 and lower rates for pH greater than 7 within the rate structure.
1 Do not use on sand with less than 1% organic matter.
2 A reduced rate structure is provided to be used in the fall, pre-plant, and preemergence in a Roundup Ready soybean system

The sulfentrazone component has shown excellent preemergence control of pigweed, lambsquarter, morningglory and good control on annual smartweeds and black nightshade. The addition of imazethapyr will increase control on velvetleaf and foxtail.

Balance FLEXX [isoxaflutole + safener]**, Corvus** [isoxaflutole + thiencarbazone + safener]**, and Capreno** [tembotrione + thiencarbazone + safener] **– Bayer CropScience:**

[Not presently labeled in Indiana] **Balance FLEXX**, **Corvus** and **Capreno** will all include a new safener to reduce the potential of injury to corn. The new safener is reported by Bayer CropScience to increase corn metabolism of isoxaflutole[1]. Thiencarbazone controls grass and broadleaf weeds and is an ALS inhibitor[2]. In trials in the Midwest, the addition of thiencarbazone was reported to increase giant ragweed and morningglory control over **Balance Pro** alone. **Capreno** is a premix of **Laudis**[3.5 lb tembotrione] and thiencarbazone.

Cadet [0.91 lb ai fluthiacet-methyl] **– FMC**:

Cadet is a new herbicide labeled in corn and soybean. The active ingredient is in the PPO, group 14, family of herbicides. The PPO herbicides are contact herbicides and include herbicides such as Cobra[2 lb ai lactofen] and Ultra Blazer[2 lb ai acifluorfen]. Use rate will be 0.4 to 0.9 fl oz/A. It can be tank mixed with glyphosate, dicamba, Callisto, Impact and atrazine products. Cadet can be applied over the top of corn from the 2nd leaf stage until the corn reaches 48 inches tall. In soybean it can be applied over the top from the 1st trifoliate through full flowering. NIS at 0.25% v/v or COC at 1% v/v are recommended for an adjuvant.

In a Purdue field trial, Cadet at 0.5 fl oz/A with glyphosate at 16 fl oz/A increased control of 4-6 inch velvetleaf 23% when compared to glyphosate alone at 24 fl oz/A 25 days after treatment. In studies conducted in the Mid-west, lambsquarter control ranged from 80% to 95% with the use of Cadet + COC, depending on location. Partnering Cadet with

atrazine or glyphosate would provide consistency to the control of lambsquarter. In a study done in South Dakota control of common waterhemp was reported at 93% 15 days after application. PPO herbicides have commonly been used for waterhemp control; however, it should be noted that there are several cases of waterhemp resistance to PPO herbicides reported in several states.

Callisto [4 lb ai mesotrione / gal] **– Syngenta:**

[Labeled in Indiana] There have been some changes to the Callisto label this year. The first change has been to change the control of burcucumber from 'partial control' to 'control'. The label recommendations are 3 fl oz/A to be tank mixed with 0.25 lb ai/A atrazine with COC and AMS. In a study done at Purdue University in North West Indiana, Callisto coupled with a preemergence of **Dual II Mangum**[7.64 lb s-metolachlor] or **Lumax** [2.68 lb s-metolachlor + 0.28 lb mesotrione + 1 lb atrazine] controlled burcucumber 91% or 96%, 29 days after treatment respectively[3]. Burcucumber is a vine that can germinate as late as August and still become a problem at harvest. **Callisto** and atrazine provide some residual control of burcucumber, but complete success at harvest may also depend on environmental conditions and soil type. Muck soils provide a challenge to all residual herbicides. Unfortunately this is the case with several residual products that have activity on burcucumber.

A "tank mix with glyphosate" section has been added to the label for Roundup Ready [RR] corn. This section allows the use of 3 fl oz/A of **Callisto** in a tank mix with glyphosate plus AMS at 8.5 to 17 lb/100 gals. This section warns not to add COC or UAN to the tank mix if the glyphosate product has a premixed adjuvant. If an adjuvant is required by the glyphosate product it is recommended to use 0.25% to 0.5% v/v NIS as the adjuvant. Failure to follow these recommendations may lead to crop injury.

FlexStar [1.88 lb ai fomesafen / gal] **– Syngenta:**

[Labled in Indiana] Previous to recent supplemental labeling, **FlexStar** could be tank mixed at 6-12 fl oz/A with glyphosate. New supplemental labeling allows rates up to 24 fl oz/A in Southern Indiana [defined as being south of I-70]. In North Indiana, above I-70, a maximum rate of 20 fl oz/A can be tank mixed. This is due to potential carryover concerns with the **FlexStar** active ingredient into corn. **FlexStar** has a 10 month rotation restrictions to field corn and a 12 month rotation restriction for popcorn when 1 pt/A or more is used. For individuals wishing to plant winter wheat in the fall, applications must occur at least 4 months before planting.

Fultime [2.4 lb ai actochlor + 1.6 lb ai atrazine / gal] **and TopNotch** [3.2 lb ai acetochlor / gal] **- Dow AgroSciences:**

[Labeled in Indiana] The **TopNotch** and **FulTime** labels have expanded on the rotation restrictions. The previous label specified the rotation restrictions with corn, sorghum, soybeans, tobacco, and wheat. Several crops and situations were not addressed in these rotation restriction sections, but the labels have been reworked to include several other crops. Corn can be planted anytime after an application of either **Fultime** or **TopNotch**, including replant situations. Since **TopNotch** does not have atrazine, several crops such as alfalfa, sorghum, soybean, sugar beets, tobacco, sorghum, etc. can be planted the following spring. Wheat has a 4 month restriction with **TopNotch**, which works with the fall seeding of wheat.

FulTime is a premix containing atrazine, which changes the rotation interval for several sensitive crops. Alfalfa, sugar beets, tobacco and

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Some of the Things You May Encounter While Reading About Herbicides

To make things complicated, herbicides have more than one name. One is used to sell the herbicide and one is used to know what is in the herbicide. What is in a herbicide is its "active ingredient" [ai].

Common name : This is the term used for its active ingredient. For example, glyphosate. Glyphosate can be found in several different products with several names.

Trade name: This is the name that a herbicide is sold under. Its purpose is to have market appeal or recognition. For example Roundup PowerMax

Lb ai : This is an abbreviation for pounds active ingredient.

Lb ae : Similar to above, this is pounds acid equivalent. Herbicides are formulated in several different ways to be more effective. The acid equivalent refers to the amount of the basic active ingredient without the formulation as a salt etc. This is used for comparisons of herbicides with the same active ingredient.

fb: followed by. This is used when listing sequential applications in a treatment.

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others require 15 months between application and planting. This also pushes back wheat to 15 months.

Ignite 280 SL [2.34 lb ai glufosinate / gal] **– Bayer:**

[labeled in Indiana] **Ignite 280 SL** is similar to **Liberty**; however, **Ignite 280 SL** contains a higher concentration of the active ingredient at 2.34 lb ai/gal. **Ignite 280 SL** is labeled for crops that are glufosinate tolerant, known as Liberty Link [LL]. At present, there are LL corn hybrids available and in the future there will be LL soybean varieties [see weed science section below]. **Ignite 280 SL** can also be used before planting or prior to emergence in conventional soybean or corn. See table 2 for a rate comparison between **Ignite 280 SL** and **Liberty**.

Glufosinate does not have any residual activity and will not control weeds not yet emerged. A second preemergence application or a postemergence applications may require tank mixing with a residual products for extended control in problematic fields. Sequential applications should be at least 10 to 14 days apart. Maximum amount that can be applied on LL corn and soybean, in sequential applications, is 44 fl oz/A/growing season. For more consistent lambsquarter and velvetleaf control apply between dawn and 2 hours before sunset. The use of soil residual herbicides before

Table 3. Comparison of glufosinate and glyphosate on six troublesome weeds. [Adapted from Beyers et al. 2002. Weed Technology 16:267-273]

		Weeds					
Herbicide	Rate	Foxtail[1]	Velvet[2]	Lambs[3]	G.Rag[4]	Cockle[5]	Morn[6]
	Lb ai						
Glufosinate	0.28	81	92	72	83	81	92
Glufosinate	0.36	88	91	74	90	97	93
Glufosinate fb glufosinate	0.28 fb 0.28	96	95	90	99	96	96
	Lb ae						
Glyphosate	0.56	95	92	94	90	76	82
Glyphosate	0.75	96	93	94	95	87	90
Glyphosate fb glyphosaste	0.56 fb 0.56	97	97	98	97	98	95

[1]Giant foxtail—averaged over DeKalb IL; Urbana IL 1997 and 1998; Columbia MO 1997-98.
[2]Velvetleaf—averaged over DeKalb IL 1997-98; Urbana IL 1997.
[3]Common lambsquarters—averaged over DeKalb IL 1997 and 1998; Urbana IL 1997 and 1998.
[4]Giant ragweed—averaged over two years at one site, DeKalb IL, 1997 and 1998.
[5]Common cocklebur—averaged over two years at one site, Columbia MO 1997 and 1998
[6]Ivyleaf morningglory—averaged over Urbana IL 1998; Columbia MO, 1997-98.

Table 2. Ignite 280 SL and Liberty rate comparison

Ignite 280 SL	Glufonsinate	Liberty
fl oz/A	lb ai/A	fl oz/A
22	0.40	31
26	0.48	36
36	0.66	50

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and

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Some labels of the products listed in this article are not currently available at the time of writing.

crop emergence can reduce the number of crop postemergence applications required or provide a larger window for later season control.

In LL corn, **Ignite 280 SL** can be applied over-the-top to corn up to and including V5 [five developed collar leaves] at a rate of 22 fl oz/A. To reduce possible leaf burn **Ignite 280 SL** must be applied with ammonium sulfate [AMS] at 3 lb/A or 1.5 lb/A if temperatures are expected to exceed 85 degrees F.

Ignite 280 SL can be applied postemergence at 22 fl oz/A in LL soybean from emergence up to but not including the bloom stage. Applications should be made 70 days before harvest of soybean. Do not graze or cut soybean for hay. Unlike corn, the soybean section of the **Ignite 280 SL** label did not have an AMS use requirement at the time of writing this article.

Ignite 280 SL and the LL system will be marketed as an alternative to a glyphosate tolerant system. It allows rotating herbicide modes of action to reduce the potential of developing glyphosate resistance biotypes of weeds. Glufosinate and glyphosate are both non-selective herbicides and slight differences exist in efficacy of some species [table 3][5]. Glufosinate can be slightly less effective on grasses such as yellow foxtail, johnsongrass, quackgrass, shattercane, and barnyardgrass, but is more effective on some of the broadleaf weeds such as annual morningglory, black nightshade, and smartweed. Timing is more crucial than with glyphosate[6, 7]. However, weed size is still important with glyphosate; spray applications should be done when weeds are 4 to 6 inches tall.

Lexar [1.74 lb ai s-metolachlor + 0.224 lb ai mesotrione + 1.74 atrazine / gal] **– Syngenta:**

[Labeled in Indiana] New changes to the **Lexar** label touch on the incorporation method. A cautionary statement has been added that if rainfall does not occur within 7 days of application efficacy may be decreased. If irrigation is available, apply 0.5 to 1 inches of water to incorporate herbicide. If neither rainfall or irrigation occurs a shallow cultivation is recommended as soon as weed emerge. **Lexar** is not labeled for sweet corn or popcorn.

NIC-IT [2 lb ai nicosulfuron / gal] **– Cheminova:**

NIC-IT has the same active ingredient found in **Accent**[75% nicosulfuron]. It is labeled for field corn [seed or grain] popcorn, and sweat corn. **NIC-IT** can be applied at a rate of 2 to 4 fl oz/A up to V6 or 20 inch corn. However, the label recommends early post applications to corn less than 12 inches tall. This maintains applications on small weeds to reduce weed competition with corn. Nicosulfuron is excellent on several annual and perennial grasses such as foxtails, johnsongrass, quackgrass, and shattercane; good to excellent on barnyardgrass and fall panicum, but weak on crabgrass. Also has good activity on some broadleaf weeds such as annual morningglory, jimsonweed, pigweeds, and annual smartweeds. For season long control apply in a program that utilizes a residual herbicide. For best results, apply to 2 to 4 inch foxtail and fall panicum, 4 to 10 inch quackgrass, 4 to 12 inch shattercane, and 8 to 18 inch rhizome johnsongrass.

Stout [67.5% nicosulfuron and 5% thifensulfuron / gal] **– DuPont:**

[Labeled in Indiana] **Stout** is a premix of **Accent** and **Harmony** [75% thifensulfuron]. **Stout** can be applied at a rate of 0.5 to 0.75 oz/A to field corn with a relative maturity rating of 77 days or more. **Stout** can be applied to corn that up to V5 or 16 inches tall. Apply with COC at 1% v/v, MSO at 0.5% v/v, or NIS at 0.25% v/v. The use of UAN at 2 qt/A or AMS at 2 qt/A is also required. If

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Table 4. Control with Liberty or Ignite 280 SL

Excellent
Giant foxtail
Black nightshade
Cocklebur
Common ragweed
Giant ragweed
Jimsonweed
Smartweed
Good
Crabgrass
Fall panicum
Shattercane
Seedling johnsongrass
Annual morningglory
Burcucumber
Common lambsquarter
Pigweed
Velvetleaf
Waterhemp
Fair
Barnyardgrass
Yellow foxtail
Rhizome johnsongrass

tank mixed with **Callisto** at a rate greater than 1.5 fl oz, the use of MSO is not recommended.

Sequence [2.25 lb ae glyphosate + 3 lb ai s-metolachlor / gal] – **Syngenta:**

[Labeled in Indiana] **Sequence** is a glyphosate and **Dual II Magnum** premix labeled for corn, soybean and sorghum. It can be applied as a fall, preemergence or postemergence broadcast application in glyphosate resistant hybrids and cultivars. The glyphosate component will not control weeds that have not emerged. The s-metolachlor component will not have activity on emerged weeds, but will provide some residual activity. Residual activity will be decreased if not activated by rainfall or irrigation within 7 days. The s-metolachlor component can provide good preemergence control of annual grasses yellow nutsedge, black nightshade and pigweeds.

Valor SX [51% flumioxazin] – **Valent:**

[Labeled in Indiana] A new supplemental label allows the use of Valor before field corn emergence in no-till or minimum tillage. Apply in the spring 14 to 30 days before planting at a rate of 2 oz/A. Valor will provide residual and some burndown activity, if used in a burndown treatment it is recommended to be applied with an appropriate burndown partner such as 2,4-D, **Gramoxone Inteon**, or a glyphosate product. Do not apply irrigation until field corn is at least at the 2-leaf stage. Do not incorporate crop residue. **Valor** has good to excellent preemergence activity of black nightshade, lambsquarter, pigweeds, horseweed/marestail, and waterhemp.

Forages

Chateau [51% flumioxazin] – **Valent:** [Pending Indiana approval]**:**

Chateau has been labeled for established alfalfa with a use rate of 4 oz/A. Apply to established alfalfa when growth is 6 inches or less. Sequential applications can be made; however, applications must not be within 60 days of the first application and must not exceed 8 oz/A in one growing season. Do not use any adjuvants or apply with a tank mix partner that is formulated as an emulsifiable concentrate [EC]. **Chateau** can control preemergent black nightshade, common ragweed, jimsonweed lambsquarters, horseweed/marestail, pigweed, smartweed, velvetleaf and waterhemp. Do not use on alfalfa/grass mixes or mixes with other legumes. **Gramoxone Inteon**[2 lb paraquat] can be tank mixed to increase burndown activity after cutting. Apply within 5 days after cutting and removal, preferably before 2 inches of new growth. Injury may be greater on first year alfalfa.

Eptam 20G [20% EPTC] – **Gowan:**

[Pending Indiana approval] **Eptam 20G** was previously labeled for preplant incorporated applications in alfalfa for the control of annual and perennial grasses and some broadleaf weeds such as henbit, lambsquarter and pigweeds. New label changes will allow the use in established alfalfa, previously only allowed in the western US. In the near future [not on Indiana state chemist data base at time of writing article], **Eptam 20G** will receive labeling that will allow the use of 15 to 20 lb/A on established alfalfa where irrigation is available. The irrigation will be needed for incorporation. A 14 day waiting period is required before harvest.

Milestone [2 lb ai aminopyralid / gal] **and ForeFront** [0.33 lb ai aminopyralid + 2.67 lb ai 2,4-D / gal] **- Dow AgroScience:**

[Labeled in Indiana] **Milestone**

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and **ForeFront** are labeled for permanent pastures, conservation reserve program, wildlife areas, and several non-crop areas. The active ingredient aminopyralid is good to excellent on several thistles and annual and perennial weeds such as common ragweed, horseweed, dock species, and some buttercups. Aminopyralid is in the herbicide family of pyridine carboxylic acids. Other herbicides that have active ingredients that belong to this family of herbicides are **Crossbow** [triclopyr + 2,4-D], **Stinger** [clopyralid], **Transline** [clopyralid], **Tordon** [picloram]. Two issues with the use of these herbicides should be taken into account. Both of these issues have to do with the chain of events after an application of these products. When using these products and other herbicides, it is important to consider what is going to be done to the site after application. Not only do we have to consider this for rotational aspects but for environmental reasons. In some cases it is also important to consider what the vegetative material sprayed is going to be used for after application.

Residual activity – Pyridine carboxylic acids can remain in soil and plant residue for some time. The half-life of aminopyralid, clopyralid, picloram and triclopyr are approximately 34.5, 40, 90 and 30 days, respectively[8]. This is dependent on the soil and environment. Picloram has been reported to have a half-life of 300 days in some conditions. This leads to the need to know what is going to happen to the land and plants where these herbicides could be applied.

In the scenario to the right, an application is made by a company or one family member to an old stump then chipped, then the mulch is sold to a third party. The third party, possibly a neighbor, uses the mulch not realizing that herbicide was used and that residues may still be in the mulch. It has happened. The same situation can happen with chipped shrubs and trees that have originally been sprayed. The **Milestone** label states "Do not use aminopyralid-treated plant residues, including hay or straw from treated areas. . . in compost or mulch that will be applied to areas where commercially grown mushrooms or susceptible broadleaf plants may be grown."

Movement in the animal - Herbicides that have these active ingredients generally do not have grazing restriction for non-lactating animals but the labels will generally require the animals be grazed on non-treated forages for 3 days before the animals can be moved to pastures of sensitive crops. The reason for this is that the herbicide simply passes though the animals on the food they consume. The herbicides in this family are not altered as they pass through the animal's body and can be found in the urine and manure produced by the animal. If the animal is moved from a treated pasture or fed feed from a treated pasture then moved to a pasture with legumes or other sensitive broadleaf crops, injury of those sensitive crops will occur. One way to think of this is if the animal has been feeding on treated feed, when the animal relieves its self, it is essentially making a herbicide application. Rotation restrictions state that to switch from pasture to a sensitive crop, a one year period has to occur before planting. The use of a bioassay is recommended. It might be safe to assume that if you move cattle from a treated pasture to a non-treated pasture you may be making a herbicide application, and the one year rotation restriction could imply even though you have not applied the herbicide directly to the pasture. In one case experienced in 2008 in Indiana, cattle were fed treated feed, and then moved to a grass/legume mixed pasture where the legumes started to show growth regulator injury.

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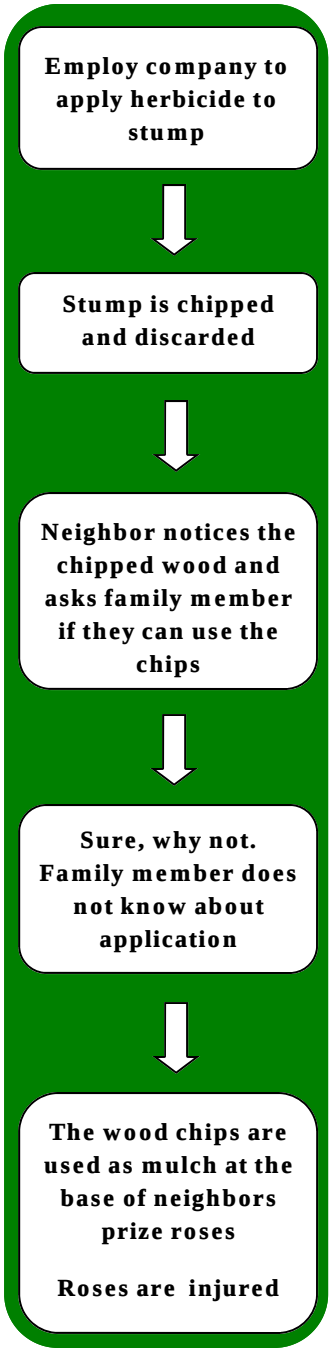

Figure 1. Example of where problems can occur with residual products

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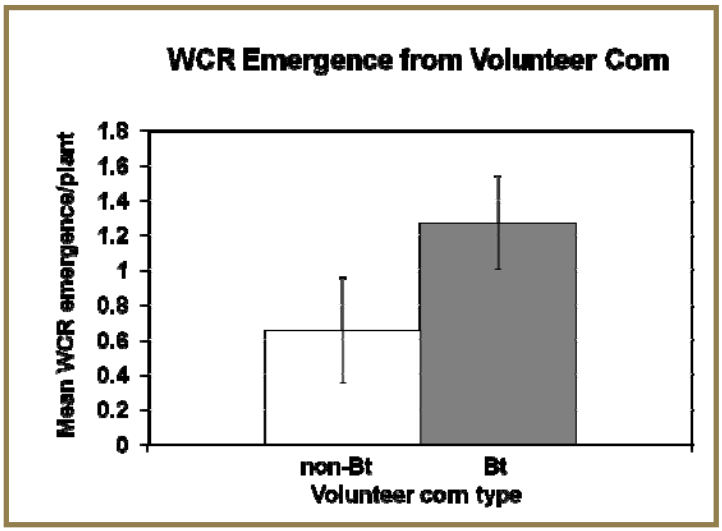
Weed Science Update and Notes

Genetics

European Approval of LL Soybean – Liberty Link [LL] corn has been around for some time. The trait LL allows over the top applications of glufosinate, the active ingredient in the herbicide **Liberty** and now **Ignite 280 SL** [see above herbicide section]. Although, LL soybean had been approved in the US and Canada, it was not approved in Europe. In September the European Commission approved the import LL soybean for food and feed. The use of LL corn and soybean will be marketed as an alternative to glyphosate tolerant systems. It is a different mode of action that can be used to lower the selection pressure for herbicide resistance by providing another mode of action. At present there are no cases of resistance reported[9]. Glufosinate inhibits the production of glutamine synthetase having good to excellent control on some annual grasses and several broadleaves [Table 4].

RR/BT Volunteer Corn - Transgenic volunteer corn expressing herbicide resistance [HR] traits is a significant problem weed in corn/ soybean rotational systems. This issue is particularly timely due to the increasing prevalence of stacking both herbicide and insect-resistant [mainly B.t.] traits into the same genetically-modified plant. With increased adoption of transgenic corn technology containing multiple transgenic traits, more growers are experiencing increases in the number of volunteer corn plants in soybean surviving regular applications of glyphosate[10]. Through greenhouse dose response studies, these volunteer corn plants have consistently expressed resistance to glyphosate at levels similar to that of their parental transgenic plants. In addition, many of these transgenic volunteer corn plants surviving glyphosate treatments are exhibiting some insect resistance with the expression of B.t. traits. Transgenic volunteer corn plants that escape glyphosate treatments are not only economically damaging, but these plants are providing increased selection pressure on insects such as the western corn rootworm [WCR] by exposing WCR to B.t. toxins outside of mandated insect resistance management or refuge programs. Preliminary data has shown that more WCR emerge from volunteer corn plants expressing B.t. than non-B.t. volunteer corn plants, indicating that the toxin, while still present, may be doing little to inhibit the development of WCR. The simple solution to this problem is to scout for volunteer corn, especially in soybean fields following multiple-trait transgenic corn. Where corn is present, the addition of grass herbicides in combination with glyphosate should take care of the problem.



Herbicide Injury

Corn injury and problems – This past year has not been an easy year for corn growers in some parts of Indiana. A spring that delivered too much rain[11], so much so that parts of the state were under water, then when the rain stopped, high temperatures and drought doubled the crop stress. When it came to corn there were two interesting problems seen in the Plant & Pest

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Figure 2. Right angled stems seen in corn.

Figure 3. Slight curvature of the stem.

Figure 4. Submitted sample showing "pinched ears."

Diagnostic Lab [http://www.ppdl.purdue.edu/ppdl/]. The first, were random plants with curves in the stems, some as pronounced as to produce a right angle in the stem [figure 1]. At first glance the diagnosis of possible growth regulator injury could be deduced. Growth regulators can cause such abnormalities such as 'onion leaf' and curvatures of the stem [figure 2]. Different hybrids, environmental conditions, and equipment malfunction can produce a variable response to growth regulators. However, in some of these cases growth regulators were not suspected to be the prime driver for this, partially due to the fact that there was no pattern of injury. In one case it was only the male line that showed this effect. European corn borer has been reported to cause bending or breaking of stems, in some cases "goose necking" can be associated with European corn borer when lodging occurs. The "goose neck" appearance occurs as the plant tries to right itself. Splitting the stems can identify the presence of tunneling. There was no evidence of tunneling. Could

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this symptom be due to other factors? There were no good answers found for this situation.

The second issues seen in larger degrees this past year were ears showing abnormalities such as "pinched ears" [Figure 4] and nubbin ears [blunt ears]. "Pinched ears" are a result of a reduced number of kernel rows and nubbin ears are a result of reduce ear elongation. Diagnosing herbicide injury is a precarious task at harvest. With no foliar symptomology to rely on to support or rule out herbicide problems it is very difficult to put the whole blame on a herbicide. Late applications of ALS herbicides over the top after v6 can induce pinched ears in corn. The cause of nubbin ears has been associated with stress applied to corn in the V8 to V12 stages[12]. This could be herbicide related or be sudden changes in temperature and growing conditions. A recent article by Neilson, Wise, and Gerber suspect adjuvants may have some impact[13].

Weed Update

Update on Herbicide-Resistant Horseweed [marestail] in Indiana - It has been awhile since we have written much about glyphosate-resistant horseweed in Indiana. It was first collected in a Roundup Ready soybean fields in southeastern Indiana in the fall of 2002. This weed was a concern for many soybean farmers and was the subject of many extension articles for a few years after that first documentation; much information can still be found on our Horseweed/ Marestail website. We conducted an extensive in-field survey throughout Indiana in the fall months from 2003 through 2005 to understand the distribution and frequency of this weed problem. We found glyphosate -resistant horseweed infested over 1/3 of all soybean acres in the southeastern region of the state. We also found glyphosate-resistant horseweed in the other regions of the state as well but at a frequency of less than 2% of randomly sample fields. A number of previous articles suggested recommendations for the control of glyphosate-resistant

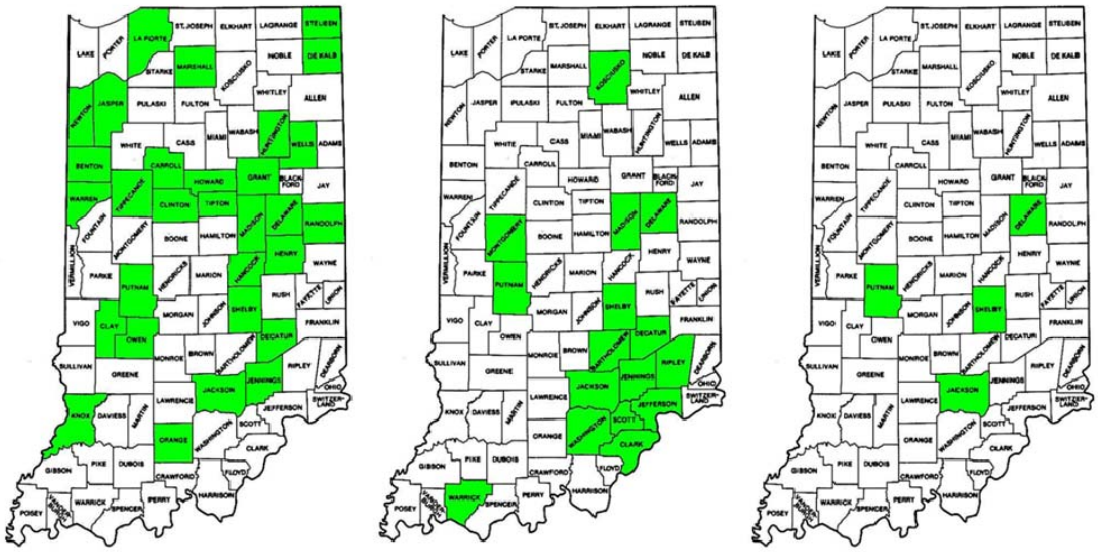

Figure 5. Indiana counties colored in green had horseweed/marstail populations with plants resistant to chlorimuron [left] glyphosate [middle] and both [right].

horseweed, and many farmers and advisers have learned how to control this weed over the last six years. However, during our late summer and fall travels throughout the state, it has been obvious that horseweed is still a persistent and challenging weed for many soybean farmers. It also appears this problem may be increasing in the other three regions of the state; although, we have not continued late-season in-field surveys to make that statement conclusive. The persistence and constant invasion on horseweed to new areas is not surprising because horseweed can produce hundreds of thousands of seeds. Worse yet, each of these seeds have an appendage [called a pappus] like dandelion that allow them to be blown by the wind and infest unsuspecting adjacent no-till fields.

In addition to investigating glyphosate -resistant horseweed, we recently completed herbicide screens on all of our collected horseweed populations for resistance to 2,4-D and acetolactate systhesis inhibitor [ALS] herbicides. We found horseweed populations with plants resistant to chlorimuron in 30 Indiana counties [Figure 5]. Several of these counties also had populations with glyphosate-resistant horseweed, but fortunately we found few populations resistant to tank-mix combinations of the two herbicides. Therefore, if you must control horseweed at the postemergence soybean timing and you suspect either glyphosate or ALS-resistant plants in your field, tank-mixing these herbicides may still be a viable option. However, as we have always recommended, the best management practice with horseweed is to control plants when they are small and prior to planting your soybeans. The good news is, we did not find any populations that were resistant to 2,4-D. We did find some of our horseweed populations had a remarkable increase in tolerance to 2,4-D though. This leads to some cause for concern about over relying on 2,4-D. Applying 2,4-D on horseweed in the rosette stage or under 4 inches of stem elongation is the best timing for adequate control. This is likely to occur in early April for fall emerging plants and late-April to the middle of May for spring emerging plants. Applying 2,4-D to small plants provides the best control and should also allow plenty of time to follow soybean preplant restrictions on the 2,4-D label. If horseweed becomes larger than 4 inches, higher rates and tank-mixing other herbicides will be more critical to achieve adequate control.

More information about horseweed distribution in Indiana as well as management recommendations can still be found at: [www.btny.purdue.edu/weedscience/marestail/index.htm]. Another very useful resource available online is a publication titled "Biology and Management of Horseweed" produced by Purdue University, The Ohio State University, and the University of Illinois.

Other glyphosate resistant weeds include giant ragweed and there are common ragweed populations under suspicion.

Foxtail - Giant foxtail [*Setaria faberi*] is a problematic weed in both soybean and corn. Previous work has indicated that some populations of G. foxtail are resistant to ALS inhibitors. In Indiana, due to the large amount of acreage planted to glyphosate-resistant soybean each year [> 90%] and the use of glyphosate as the primary herbicide in these fields, the issue of G. foxtail developing resistance to glyphosate is a serious concern. In 2008, greenhouse glyphosate dose-response research was conducted on 7 G. foxtail populations collected from 7 different sites around Indiana. We found no significant difference between the 7 populations and their response to increasing doses of glyphosate. This has led us to conclude that G. foxtail has not yet

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Figure 6. Lanceleaf ragweed [Britton, N.L. and A. brown. 1913. An illustrated flora of the Northern United States, Canada and the British Possessions]

Figure 7. Lanceleaf ragweed [Missouri Plants, www.missouriplants.com/Greenalt/Ambrosia_bidentata_page.html

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developed resistance to glyphosate, but this weed should remain on the "watch list" as a possible candidate in the future.

Lanceleaf ragweed [*Ambrosia bidentata*]**:** Lanceleaf ragweed, as the name suggests, is a relative of Indiana's number one weed, giant ragweed. At first appearance and for that matter second appearance, lanceleaf ragweed does not appear to look anything like giant ragweed. However, these two native plants have been reported to hybridize[14]. The first difference is stature; lanceleaf ragweed maxes out at about 3 feet tall. Lanceleaf ragweed has a fairly hairy appearance, and its leaves are lance shaped, single nerved and do not have petioles. Leaves are 1 to 3 inches long and 2.7 to 0.3 inches wide. Leafs can have 1 or 2 sharp lobes. Flowers are arranged in tight spikes 3 to 7 inches long and have a distinctive lobe that appears like a bract [figure]. Lanceleaf ragweed blooms in July to September[15].

Next to giant and common ragweed, lanceleaf ragweed is a small player and has not typically been a problem in Indiana, but can it can be found in the odd pasture and in waste area. Rice and Stritzke reported at least a 94% decrease in density when using 2,4-D at 0.5 lb ai/A[16]. Both Banvel and Cimarron Max have lanceleaf ragweed on their labels as being controlled. Banvel should be used at 1 pt/A. Cimarron Max is a co-pack and should be applied at 0.25 oz/A of part A and 1 pt/A of part B.

Ironweed [*Vernonia* spp.]: Ironweed has not been a stranger to Indiana's pastures, but this year it appeared to be more common than in the past. They are often 3 to 5-foot tall with purple inflorescence, although they can reach heights of 10 feet tall. In a pasture that has been heavily grazed, they are often the only plant of substantial size left. The ironweeds are a group of native perennials that can be troublesome in pastures throughout the US. They belong to the genus *Vernonia* spp.

The use of glyphosate has been reported to have good to excellent control of ironweed. However, control with glyphosate may provide variable results. In a study by Peters and Lowance [1979] control was reported to range from 2% to 88% depending on year[17]. The authors attributed low control to lack of rainfall and the poor growing conditions of those years. For sufficient efficacy on perennial weeds, glyphosate requires the weed to be translocating efficiently. Glyphosate efficacy is increased when weeds are growing in good conditions. Glyphosate can only be applied as a directed application, such as a wiper application or as a spot application for it can injure or control desired grasses and legumes.

Herbicides containing the active ingredients dicamba [Banvel, Clarity], 2,4-D [many], and triclopyr [Garlon 4 Ultra, Garlon 3A] were investigated for the control of tall ironweed3. Dicamba alone did not control tall ironweed greater than 76% and had 81% or greater regrowth. The use of triclopyr alone or triclopyr plus 2,4-D provided control 91% and up. In the triclopyr alone or with 2,4-D, regrowth did not exceed 39% of the original stand. Two years after the study, control of tall ironweed was maintained above 90%.

Table 5. Pricklypear control with and without mowing.

Herbicide treatment	Rate	5% Injury
Tordon RTU—Injection[1]	1 ml/cladode	69 a
Crossbow	4 qt/A	34 b
Crossbow + mowing	4 qt/A	20 bc
Roundup PowerMax + AMS	27 fl oz/A	5 c
Roundup PowerMax + AMS + Mowing	27 fl oz/A	4 c
Forefront + NIS	2 pt/A	1 c

[1]Tordon was injected into each cladode at 1 ml/injection

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Crossbow, a premix of triclopyr and 2,4-D can be used to control tall ironweed at 2 qt/A broadcast or in a hand-held applicator at 1% v/v. Milestone at 5 to 7 floz/A or ForeFront at 2 to 2.6 pt/A will have good activity on ironweed[5]. [information previously appeared as a Picture of the Week, P&PDL: http://www.ppdl.purdue.edu/PPDL/weeklypics/9-22-08.html].

Pricklypear [*Opuntia* spp.]: This group of plants have had a rich history in the US. Watch out, this armed plant bites back. Touching this plant will more than likely leave you in a cranky mood. Small yellow brown barbed hairs called glocides will end up everywhere causing welting and discomfort. Each segment or cladode of pricklypear can take root to form a new plant. For more information on the prickly pear in Indiana please see "A Prickly Situation That Pricklypear" on the Weed Science web page.

Pricklypear can be troublesome in a pasture or waste areas. In one reported case it was causing complications in a cemetery. Control can be difficult. Mowing alone has promoted its growth. Plant parts that become separated during mowing take root and form new colonies. Plants can be cut below the soil level with dandelion fork then burned. In a study conducted in Texas with tulip pricklypear [*O. phaeacantha*], prescribed burning over three years controlled plants 75%, 81%, and 68% when plants were 1-10, 11-25, and over 25 cladodes large[18].

In many cases people will try and use 2,4-D to control pricklypear. This is generally ineffective. Herbicides with the active ingredient picloram are most often cited to control pricklypear. Although most often effective, products with picloram are not all labeled in the state of Indiana, and many state that the product cannot be used on sandy soils. This can complicate things, for pricklypear often is a problem on Indiana's more sandy soils. There has been some report of herbicides with the active ingredient triclopyr having some activity on pricklypear.

There has not been a large body of research on pricklypear's control. In a demonstration conducted in Indiana, 6 treatments were applied on July 10. Ratings were taken July 22 and October 6. Ratings were based on percent of dead material or injury to live material. Dead material could be identified in plots. Due to the sporadic nature of the populations, comparisons to a non-herbicide check were inconclusive. The October 6th rating is presented in table 5.

The injected Tordon RTU appeared to be the most damage to the pricklypear plants at 69%. However, the amount of effort put into injecting each cladode in a large infestation would not make this treatment practical. If that amount of effort was required, then manually removing plants and burning them would be about equal to using the injection method. Mowing was included with Crossbow and Roundup PowerMax to investigate the possibility that applying herbicide treatments would inhibit cladode rooting and plant growth. Mowing followed by the application of Crossbow did have similar injury to Crossbow alone.

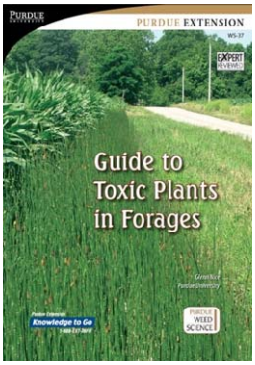
Weed Science Tools

New tool for non-crop weed management, Select-A-Herb: Some of you may have used Select-A-Herb for row crops in the past [http://btny.agriculture.purdue.edu/herbsel/]. If you have not, Select-A-Herb is a free web based program that lists herbicides and the weeds that the herbicides are effective on. The program and data base have been described as "a point in the right direction." It is not meant to be the final say in what herbicide is best suited for the situation, experience,

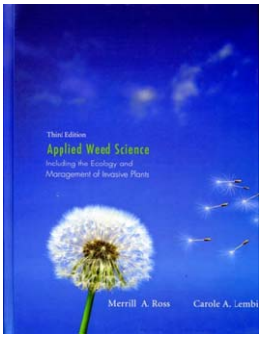
knowledge of herbicide use and the herbicide label are required for that, but it is a source to start with to get an idea of the options available. The row crop Select-A-Herb provides a drop down menus of the weed, crop, or herbicide. Selecting from these drop down menus will provide the options available. The new Non-Crop Select-A-Herb will provide more.

The Non-Crop Select-A-Herb is backed by a data base of 25 thousand records and provides information on over 1000 labeled weeds. This new data base will give herbicide options with rates, timing, weed sizes, and notes from the label to help in the selection process. This information will be organized in an easy to print handout. Non-Crop Select-A-Herb will not provide you with a label, but will provide a link to the CDMS search web site that will provide a label. The Select-A-Herbs are not the label and the label should always be read and followed when using pesticides.

Toxic Plants in Forages: Certain plants produce toxins that can decrease the fitness of livestock. In severe cases animals can die. The Plant & Pest Diagnostic Lab at Purdue University often receives samples from around the state of plants that have been associated with possible poisonings. In 2007, 13 samples were submitted to the Plant & Pest Diagnostics Lab where suspected poisoning of animals occurred. Eight of these had plants that are known to be toxic to livestock present. In 2008, 18 samples were submitted; however, only 2 had plants that were identified as toxic. Identification and control of these plants are an important aspect of pasture management.



The Guide to Toxic Plants is 26 pages of information about the plants that if you have pasture you should be aware of. Each plant has illustrations and pictures to help with its identification and control recommendations. This publication can be viewed on line [http://www.ces.purdue.edu/extmedia/WS/WS_37_ToxicPlants08.pdf] or bought through Purdue Media Distribution for $4 a copy



The third edition of "Applied Weed Science" is now available. This edition of the text book by Merrill A. Ross and Carole A. Lembi provides updates on all management methods, including herbicide technology and resistance, and new chapters on weed ecology and plant invasions. This new edition incorporates the principles of plant management to both crop weeds and invasive plants [including woody perennials] in natural systems. This text book can be purchased at Amazon.com for $74.66 .

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For Free Herbicide Labels

www.greenbook.net

and

www.cdms.net

Some labels of the products listed in this article are not currently available at the time of writing.

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