Integrating Residual Herbicides into Corn and Soybean Weed Management Plans

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EXTENSION

Driven to Discover℠

Harvest Time Reveals Weed Issues

Giant Ragweed

Harvest Time Reveals Weed Issues

Common Waterhemp

Harvest Time Reveals Weed Issues

Common Waterhemp

What can be done to prevent this?

A Bit of Weed Management History

- Our problem weeds today, are no different than when we left the Pursuit and Accent era of the 1990's
  - Problem weeds were common and giant ragweed, waterhemp and common lambsquarters.
  - However, one difference is an increase in frequency of herbicide-resistance in all but lambsquarters
  - In the 1990's MN farmers readily adopted Postemergence weed control because it decoupled planting date from spray date

A Bit of Weed Management History

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  - However, one difference is an increase in frequency of herbicide-resistance in all but lambsquarters

We need to rethink the total post-emergence approach

Which herbicide application timings do your currently use?

(from SE/SC MN PPAT Survey)

	2003	2004	2005	2006 All S MN	2007	2008	2009	2010 Soybean	2010 Corn
Postemergence only	53	58	50	53	60	50	50	71	47
Sequential (pre/post)	43	35	37	34	34	30	36	17	37
Pre-plant incorporated	32	31	32	35	31	25	24	9	22
Pre-plant surface	23	20	2	18	21	18	14	5	16
Preemergence only	27	20	18	20	21	14	13	6	14
Burndown	24	19	14	16	16	11	11	14	12
Fall applications for control of next season's summer annual weeds	10	8	6	4	15	5	5	0	3
Fall applications for control of perennial and winter annual weeds	8	5	3	4	2	2	1	0	2

Development of herbicide resistance

Herbicide resistance generally derives from a lack of diversification

Herbicide resistance usually develops within an individual field or farm, rather than carried in from elsewhere.

Field records typically hold the key to understanding why resistance has developed.

Note: As resistance becomes more prevalent the likelihood of seed movement by water and combine or pollen increases, rapidly increasing the prevalence of resistant weed biotypes.

How do you manage weed resistance?
(Top 2 answers from SE/SC MN PPAT Survey)

1. Use mechanical control
2. Rotate herbicide mode of action
3. Not concerned about weed resistance
4. Tank mix with additional herbicides
5. Use Preplant or Preemergence followed by POST program

How do you manage weed resistance?
(Top 2 answers from SE/SC MN PPAT Survey)

13% 1. Use mechanical control

28% 2. Rotate herbicide mode of action

3% 3. Not concerned about weed resistance

41% 4. Tank mix with additional herbicides

16% 5. Use Preplant or Preemergence followed by POST program

Moving Forward

- An observation from this year's North Central Weed Science Society meeting makes it clear that as the Seed/Agrichemical Industry develops new Herbicide Resistant Crop Technologies - All Companies will implement a PRE / POST system

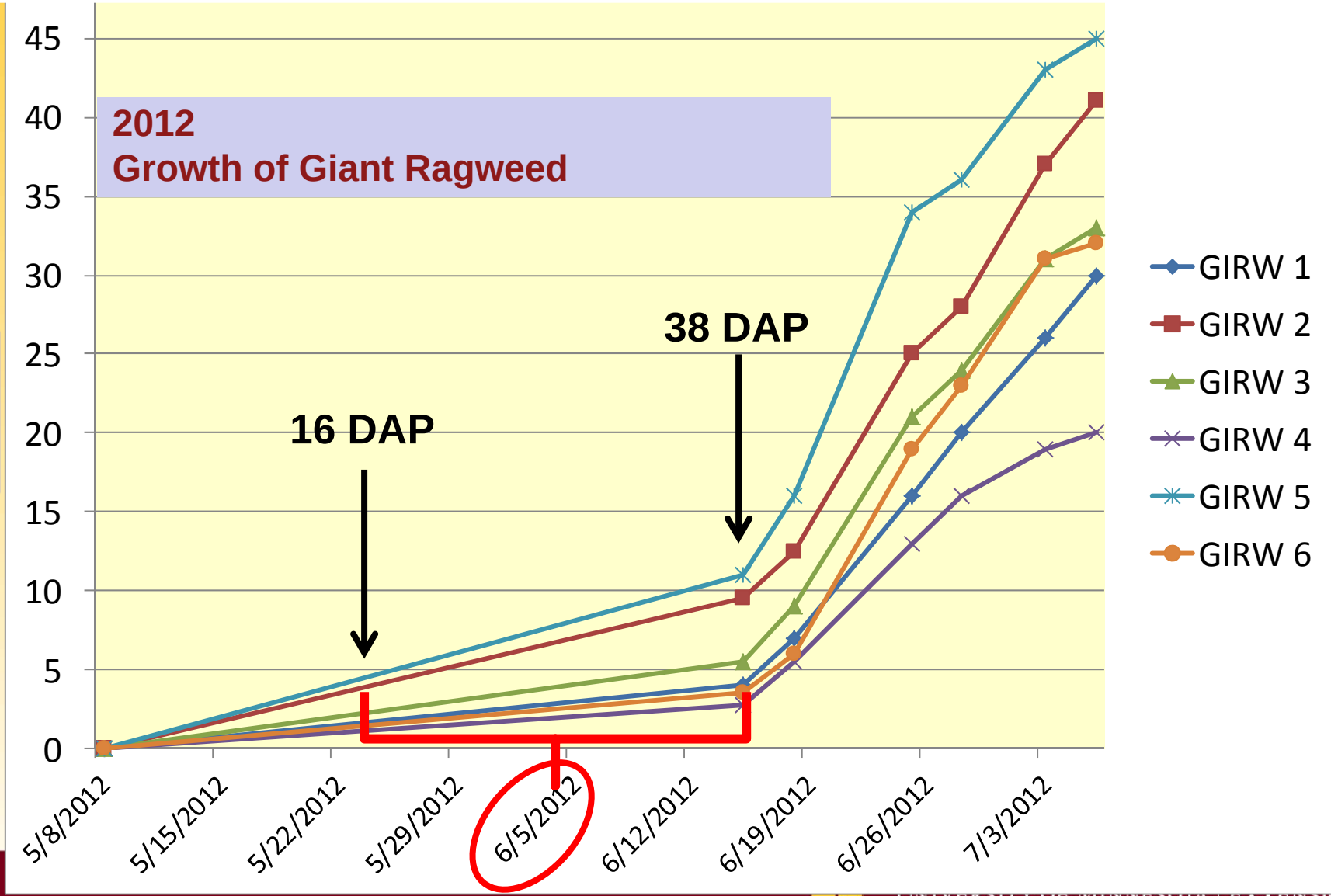
  - ✓ Enlist from Dow AgroSciences (SOA #4)
  - ✓ Xtend from Monsanto (SOA#4)
  - ✓ MGI from Bayer & Syngenta (SOA #27)

Advantages PRE Herbicides Bring to Weed Management

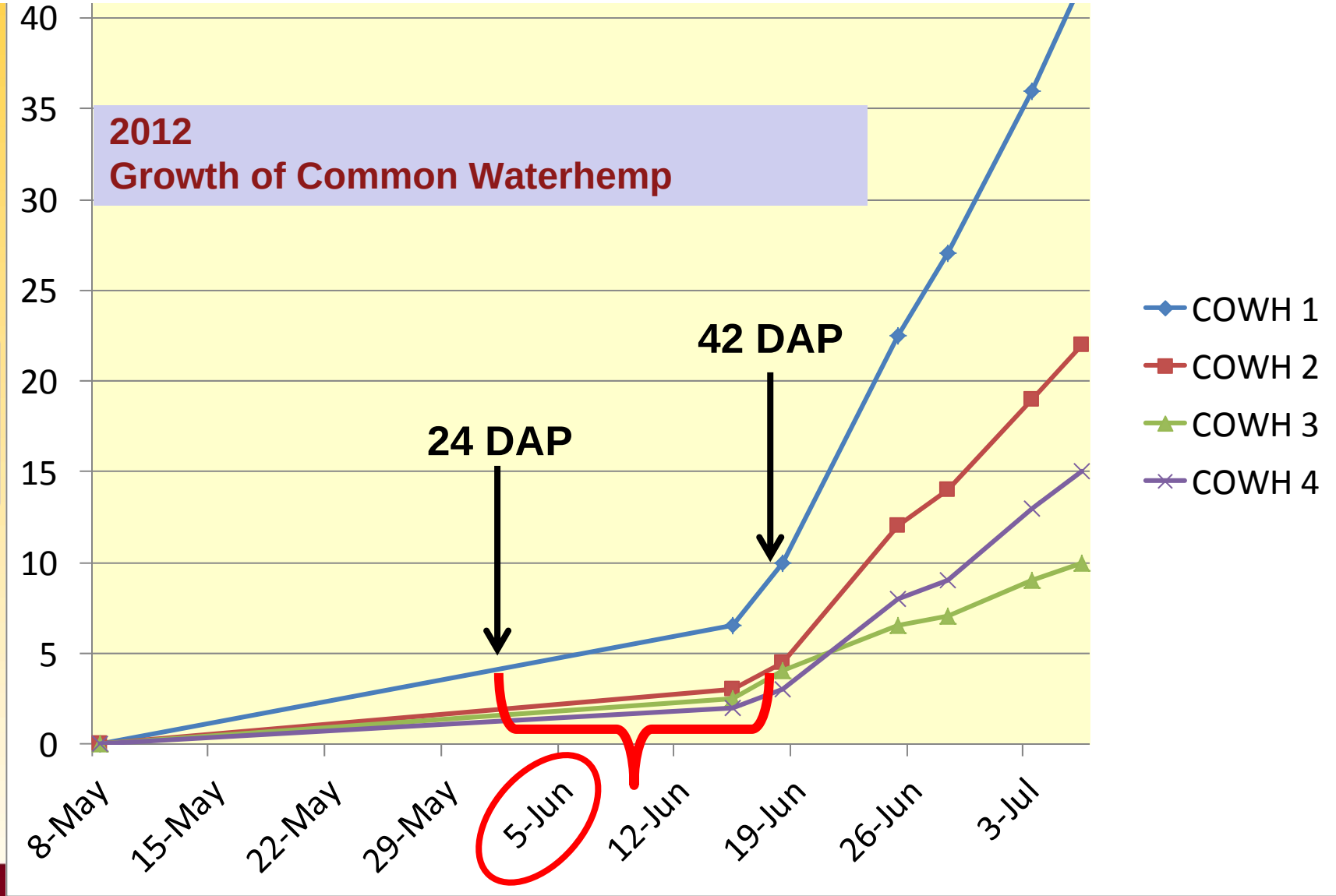
Reduces:	Increases:
Weed density	Increases yield potential
Weed species diversity	Herbicide/adjuvant compatibility
Weed size at time of postemergence application	Consistency of weed control
	Nitrogen efficiency in corn
	Early season weed canopy in soybean – Free Weed Control

PRE's provide added value – Value that isn't always easy to quantify

Weed Spectrum, Differing Emergence Rates and Early-Season Weed Growth Influence Control



Weed Spectrum, Differing Emergence Rates and Early-Season Weed Growth Influence Control



Proactive Weed Management Strategies

- **Why Are Farmers Reluctant To Adopt PRE Herbicides?**
  - Concerned about Cost
    - + Competitive market
    - + Incentives often available
    - + In weedy fields we see a favorable return on investment
  - Concerned about Time
    - + Uneven weed emergence and rapid weed growth make timing of POST control challenging
  - Lack of Experience with PRE Herbicides
    - - Crop Injury Potential and Crop Rotation Restrictions
    - - Not as Easy

Proactive Weed Management Strategies

- Start with a Preemergence herbicide
  - Provides a great opportunity to reduce selection intensity in herbicide resistant crops
  - Often introduces a different Site of Action
  - Controls weeds as they germinate and when they are most vulnerable
  - **Use the Right Herbicide, for the Right Weeds at the Right Rate and Right Time.**
  - **A good day to PLANT is a good day to apply a PRE herbicide**

Several PRE Options in Soybean

In Soybean there aren't many broad-spectrum control options

Soybean PRE							Rotation
Tier 1	**SOA#**			**Girw**	**Colq**	**Cowh**	**Sugarbeet**
Authority First/Sonic	2	14		P/G	G/E	G/E	30
Gangster	2	14		P/G	G/E	G	30
Optill	2	14		F/G	G/E	G	40
Prefix	15	14		F	G	G/E	18
Tier 2				**Girw**	**Colq**	**Cowh**	
Boundary	5	15		P/F	G	G/E	18
Verdict - 5 oz/A	14	15		P	G	F/G	NCS
Valor	14			N/P	G	G/E	4 to 10

Girw = Giant Ragweed; Colq= Lambsquarters; Cowh = Waterhemp.

Several PRE Options in Soybean

Why the big spread in Girw response to Tier 1 options?

Tier 1	SOA#			Girw	Colq	Cowh	Sugarbeet
Authority First/Sonic	2	14		P/G	G/E	G/E	30
Gangster	2	14		P/G	G/E	G	30
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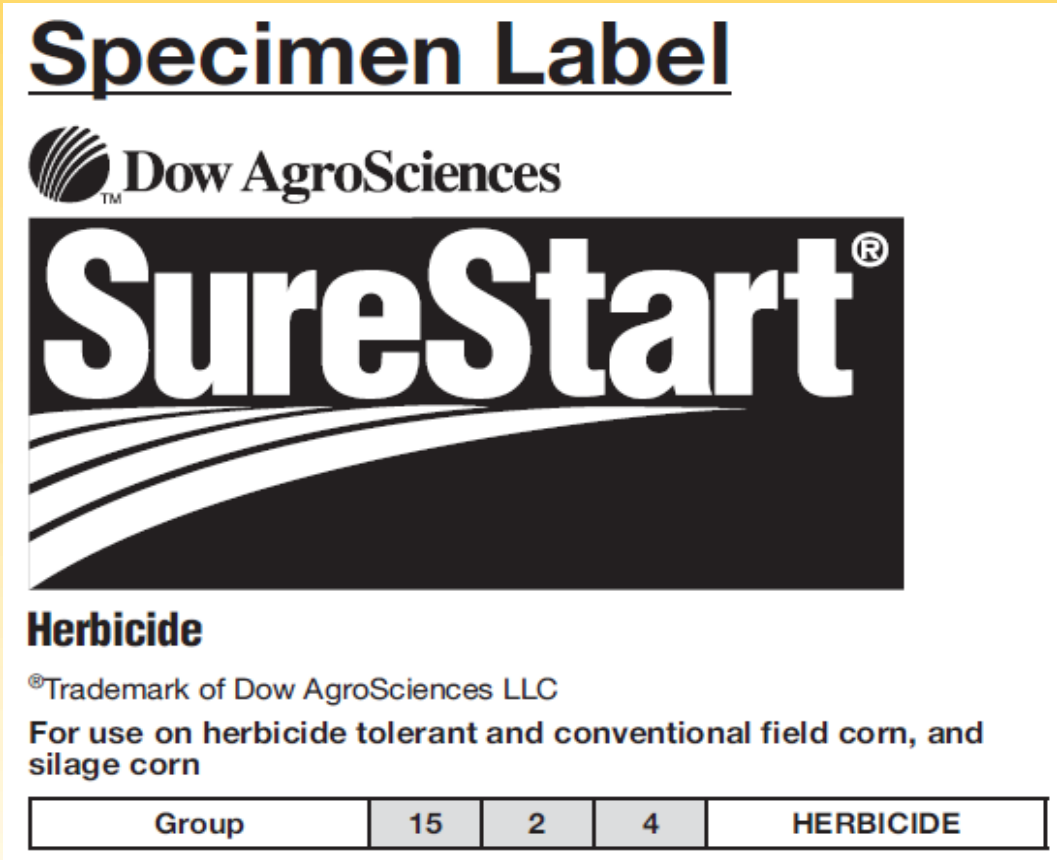
Where Do I Find SOA Information?

- Herbicide Labels are Starting to Include them



Specimen Label

Dow AgroSciences

SureStart®

Herbicide

®Trademark of Dow AgroSciences LLC

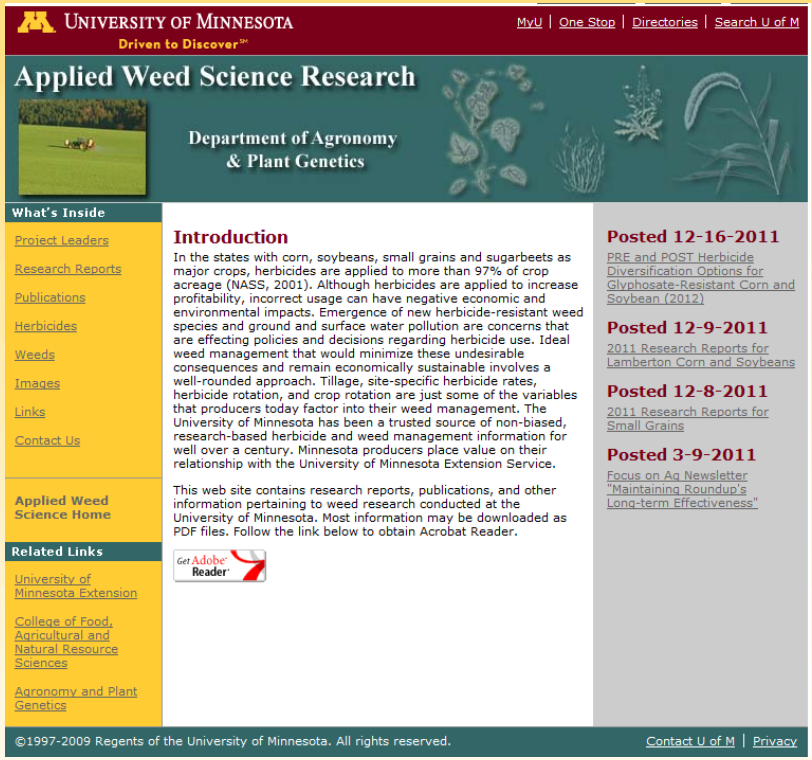
For use on herbicide tolerant and conventional field corn, and silage corn

Group	15	2	4	HERBICIDE

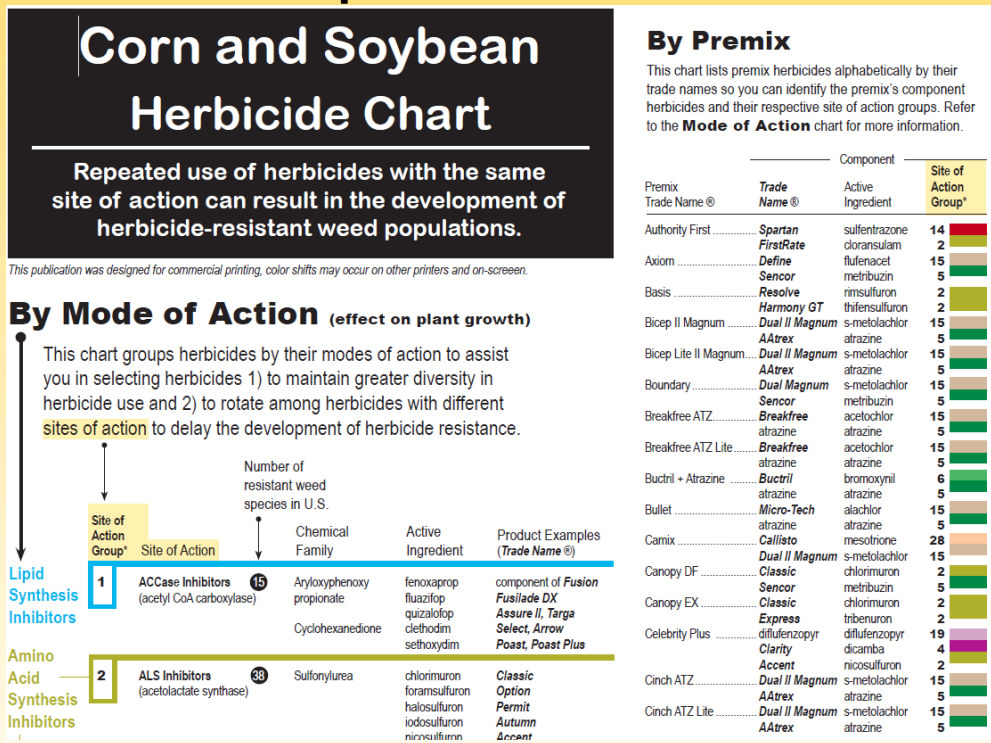
Where Do I Find SOA Information?

- Check out the following web sites

http://appliedweeds.cfans.umn.edu



http://glyphosateweedscrops.org/Info/MOA_060807.pdf



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Tier 2				Girw	Colq	Cowh	
Boundary	5	15		P/F	G	G/E	18
Verdict	14	15		P	G/E	F/G	NCS
Valor	14			N/P	G	G/E	4 to 10

Girw = Giant Ragweed; Colq= Lambsquarters; Cowh = Waterhemp.

All of the SOA #14 options must be applied by 3 days after planting except:

Prefix can be applied from cracking - V3

Warrant (SOA #15) is also an option

Soybean PRE							Rotation
Tier 1	**SOA#**			**Girw**	**Colq**	**Cowh**	**Sugarbeet**
Authority First/Sonic	2	14		P/G	G/E	G/E	30
Gangster	2	14		P/G	G/E	G	30
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Boundary	5	15		P/F	G	G/E	18
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Valor	14			N/P	G	G/E	4 to 10

Girw = Giant Ragweed; Colq= Lambsquarters; Cowh = Waterhemp.

Follow a PRE herbicide with a timely application of a POST herbicide for extended weed control; Diversification of SOA's will help combat herbicide resistant biotypes

Note Soybean options for broadleaf weed control has a limited number of SOA's

	SOA				Girw	Colq	Cowh	Sugarbeet
Cadet	14				P	F	F	NCS
Cobra	14				G	P	G/E	0
First Rate	2				E	P	P	30
Flexstar GT	14	9			G/E	F-E	E	18
Flexstar	14				G	P/F	G/E	18
Resource	14				P	F	F	1
Liberty (in LL Soybean	10				G	F	G	0

Girw = Giant Ragweed; Colq= Lambsquarters; Cowh = Waterhemp.

Soybean Carryover Concerns from 2012 to 2013

Carryover of Prefix and Flexstar to Corn

Photo Credit to Bob Hartzler at ISU, Ames, IA

Crop rotation -
10 months to Corn

Vegetable Friendly Program

- Pre - Boundary + Sharpen (5-14-15)
- Alternate years with glyphosate (9) & glufosinate (10)
- If you don’t grow alfalfa
  - Consider Flexstar GT (9 - 14)

Vegetable Friendly Program

- Pre - Enlite (2-14)
- Alternate years with glyphosate (9) & glufosinate (10)
- If you don’t grow alfalfa
  - Consider Flexstar GT (9 - 14)

Several PRE Options in Corn

Corn PRE								Rotation
Tier 1	SOA #				Girw	Colq	Cowh	Sugarbeet
Lumax	5	15,27			G	G/E	E	18
Surestart/TripleFlex	2	4,15			G	G/E	G	26
Verdict - >10 oz/A	14	15			G	G/E	G/E	NCS
Tier 2					Girw	Colq	Cowh	
Atrazine <0.38#	5				P/F	G/E	F	NCS
Atrazine + Tier 3	15	5 w/higher rate			F/G	G/E	F/G	2CS
Zemax	15	27			F/G	G/E	E	18
Tier 3					Girw	Colq	Cowh	
Dual	15				N	P/F	G	NCS
Harness/Surpass	15				P	F/G	G	NCS
Outlook	15				N	P/F	G	NCS

Girw = Giant Ragweed; Colq= Lambsquarters; Cowh = Waterhemp.

Early POST Options for PRE Corn Herbicides

Tier 2					
Atrazine <0.38#	5				0-12 inch
Atrazine + Tier 3	15	5 w/higher rate			0-12 inch
Zemax	15	27			0-12 inch
Tier 3					0-30 inch directed
Dual	15				0-5 inch
Harness/Surpass	15				0-11 inch
Outlook	15				0-12 inch
Corn POST					
Tier 1					
Callisto Xtra	Ps	HPPD			18
Capreno	ALS	HPPD			18
Halex GT	EPS	Acetanalide	HPP		18

Girw = Giant Ragweed; Colq= Lambsquarters; Cowh = Waterhemp.

Follow a PRE herbicide with a timely application of a POST herbicide for extended weed control; Diversification of SOA's will help combat herbicide resistant biotypes

Note POST weed control offers more opportunities to diversify effective SOA's

Corn POST								
Tier 1	**SOA**				**Girw**	**Colq**	**Cowh**	**Sugarbeet**
Callisto	**27**				G	G/E	E	**18**
Capreno	**2**	**27**			G	G/E	G/E	**18/24**
Halex GT	**9**	**15, 27**			E	E	G/E	**18**
Hornet	**2**	**4**			G/E	P/F	P/F	**26**
Impact	**27**				G	G/E	G/E	**18**
Laudis	**27**				G	G/E	G/E	**10/18***
Status	**4**				G/E	G/E	G	**4**
Liberty (in LL Corn)	**10**				**G**	**F**	**G**	**0**

Girw = Giant Ragweed; Colq= Lambsquarters; Cowh = Waterhemp.

Corn Carryover Concerns from 2012 to 2013

Carryover of Callisto to Soybean (esp. low pH <6.0 and low OM and CEC soils)

Crop rotation interval – 10 months to Soybean

Photo Credit – Practical Weed Science for the Field Scout – U of MO
Mike Owen – ISU, Ames, IA

Vegetable Friendly Program

- Pre - Verdict (14-15)
- SureStart/TripleFlex (2-4-15)
  - No sweet corn the following year
- Alternate years with glyphosate (9) & glufosinate (10)
- Other post-emergence tank mix partners

CONFIRMED HPPD RESISTANCE

Year	Crop	Pre	Post
2003	Corn	Dual + Simazine	Callisto + atrazine
2004	Corn	Dual + Simazine	Callisto + atrazine
2005	Corn	Dual + Simazine	Callisto + atrazine
2006	Corn	Dual + Simazine	Impact + atrazine
2007	Corn	Dual + Simazine	Impact + atrazine
2008	Corn	Dual + Simazine	Impact fb Callisto
2009	Corn	Dual + Simazine	Impact fb Callisto

TAKE CONTROL with MY PLAN

Year	Crop	PRE	MOA*	POST	MOA*
2012	Corn Beans				
2013	Corn Beans				
2014	Corn Beans				
2015	Corn Beans				
2016	Corn Beans				

MOA*= Herbicide Mode of Action

http://appliedweeds.cfans.umn.edu/Pubs.html

Use the Right Herbicide, for the Right Weeds at the Right Rate and Right Time

CONFIRMED HPPD RESISTANCE

Year	Crop	Pre	Post
2005	Corn	Dual + Simazine	Callisto + atrazine
2006	Corn	Dual + Simazine	Impact + atrazine
2007	Corn	Dual + Simazine	Impact + atrazine
2008	Corn	Dual + Simazine	Impact fb Callisto
2009	Corn	Dual + Simazine	Impact fb Callisto

TAKE CONTROL with MY PLAN

Year	Crop	PRE	MOA*	POST	MOA*
2012	Corn				
	Beans				
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2015	Corn Beans				
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TAKE CONTROL with MY PLAN

Year	Crop	PRE	MOA*	POST	MOA*
2012	Corn				
	Beans				
2014	Corn				
2016	Corn Beans				

Use the Right Herbicide, for the Right Weeds at the Right Rate and Right Time

Your Goal is Diversification of Effective Herbicide SOA's on Weed Species Present Applied in a Timely Manner

MOA*= Herbicide Mode of Action

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When Planning to Use a PRE Herbicide Consider:

Using full label rates as a good resistance mgmt. BMP

Table 1: Soil Texture Groupings for SureStart Use Rate Selection.

Coarse	Medium	Fine
Sand Loamy Sand Sandy Loam	Loam Silt Silt Loam Sandy Clay Loam	Silty Clay Loam Silty Clay Sandy Clay Sandy Clay Loam Clay Loam Clay

Use Rates for SureStart by Soil Texture and Organic Matter Content

Soil Texture	Soil Organic Matter Content	
	Less Than 3%	3% or Greater
	Pints/Acre	Pints/Acre
Coarse	1.5 – 2.0	1.5 – 2.0
Medium	1.5 – 2.5	1.75 – 3.0
Fine	2.0 – 3.0	2.0 – 3.0

When Planning to Use a PRE Herbicide Consider:

Influence of soil type and pH on Crop Injury

- Use of SureStart in soil-applied treatments on soils with less than 1.5% organic matter (O.M.) may result in crop injury. Apply as a soil-treatment to fields which have less than 1.5% O.M. only if the risk of crop injury is acceptable.

Restrictions And Precautions For Soil Application (Not Applicable To Postemergence Use)

- **Corn Planting Depth:** Minimum planting depth should be at least 1 1/2 inches.
- Do not apply to areas where the soil pH is greater than 7.8 as this may result in increased crop injury.

When Planning to Use a PRE Herbicide Consider:

Impact of weather

Adverse Weather Conditions

- Extended cold, wet conditions (soil temperatures below 50°F and excessive rainfall with wet soil conditions), following application of SureStart to herbicide tolerant corn, which persist during germination and/or early crop development may result in crop injury. Injury symptoms, which include yellowing of leaves and/or crop stunting, are usually temporary and affected corn plants usually recover without affecting yield.
- Dry weather following preplant surface or preemergence applications of SureStart may reduce effectiveness. If sufficient activating rainfall or overhead irrigation does not occur within 7 to 10 days of application, rotary hoe, harrow, or shallowly cultivate to incorporate the herbicide lightly into the soil. Use a preplant incorporated application when a period of dry weather is predicted after application.

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When Planning to Use a PRE Herbicide Consider:

Interactions with other pesticides:

Soil Insecticide Advisories

When SureStart is used for soil applied weed control in corn:

- Soil applied organophosphate insecticides (except terbufos or phorate, see below) should be applied in a T-band or a band to avoid potential crop injury.
- Terbufos (Counter insecticide products) or phorate (Thimet insecticide products) should not be used.
- Soil insecticides from other classes of chemistry may be applied in-furrow, T-banded, or banded.

- If any herbicide with ALS (acetolactate synthase) inhibition mode of action such as Pursuit, Canopy, Classic, Scepter, or Squadron herbicide, etc., was applied the previous year, apply SureStart to corn only if the rotational restrictions applicable to corn for the preceding product has been met.

When Planning to Use a PRE Herbicide Consider:

The PRE approach requires some planning and isn't as easy as the multiple application, glyphosate approach to weed management but it is still

A LOT EASIER THAN……

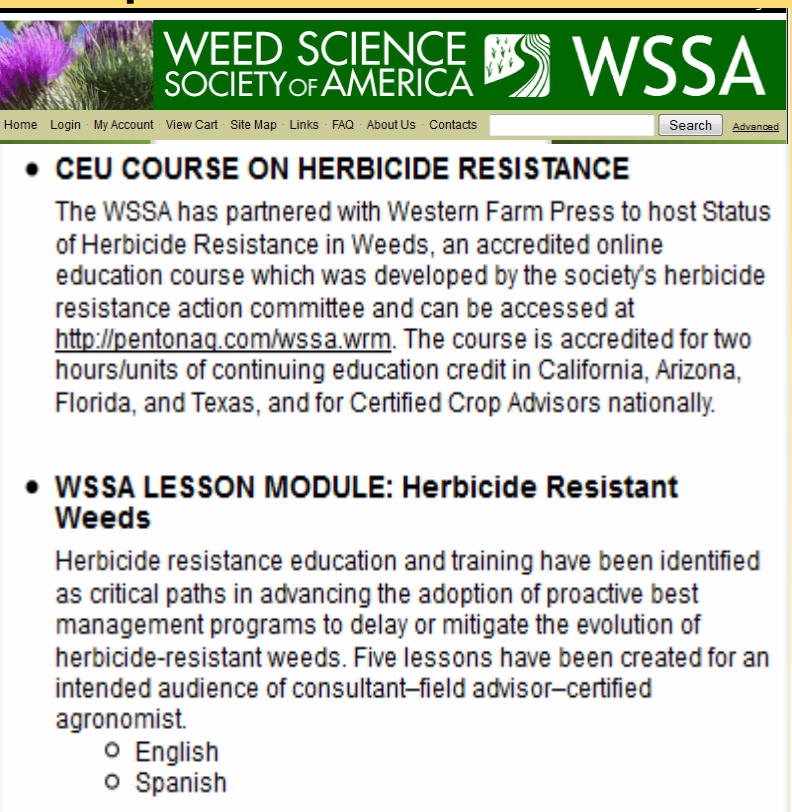
Hand Weeding

Reactive Weed Management Strategies

- In addition to proactive practices, even greater diversification will be required
  - Crop Rotation with Chemical Rotation
  - Liberty Link technology
  - Early-season competitive crops in the rotation
  - Cultivation, yes cultivation
  - Target the use of the HRC in the crop w/in your crop rotation where you really need it to be effective
  - Don’t rely on HRC technology where effective herbicide alternatives exist

Where Do I Find More Information Regarding Herbicide Resistance Mgmt.?

http://www.wssa.net



http://glyphosateweedscrops.org/

How Do You Win A Game?

- You have a plan
- You develop a strategy
- You keep you opponent guessing
- You keep one step ahead
- You take advantage of weaknesses
- You take note of changes and adjust
- You *TAKE CONTROL*