

**2010 CORN CONGRESS
A LOOK AHEAD AT
HERBICIDE RESISTANCE
MANAGEMENT STRATEGIES**

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**“Farmers Cope With
Roundup-Resistant Weeds”**

By William Neuman and Andrew Pollack

May 3, 2010

BREITBART.COM

**“Roundup Resistant Weeds
Pose Environmental Threat”**

**By David Mercer
Associated Press Writer**

June 21, 2010

RESISTANCE IS NOT NEW!

- 2,4-D introduced ~ 1940



RESISTANCE IS NOT NEW!

- 2,4-D introduced ~ 1940
- Resistance reported-1952

Wild carrot

Ontario Canada

TRIAZINE-RESISTANCE

- Triazines introduced ~ 1960



TRIAZINE-RESISTANCE

- Triazines introduced ~ 1960
- Resistance reported – 1970

Common groundsel

Washington State

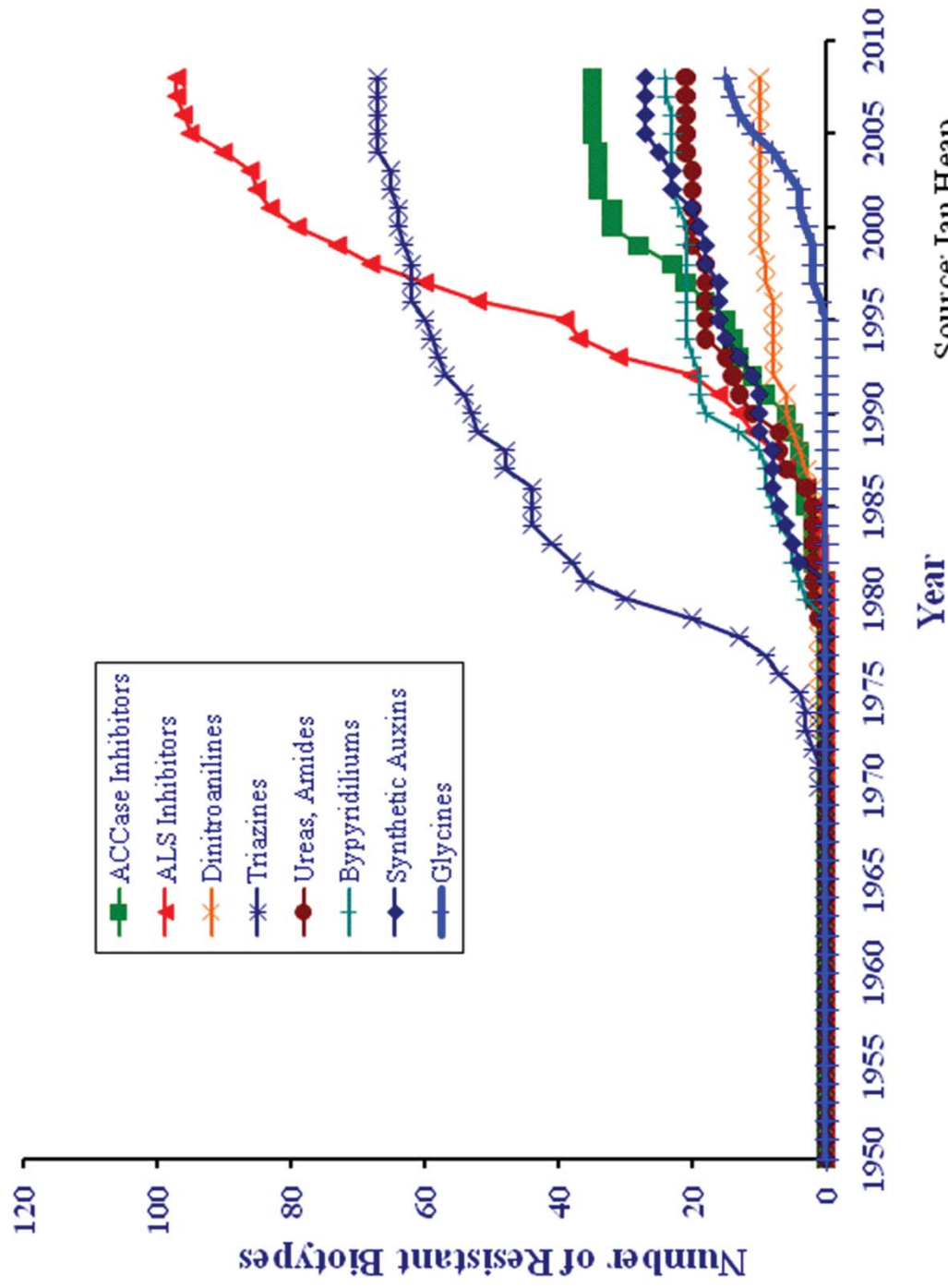
TRIAZINE-RESISTANT WEEDS IN NEW YORK STATE

- **Common lambsquarters – 1977**



TRIAZINE-RESISTANT WEEDS IN NEW YORK STATE

- **Common lambsquarters – 1977**
- **Smooth pigweed – 1980**
- **Common groundsel – 1989**
- **Common ragweed - 1993**



Source: Ian Heap
<http://WeedScience.com>

HERBICIDE RESISTANT WEEDS

SUMMARY 1/11/11

Herbicide Group	WSSA Group	Example Herbicide	Total
ALS inhibitor	2	Steadfast Q	107
Triazine	5	Atrazine	68
ACCase inhibitor	1	Fusilade	37
Synthetic Auxin	4	2,4-D	28
Bipyridilium	22	Gramoxone	25
Ureas and Amide	7	Lorox	21
Glycine	9	Roundup	21
Dinitroaniline,etc	3	Prowl	10

HERBICIDE RESISTANT WEEDS

SUMMARY 1/11/11

Herbicide Group	WSSA Group	Example Herbicide	Total
Thiocarbamates, etc.	8	Eptam	8
Triazoles, Ureas, etc.	11	Amitrole	4
PPO Inhibitors	14	Sharpen	4
Chloroacetamides, etc	15	Dual II Mag.	4
Nitriles and others	6	Buctril	3
Carotenoid Inhibitors	12	Zorial	2
Others	-	-	8
Total Herbicide Resistant Biotypes			350

CURRENT CONCERN

- **Rapid increase in number of ALS - resistant weeds and their use on multiple crops.**

CURRENT CONCERN

- **With glyphosate resistant crops, there's temptation to**
 - **grow them in rotation**
 - **to use glyphosate multiple times during the growing season.**

GLYPHOSATE-RESISTANT WEEDS IN USA 1/11/11

#	Weeds	1 st Occurrence
1	Palmer amaranth	2005 – Georgia – 9*
2	Tall waterhemp	2005 – Missouri – 7*
3	Common ragweed	2004 – Arkansas – 7*
4	Giant ragweed	2004 – Ohio – 9*
5	Hairy fleabane	2003 – S. Africa - 1*
6	Horseweed	2000 – Delaware – 17*

*Number of states reporting this biotype.

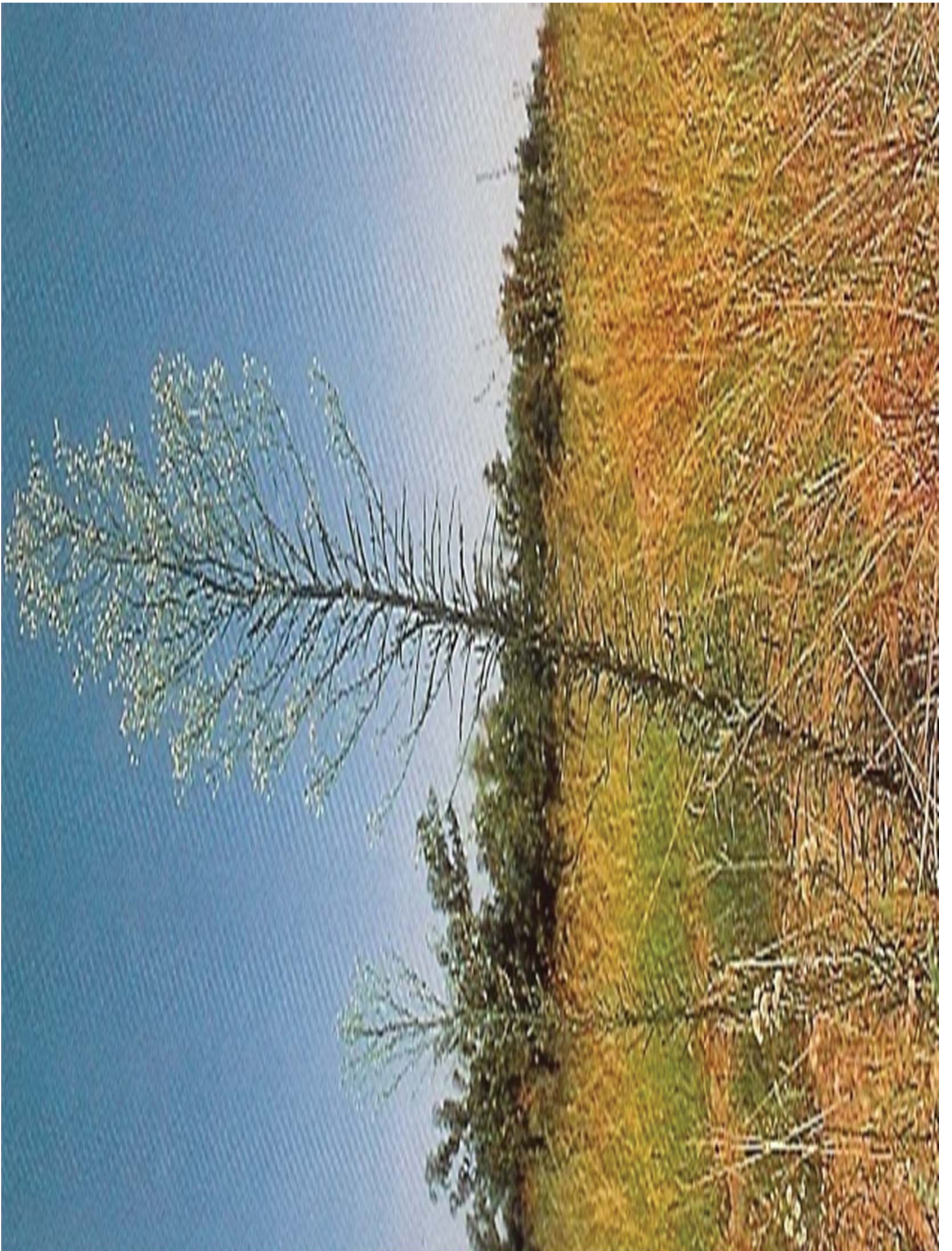
GLYPHOSATE-RESISTANT WEEDS IN USA 1/11/11

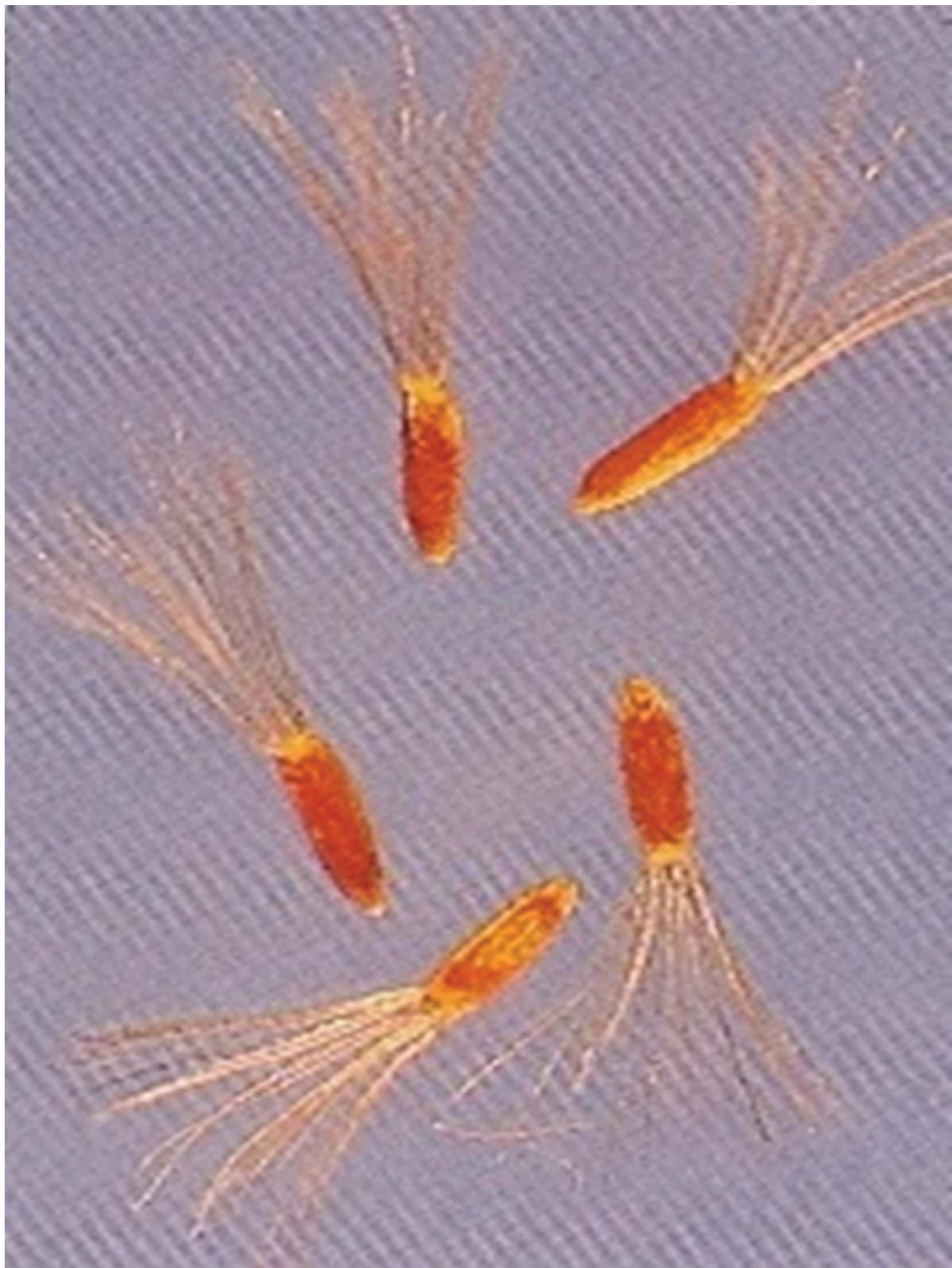
#	Weeds	Occurrence
7	Goosegrass	2010 – Mississippi – 1*
8	Kochia	2007 - Kansas – 1*
9	Italian ryegrass	2001 - Chile – 3*
10	Rigid ryegrass	1996 - Australia -1*
11	Annual bluegrass	2010 – Missouri – 1*
12	Johnsongrass	2005 - Argentina – 1*

*Number of states reporting this biotype.









RESISTANCE MANAGEMENT FOR GROWERS

- Rotate crops, i.e. genetics
- Cultivate to control escapes
- Rotate sites of action
- Tank mixes or sequential herbicide applications with different sites of action

INDUSTRY STRATEGIES FOR RESISTANCE MANAGEMENT

- Premixes of herbicides with
different sites-of action

HALEX GT

Active Ingredients	Active/ Gallon	Mode of Action
Touchdown	2.09 lb	GROUP 9 – inhibit amino acid synthesis
Dual II Mag	2.09 lb	GROUP 15 – inhibit long-chain fatty acids
Callisto	0.209 lb	GROUP 27 – inhibit pigment formation

INDUSTRY STRATEGIES FOR RESISTANCE MANAGEMENT

- Premixes of herbicides with different sites-of action
- Developing crops with multiple types of herbicide resistance

CROPS WITH MULTIPLE TYPES OF RESISTANCE

Product	Crop(s)	Resistant To	Group
SmartStax	Corn	Glyphosate Ignite (Liberty)	9 10

CROPS WITH MULTIPLE TYPES OF RESISTANCE

Product	Crop(s)	Resistant To	Group
SmartStax	Corn	Glyphosate	9
		Ignite (Liberty)	10
DHT	Corn	Glyphosate 2,4-D	9
	Soybean		4

CROPS WITH MULTIPLE TYPES OF RESISTANCE

Product	Crop(s)	Resistant To	Group
SmartStax	Corn	Glyphosate	9
		Ignite (Liberty)	10
DHT	Corn	Glyphosate	9
	Soybean	2,4-D	4
??	Soybean	Glyphosate	9
		Dicamba	4

CONCERNS ABOUT GROUP 4 AND 9 GENETICS

- Increased use of 2,4-D and dicamba (ie. Banvel, Clarity)
- Off-site movement, due to drift and/or volatility, affecting sensitive broadleaf species.

EFFORTS TO MINIMIZE VOLATILITY

For 2,4-D

- **New 2,4-D with low spray drift potential and little volatility.**
- **DHT corn and soybeans will require this 2,4-D formulation.**
- **Will recommend use of air induction spray nozzles to reduce fine spray particles.**

EFFORTS TO MINIMIZE VOLATILITY

For dicamba

- BASF - Banvel to Clarity.
- BASF and Monsanto are working on next generation dicamba products.

CROPS WITH MULTIPLE TYPES OF RESISTANCE

Product	Crop(s)	Resistant To	Group
SmartStax	Corn	Glyphosate	9
		Ignite (Liberty)	10
DHT	Corn	Glyphosate	9
	Soybean	2,4-D	4
??	Soybean	Glyphosate	9
		Dicamba	4
Optimum GAT	Corn	Glyphosate	9
	Soybean	ALS Inhibitors	2

CONCERNS ABOUT OPTIMUM GAT

- Great number of ALS resistant weed biotypes in World - 107
- Growing number of glyphosate-resistant weed biotypes - 21
- In US there are populations of five weeds with glyphosate and ALS resistance.

POPULATIONS WITH GROUP 2 & 9 RESISTANCE

Weeds	State	# Sites	Acres
Palmer amaranth	GA	101-500	1001-10,000
	MS	?	?
Tall waterhemp	MO	101-500	100,000+
	IL	1	50-100
Common ragweed	OH	1	501-1000
Giant ragweed	OH	1	101-500
Horseweed	OH	2-5	101-500

Palmer Amaranth





**Tall
Waterhemp**

CROPS WITH MULTIPLE TYPES OF RESISTANCE

Product	Developed by	Crop(s)	Date
SmartStax	Monsanto Dow	Corn	2010
DHT	Dow Pioneer/Others	Corn Soybean	2013 2015
??	Monsanto BASF	Soybean	2014+
Optimum GAT	Pioneer/ DuPont	Corn Soybean	2015+ 2015+

OVERVIEW OF RESISTANCE

- Weed resistance to many sites of action is common
- Resistance is manageable
- Most products retain value despite resistance

QUESTIONS??

