Future of Weed Control in Cotton, Corn, and Soybean

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Current State of Biotech Crops

- 10 million farmers in 22 countries
- Area planted to biotech crops has increased 60-fold in 11 years
- 100 million hectares
  - 80% glyphosate resistant

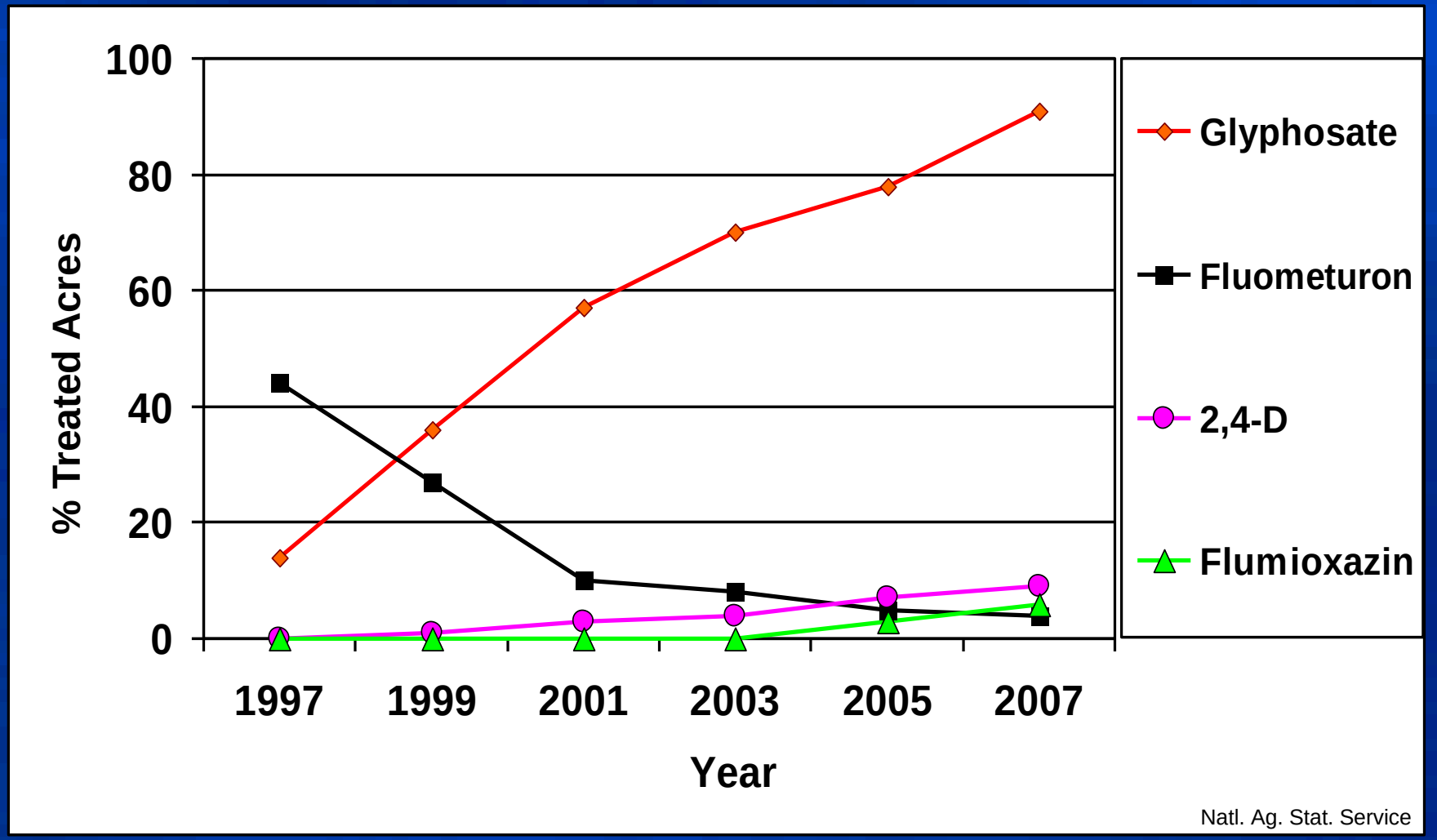
Where Are We Today?

- Cotton
  - 99% of cotton in Mississippi is RR or RF
  - 93% of U.S. cotton is RR or RF
- Corn
  - 90+% of Mississippi corn is RR
  - 63% of U.S. corn is herbicide resistant or stacked gene
- Soybean
  - 96% of Mississippi soybeans are RR
  - 91% of U.S. soybeans are RR

"Glyphosate is as important to world agriculture as penicillin is to human health"

- Dr. Stephen Powles – Science 2007

Herbicide Use in Cotton



Development of Current Weed Control Technology

- Glyphosate
  - Weed control properties identified in 1970
  - Glyphosate-resistance gene first inserted into plants in 1986
- Metolachlor
  - Synthesized in 1972
- Dicamba
  - U.S. patent awarded in 1958
- 2,4-D
  - Synthesized in 1941
- Atrazine
  - Synthesized in 1952

Where Are We Going?

- Many of the new options in weed control in the next 3-5 years will be in the form of traits
  - Expand uses of currently available herbicides
  - Expand use of currently available traits
- New herbicide discovery
  - Time consuming
  - Very expensive
- Integrate new herbicides as they are developed

Glytol/H2

- Developed by Bayer CropScience
- Glytol
  - Glyphosate-resistance similar to RR Flex
  - Different gene and promoter than RR Flex
- H2
  - Glyphosate/glufosinate resistance

Bayer CropScience

Glytol/H2

- Cotton:
  - Glytol – 2009
  - H2 – 2010
  - BG II/H2 – 2011
  - Twinlink/H2 – 2012

- Soybeans:
  - Glytol + HPPD – 2014
  - Glytol + HPPD + Liberty Link – 2016

Liberty Link

- Bayer trait
  - Available in cotton
    - Acreage very limited in Mid-South
  - Licensed to Monsanto for use in corn and soybean
  - Part of SmartStax™ package

- Liberty Link soybeans available in 2009

Bayer CropScience

Liberty Link

- Use of the Liberty Link system will require a change in mindset
- Like anything, has limitations
- Increasing rate will not be cost effective or efficacious

Bayer CropScience

Optimum GAT

- Glyphosate ALS Tolerance
- Developed by DuPont
- Different glyphosate resistance gene than Monsanto
  - Derived from soil bacterium
  - Enzyme binds to glyphosate and breaks it down into non-toxic metabolites
- ALS enzyme insensitive to all 5 classes of ALS-chemistry
  - Proprietary DuPont discovery

optimum® GAT® Herbicide Tolerance

Optimum GAT

- Corn: 2010
  - Plans in place to include Bayer's Liberty Link trait with Optimum GAT
  - Glyphosate/Glufosinate/ALS
- Soybean: 2011
- Cotton: ???

optimum® GAT® Herbicide Tolerance

Optimum GAT

- Pros:
  - Competition in the marketplace
  - Allows for increased utility of ALS-inhibiting herbicides
- Cons:
  - Allows for increased utility of ALS-inhibiting herbicides
  - Variety/hybrid introgression

optimum® GAT® Herbicide Tolerance

DHT

- DowAgrosciences Herbicide Trait
- 2,4-D + “Fop” resistance
  - NOT dicamba resistance
  - NOT “Dim” resistance
- Corn: 2012
  - Offered in conjunction with SmartStax™ package
- Cotton and Soybean: 2013
  - Offered in conjunction with glyphosate-resistance

Dow AgroSciences

DHT

- Pros:
  - Use of additional chemistry
  - “Protection” from 2,4-D drift
- Cons:
  - Potential for off-target movement of herbicides
  - Education regarding product selection
  - Crops becoming weeds

Dow AgroSciences

HPPD Resistance

- 4-Hydroxyphenyl Pyruvate Dioxygenase inhibitors
- Balance Pro, Callisto, Impact, Laudis
- Will be offered in a three-way stack in soybeans
  - Glyphosate/glufosinate/HPPD
- Potential for development in cotton

Bayer CropScience

Dicamba Tolerance

- University of Nebraska
  - Technology based on a soil bacteria gene discovered at a dicamba manufacturing plant
- DMO gene
- Soybeans have displayed tolerance of up to 5 lbs ai/acre
- Tobacco plants with tolerance of up to 25 lb ai/acre

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Future Options

- Three-way herbicide resistance from Dupont
  - Soybeans
  - Discovery phase
- Dicamba + glufosinate tolerant cotton from Monsanto
  - Proof of concept phase
- Paraquat resistance???
- PPO-resistance???
- New active ingredients and modes of action

Conclusions

- For foreseeable future, weed control will be trait based
- New herbicides will be incorporated into existing systems
- Quest for next glyphosate is underway
- “Weed control in the early 2000’s was as easy as it will ever be”
  - Dr. Larry Steckel – Delta Farm Press 2008

Questions