

Herbicide and Pesticide Options for Cotton Production

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Ben McKnight, Ph.D.

Assistant Professor and Extension Specialist

Texas A&M AgriLife Extension

Department of Soil and Crop Science



Weed Management in Cotton

Why is weed management so important?

- **Weeds compete for resources required by crop plants to produce economically viable yields**
 - **Sunlight**
 - **Space**
 - **Water**
 - **Nutrients**

- **Additionally, weeds:**
 - **Interfere with harvesting activities**
 - **Extraneous matter in harvested material (leaf content)**
 - **Reduced grade and reduced returns**

Weed Management in Cotton

What tools for weed control are available?

- **Mechanical Control**
- **Cultural Control**
- **Herbicides**



Weed Management in Cotton- Mechanical

- **Once a mainstay in cotton production**
- **Cultivation for weeds was greatly reduced with the adoption of glyphosate and glufosinate technologies**
- **With the increase in herbicide resistance, cultivation is once again a viable option**
- **Recent interest in developing new mechanical weeding technologies**



Weed Management in Cotton- Cultural

- **Field selection**
 - **Cotton is a perennial plant, slow to develop**
 - **Weed management easier in fields with reduced weed pressure**
 - **Important considerations include knowing field history of:**
 - **soil test results**
 - **fertility history**
 - **disease/weed pressure**
 - **past management practices**

Weed Management in Cotton- Cultural

- **Prevention**
 - **Weed management in adjacent areas and field borders?**
 - **Cleaning equipment prior to moving from field to field**
- **Seedbed Preparation**
 - **Good seedbed preparation leads to better emergence**
 - **Important for cotton seedlings to get a strong start**
 - **Uniform cotton stand is more competitive against weeds**

Weed Management in Cotton- Cultural

- **Row spacing**
 - **Crop canopy closure occurs faster on narrower rows**
 - **May not be feasible option depending on equipment setup**
- **Seed quality**
 - **Good seed quality = enhanced emergence**
 - **Reduced likelihood for replant situation**
 - **Better weed competition through enhanced growth and establishment**

Weed Management in Cotton- Cultural

- **Variety selection**
 - **Different varieties have different growth characteristics**
 - **Aggressive early-season growth may speed up canopy closure**
- **Planting date**
 - **Planting in favorable conditions expedites cotton establishment**
 - **Soil temps above 60 degrees, the warmer the better**
 - **Sluggish growth early in the season leads to weak weed competition**

Weed Management in Cotton- Cultural

- **Crop rotation**
 - Assists in reducing weed populations gradually
 - Different crops = different life cycle, growing window, rooting depth, leaf orientation, moisture and nutrient requirements
 - All of these differences modify favorable conditions for continuous weed proliferation in a cotton monoculture production system
 - Allows for rotation of different herbicides with different modes of action....**important component of overall resistance management program**

Weed Management in Cotton- Herbicide Resistance

Herbicide resistance – the inherited ability of a plant to survive and reproduce following exposure to a dose of herbicide normally lethal to the wild type. In a plant, resistance may be naturally occurring or induced by such techniques as genetic engineering or selection of variants produced by tissue culture or mutagenesis.

- WSSA definition



Weed Management in Cotton- Herbicide Resistance

- **Naturally occurring biotypes of a weed species may have the inherent ability to survive exposure to a herbicide that was previously effective for controlling that species**
- **Biotype = plants within a weed species that may look exactly alike, but have biological traits uncommon to the population as a whole**
- **Development of herbicide resistance is accelerated when chemical weed control is relied too heavily upon without including cultural, mechanical, or biological control means**

Prevention and Management of Resistant Weeds

- **Diversify crop production practices**
 - Crop rotation allows for the use of different herbicide MOAs

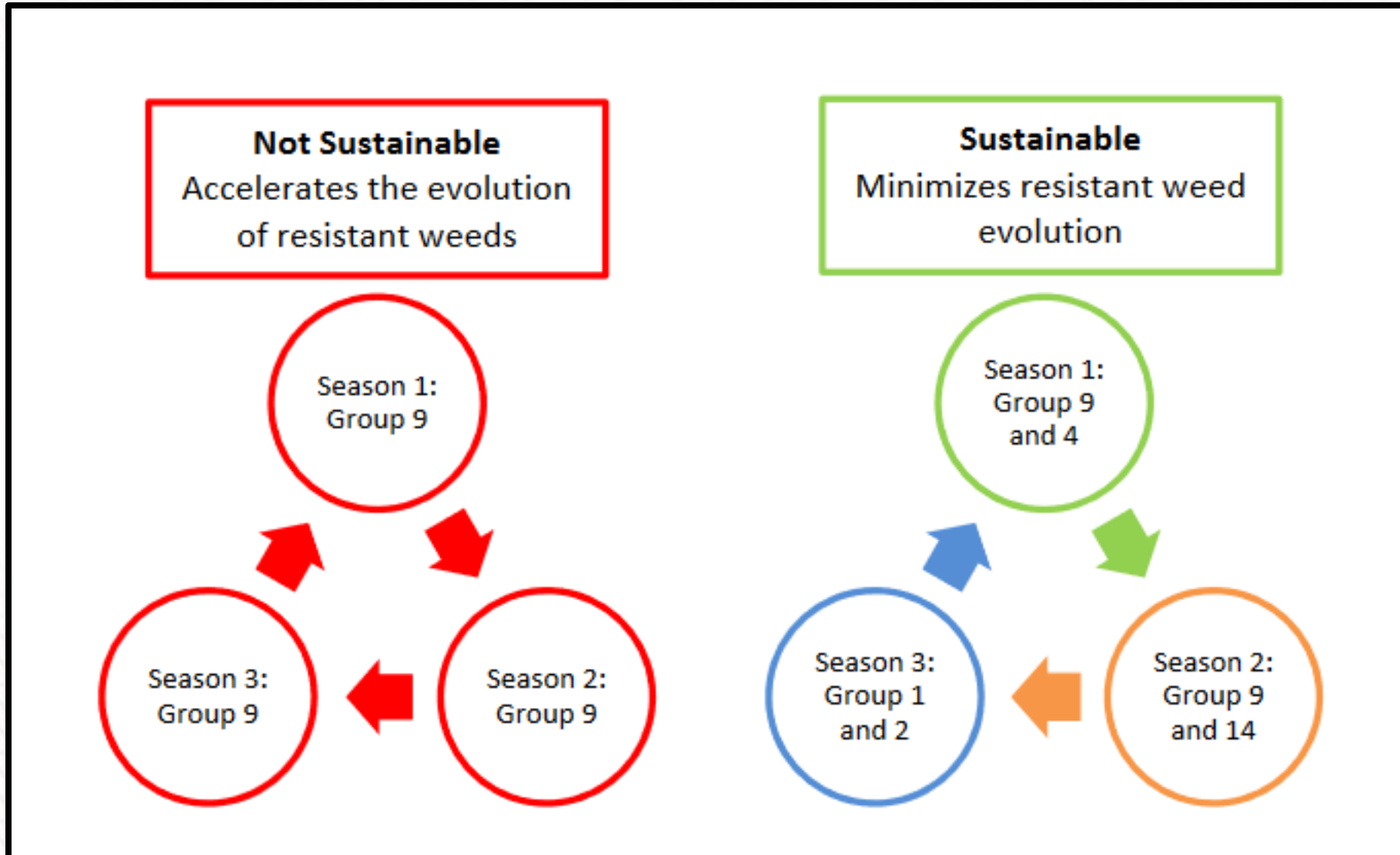
- **Cultivation**
 - Still a viable means of controlling resistant weeds, no weed resistance to tillage equipment

- **Appropriate application rates, timings, and spray volume**
 - Always use rates recommended on herbicide label
 - Applications on weeds too large may result in escapes and reduced efficacy
 - Good coverage essential, reduced application rates can lead to problems

Prevention and Management of Resistant Weeds

- **Avoid relying on single mechanism of action in weed control programs**
 - **Currently, 12 different herbicide mechanisms of action available**
 - **Important to utilize 2 different mechanisms of action for troublesome, difficult to control weed species**
 - **Change herbicide programs from year to year**

Prevention and Management of Resistant Weeds



Prevention and Management of Resistant Weeds

Table 1. Mechanism of action of herbicides labelled for use in cotton

Mechanism of Action	WSSA Group #	Representative products
ACCase inhibitors	1	Assure II, Fusilade DX, Poast Plus, Select Max
ALS inhibitors	2	Envoke, Express, FirstShot, Harmony, LeadOff, Staple
Microtubule assembly inhibitors	3	Prowl, Treflan
Synthetic auxins	4	2,4-D, Enlist Duo, Clarity, XtendiMax, Engenia, FexaPan,
Photosystem II inhibitors	5	Caparol,
	7	Cotoran, Direx, Karmex, Linex, Layby Pro
EPSP synthase inhibitors	9	Roundup (glyphosate)
Glutamine synthetase inhibitors	10	Liberty
Carotenoid biosynthesis inhibitors	12	Brake FX, Solicam DF
	13	Command
PPG oxidase inhibitors	14	Aim, Cobra, ET, Goal, Reflex, Resource, Sharpen, Valor
VLCFA inhibitors	15	Dual Magnum, Warrant, Zidua, Outlook
Unknown	17	MSMA
Photosystem I inhibitors	22	Gramoxone SL

Weed Identification

- **WSSA survey of common and troublesome weed species**

- **Most Common**

- 1) Palmer amaranth
- 2) morningglory spp.
- 3) Urochloa spp.
- 4) crabgrass spp.
- 5) barnyardgrass

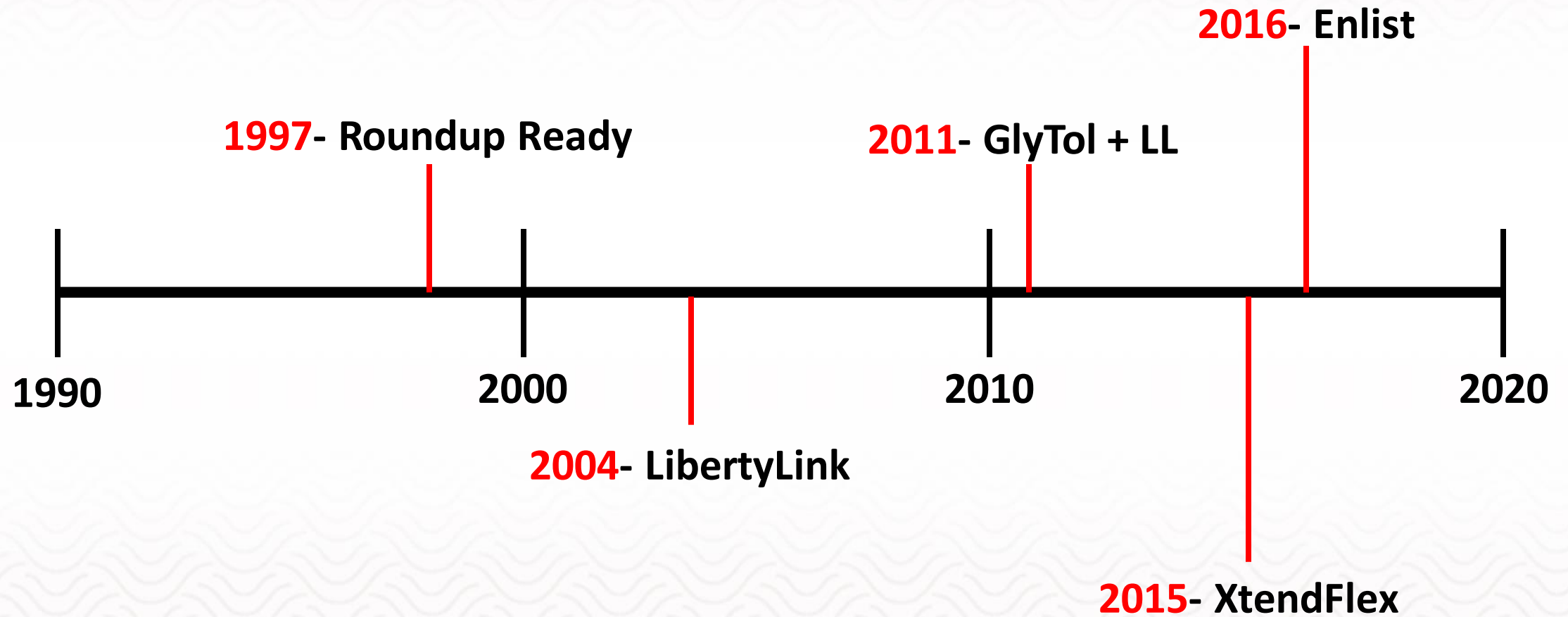


- **Most Troublesome**

- 1) Palmer amaranth
- 2) morningglory spp.
- 3) horseweed
- 4) BYG, goosegrass, nutsedge and kochia



Herbicide Tolerant Traits in Cotton



Herbicide Tolerant Traits in Cotton

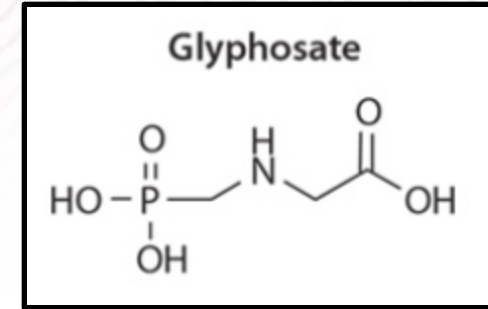
- Roundup Ready®

- Glyphosate

- First time a non-selective herbicide safely applied over the top
- Simplified weed control
- Resistance confirmed in Palmer amaranth, 2005

- Resistance in Texas

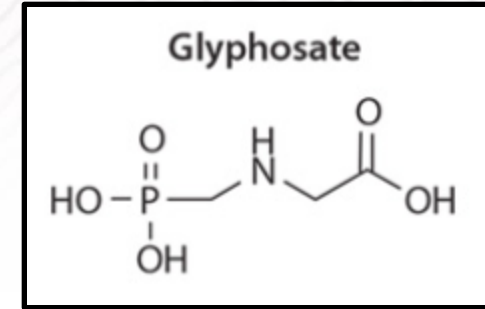
- 2006- tall waterhemp
- 2011- Palmer amaranth
- 2015- common sunflower



Herbicide Tolerant Traits in Cotton

- Glyphosate-tolerant cotton

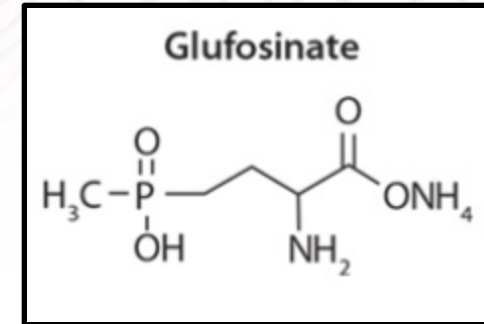
- Where are we at today?
- Resistance issues prevalent in some parts of Texas
- Still a good means of control for non-resistant, troublesome weed species
- Viability?
- Technology fees?
- Future depends on good herbicide resistance management practices



Herbicide Tolerant Traits in Cotton

- LibertyLink[®]

- Glufosinate
- **Similar to RR system, non-selective herbicide safely applied over the top**
- **Different MOA**
- **Good activity on Palmer and tall waterhemp**
- **Resistance Issues?**
 - **Currently none reported in Texas**
 - **2010- Oregon, Italian ryegrass**
 - **2015- California, Italian ryegrass**



Herbicide Tolerant Traits in Cotton

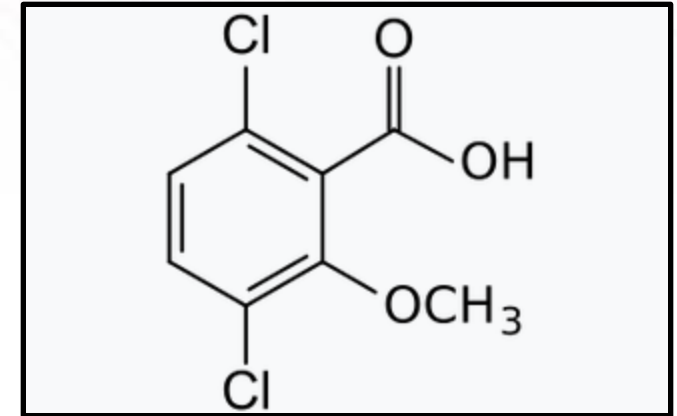
- Glufosinate-tolerant cotton

- Where are we at today?
- Still a viable technology in Texas
- Reminders on glufosinate
- Apply to small, actively growing weeds
- Apply at 15 GPM minimum, good coverage is very important
- Apply between sunrise and 2 hours prior to sunset
- Always read the label



Herbicide Tolerant Traits in Cotton

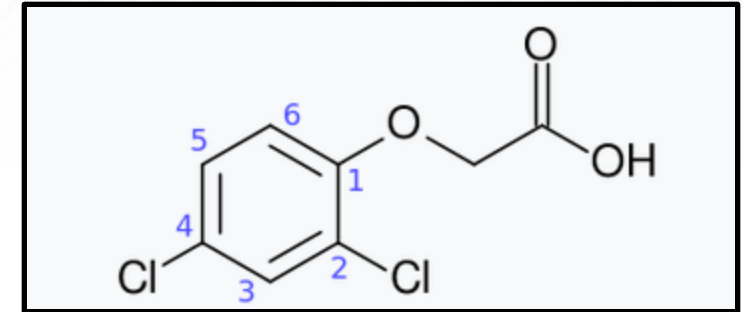
- **XtendFlex[®]**
 - **Dicamba**
 - **Old chemistry, 1960s**
 - **Group 4, synthetic auxin**
 - **Good control of broadleaf weeds**
 - **Developed as a means to combat resistance problems**
 - **Engenia[®] - BASF**
 - **XtendiMax[®] – Bayer**
 - **Tavium[®] - Syngenta**



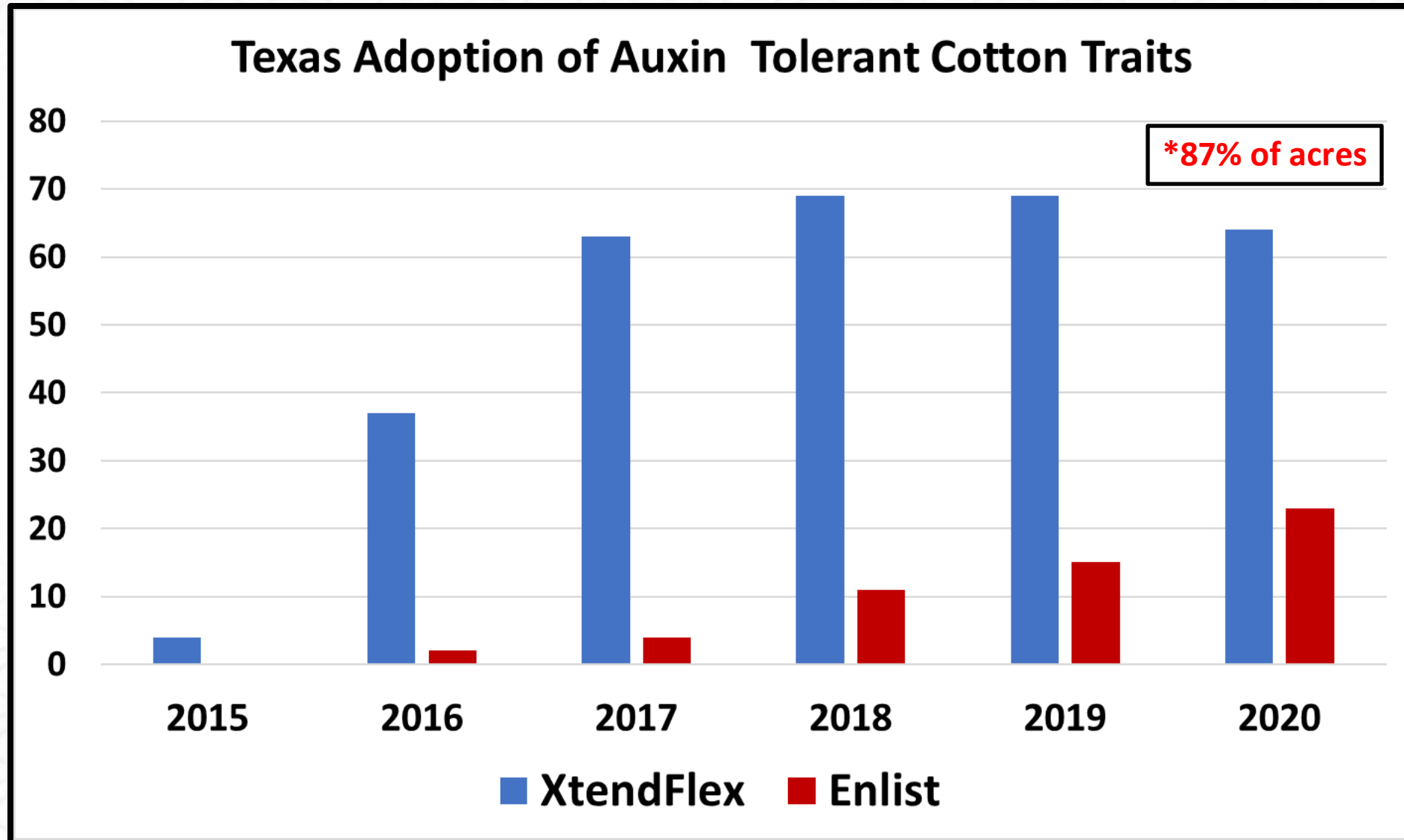
Herbicide Tolerant Traits in Cotton

- Enlist™

- 2,4-D
- Another old chemistry, 1940s
- Group 4, synthetic auxin
- Good control of broadleaf weeds
- Another technology to combat resistance problems
 - Enlist One® - 2,4-D choline
 - Enlist Duo® - 2,4-D choline + glyphosate

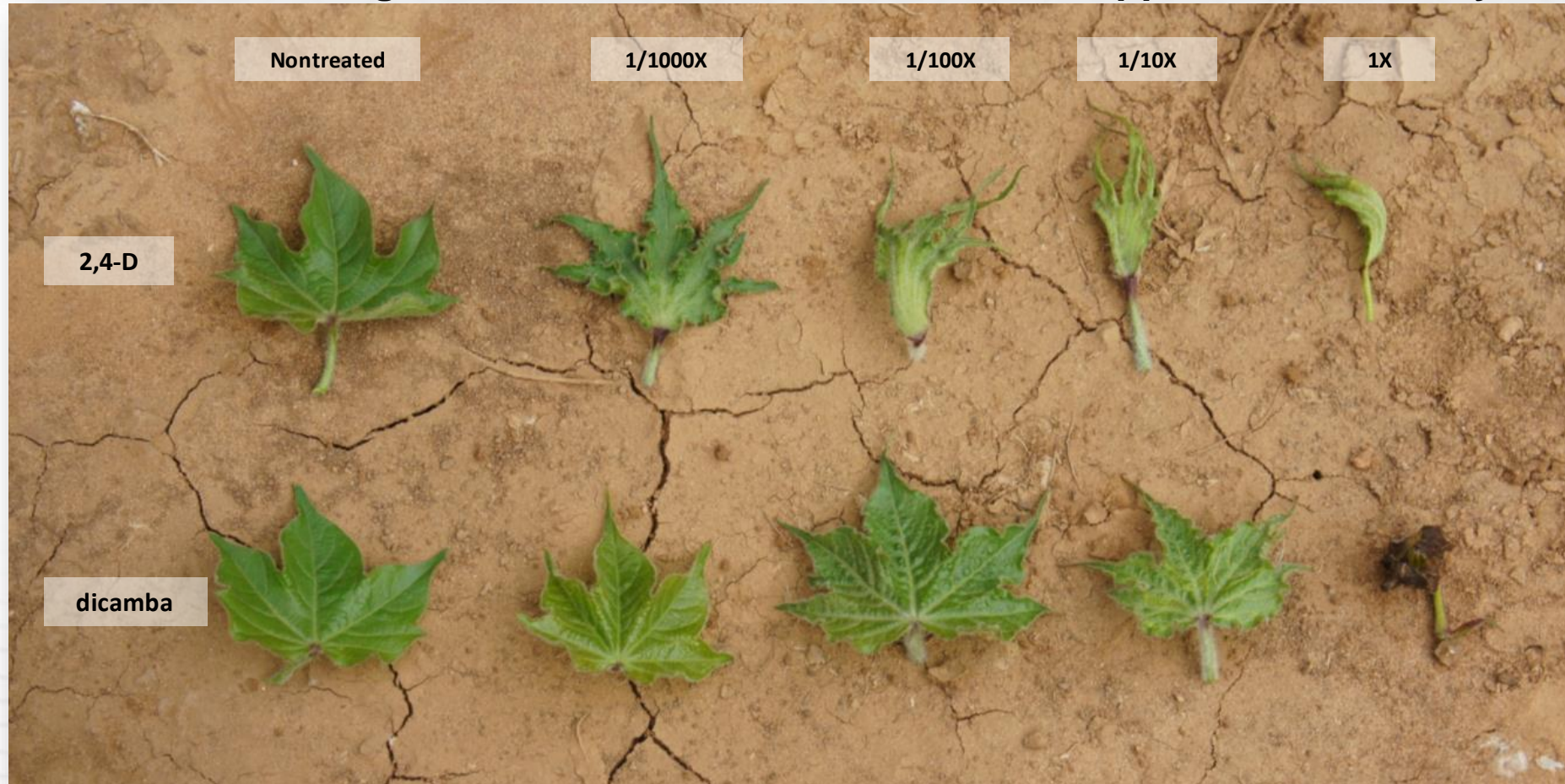


Auxin Tolerant Traits in Texas



Auxin Tolerant Traits in Texas

2014 Texas Agrilife Research Trial – 3 weeks after application - Halfway, TX



**Most recent fully unfurled leaf

Cotton is more sensitive to 2,4-D than Dicamba

Auxin Tolerant Traits in Texas

2,4-D Injury on cotton during the reproductive stage



Auxin Tolerant Traits in Texas

Sprayer cleanout



Chemical Weed Management

Preplant Options- Starting clean is critical

- **Glyphosate**
- **2,4-D and dicamba products**
- **Gramoxone**
- **Valor (30 d, 14-21 d reduced till)**
- **FirstShot**
- **Sharpen**
- **Tillage**

Chemical Weed Management

Preplant Incorporated

- **Nothing new about DNAs**
- **Can reduce 70 to 90% of weed pressure off postemergence herbicide program to follow**
- **Should be a priority, especially if pigweed (careless weed) is the primary target**

Chemical Weed Management

Preemergence

Caparol
 (Prometryn)

Direx (diuron)

Cotoran
 (fluometuron)

Dual
 (metolachlor)

Warrant
 (acetochlor)

Prowl H2O

Reflex*
 (fomesafen)

Brake
 (fluridone)

- Check the label for soil texture restrictions and rates
- * only for course textured soils
- Needs to be “activated”

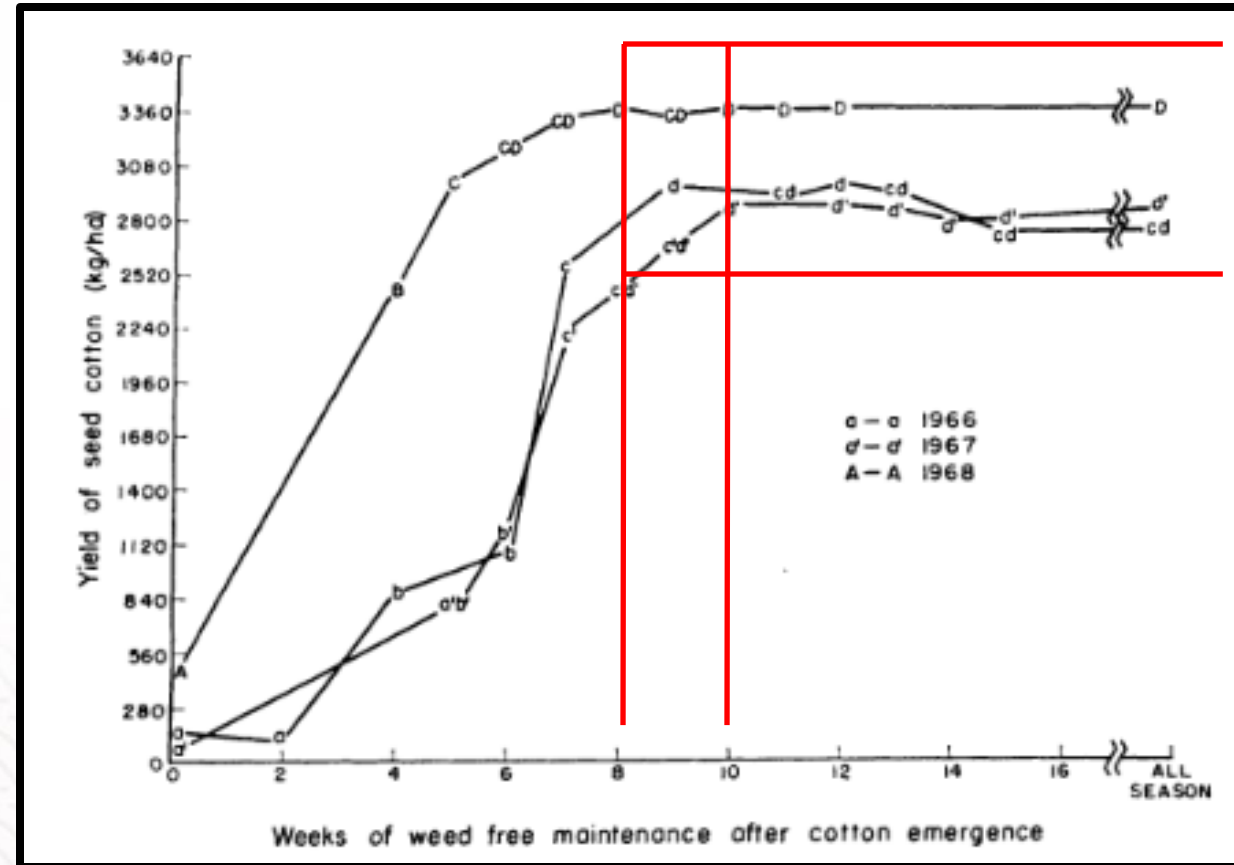
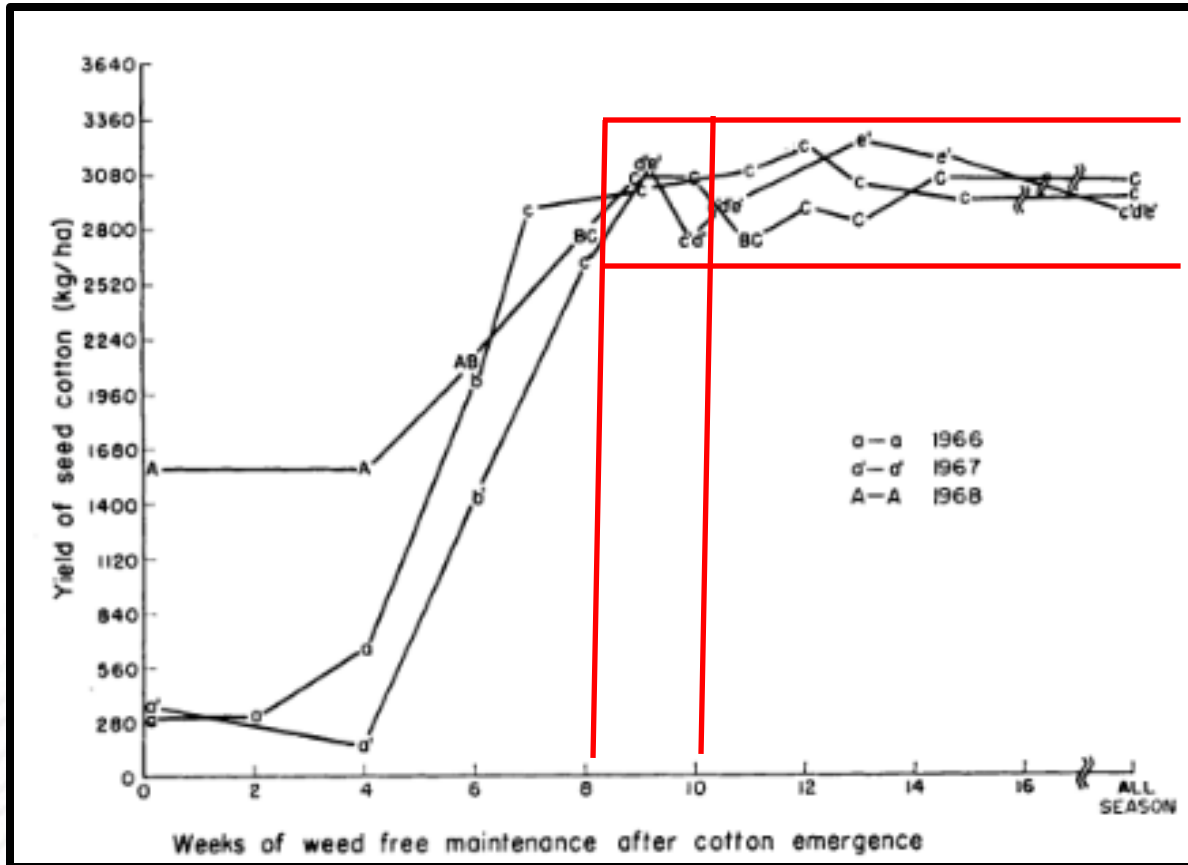
Chemical Weed Management

Preemergence

- **Herbicides selected/used as needed:**
 - **Caparol (sand, loamy sand –DO NOT USE; sandy loam- 1.6 pts; loam, sandy clay- 2.4 pts)**
 - **Direx (sandy loam- 1.6 pts)**
 - **Cotoran (Do not use on sandy, loamy sand, or fine sandy loam soils)**
 - **Dual Magnum (Do not apply on sand or loamy sand soils)**
 - **Warrant (coarse- 1.25 to 1.6 qts)**
 - **Staple (0.6 oz)**
 - **Prowl (coarse- 1 to 2 pts)**

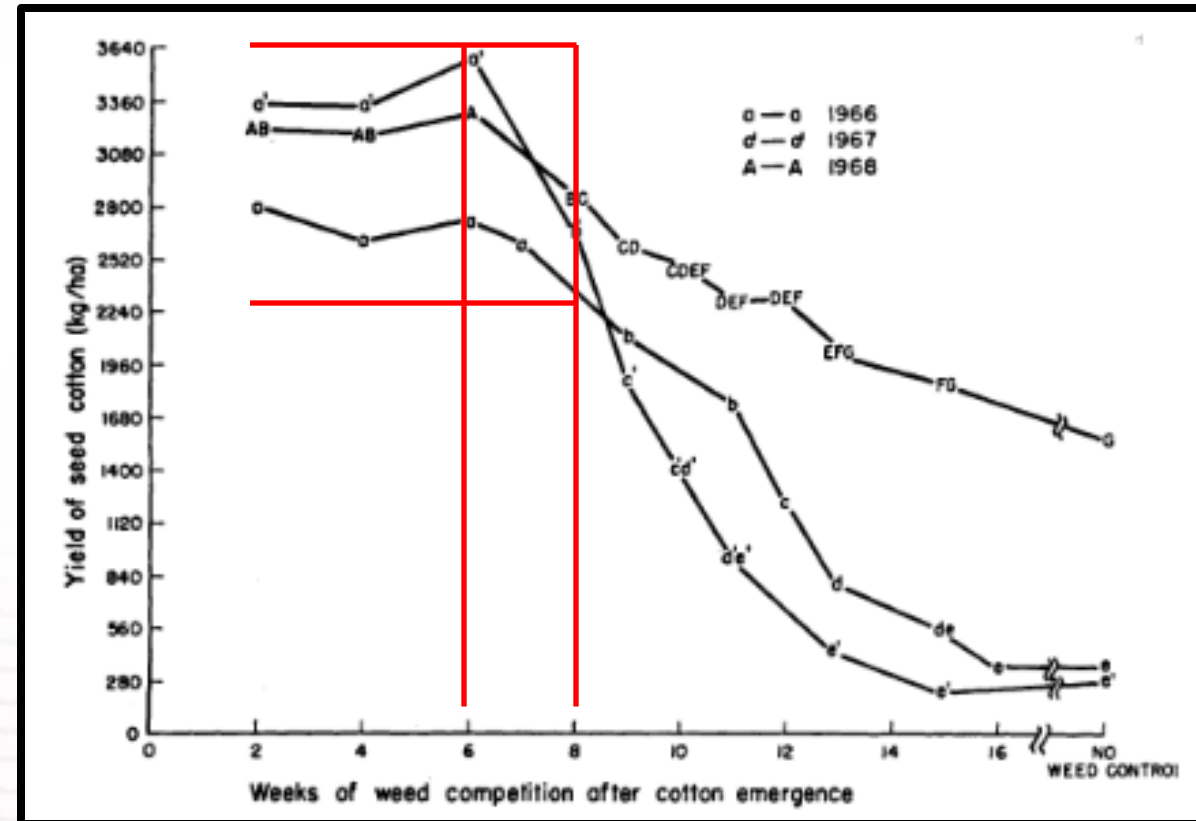
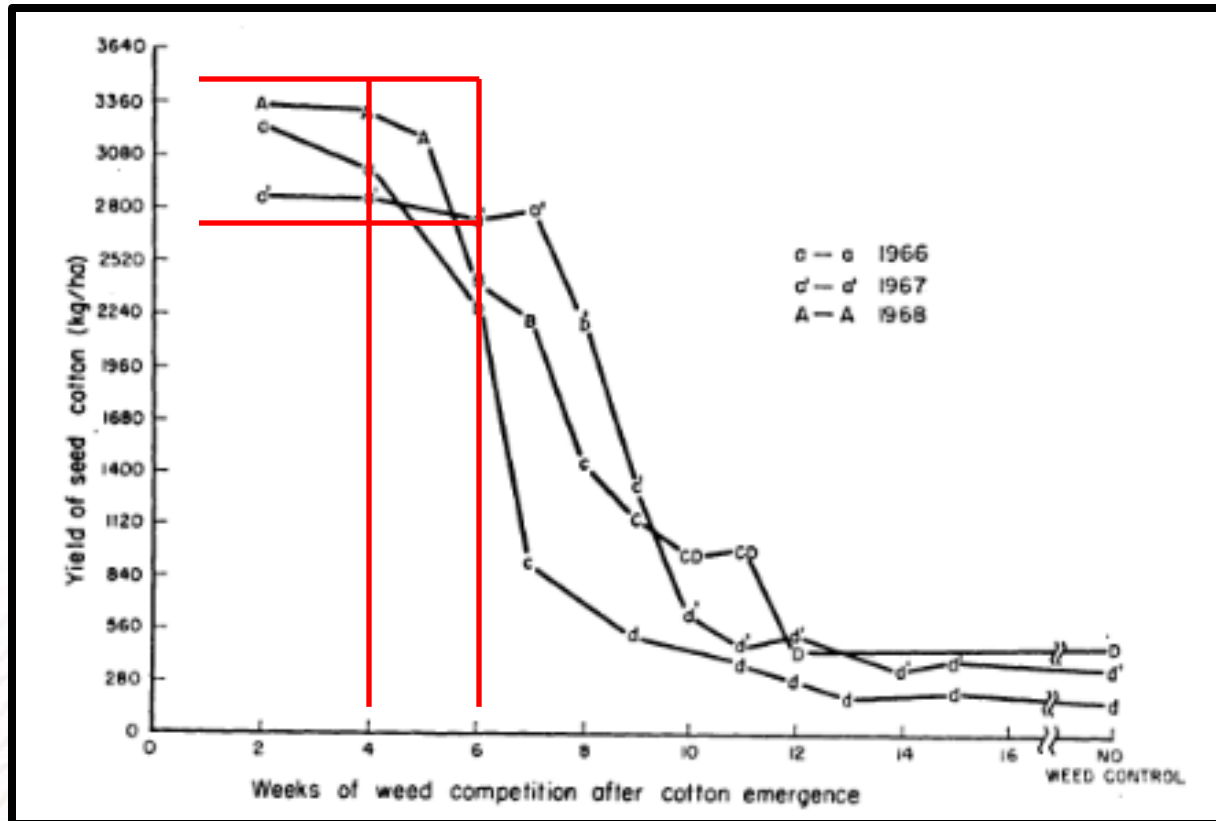
Weed Management in Cotton

How important is early-season weed management?



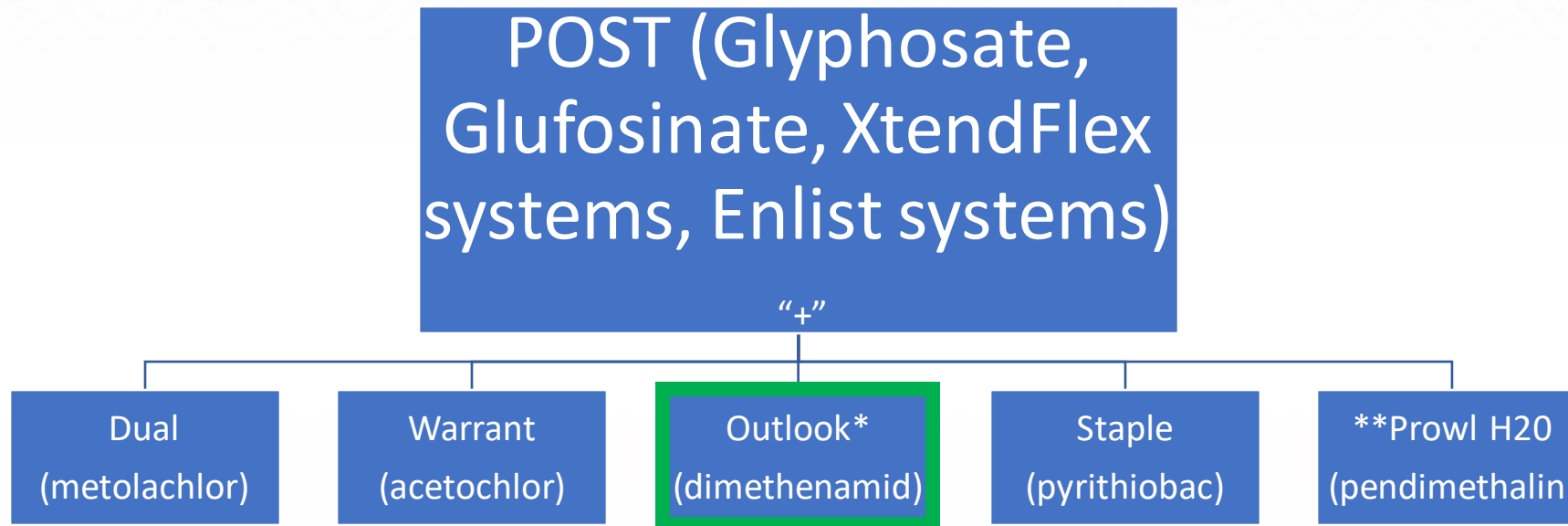
Weed Management in Cotton

How important is early-season weed management?



Chemical Weed Management

Early-Postemergence and/or Mid-Postemergence



- **Treat when weeds are small and actively growing**
- **Residuals need to be “activated”**
- **Know the plant-back restrictions**
- *** 1st true leaf to mid-bloom**
- **** may be used between the 4- and 8-leaf stage**

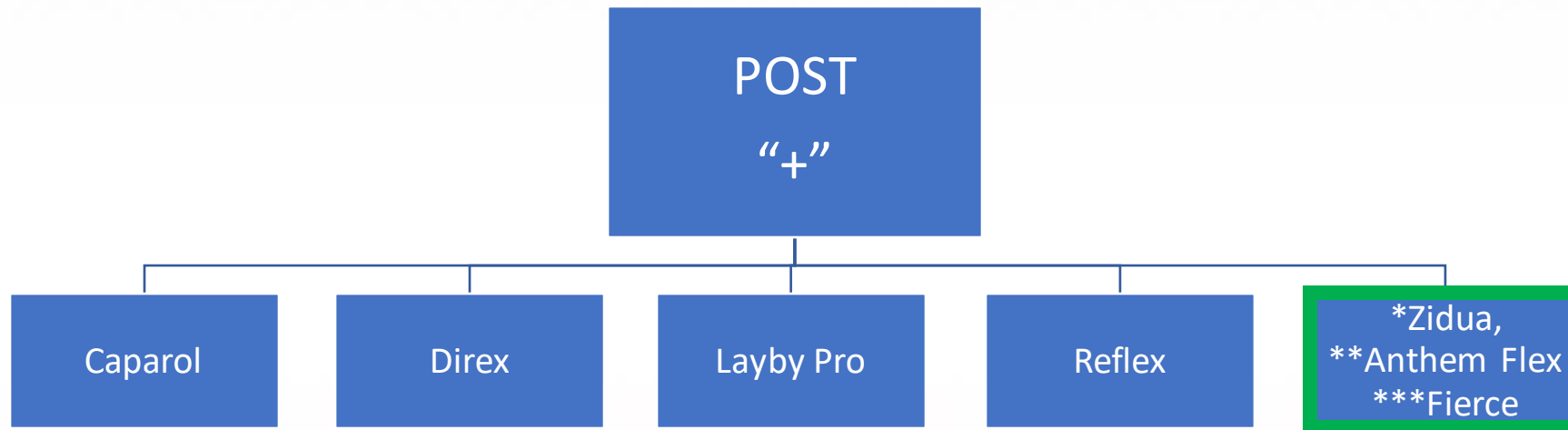
Chemical Weed Management

Early-Postemergence and/or Mid-Postemergence

- **Reminders on glufosinate**
 - **Still a viable means of control pigweeds**
 - **Apply to small actively growing weeds less than 4 inches**
 - **Apply at 15 GPA minimum, good coverage is very important**
 - **Apply between sunrise and 2 hours prior to sunset**
 - **Always read the label**

Chemical Weed Management

Postemergence- Directed/Layby



- **Treat when weeds are small and actively growing**
- **Residuals need to be “activated”**
- *** 5-leaf to beginning bloom**
- **** 6-inches to beginning of bloom**
- ***** 6-inches, layby at 16 inches**

Chemical Weed Management

- Summary

- **Fall and Winter management**
- **Start clean and stay clean**
- **Be aggressive and timely on the front end**
- **Continue to follow up, timeliness important**
- **Optimize each and every application**
- **Rotate herbicide MOA**

Bt Traits in Cotton- How does it work?

- **Bt cotton is genetically modified with genes to produce insect toxins (Cry toxins) from the soil bacterium, *Bacillus thuringiensis***
- **When ingested, the toxins are dissolved in high pH gut of lepidopteran larvae**
- **The dissolved Cry toxin molecules bond to proteins on cells in the midgut, eventually forming a pore**
- **The insect stops feeding and eventually dies**

Bt Traits in Cotton

- 1st and 2nd generation Bt technologies consisted of Cry toxins
- In 2017, 3rd generation Vip Bt technologies were commercialized
- Vip = Vegetative insecticidal proteins

Bt Technologies	Proteins expressed
<i>Second generation</i>	
Bollgard [®] II	Cry1Ac + Cry2Ab
WideStrike [®]	Cry1Ac + Cry1F
TwinLink [®]	Cry1Ab + Cry2Ae
<i>Third generation</i>	
WideStrike [®] 3	Cry1F + Cry1Ac + Vip3A
Bollgard [®] 3	Cry1Ac + Cry2Ab + Vip3A
TwinLink [®] Plus	Cry1Ab + Cry2Ae + Vip3Aa19

New and Emerging Bt Cotton Technologies

- **Thryvon technology**
- **Provides protection against tobacco thrips, Western flower thrips, tarnished plant bug, and Western tarnished plant bug**
- **Reduce, if not alleviate, the need for early-season chemical applications for thrips control**



Adult western flower thrips (top) and larva (bottom).



Young cotton plant damaged by thrips feeding.



Young leaves damaged by thrips become curled and distorted and the underside will develop a silvery appearance. Note thrips via arrows.

Source- cottonbugs.tamu.edu

Ben McKnight
Extension Cotton Specialist

2474 TAMU

College Station, TX 77843-2474

Office: (979) 845-0870

Cell: (225) 454-0435

bmcknight@tamu.edu



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