Weed Management in Conventional and Conservation Tillage

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Weed Science and Cropping Systems
Lubbock, Texas

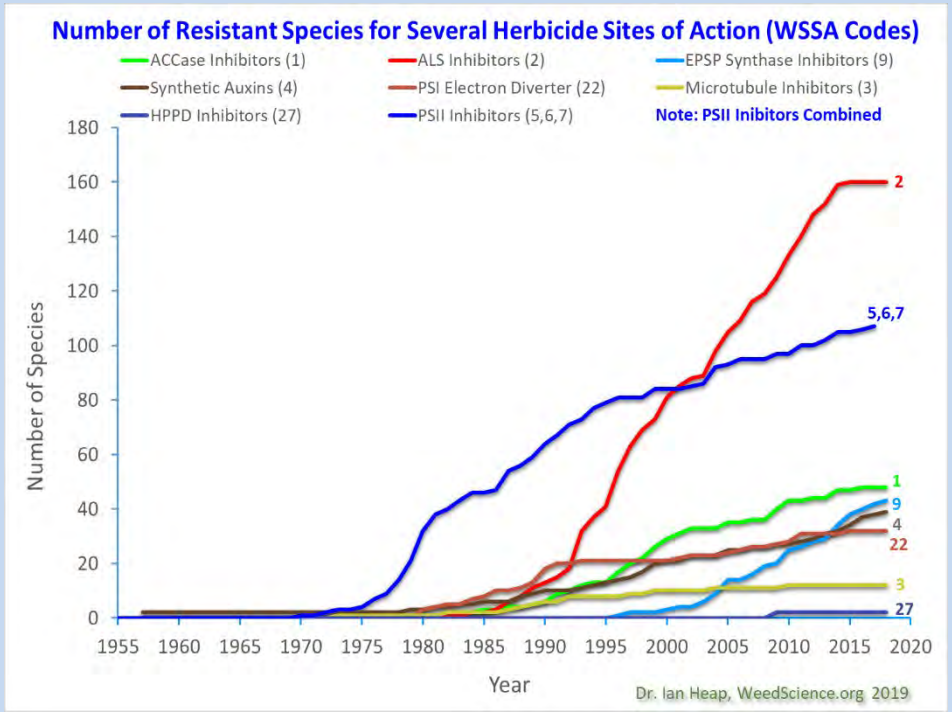
TEXAS A&M AGRILIFE RESEARCH

Overview

- Weed resistance – more than Palmer amaranth/glyphosate
- Palmer amaranth – past and present
- Strategies for managing resistant Palmer amaranth
  - Residual herbicides – PPI, PRE and POST options
  - POST options – Liberty®, Staple®
- Volunteer cotton control
- Roundup Ready Xtend™ Crop System- Xtendimax, Engenia
- Enlist™ Weed Control System
- Rotational crops – herbicides

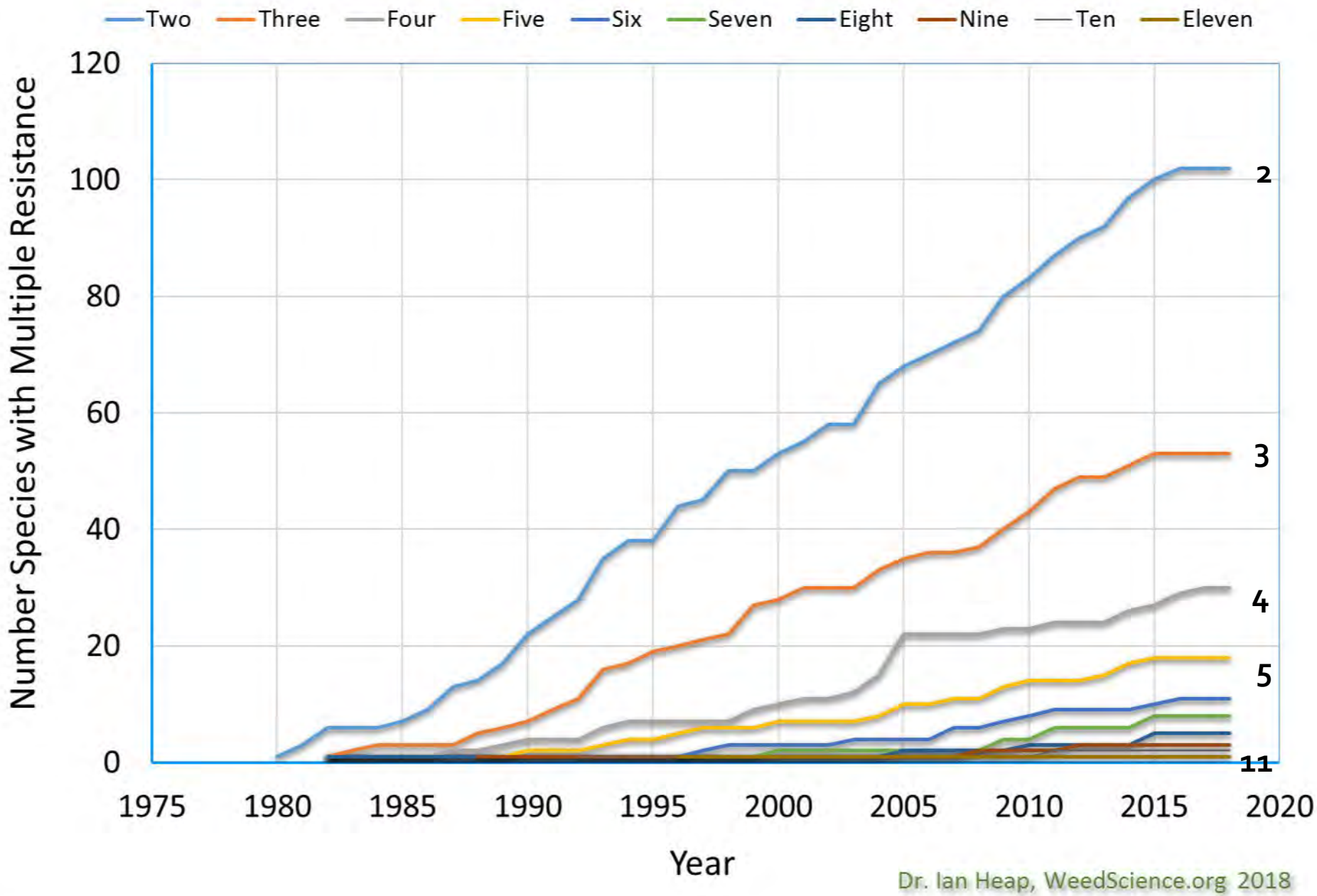
Status of Weed Resistance (02/04/20)

- 512 unique cases (species by site of action) (up 15)
- 262 species (152 dicots and 110 monocots)
- 23 of the 26 known herbicide sites of action
- 167 different herbicides
- 93 crops in 70 countries
  - 48 weeds HRAC Group G
    - P amaranth* NE, IL, TN
  - 41 weeds HRAC Group O
    - Waterhemp* (NE, IL) to 2,4-D
    - Kochia* (CO, KA, NE) to dicamba
  - 13 weeds HRAC Group E
    - Waterhemp, P. amaranth
  - 2 weeds HRAC Group F2
    - Waterhemp, P. amaranth



International Survey of HRW
www.weedscience.org

Weed Species with Resistance to More than One Site of Action

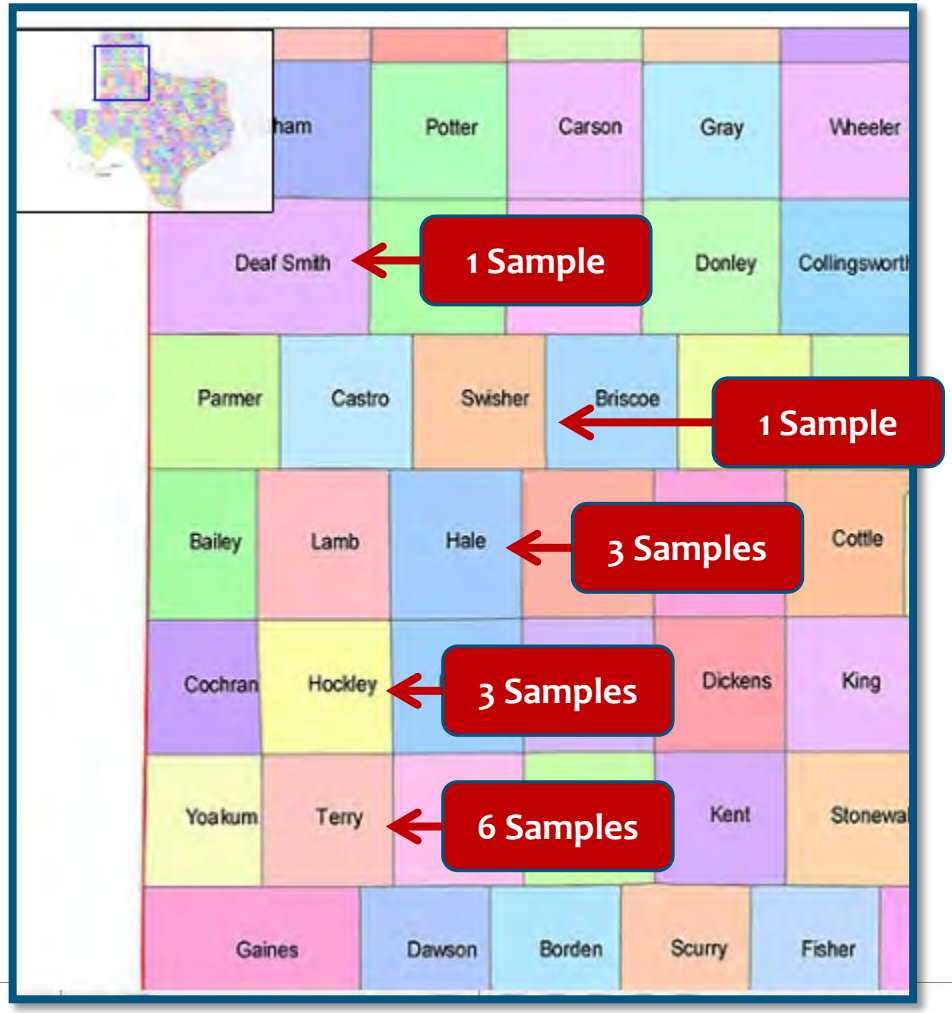


Cotton Herbicides-Palmer amaranth control

- Trifluralin
- Prowl
- Caparol
- Direx
- Cotoran
- Reflex
- Staple
- Dual Magnum

Warrant
Outlook
Glyphosate
Liberty
dicamba
2,4-D (Enlist)
Paraquat
Valor

Greenhouse Results Glyphosate-Resistant Palmer amaranth - 2011



- Greenhouse study
  - Samples collected from field brought to greenhouse
  - Varying rates of glyphosate were applied
  - **8:12 samples exhibited some level of glyphosate resistance**

Southwest Lubbock County - 2013

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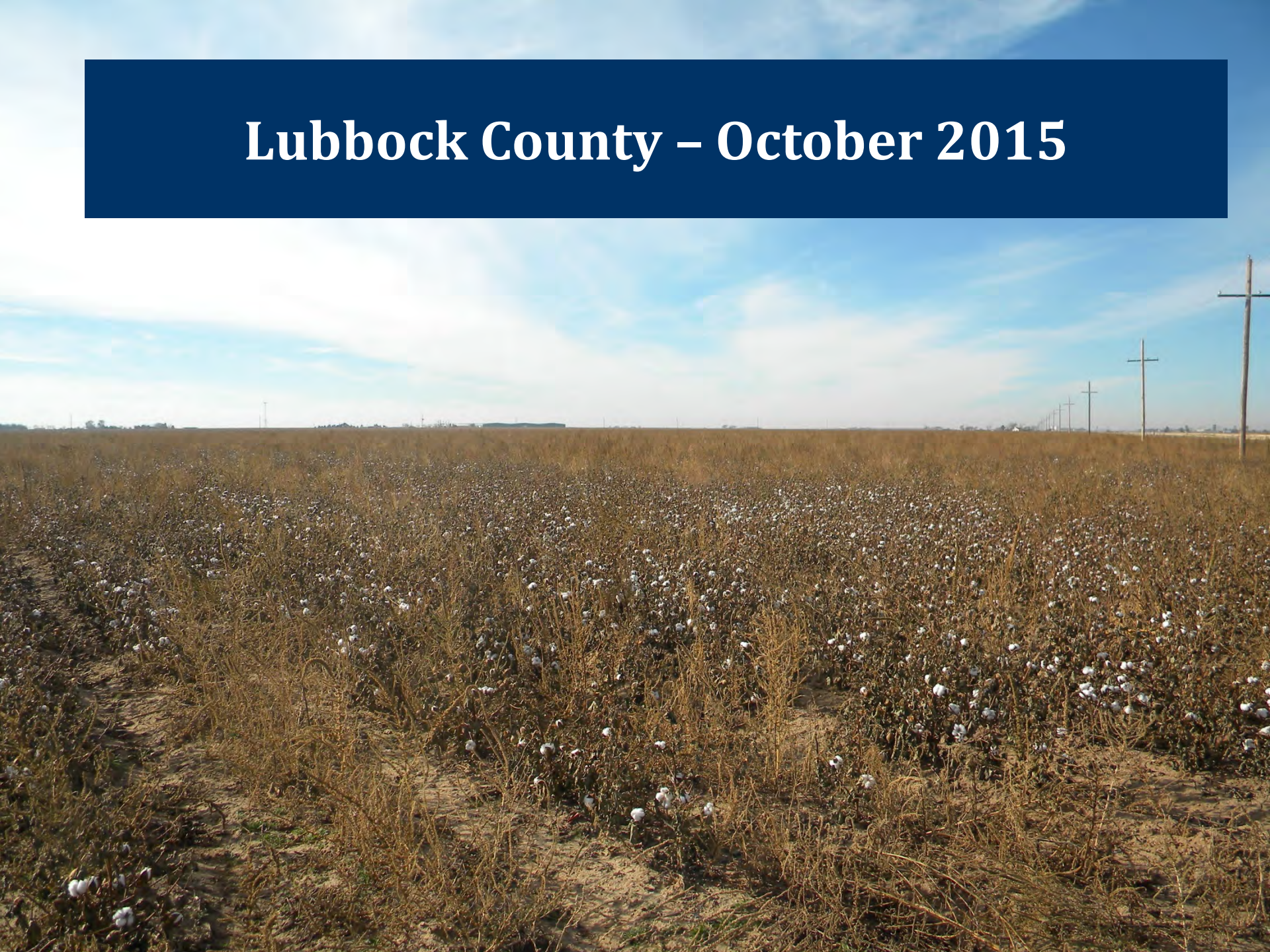
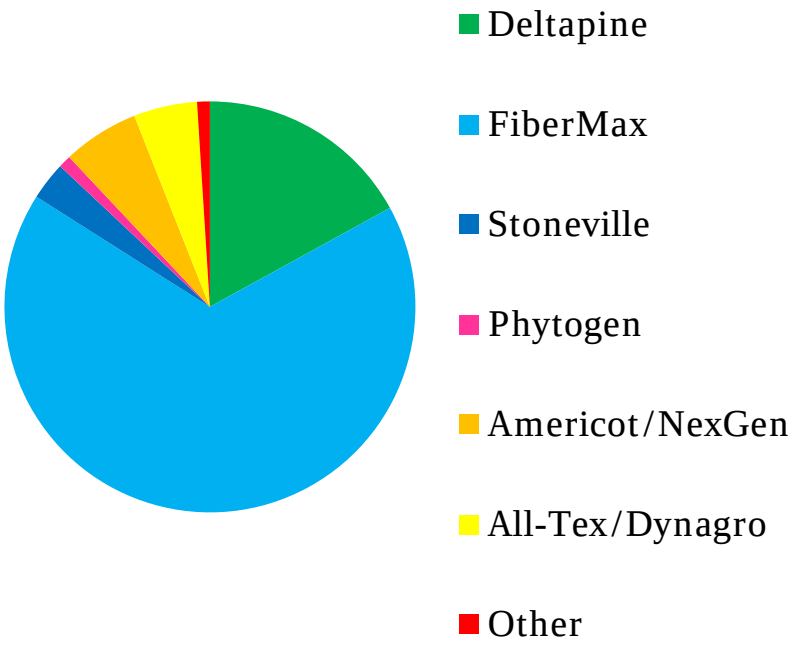
Lubbock County – October 2015

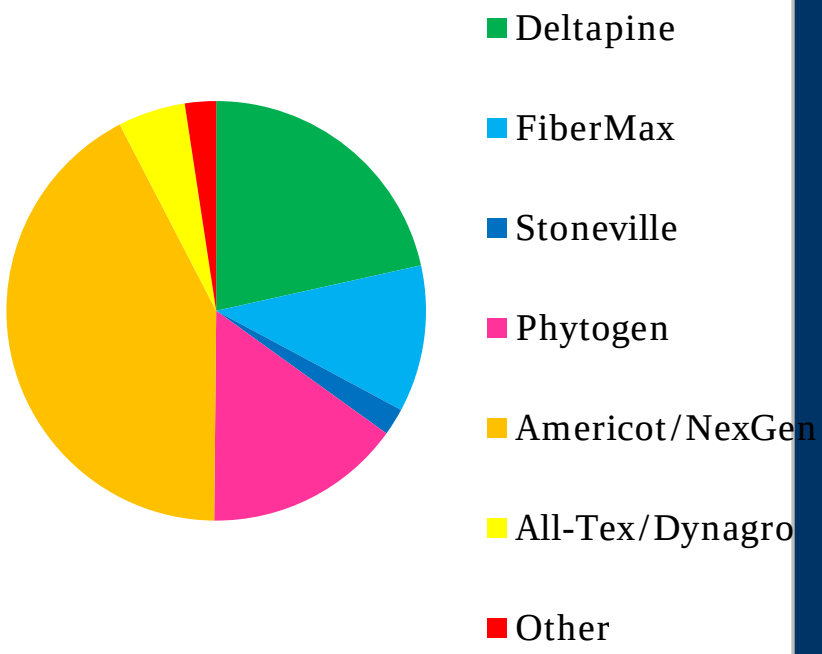


Southwest Cotton Seed Variety Market Share

SW Market Share by Variety Brand, 2008



SW Market Share by Variety Brand, 2018



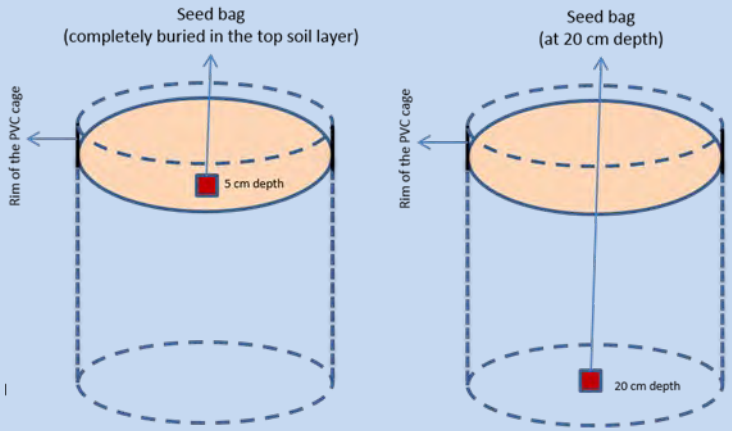
USDA Agricultural Marketing Service

Palmer amaranth

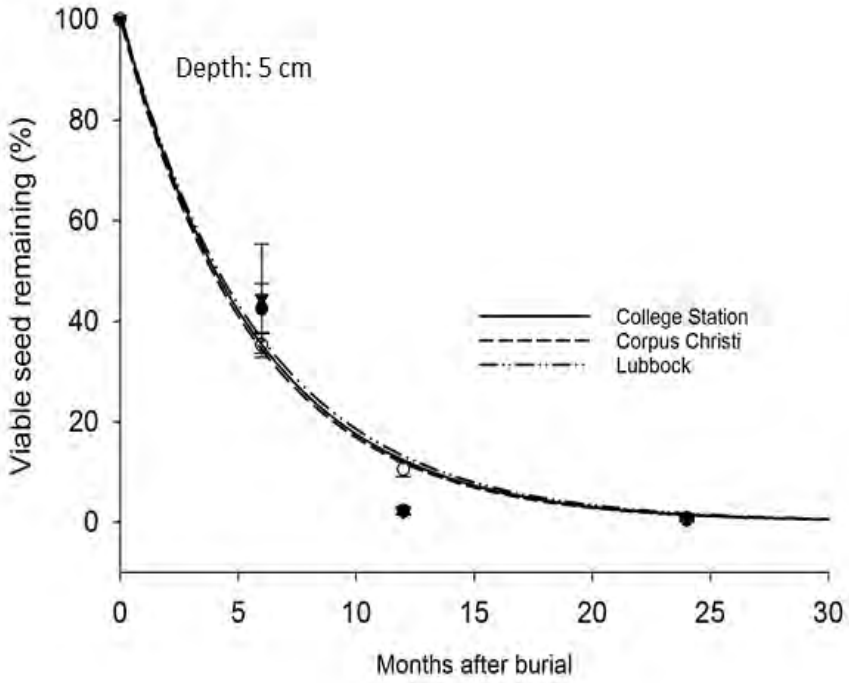
- Infests all cultivated cropland
- Emerges from May—September
- Prolific seed producer
- Can be controlled by wide range of PRE and POST herbicides in addition to glyphosate
- Seed viability in the soil

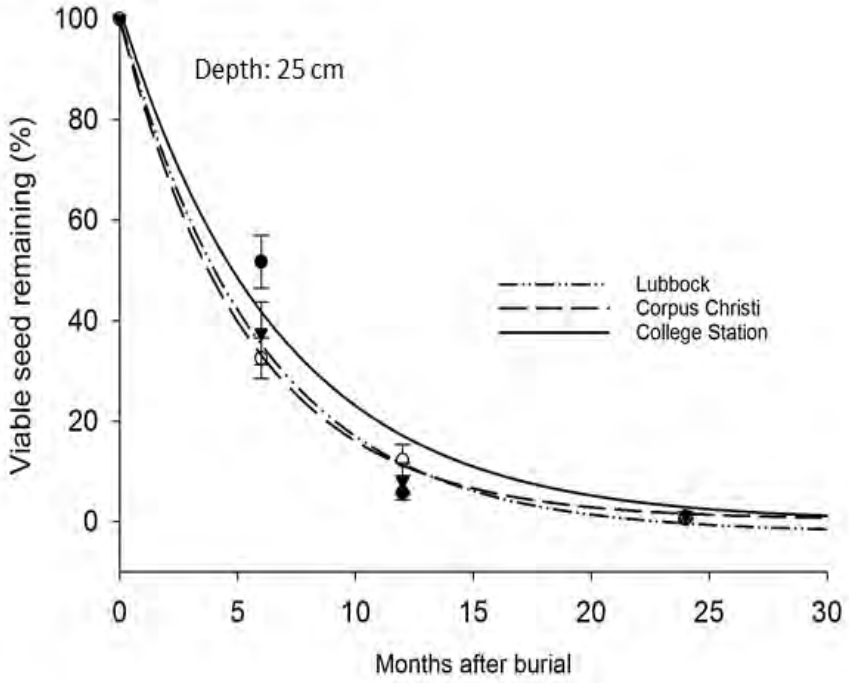
Seedbank longevity of Palmer amaranth and Common Waterhemp

- 3 locations: Lubbock, College Station, Corpus Christi
- 5-year study
- 200 seed were placed in nylon micromesh bags
- Buried: Mar 31, 2016
- 2 depths: 2- and 8-inches
- 2 weeds: PA, WH
- Retrieval times (months):
  - 06 (Sep 30, 2016)*
  - 12 (Mar 31, 2017)*
  - 24 (Mar 31, 2018)*
  - 36 (Mar 31, 2019)*
  - 48 (Mar 31, 2020)
  - 60 (Mar 31, 2021)



Palmer amaranth seedbank longevity (% of original viable seeds) when buried at 5 or 25 cm deep, 2 years after burial





Herbicide Application

Application Method	Acres Treated (%)
PPI	91
PRE	20
POST	1
Spot Treatment	40
Layby	1
Cultivation (3.1x)	98

Source: Smith, et al., 1996

Roundup Ready® Flex or GlyTol® Cotton

- Weed Challenges
  - Russian thistle
  - Morningglory
  - Horseweed

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Residual Kochia Trial

Texas A&M Agrilife – Lubbock, TX

Kochia Control on April 28, 2019 (~7 WAT)

Untreated

12.8 fl oz/A Engenia® herbicide + 2 oz/A Valor® SX herbicide Applied March 8th

32 fl oz/A 2,4-D + 2 oz/A Valor SX Applied March 8th

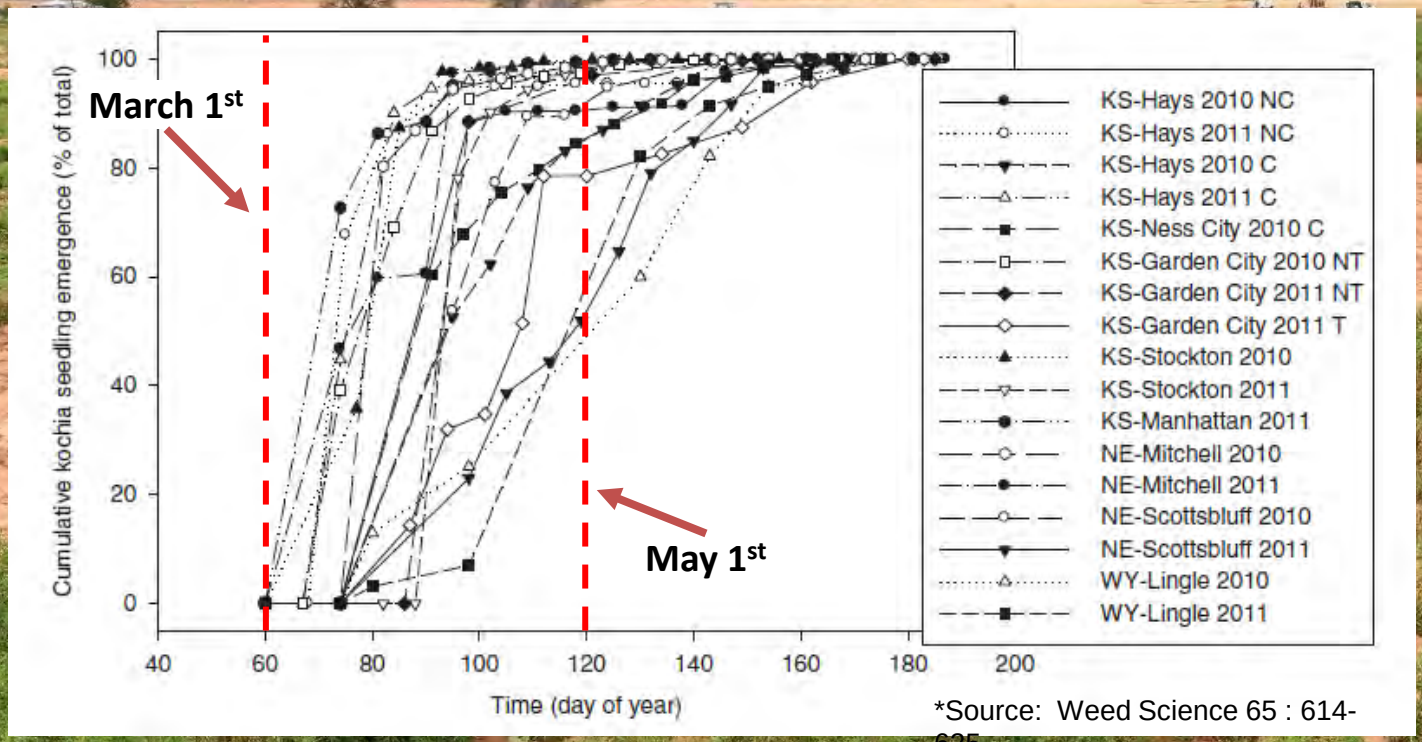
2019 – Dr. Wayne Keeling – Lubbock, TX

Applications made prior to kochia emergence

Engenia is a US EPA Restricted Use Pesticide. Additional state restrictions may apply.
Always read and follow label directions.

BASF
We create chemistry

Kochia Control on May 30, 2019 (~11 WAT)



*Source: Weed Science 65 : 614-625

BASF
We create chemistry

Volunteer cotton-a weed in no-till

Paraquat applied through hooded sprayer

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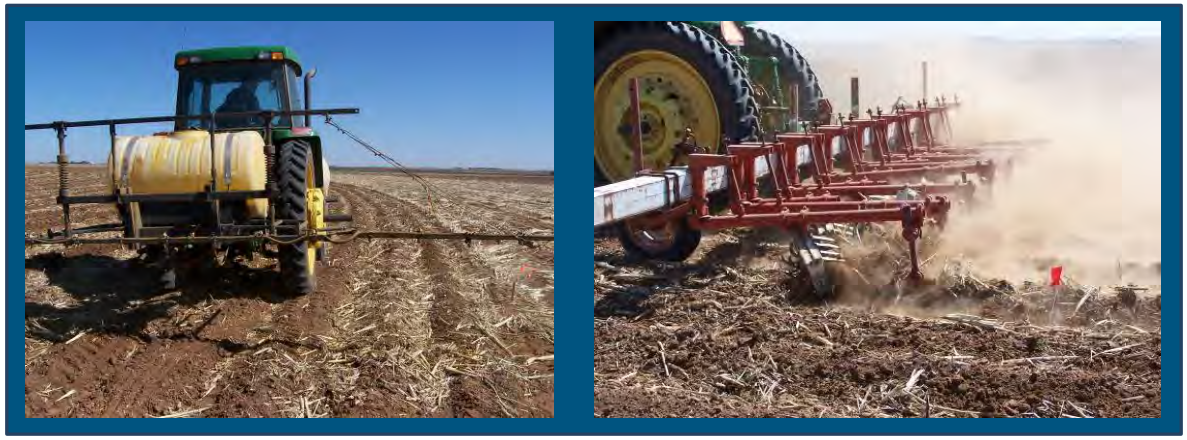
Residual Herbicides

- Pre-plant Incorporated (PPI)
- Dinitroanilines (DNA): Trifluralin (generics), Prowl
  - Incorporation: tillage, irrigation
  - Control small-seeded broadleaf weeds, annual grasses
  - Rate related to soil type



Dinitroanilines – “Yellows”

- Low water solubility – no leaching
- Volatility: Trifluralin – most volatile; Prowl – less volatile
- Photodecomposition
- 2-pass mechanical incorporation – disk, spring-tooth harrow, field cultivator, rolling cultivator
- Incorporation by irrigation or rainfall – Prowl
- Soil activity: clay content, organic matter

- Valor® – Cotton – EPP
- 1.5 – 2.0 oz/A
- 21d interval prior to planting
  - 1” irrigation
- Tank-mix with 2,4-D or glyphosate
- Residual Control—Kochia, Russian-thistle, Palmer amaranth

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Residual Herbicides

- PreEmergence (PRE)
- Caparol, Direx, Cotoran, Dual Magnum, Warrant, Staple LX, Reflex
- Palmer amaranth/broadleaf annuals – broader spectrum than DNAs
- Dual Magnum – grasses, yellow nutsedge
- Staple LX/Reflex – potential soil residual/rotation problems to sorghum or corn

Residual Herbicides

- PostEmergence Topical (POST)
- Dual Magnum, Outlook, Warrant, Staple LX, Prowl H20
- Tank mix with Roundup, dicamba, Enlist, or Liberty.
- Residual Palmer amaranth control
- Staple LX – improved POST and residual morningglory control

Residual Herbicides

- PostEmergence Direct/Layby
- Caparol, Direx, Cotoran, Layby Pro
  - Alone or with glyphosate
  - Residual Palmer amaranth and morningglory control
  - POST morningglory control
- Zidua, Anthem Flex (not-labeled on sandy soils)

2020 Weed Control Programs for Texas High Plains Cotton Growers

2/19/2020

Delaney C. Foster, Peter A. Dotray, and J. Wayne Keeling
Texas A&M AgriLife Research and Extension Service – Lubbock, TX

This publication serves as a guide to commonly used cotton herbicide options in the Texas Southern High Plains. Always carefully read and follow herbicide labels for rates and soil and plant back restrictions. Other generic brand names may exist that are not listed in these tables as well as other herbicides registered for use in cotton.

Preplant Incorporated (Conventional Tillage)/ Burndown (Conservation Tillage)

Tillage	Herbicide	Rate
Conventional	Treflan[1], generic trifluralin	1-2 pints/acre[2]
	Prowl H_2O[1], generic pendimethalin	1-3 pints/acre[2]
Conservation/No-till	Prowl H_2O[1], generic pendimethalin	2-4 pints/acre[2]
	Dicamba/2,4-D	See product label for rates and planting restrictions
	Roundup, generic glyphosate	32-44 fl oz/acre
	Valor, generic flumioxazin	2 oz/acre >21 days before planting + at least 1-inch irrigation
	Gramoxone, generic paraquat (2 and 3 lb formulations)	1-2 pints/acre (2 lb/gallon) 1.7-2.7 pints/acre (3 lb/gallon)

Preemergence Herbicide Options[3]

Herbicide	Rate
Prowl H_2O[1], generic pendimethalin	1-3 pints/acre[2]
Caparol, generic prometryn	1.6-3.2 pints/acre[2] DO NOT USE on sand or loamy sand soils
Direx, generic diuron	0.8-1.2 quarts/acre[2] DO NOT USE on sand or loamy sand soils
Cotoran, generic fluometuron	2 pints/acre DO NOT USE on coarse soils
Warrant	3 pints/acre
Reflex[4], generic fomesafen	1 pint/acre DO NOT USE on coarse soils
Staple LX, generic pyrithiobac	2 fl oz/acre DO NOT USE on coarse soils
Brake	16 fl oz/acre DO NOT USE on coarse soils

[1] For optimal weed control, a two-pass incorporation system should be utilized with the dinitroaniline herbicides.
[2] Rate dependent on soil type. Always consult the label prior to herbicide application.
[3] Preemergence herbicides will be most effective when activated by irrigation or rainfall events.
[4] Reflex may be applied at 1 pt/acre immediately after planting of cotton provided that 0.5 inch of irrigation is applied prior to cotton cracking the soil surface. Do not apply more than 1 pt/acre of Reflex in any year.

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2020 Weed Control Programs for Texas High Plains Cotton Growers

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Sequential postemergence applications are often needed. A two-pass system is typical for most farms; including a residual herbicide in either the first or second pass as well as tank mixing different modes of action better steward new technologies and combat herbicide resistance. Two broadcast applications followed by a residual herbicide at layby will finish the season clean and prevent late emerging weeds from producing seed.

Postemergence Herbicide Options

	Xtendflex	GlyTol/ LibertyLink	Enlist	Roundup Ready	Conventional
Post Herbicides	Xtendimax[3] or FeXapan[3] 22 fl oz/acre	Liberty 43 fl oz/A[1]	Enlist One[3] 1.5-2 pints/acre	Roundup 32-44 fl oz/acre	Staple LX 2 fl oz/acre
	Engenia[3] 12.8 fl oz/acre	Roundup 32-44 fl oz/acre	Enlist Duo[3] 3.5-4.75 pints/acre		
	Liberty 43 fl oz/acre[1]		Liberty 43 fl oz/acre[1]		
	Roundup 32-44 fl oz/acre		Roundup 32-44 fl oz/acre		
	Tavium[3] 56.5 fl oz/acre				

Plus...

Post-Topical Residual Herbicides	Dual Magnum, generic *S*-metolachlor	1-1.33 pints/acre
	Outlook	14-16 fl oz/acre Apply between 1st leaf and mid-bloom stage
	Warrant	3 pints/acre
	Staple LX, generic pyrithiobac	2 fl oz/acre Apply between 4- and 8- leaf stage
	Prowl H_2O, generic pendimethalin	1-2 pints/acre Apply between 4- and 8- leaf stage

Layby/Post-Directed Residuals

Herbicide	Rate
Direx, generic diuron	0.8-1.2 quarts/acre[2]
Caparol, generic prometryn	1.6-3.2 pints/acre[2]
Roundup, generic glyphosate	32-44 fl oz/acre
Valor, generic flumioxazin	2 oz/acre
Zidua, generic pyroxasulfone	0.75-2.1 fl oz/acre[2] Apply between 5 leaf and early bloom stage

[1] Total Liberty rate per year should not exceed 72 fl oz/acre, maximum rate per application is 43 fl oz/acre.
[2] Rate dependent on soil type. Always consult the label prior to herbicide application.
[3] Check product websites or labels for approved tank mix partners.

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TEXAS A&M AGRILIFE RESEARCH

- **Conventional Tillage**

Trifluralin ⇨ PRE ⇨ Roundup + POST? + D,O, or W ⇨ Roundup + POST?

- **Conservation/no-till**

Valor + dicamba/2,4-D + Roundup? ⇨ paraquat + PRE ⇨ Roundup + POST? + D,O, or W ⇨ Roundup + POST?

ROUNDUP READY PLUS™
WEED MANAGEMENT SOLUTIONS

ROUNDUP READY® XTEND CROP SYSTEM

Enlist™ Weed Control System

Technical Attributes

- Provides tolerance to 2,4-D
  - Removes planting intervals in burndown applications
  - Widens/enables post emergence application window
- Will be stacked with glyphosate-tolerant traits

Enlist Cotton

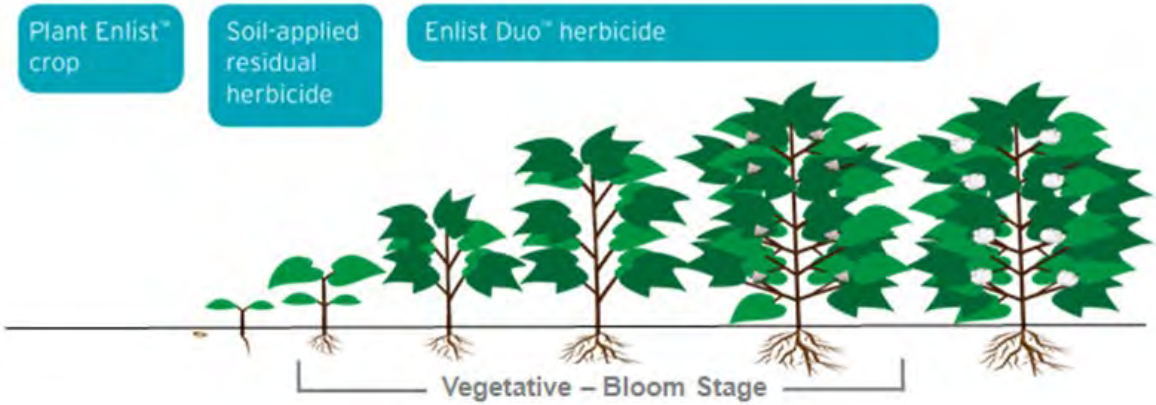
Tolerance to: 2,4-D and glufosinate

Stacked with: Roundup Ready® Flex
3rd generation *Bt*.
Potential for others

Cotton without the Enlist™ trait treated with Enlist herbicide solution *

Enlist cotton treated with Enlist herbicide solution *

*4.7 pts./A and N-Pak AMS at 2.5% v/v



Roundup

Roundup + dicamba

Roundup

Roundup + dicamba

Crop Response

Engenia (12.8 fl oz/A) + Roundup (28 fl oz/A)

Roundup

Symptomology

- Dicamba

2,4-D

Rotating Cotton Following Sorghum

West Texas – 2021

Wayne Keeling, Peter Dotray
Texas A&M AgriLife Research and Extension, Lubbock

Plant Back Intervals Following Herbicides Applied in Sorghum

Waiting Period	Herbicide Trade Names	Comments
Unknown	Huskie	Do an in-field bioassay. Plant strips and monitor crop response the season following Huskie application. Cool, dry soil conditions will slow degradation.
24 months	Lumax EZ	May only plant corn or sorghum the following season.
24 months	Lexar EZ	May only plant corn or sorghum the following season.
18 months	Peak	
Next Season	Atrazine, AAtrex	MUST follow Texas 24C label on rates and soil type.
Next Season (See Comments)	Bicep II Magnum, Cinch ATZ, Degree Xtra	These premixes containing atrazine should follow the crop rotation guidelines based on the rates and restrictions placed on atrazine used alone.
Next Season	Outlook, Commit, Sortie, Verdict	Verdict contains the active ingredients in Outlook and Sharpen.
10 months	Facet, Paramount	
4 months	Permit, Yukon	Yukon is a mix of Permit and dicamba.
1.5 - 3 months	Sharpen	Plant back interval depends on the rate used in sorghum.
9 months	ImiFlex	For use in igrowth® sorghum only.
10 months	Zest	For use in Inzen™ sorghum only.
None	Dual, Dual Magnum, Medal, Brawl, Cinch, Moccasin, Charger	
None	Warrant, Arrest	

Cotton may be planted the following season depending on rate and timing

Replant restrictions are greater than one year, cotton may not be planted following season

Texas A&M AgriLife Research

Rotating Sorghum Following Cotton

West Texas – 2021

Wayne Keeling, Peter Dotray
Texas A&M AgriLife Research and Extension, Lubbock

Plant Back Intervals Following Herbicides Applied in Cotton

Waiting Period	Herbicide Trade Names	Comments
>36 months	Reflex, Flexstar, Sinister	Successful field bioassay before planting.
>22 months	Envoke	After 22 months, conduct field bioassay.
>14 - 22 months	Brake	Interval depends on rate applied.
>12 months	Staple LX	Do not rotate to grain sorghum in the season following application.
12 months	Trifluralin, Treflan, Trust	
Next season	Caparol, prometryn	
10 months	Prowl EC, Prowl H20, Acumen, Stealth, Satellite, Pendimethalin	
9 months	Cotoran, Fluometuron	
6 - 12 months	Zidua, Zidua SC	Interval depends on rate applied.
6 - 12 months	Anthem Flex	Interval depends on rate applied.
4 months	Direx, Diuron, Karmex	May be planted the following spring after application.
30-120 days	Valor, Panther, Chateau, Outflank, Tuscany, Warfox	At least one inch of rain or irrigation between application and planting.
None	Dual, Dual Magnum, Medal, Brawl, Cinch, Moccasin, Charger	
None	Outlook	
None	Warrant, Arrest	

Sorghum may be planted the following season depending on rate and timing

Replant restrictions are greater than one year, sorghum may not be planted following season

Disclaimer

This document highlights information found on 2021 herbicide labels but **DOES NOT** substitute for the need to fully read and follow all label guidelines and restrictions. Consult the herbicide manufacturer or authors for additional information. Other generic brand names may exist that are not listed in these tables.

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General Cotton Production

For more than 100 years, the Lubbock Center and its satellite research stations have been addressing key issues for Southern High Plains producers. We develop and deliver information and technology that help production agriculture remain viable and profitable, while preserving environmental resources and improving the quality of life in our region.

Lubbock Historical Precipitation (PDF)

AGRILIFE TODAY

New web tool will facilitate military, wind energy industry collaboration
JAN 13

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JAN 13

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New web tool will facilitate military, wind energy industry collaboration
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