

# LAYERED RESIDUAL HERBICIDES

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**K-STATE**  
Research and Extension

## Dicamba update - traits

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- XtendFlex
  - Resistant to
    - Dicamba
    - Glyphosate
    - Glufosinate



# Volatility reduction agents/ pH buffers 1/27/21

<http://www.xtendimaxapplicationrequirements.com/#vralist>

<p><b>VRA</b></p> <p><b>AQUADRAFT™ VRA, a VaporGrip® Xtra Agent</b>                      Manufacturer/Distributor: Meristem Crop Performance Group, LLC                      Application Rate: 20 oz/A</p>	<p><b>VRA</b></p> <p><b>Cornbelt® Vapor-Shield™, a VaporGrip® Xtra Agent</b>                      Manufacturer/Distributor: Van Diest                      Application Rate: 20 oz/A</p>	<p><b>VRA</b></p> <p><b>FS Dissension™, a VaporGrip® Xtra Agent</b>                      Manufacturer/Distributor: GROWMARK, Inc                      Application Rate: 20 oz/A</p>
<p><b>VRA</b></p> <p><b>LEVY™, a VaporGrip® Xtra Agent</b>                      Manufacturer/Distributor: Rosen's Inc                      Application Rate: 20 oz/A</p>	<p><b>VRA</b></p> <p><b>Placeholder™, a VaporGrip® Xtra Agent</b>                      Manufacturer/Distributor: Exacto                      Application Rate: 20 oz/A</p>	<p><b>VRA</b></p> <p><b>SETTLE™, a VaporGrip® Xtra Agent</b>                      Manufacturer/Distributor: EGE Products                      Application Rate: 20 oz/A</p>
<p><b>VRA</b></p> <p><b>Suralta™, a VaporGrip® Xtra Agent</b>                      Manufacturer/Distributor: CHS Inc.                      Application Rate: 20 oz/A</p>	<p><b>VRA</b></p> <p><b>TIE DOWN™, a VaporGrip® Xtra Agent</b>                      Manufacturer/Distributor: Wilbur-Ellis Company, LLC                      Application Rate: 20 oz/A</p>	<p><b>VRA</b></p> <p><b>Vapex™, a VaporGrip® Xtra Agent</b>                      Manufacturer/Distributor: KALO, Inc.                      Application Rate: 20 oz/A</p>
<p><b>VRA</b></p> <p><b>Verified™, a VaporGrip® Xtra Agent</b>                      Manufacturer/Distributor: Helena Agri-Enterprises, LLC                      Application Rate: 20 oz/A</p>	<p><b>VRA</b></p> <p><b>VOLACEPT™, a VaporGrip® Xtra Agent</b>                      Manufacturer/Distributor: Innvictis Crop Care, LLC                      Application Rate: 20 oz/A</p>	<p><b>VRA</b></p> <p><b>Volimate™, a VaporGrip® Xtra Agent</b>                      Manufacturer/Distributor: Precision Laboratories, LLC                      Application Rate: 20 oz/A</p>
<p><b>VRA</b></p> <p><b>Volt-Edge™, a VaporGrip® Xtra Agent</b>                      Manufacturer/Distributor: Winfield United, LLC                      Application Rate: 20 oz/A</p>		<p><b>Sentris</b>                      Buffering Technology</p>

# Herbicide registrations

## Corn

- Impact Core
  - Impact + acetochlor
  - 20-40 fl oz/A through 11”
  - AMS *plus* MSO
- Sinate
  - Impact + Liberty
  - 21-28 fl oz/A through V7/24”
  - AMS *plus* MSO or HSOC

## Soybean

- Kyber
  - Same products as Fierce MTZ (pyroxasulfone + flumioxazin + metribuzin)
- Panther MTZ
  - Same products as Dimetric Charged (metribuzin + flumioxazin)

## Other label updates

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- Anthem Flex – sunflowers and soybean added to label
- Anthem Maxx – apply through V6 soybean (was V3)
- Authority Edge – soybean and sunflower added to label
- BroadAxe – rotation restriction for dry beans added (4 months)
- Outlook – increase to 31 fl oz/A/yr (was 21 fl oz/A/yr)
- Zidua – apply through V8 corn (anticipated)

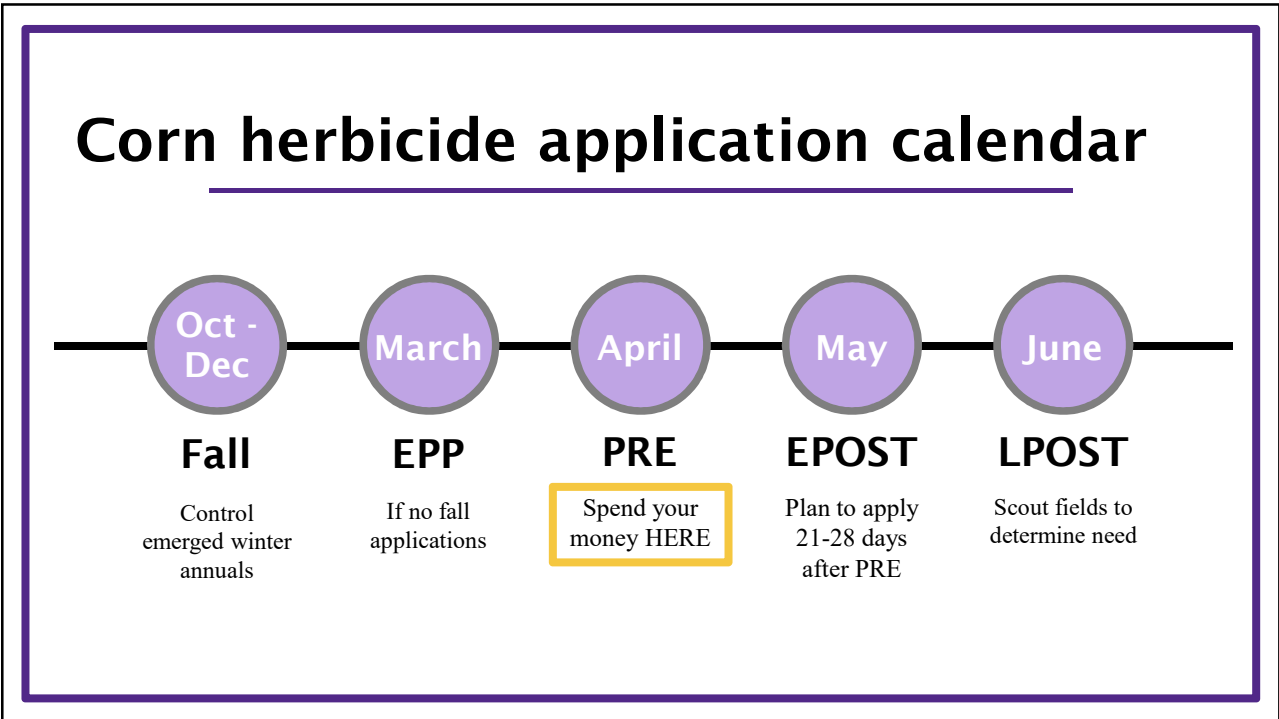
## Atrazine registration review

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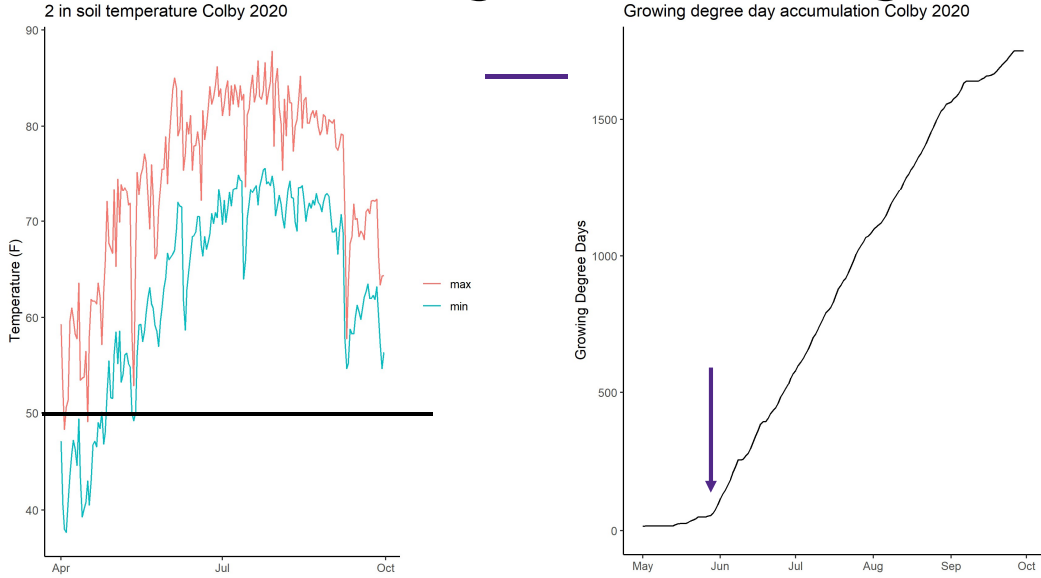
- Interim decision released Sept 2020
- Two more assessments
  - Endangered species assessment (deadline 9/28/21)
  - Endocrine disruptor screening
- Changes most likely to affect Kansas farmers
  - 15 MPH weed speed restriction
  - 5-foot buffer from edge of streams/rivers and endangered species habitat
  - Medium-sized droplets or larger

**What are the two most challenging weeds in your crops?**

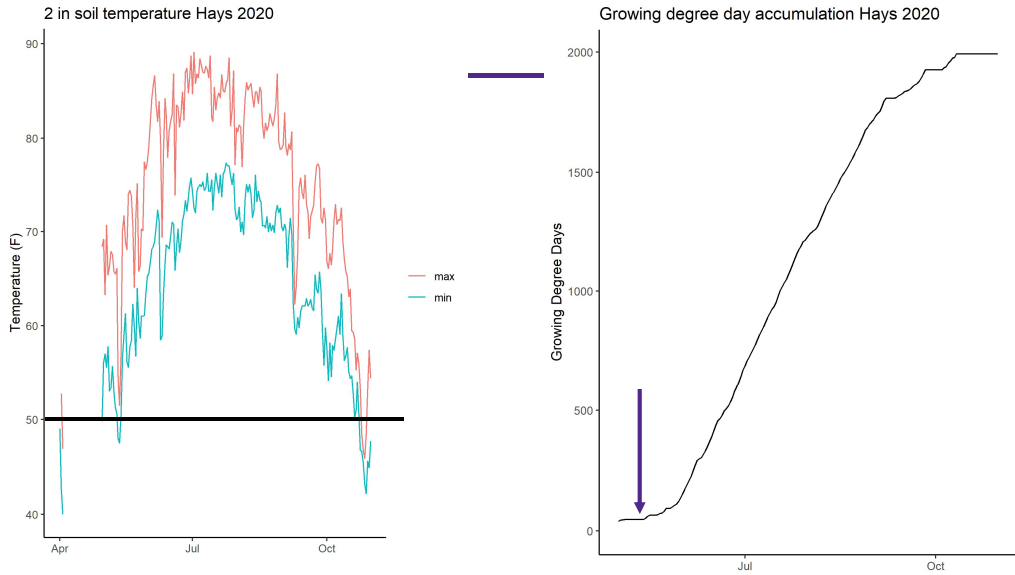
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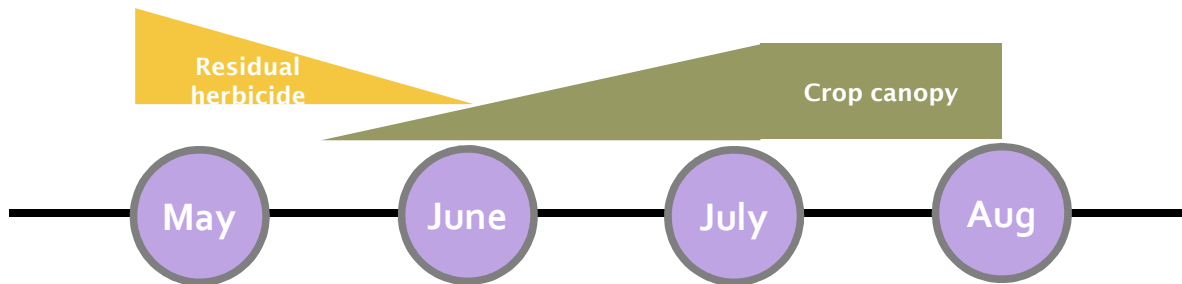
# Palmer amaranth germination & growth



# Palmer amaranth germination & growth



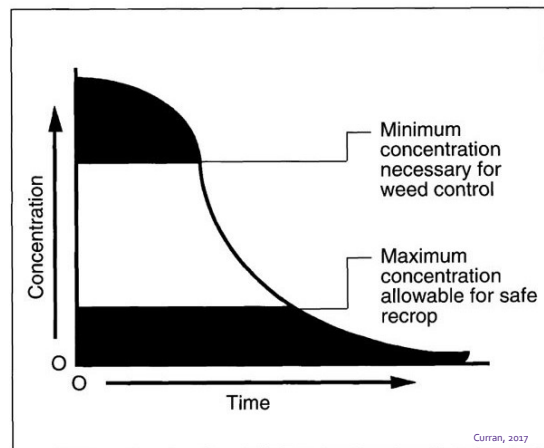
## Residual herbicide activity



Adapted from Hartzler and Anderson 2019

## Herbicide persistence

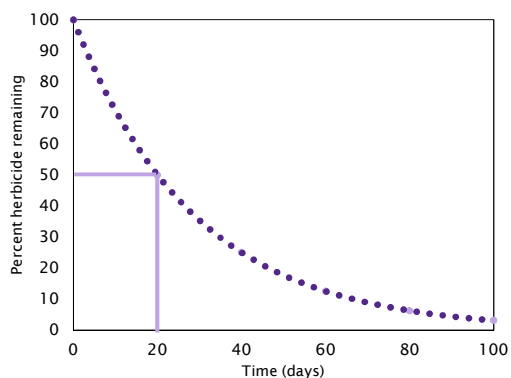
- The length of time a herbicide is active in soil
- Needs to be in a 'sweet spot' for residual herbicides
  - Want extended control
  - Don't want carryover



Curran, 2017

## Herbicide persistence

- Described by the half-life ( $t_{1/2}$ )
  - Time required for one-half of the herbicide dissipate



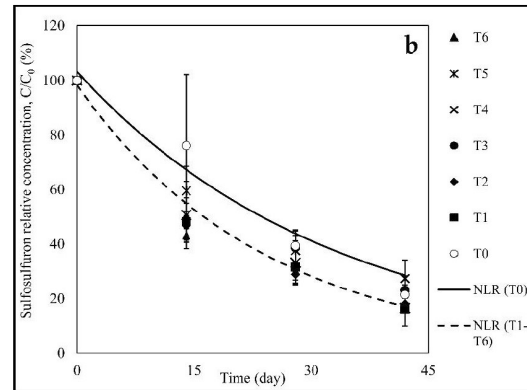
## Half-life of some residual herbicides

Herbicide	Example	SOA group	Half-life	Control duration
Pendimethalin	Prowl H2O	3	44 d	
Atrazine	Aatrex 4L	5	60 d	
Acetochlor	Harness	15	4-20 d*	8-12 weeks
S-metolachlor	Dual II Magnum	15	30-50 d	10-14 weeks
Dimethenamid-P	Outlook	15	20 d	
Pyroxasulfone	Zidua	15	16-26 d	
Flumioxazin	Valor	14	12-18 d	
Saflufenacil	Sharpen	14	1-36 d	
Isoxaflutole	Balance Flexx	27	0.5-2.4 d	

Herbicide Handbook, 2014  
\*Ma et al. 2004

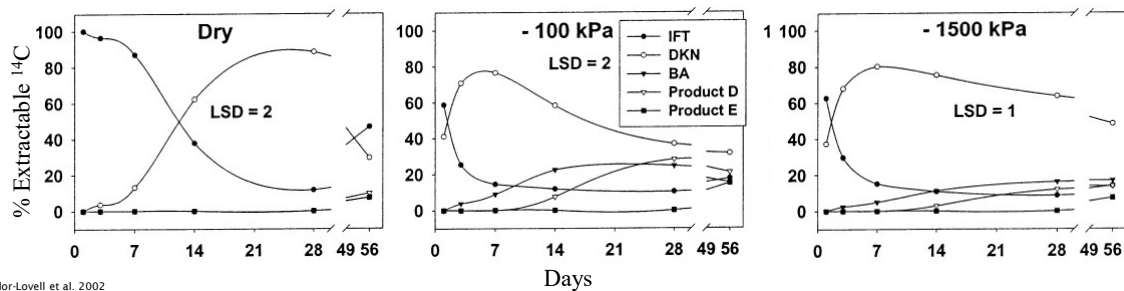
# Microbial degradation

- Influenced by:
  - Sorption
  - Previous applications



# Microbial degradation

- Influenced by:
  - Moisture

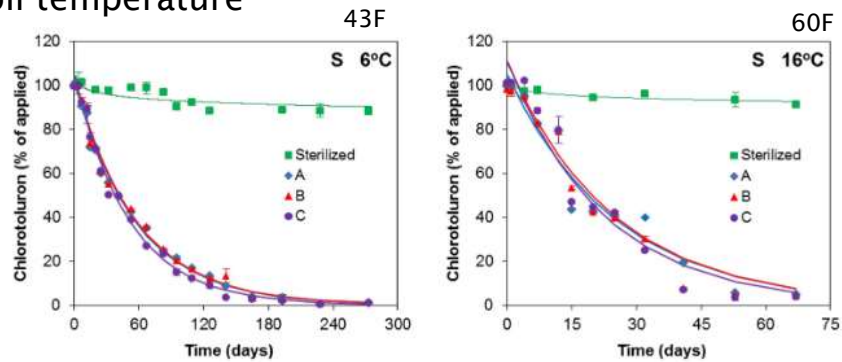


Taylor-Lovell et al. 2002



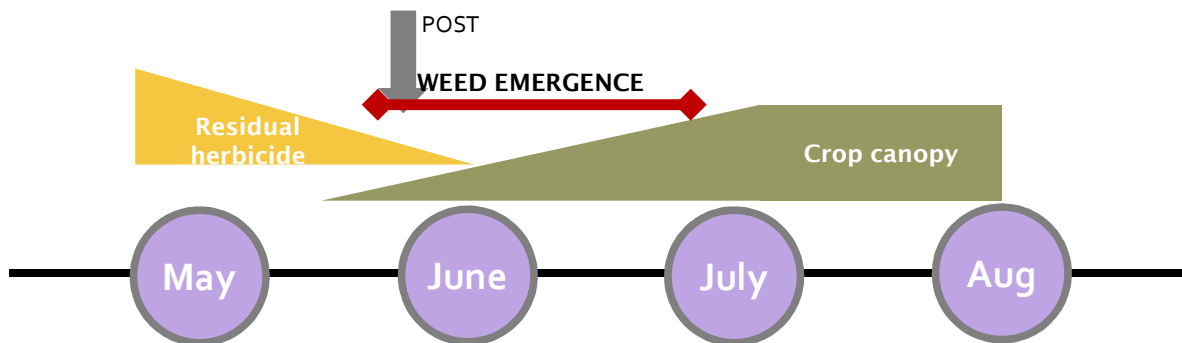
## Microbial degradation

- Influenced by:
  - Soil temperature



Marin-Benito et al. 2019

## Residual herbicide activity



Adapted from Hartzler and Anderson 2019

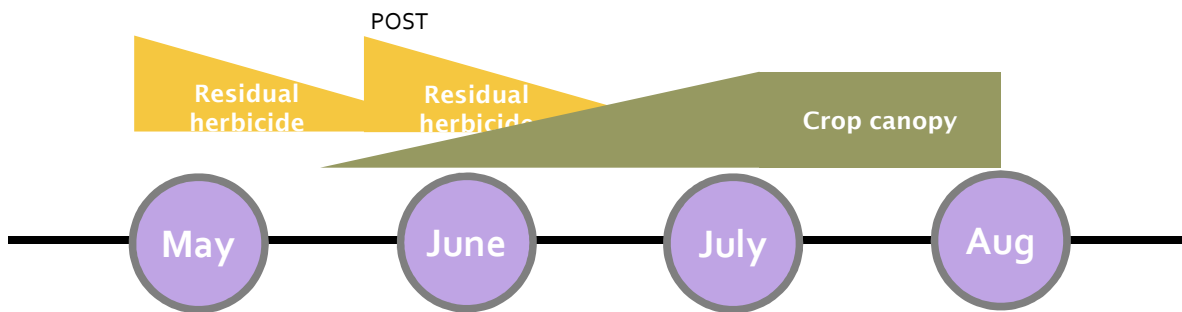
## Weed escapes still produce seed



**Up to 7 MILLION seeds per acre**

Werner et al. 2020

## Residual herbicide activity



Adapted from Hartzler and Anderson 2019

**Which herbicides have you used as a layered residual?**

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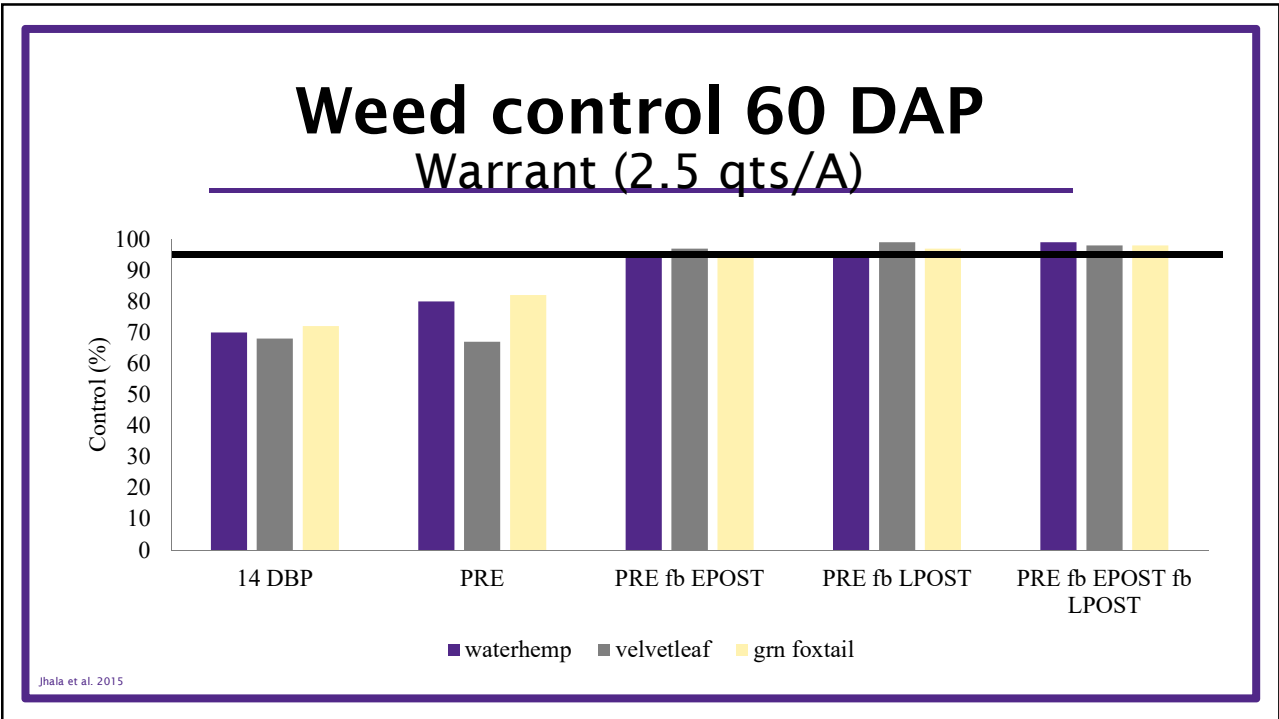
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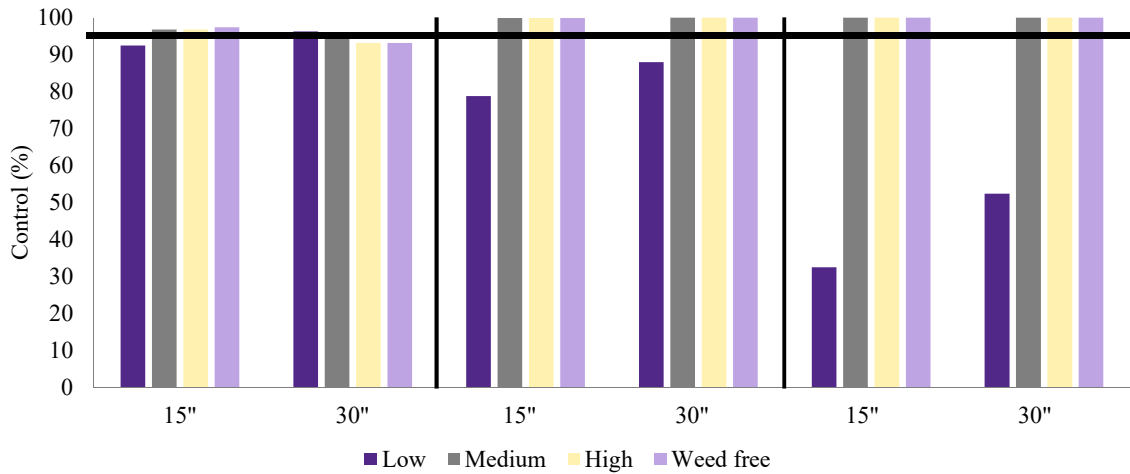
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Herbicide	Example	SOA group	Activation	Crop	Restriction
Atrazine	Aatrex 4L	5	NA	Corn Grain sorghum	12" 2-5 lf
Acetochlor	Harness	15	1/4-3/4"	Corn Grain sorghum Soybean	11"* 11" R2
S-metolachlor	Dual II Magnum	15	1/2-1"	Corn Grain sorghum Soybean	12" 75 d PHI V3
Dimethenamid-P	Outlook	15	NA	Corn Grain sorghum Soybean	12" 12" V5
Pyroxasulfone	Zidua	15	1/2"	Corn Soybean	V4** V6
Mesotrione	Callisto	27	1/4"	Corn	V8

\*Warrant = 30"  
\*\*V8 anticipated



## Common waterhemp control 4, 8, & 16 WAP



## Is 95% control enough? Palmer amaranth example

**Seed rain year 1**       $350,000 \frac{\text{seeds}}{\text{acre}} \times 20\% = 70,000 \frac{\text{viable seeds}}{\text{acre}}$

**Plants emerged year 2**       $70,000 \text{ seeds} \times 40\% = 28,000 \frac{\text{plants}}{\text{acre}}$

**Plants escaped year 2**       $28,000 \text{ plants} \times 95\% = 1,400 \frac{\text{plants}}{\text{acre}}$

**Resistant plants year 2**       $1,400 \text{ plants} \times 84\% = 1,176 \frac{\text{plants}}{\text{acre}}$

**Seed rain from resistant plants year 2**       $1,176 \text{ plants} \times 487 \frac{\text{seeds}}{\text{plant}} = 572,712 \frac{\text{seeds}}{\text{acre}}$

## Is 95% control enough? Marestail example

<b>Seed rain year 1</b>	$74,800 \frac{\text{seeds}}{\text{acre}} \times 30\% = 22,500 \frac{\text{viable seeds}}{\text{acre}}$
<b>Plants emerged year 2</b>	$22,500 \text{ seeds} \times 80\% = 18,000 \frac{\text{plants}}{\text{acre}}$
<b>Plants escaped year 2</b>	$18,000 \text{ plants} \times 95\% = 900 \frac{\text{plants}}{\text{acre}}$
<b>Resistant plants year 2</b>	$900 \text{ plants} \times 50\% = 450 \frac{\text{plants}}{\text{acre}}$
<b>Seed rain from resistant plants year 2</b>	$450 \text{ plants} \times 900 \frac{\text{seeds}}{\text{plant}} = 405,000 \frac{\text{seeds}}{\text{acre}}$

## Marestail control in Enlist soybean

