

# Management of Herbicide Resistant Palmer Amaranth in South Carolina Agronomic Crops.

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## General Information

Palmer amaranth (*Amaranthus Palmeri* S. Wats.) is a dioecious, erect summer annual that may reach 6 1/2 feet in height. Leaves are alternate and occur on relatively long petioles that are longer than the leaves. Small, green, inconspicuous flowers are produced in terminal panicles that are from 1/2 to 1 1/2 feet in length. Smaller lateral inflorescences also occur between the stem and the leaf petioles. Male and female flowers occur on separate plants. Palmer amaranth biotypes exist in South Carolina that are resistant to acetolactate synthase (ALS) inhibiting herbicides and dinitroaniline (yellow) herbicides. Palmer amaranth has been documented with glyphosate-resistance in Georgia, North Carolina, and Tennessee.

The following information and tables are designed to aid producers in making herbicide program decisions based on suspected Palmer amaranth resistance to herbicides.

## Resistance Management Guidelines

To delay herbicide resistance the following guidelines should be followed.

1. Diversify your weed management practices.
  - Do not rely on a single herbicide for weed control in all situations.
  - Rotate the use of herbicides that control the same weed in a particular field.
  - Use tank mixtures with herbicides from different groups when possible.
  - Use herbicides based on an Integrated Pest management (IPM) program that includes scouting, historical information related to herbicide use and crop rotation, and considers tillage (or other mechanical), cultural, biological and other chemical control practices.
  - Prevent movement of resistant weed seeds to other fields by cleaning harvesting and tillage equipment before moving to a new field.
2. Monitor fields for weed escapes and manage these escapes with an alternate herbicide or cultural practice before they set seed. Notify your county extension agent of the problem.
3. Manage weeds with the future in mind (Proactive approach)
  - Plan for the next 3-5 years of weed control (not just the current season).
4. Stewardship of herbicide tolerant seed trait technologies is essential to maintain current economic returns on crop production.

**Table 1.** Palmer amaranth control programs to manage ALS, glyphosate, and dinitroaniline- resistance in Roundup Ready cotton.

Resistance Suspected <sup>1</sup>			Herbicide Program				
ALS	DNA	Glyphosate	PPI or PRE <sup>2</sup>	EPOST <sup>3</sup>	MPOST <sup>4</sup>	LPOST <sup>5</sup>	LAYBY <sup>6</sup>
no	no	no	Prowl or Treflan PPI or Prowl H <sub>2</sub> O PRE	glyphosate + Dual Magnum (Sequence)	glyphosate	glyphosate + Envoke	Caparol + MSMA Direx + MSMA Suprend + MSMA Valor + MSMA Caparol + glyphosate Direx + glyphosate Suprend + glyphosate Valor + glyphosate
yes	no	no	Prowl or Treflan PPI or Prowl H <sub>2</sub> O PRE	glyphosate or glyphosate + Dual Magnum (Sequence)	glyphosate or glyphosate + Dual Magnum (Sequence)	glyphosate or glyphosate + Dual Magnum (Sequence)	Caparol + MSMA Direx + MSMA Suprend + MSMA Valor + MSMA Caparol + glyphosate Direx + glyphosate Suprend + glyphosate Valor + glyphosate
no	yes	no	Cotoran PRE	<i>no Palmer emerged</i>  glyphosate or glyphosate + Dual Magnum (Sequence) <i>Palmer &lt;3 in.</i> glyphosate + Staple	<i>no Palmer emerged</i>  glyphosate or glyphosate + Dual Magnum (Sequence) <i>Palmer &lt;3 in.</i> glyphosate + Staple	<i>no Palmer emerged</i>  glyphosate or glyphosate + Dual Magnum (Sequence) <i>Palmer &lt;3 in.</i> glyphosate + Envoke	Caparol + MSMA Direx + MSMA Suprend + MSMA Valor + MSMA Caparol + glyphosate Direx + glyphosate Suprend + glyphosate Valor + glyphosate
no	no	yes	Prowl or Treflan PPI followed by Cotoran PRE or Prowl H <sub>2</sub> O + Cotoran PRE	<i>no Palmer emerged</i>  glyphosate or glyphosate + Dual Magnum (Sequence) <i>Palmer &lt;3 in.</i> glyphosate + Staple	<i>no Palmer emerged</i>  glyphosate or glyphosate + Dual Magnum (Sequence) if no PPI or PRE was used. <i>Palmer &lt;3 in.</i> glyphosate + Staple	<i>no Palmer emerged</i>  glyphosate or glyphosate + Dual Magnum (Sequence) <i>Palmer &lt;3 in.</i> glyphosate + Envoke	Caparol + MSMA Direx + MSMA Suprend + MSMA Valor + MSMA Caparol + glyphosate Direx + glyphosate Suprend + glyphosate Valor + glyphosate
yes	yes	no	Cotoran PRE	glyphosate or glyphosate + Dual Magnum (Sequence)	glyphosate or glyphosate + Dual Magnum (Sequence)	glyphosate or glyphosate + Dual Magnum (Sequence)	Caparol + MSMA Direx + MSMA Suprend + MSMA Valor + MSMA Caparol + glyphosate Direx + glyphosate Suprend + glyphosate Valor + glyphosate
yes	no	yes	Prowl or Treflan PPI followed by Cotoran PRE or Prowl H <sub>2</sub> O + Cotoran PRE	glyphosate or glyphosate + Dual Magnum (Sequence)	glyphosate or glyphosate + Dual Magnum (Sequence)	glyphosate or glyphosate + Dual Magnum (Sequence)	Caparol + MSMA Direx + MSMA Suprend + MSMA Valor + MSMA Caparol + glyphosate Direx + glyphosate Suprend + glyphosate Valor + glyphosate

Resistance Suspected			Herbicide Program				
ALS	DNA	Glyphosate	PPI or PRE	EPOST	MPOST	LPOST	LAYBY
no	yes	yes	Cotoran PRE	<i>no Palmer emerged</i>  glyphosate or glyphosate + Dual Magnum (Sequence) if no PPI or PRE was used.	<i>no Palmer emerged</i>  glyphosate or glyphosate + Dual Magnum (Sequence) if no PPI or PRE was used.	<i>no Palmer emerged</i>  glyphosate or glyphosate + Dual Magnum (Sequence)	Caparol + MSMA Direx + MSMA Suprend + MSMA Valor + MSMA Caparol + glyphosate Direx + glyphosate Suprend + glyphosate Valor + glyphosate
				<i>Palmer &lt;3 in.</i>  glyphosate + Staple	<i>Palmer &lt;3 in.</i>  glyphosate + Staple	<i>Palmer &lt;3 in.</i>  glyphosate + Envoke	
yes	yes	yes	Cotoran PRE	glyphosate or glyphosate + Dual Magnum (Sequence)	glyphosate or glyphosate + Dual Magnum (Sequence)	glyphosate or glyphosate + Dual Magnum (Sequence)	Caparol + MSMA Direx + MSMA Suprend + MSMA Valor + MSMA Caparol + glyphosate Direx + glyphosate Suprend + glyphosate Valor + glyphosate

<sup>1</sup> Palmer amaranth biotypes with documented resistance to acetolactate synthase (ALS)-inhibiting herbicides and dinitroaniline (DNA) exist in South Carolina. Glyphosate-resistant Palmer amaranth has been documented in Georgia, North Carolina, and Tennessee.

<sup>2</sup> PPI = Preplant incorporated. Mix herbicide uniformly with the top 2 inches of soil. PRE = Preemergence. Apply to soil surface after all tillage and planting has occurred.

<sup>3</sup> EPOST = Early postemergence. Apply when weeds have emerged and cotton is at the 1-2 leaf stage.

<sup>4</sup> MPOST = Mid postemergence. Apply when weeds are present and cotton is at the 4-5 node stage.

<sup>5</sup> LPOST = Late postemergence. Apply to Roundup Ready Flex™ cotton varieties when weeds are present and cotton has 6 or more nodes.

<sup>6</sup> Apply when cotton is at least 12 inches tall and has woody bark layer at soil surface. Layby applications are still recommended with the Roundup Ready Flex™ system for resistance management.

**Table 2.** Palmer amaranth control programs to manage ALS, glyphosate, and dinitroaniline- resistance in Roundup Ready soybean.

Resistance Suspected <sup>1</sup>			Herbicide Program		
ALS	DNA	Glyphosate	PRE <sup>2</sup>	1 <sup>st</sup> POST	2 <sup>nd</sup> POST
no	no	no	Dual Magnum, Intrro, Outlook, Prowl H <sub>2</sub> O, Sencor, Canopy SP, Pursuit, Scepter, Squadron, Valor	<i>Roundup Ready variety</i> glyphosate, Pursuit, Scepter, glyphosate + Reflex, glyphosate + Ultra Blazer, glyphosate + Cobra, Harmony GT	<i>Roundup Ready variety</i> Reflex, Ultra Blazer, Cobra, Harmony GT
				<i>Conventional variety</i> Reflex, Ultra Blazer, Cobra, Harmony GT	<i>Conventional variety</i> Reflex, Ultra Blazer, Cobra, Harmony GT
yes	no	no	Dual Magnum, Intrro, Outlook, Prowl H <sub>2</sub> O, Triflan, or Sencor, Valor	<i>Roundup Ready variety</i> glyphosate, glyphosate + Reflex, glyphosate + Ultra Blazer, glyphosate + Cobra	<i>Roundup Ready variety</i> Reflex, Ultra Blazer, Cobra
				<i>Conventional variety</i> Reflex, Ultra Blazer, Cobra	<i>Conventional variety</i> Reflex, Ultra Blazer, Cobra
no	yes	no	Dual Magnum, Intrro, Outlook, Sencor, Valor, Canopy SP, Pursuit, Scepter, Squadron, Valor	<i>Roundup Ready variety</i> glyphosate, glyphosate + Reflex, glyphosate + Ultra Blazer, glyphosate + Cobra, Harmony GT	<i>Roundup Ready variety</i> Reflex, Ultra Blazer, Cobra, Harmony GT
				<i>Conventional variety</i> Reflex, Ultra Blazer, Cobra, Harmony GT	<i>Conventional variety</i> Reflex, Ultra Blazer, Cobra, Harmony GT
no	no	yes	Dual Magnum, Intrro, Outlook, Prowl H <sub>2</sub> O, Sencor, Canopy SP, Pursuit, Scepter, Squadron, Valor	<i>Roundup Ready variety</i> Reflex, Ultra Blazer, Cobra, Pursuit, Scepter, Harmony GT	<i>Roundup Ready variety</i> Reflex, Ultra Blazer, Cobra, Harmony GT
				<i>Conventional variety</i> Reflex, Ultra Blazer, Cobra, Pursuit, Scepter, Harmony GT	<i>Conventional variety</i> Reflex, Ultra Blazer, Cobra, Harmony GT
yes	yes	no	Dual Magnum, Intrro, Outlook, Sencor, Valor	<i>Roundup Ready variety</i> glyphosate, glyphosate + Reflex, glyphosate + Ultra Blazer, glyphosate + Cobra	<i>Roundup Ready variety</i> Reflex, Ultra Blazer, Cobra
				<i>Conventional variety</i> Reflex, Ultra Blazer, Cobra	<i>Conventional variety</i> Reflex, Ultra Blazer, Cobra
yes	no	yes	Dual Magnum, Intrro, Outlook, Prowl H <sub>2</sub> O, Sencor, Valor	<i>Roundup Ready variety</i> Reflex, Ultra Blazer, Cobra,	<i>Roundup Ready variety</i> Reflex, Ultra Blazer, Cobra
				<i>Conventional variety</i> Reflex, Ultra Blazer, Cobra,	<i>Conventional variety</i> Reflex, Ultra Blazer, Cobra
no	yes	yes	Dual Magnum, Intrro, Outlook, Sencor, Valor, Canopy SP, Pursuit, Scepter, Squadron, Valor	<i>Roundup Ready variety</i> Reflex, Ultra Blazer, Cobra, Pursuit, Scepter, Harmony GT	<i>Roundup Ready variety</i> Reflex, Ultra Blazer, Cobra, Harmony GT
				<i>Conventional variety</i> Reflex, Ultra Blazer, Cobra, Pursuit, Scepter, Harmony GT	<i>Conventional variety</i> Reflex, Ultra Blazer, Cobra, Harmony GT

Resistance Suspected <sup>1</sup>			Herbicide Program		
ALS	DNA	Glyphosate	PRE <sup>2</sup>	1 <sup>st</sup> POST	2 <sup>nd</sup> POST
yes	yes	yes	Dual Magnum, Intro, Outlok, Sencor, Valor	Roundup Ready variety Reflex, Ultra Blazer, Cobra, Conventional variety Reflex, Ultra Blazer, Cobra,	Roundup Ready variety Reflex, Ultra Blazer, Cobra Conventional variety Reflex, Ultra Blazer, Cobra

<sup>1</sup> Palmer amaranth biotypes with documented resistance to acetolactate synthase (ALS)-inhibiting herbicides and dinitroaniline (DNA) exist in South Carolina. Glyphosate-resistant Palmer amaranth has been documented in Georgia, North Carolina, and Tennessee.

<sup>2</sup> PRE = Preemergence. Apply to soil surface after all tillage and planting has occurred.

**Table 3.** Palmer amaranth control programs to manage ALS and dinitroaniline- resistance in peanut.

Resistance Suspected <sup>1</sup>		Herbicide Program		
ALS	DNA	PPI/PRE <sup>2</sup>	Cracking <sup>3</sup>	POST <sup>4</sup>
yes	no	PPI Prowl H <sub>2</sub> O or Sonalan ----- PRE Prowl H <sub>2</sub> O or Dual Magnum + Valor	Gramoxone Inteon + Basagran  <i>If no PPI/PRE applied:</i> add Dual Magnum or Outlook	Cobra or Ultra Blazer
no	yes	Dual Magnum + Valor	Gramoxone Inteon + Basagran  <i>If not applied PPI/PRE:</i> add Dual Magnum or Outlook	Cobra, Ultra Blazer, Cadre, or Pursuit
yes	yes	Dual Magnum + Valor	Gramoxone Inteon + Basagran  <i>If not applied PPI/PRE:</i> add Dual Magnum or Outlook	Cobra or Ultra Blazer

<sup>1</sup> Palmer amaranth biotypes with documented resistance to acetolactate synthase (ALS)-inhibiting herbicides and dinitroaniline (DNA) exist in South Carolina.

<sup>2</sup> PPI = Preplant incorporated. Mix herbicide uniformly with the top 2 inches of soil. PRE = Preemergence. Apply to soil surface after all tillage and planting has occurred.

<sup>3</sup> Cracking = Application from peanut ground cracking until 28 days after emergence.

<sup>4</sup> POST = Application 28 days after peanut emergence.

**Table 4.** Palmer amaranth control programs to manage herbicide resistance in field corn.

Seed Program	Herbicide Program		
	PRE <sup>1</sup>	POST <sup>2</sup>	LAYBY
Conventional	Atarazine, Bicep II Magnum, Cinch ATZ, Guardsman, Lexar	Banvel, Clarity, Distinct, 2,4-D	2,4-D or Evik
	No PRE applied	atrazine	
Clearfield	Atarazine, Bicep II Magnum, Cinch ATZ, Guardsman, Lexar	Lightning + Distinct Lightning + 2,4-D	2,4-D or Evik
	No PRE applied	Lightning + Distinct or 2,4-D Lightning + atrazine	
Liberty Link	Atarazine, Bicep II Magnum, Cinch ATZ, Guardsman, Lexar	Liberty, Banvel, Clarity, Distinct, 2,4-D	2,4-D or Evik
	No PRE applied	Liberty + atrazine	
Roundup Ready	Atarazine, Bicep II Magnum, Cinch ATZ, Guardsman, Lexar	glyphosate + atrazine (Expert) glyphosate + Banvel , Clarity, Distinct glyphosate + 2,4-D	2,4-D or Evik
	No PRE applied	glyphosate + atrazine (Expert) glyphosate + Banvel , Clarity, Distinct glyphosate + 2,4-D	

<sup>1</sup> PRE = Preemergence. Apply to soil surface after all tillage and planting has occurred.

<sup>2</sup> POST = Apply to corn 12 inches in height or less.