



Managing Glyphosate-Resistant (GR) and ALS-Resistant Palmer Amaranth (Pigweed) in Field Corn, Peanut, and Soybean - 2009

Eric P. Prostko, Ph.D.
Associate Professor and Extension Weed Specialist
Department of Crop & Soil Sciences
The University of Georgia

The occurrence of herbicide resistance in Palmer amaranth in Georgia is cause for significant concern for the agricultural industry. Recent changes in cropping practices, specifically the reliance on a limited number of herbicides, have streamlined weed management. However, the consequence has been the development of herbicide resistance. The following recommendations in Tables 1-4 are aimed at preserving the herbicide tools that are available for weed management. An effective herbicide resistant weed management plan will require the integration of multiple herbicide chemistries in an effort to lessen the selection pressure and delay the occurrence of herbicide resistance in a field. Other strategies, such as cultural practices and mechanical cultivation should also be included in a herbicide resistant weed management plan. For additional information about herbicide resistant weeds, visit the UGA Weed Science Web-Page at the following web address:

<http://www.cropsoil.uga.edu/weedsci/resistance.html>

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Table 1. Herbicide Programs for Managing Glyphosate and ALS-Resistant Palmer Amaranth in Field Corn.¹

Corn hybrid	Preemergence	Postemergence	Layby as needed
Conventional	Atrazine**	Prowl ² + Atrazine + Crop Oil	2,4-D ⁵ or Banvel/Clarity ^{4,5} or Status ¹⁰
Conventional	Bicep II Magnum ³ , or Bullet, or Guardsman, or Lariat, or Lexar	Atrazine or Banvel/Clarity ^{4,5} or 2,4-D ⁵ or Aim or Callisto or Laudis or Status ¹⁰	2,4-D ⁵ or Banvel/Clarity ^{4,5} or Status ¹⁰
Liberty Link	Atrazine**	Liberty + atrazine ⁷	2,4-D ⁵ or Banvel/Clarity ^{4,5} or Status ¹⁰
Liberty Link	Dual II Magnum ⁶ or Outlook or Micro-Tech	Liberty + atrazine ⁷	2,4-D ⁵ or Evik or Banvel/Clarity ^{4,5} or Status ¹⁰
Roundup Ready	Atrazine**	glyphosate + atrazine or Banvel/Clarity ^{4,5} or Status ¹⁰ ; Expert ⁸ or Sequence ⁹ or Halex GT ¹¹	2,4-D ⁵ or Banvel/Clarity ^{4,5} or Status ¹⁰
Roundup Ready	Bicep II Magnum ³ , or Bullet, or Guardsman, or Lariat, or Lexar at 66% normal rate	glyphosate + atrazine or Banvel/Clarity ^{4,5} or Status ¹⁰ ; Expert ⁸ or Sequence ⁹ or Halex GT ¹¹	2,4-D ⁵ or Banvel/Clarity ^{4,5} or Status ¹⁰

¹Glyphosate- and ALS-resistant Palmer amaranth are very serious concerns. An aggressive management program is necessary to slow spread of resistant biotypes and to reduce selection pressure in areas currently not infested with resistant biotypes.

²Generic brands of Prowl (pendimethalin) are available and perform similarly.

³Bicep II Magnum is a pre-mixture of S-metolachlor and atrazine. Less expensive, generic brands containing metolachlor and atrazine are available (Parallel Plus, Stalwart Xtra). These generic brands may not provide the same length of residual control as Bicep II Magnum (which contains S-metolachlor).

⁴Generic brands of Banvel (dicamba dimethylamine salt) are available and perform similarly.

⁵Use extreme caution to avoid drift to sensitive crops, such as cotton, tobacco, soybeans, and vegetables. Use only amine formulations of 2,4-D. Follow all label directions for drift management.

⁶Generic brands containing metolachlor are available (Me-Too-Lachlor-II, Parallel, Stalwart-C). However, these generic brands may not provide the same length of residual control as Dual II Magnum (S-metolachlor).

⁷Also available in a pre-mixture sold under the trade name of Liberty ATZ.

⁸Expert is a pre-mixture of glyphosate + S-metolachlor + atrazine.

⁹Sequence is a pre-mixture of glyphosate + S-metolachlor.

¹⁰Status is a pre-mixture of dicamba + diflufenzopyr + isoxadifen.

¹¹Halex GT is a pre-mixture of glyphosate + S-metolachlor + mesotrione

**** When atrazine is applied PRE + POST, a total of 2.5 lbs ai/A can be applied per year (2.5 qts/A of 4L or 44 ozs/A of 90DF). When atrazine is applied only POST, then a total of 2.0 lb ai/A can be applied per year (2 qts/A of 4L or 36 ozs/A of 90DF).**

Table 2. Suggested Herbicide Programs for Managing ALS-Resistant Palmer Amaranth in Peanut.¹

Preplant Incorporated	Preemergence ²	Cracking or early postemergence ³ (Palmer < 2 in.)	Postemergence ⁴ (Palmer < 3 in.)
Prowl ⁵ or Sonalan	Valor ^{6,7}		Cobra ⁷ or Ultra Blazer ^{7,8}
Prowl ⁵ or Sonalan	Valor ^{6,7} + Dual Magnum ⁹		Cobra ⁷ or Ultra Blazer ^{7,8}
Prowl ⁵ or Sonalan		Paraquat + Storm + Dual Magnum ⁹	Cobra ⁷ or Ultra Blazer ⁷ + Dual Magnum ⁹

¹ALS-resistant Palmer amaranth is a very serious concern. An aggressive management program is necessary to slow spread of the resistant biotypes and to reduce selection pressure in areas currently not infested with resistant biotypes. A combination of soil residual and postemergence herbicides will be required for optimum control.

²Strongarm is not included in this table because it is an ALS-inhibiting herbicide. However, it can be used for the control of other broadleaf weeds. If Strongarm is used preemergence, Cadre or Pursuit should **NOT** be applied postemergence.

³Apply cracking or early postemergence treatment only if weeds have emerged.

⁴Cadre or Pursuit may be tank-mixed with Cobra or Ultra Blazer if needed for control of other weed species. Cadre and Pursuit are ALS- inhibitors. Because of concerns with weed resistance to ALS-inhibitors, a mixture of Cobra or Ultra Blazer with Cadre or Pursuit would be preferred over Cadre or Pursuit alone. When using Cadre or Pursuit, follow all labeled crop rotation restrictions.

⁵Generic brands of Prowl (pendimethalin) are available and perform similarly. Prowl or Sonalan can be used preemergence if 0.5-0.75" of water can be applied within 48 hours of application. They can be tank-mixed with Valor in this situation.

⁶If Valor is properly activated with 0.5-0.75" of rainfall or irrigation within 7 days of application, it is unlikely that an "at-cracking" treatment will be required. However, if control with Valor is unacceptable, an "at-cracking" treatment of paraquat + Storm + Dual Magnum should be applied.

⁷Valor, Cobra, Storm, and Ultra Blazer have the same mode of action (PPO inhibitor). Consequently, no more than 2 applications of these herbicides should be used in a season.

⁸Dual Magnum can be tank-mixed with Cobra or Ultra Blazer if additional residual control is needed in these programs.

⁹Generic brands of metolachlor are available (Stalwart, Parallel PCS, Me-Too-Lachlor). However, these generic brands have not provided the same length of residual control as Dual Magnum (S-metolachlor) in some UGA field trials. When tank-mixing paraquat, Cobra or Ultra Blazer with Dual Magnum/generics, additional spray adjuvants (NIS, COC) are not needed and will likely increase peanut injury.

Table 3. Herbicide Programs for Managing Glyphosate/ALS-Resistant Palmer Amaranth and Delaying PPO Resistance in Soybeans.¹

Soybean variety	Preemergence ²	Postemergence ^{3,4}
Roundup Ready	Sencor or Canopy ⁵ or Boundary ⁶	glyphosate + Reflex ⁷ or glyphosate + Ultra Blazer ⁷ or glyphosate + Cobra ⁷ or glyphosate + Prefix ^{7,8} or Sequence ⁹
Conventional	Sencor or Canopy ⁵ or Boundary ⁶ + Prowl	Reflex ⁷ or Ultra Blazer ⁷ or Cobra ^{6,7} or Prefix ^{7,8}

¹Glyphosate- and ALS-resistant Palmer amaranth are very serious concerns. An aggressive management program is necessary to slow spread of resistant biotypes and to reduce selection pressure in areas currently not infested with resistant biotypes.

²Generic brands of Sencor (metribuzin) and Prowl (pendimethalin) are available and perform similarly. When using Boundary, Sencor or Canopy, follow label for appropriate rates, soil pH restrictions, and soybean variety tolerance. Dryland growers should consider mechanically incorporating Sencor, Canopy, Boundary, and Prowl. If mechanically incorporating herbicides, Treflan can be used instead of Prowl if preferred.

³When applied in combination with glyphosate, use either 12-16 oz/A of Reflex, 1.0-1.5 pt/A of Ultra Blazer, or 12.5 ozs/A of Cobra. Applications should be made **before** Palmer amaranth exceeds 2" in height.

⁴If residual herbicides are activated by a timely rainfall or irrigation event, a second postemergence application will usually not be needed. The total amount of these herbicides that can be applied per acre per year are as follows: Cobra - 25 ozs/A; Reflex - 1.5 pt/A; and Ultra Blazer - 2.0 pt/A. Reflex may be preferred because of residual control of Palmer amaranth. On Roundup Ready soybean, glyphosate can be included in the second application if needed for the control of other weeds.

⁵Canopy is a pre-mixture of metribuzin (Sencor) + chlorimuron (Classic).

⁶Boundary is a pre-mixture of metribuzin (Sencor) and S-metolachlor (Dual Magnum).

⁷Valor, Envive, Cobra, Prefix, Reflex, Prefix, and Ultra Blazer have the same mode of action (PPO inhibitor). More than 1 application of these herbicides in a single season should be avoided if at all possible to prevent/delay the development of PPO resistance.

⁸Prefix is a pre-mixture of fomesafen (Reflex) and S-metolachlor (Dual Magnum).

⁹Sequence is a pre-mixture of glyphosate and S-metolachlor (Dual Magnum). Sequence will not control emerged glyphosate resistant pigweed.

Soybean varieties that have exhibited acceptable tolerance to Sencor, Canopy, and Boundary in preliminary UGA tests conducted in 2008 include the following:

Ag South AGS 568	Asgrow H7242
Asgrow 4903 RR/STS	Delta Pineland DP 5634
Delta Pineland DP 6568	Northrup King NKS 80P2
Northrup King NKS 76L9	Northrup King NKS 78G6
Pioneer 95Y40	Pioneer 95Y70
Pioneer 96M60	Pioneer 97M50
Southern States RT5951	Southern States RT4808
Vigoro V61N9	Vigoro V74N9

****Soybean varieties not included in this list have not been adequately evaluated.**

Table 4. Soybean Pre-Mixtures and Equivalent Rates

Pre-Mixture	Rate/A	Equivalent
Boundary 6.5EC	1.5 pt	Dual Magnum 7.62EC @ 16.5 oz/A Sencor 75DF @ 4.9 oz/A
Canopy 75DG	6 oz	Sencor 75DG @ 5.1 oz/A Classic 25DG @ 2.57 oz/A