



MANAGING PALMER AMARANTH - NORTH

What You'll Learn...

- Palmer amaranth management requires a proactive approach and long-term planning
- Accurate identification, prevention of seed dispersal, and dedicated action are key factors for management
- Management strategies should include overlapping residual herbicides and multiple herbicide applications with unique sites of action
- Early post-emergence herbicides must be applied **before** Palmer amaranth is 4 inches tall

Palmer amaranth management requires a long-term outlook and plan, even for fields or production areas where it has not become established. The aggressiveness of this weed and risk of a substantial reduction in crop yield potential demands integrated management practices and highly effective herbicide programs.¹ Frequent and vigilant scouting coupled with accurate weed identification are the foundation of a prevention strategy. The integrated weed management plan should include multiple tactics in the current crop and throughout the rotation.

General Management Guidelines

1. Accurate identification and early detection with frequent scouting of fields, fencelines, roadsides and other crop areas.
2. Prevent seed production and dispersal. Begin scouting after harvest. Remove weed escapes prior to weed seed maturity. A single female Palmer amaranth plant can produce up to 1 million seeds.
3. Clean harvest and tillage equipment to avoid spreading seed from field to field.
4. Till in the fall or spring or use burndown herbicide applications.
5. Always use a pre-emergence (PRE) soil residual herbicide product that controls Palmer amaranth. Apply herbicides at full label rates. Use multiple herbicide applications with unique sites of action and overlapping soil residual herbicides.^{2,3,4}
6. Early post-emergence (POST) herbicides must be applied **before** Palmer amaranth is 4 inches tall. Use full rates and tank mixtures with residual herbicides.
7. Integrate additional crops into the rotation. Diversifying the rotation makes effective use of cultural practices, crop competition, multiple herbicide sites of action, and varied herbicide application timing that can increase management options and help reduce the soil seedbank.

Grass crops such as corn, grain sorghum, or wheat, provide the best opportunity for management. Three to five years of alfalfa with good weed management can help exhaust seed reservoirs.

Palmer amaranth has three to four times the photosynthetic rate of corn, cotton, and soybeans. A high photosynthetic rate contributes to its ability to grow rapidly. This weed can grow in excess of 2 inches per day during the summer. This characteristic makes timely herbicide applications essential and adds to the management challenge.

- Begin scouting fields 14 to 21 days after crop emergence.
- Apply POST herbicides before Palmer amaranth is 4 inches tall.
- Scout 7 to 14 days after POST applications to evaluate the effectiveness of PRE and POST herbicides and to detect newly emerged plants.²

Herbicides used for waterhemp management will also control Palmer amaranth. Palmer amaranth has a high propensity for resistance to many herbicide families (Figure 1).⁴ A population in Kansas has been documented to be resistant to multiple herbicide groups (Group 3 dinitroaniline, Group 5 photosystem II, and Group 27 HPPD herbicides).⁵ Populations of Palmer amaranth are under investigation for resistance to POST-applied Group 14 (PPO) herbicides.

Subsequent flushes of Palmer amaranth may require multiple POST applications or timely cultivation and hand pulling. Scout fields throughout the season so that management practices can be used to prevent Palmer amaranth from flowering and producing seed.

Always check individual product labels for application rates and timing, additional use instructions, and restrictions. Visit www.roundupreadyPLUS.com for solutions and recommendations.

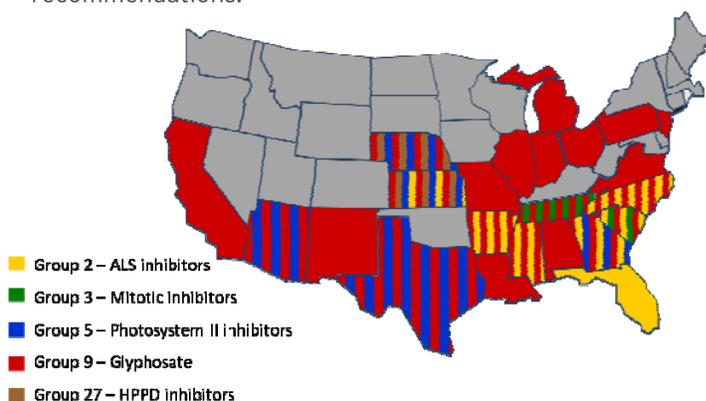


Figure 1. Distribution of herbicide resistant populations of Palmer amaranth in 2015.^{4,7}



MANAGING PALMER AMARANTH - NORTH

Table 1. Management Recommendations for Genuity® Roundup Ready 2 Yield® and Roundup Ready® Soybeans

Application Timing	Herbicides
Preplant Burndown or Tillage	Roundup PowerMAX® Herbicide + dicamba or 2,4-D
PRE at planting	Warrant® Herbicide, Rowel® Herbicide, Rowel® FX Herbicide, Fierce®, Fierce® XLT, Valor®, Valor® XLT, Gangster®, Authority® Assist, Authority® First, Authority® MAXX, Authority® MTZ, Authority® XL
Early POST* – weeds less than 4 inches	Roundup PowerMAX® Herbicide + Warrant® Ultra Herbicide or Warrant® Herbicide + Cobra® or fomesafen

*Tank mix Select Max® if volunteer corn is present. ¹Warrant® Herbicide may be applied POST up to the R2 stage of soybean growth but prior to weed emergence. Warrant® Herbicide may be applied twice per growing season. Warrant® Ultra Herbicide may be applied once per growing season. If Warrant® Ultra Herbicide has already been applied, one application of Warrant® Herbicide may be applied.

Post-Harvest Management

Mowing, disking, or a broadcast herbicide application after harvest may be necessary to prevent seed production. Tillage and mowing should take place before the plants produce seed. Prevention is key to management of Palmer amaranth and it is important to not let this weed get established in fields. Scout ditches and roadways next to fields for Palmer amaranth and remove plants before they produce seed.

Ecofarming Management

A good stand of winter wheat with vigorous spring growth should compete well with Palmer amaranth. If treatment is warranted in wheat, dicamba, 2,4-D, and other broadleaf

Table 2. Management Recommendations for Roundup Ready® Corn 2

Application Timing	Herbicides
Preplant Burndown or Tillage	Roundup PowerMAX® Herbicide + dicamba or 2,4-D
PRE at planting	Harness® brands, Degree Xtra®, TripleFLEX® II Herbicide, or other residual herbicides
Early POST – weeds less than 4 inches	Roundup PowerMAX® Herbicide + dicamba*, 2,4-D, or IMPACT®

*Apply 16 oz/acre Clarity® Herbicide from corn emergence to 8 inches or the 5-leaf stage, reduce rate to 8 oz/acre for 8-36 inch application.

herbicides are available for use. Following wheat harvest, stubble should be monitored for Palmer amaranth. High quality wheat stubble and timely weed control are essential in ecofarming systems for moisture conservation and preventing weed seed production.⁶ Burndown and residual herbicides are usually the first step in preparing no-till wheat stubble fields for planting annual crops in the spring. Dicamba and 2,4-D (Group 4) can be added to post-harvest herbicide applications to manage many broadleaf weeds including Palmer amaranth. Rowel® Herbicide (Group 14), Authority® MTZ (Groups 14 and 5), or Valor® (Group 14) can provide residual broadleaf weed control when used within 30 days after wheat harvest.⁶ Consult individual product labels prior to use for labeled crops, weeds, and application instructions.

Sources: ¹ Legleiter, T. and Johnson, B. 2013. Palmer amaranth biology, identification, and management. WS-51 Purdue University Extension. ² Hagar, A.G. 2014. Management of Palmer amaranth in Illinois. University of Illinois. ³ Zollinger, R. 2014. North Dakota weed control guide. North Dakota State University. ⁴ Bradley, K. 2014. Herbicide resistance in Palmer amaranth 2013. University of Missouri. ⁵ Hartzler, B. 2013. Palmer amaranth: ID, biology and management. Integrated Crop Management Conference. Iowa State University. ⁶ Knezevic, S. Ecofarming in 2015 Guide to weed management in Nebraska with insecticide and fungicide information EC-130. University of Nebraska. ⁷ Kruger, G., Vieira, B.C., Samuelson, S., and Jhala, A. 2015. Glyphosate-resistant Palmer amaranth confirmed in southwest Nebraska. University of Nebraska CropWatch.

This document is intended to provide information about this weed and guidelines for control. As a tough-to-control weed, knowledge about the biology and weed control programs will help in their management. For additional information, contact your local seed representative. Developed in partnership with Technology, Development & Agronomy by Monsanto.

Monsanto Company is a member of Excellence Through Stewardship® (ETS). Monsanto products are commercialized in accordance with ETS Product Launch Stewardship Guidance, and in compliance with Monsanto's Policy for Commercialization of Biotechnology-Derived Plant Products in Commodity Crops. This product has been approved for import into key export markets with functioning regulatory systems. Any crop or material produced from this product can only be exported to, or used, processed or sold in countries where all necessary regulatory approvals have been granted. It is a violation of national and international law to move material containing biotech traits across boundaries into nations where import is not permitted. Growers should talk to their grain handler or product purchaser to confirm their buying position for this product. Excellence Through Stewardship® is a registered trademark of Excellence Through Stewardship. Roundup Technology® includes Monsanto's glyphosate-based herbicide technologies. Individual results may vary, and performance may vary from location to location and from year to year. This result may not be an indicator of results you may obtain as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible. ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS. Roundup Ready technology contains genes that confer tolerance to glyphosate, an active ingredient in Roundup® brand agricultural herbicides. Agricultural herbicides containing glyphosate will kill crops that are not tolerant to glyphosate. Harness®, Rowel® Herbicide, Rowel® FX Herbicide, TripleFLEX® Herbicide, TripleFLEX® II Herbicide, Warrant® Ultra Herbicide and Warrant® Herbicide are not registered in all states. Harness®, Rowel® Herbicide, Rowel® FX Herbicide, TripleFLEX® Herbicide, TripleFLEX® II Herbicide, Warrant® Ultra Herbicide and Warrant® Herbicide may be subject to use restrictions in some states. The distribution, sale, or use of an unregistered pesticide is a violation of federal and/or state law and is strictly prohibited. Check with your local Monsanto dealer or representative for the product registration status in your state. Tank mixtures: The applicable labeling for each product must be in the possession of the user at the time of application. Follow applicable use instructions, including application rates, precautions and restrictions of each product used in the tank mixture. Monsanto has not tested all tank mix product formulations for compatibility or performance other than specifically listed by brand name. Always predetermine the compatibility of tank mixtures by mixing small proportional quantities in advance. Degree Xtra®, Genuity®, Harness®, Roundup PowerMAX®, Roundup Ready 2 Yield®, Roundup Ready PLUS®, Roundup Ready®, Roundup Technology®, Roundup®, Rowel®, TripleFLEX® and Warrant® are registered trademarks of Monsanto Technology LLC. Authority® is a trademark of FMC Corporation. Cobra®, Gangster®, Select Max® and Valor® are registered trademarks of Valent U.S.A. Corporation. Some of the product(s) discussed herein are restricted use pesticide(s) and may not be registered in all states. The distribution, sale, or use of an unregistered pesticide is a violation of federal and/or state law and is strictly prohibited. Check with your local dealer or product representative for the product registration status in your state. Impact® is a registered trademark of Amvac Chemical Corporation. All other trademarks are the property of their respective owners. ©2016 Monsanto Company. 130910013218 092115JSC.