



## Prevention and Control of Palmer Amaranth in Cotton

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### Introduction

Palmer amaranth (*Amaranthus palmeri*) is the most common and troublesome weeds in cotton cropping systems. Aggressive growth habit, the ability to germinate throughout the season, and prolific seed production all contribute to Palmer amaranth's ability to compete with cotton. Research has shown that 10 plants per 30 feet of row can decrease cotton yields up to 57% (Morgan et al. 2001).

The overreliance on a single herbicide site of action leads to the evolution of herbicide resistance. Palmer amaranth is currently resistant to glyphosate (group 9) and ALS-inhibiting herbicides (group 2) throughout the cotton growing region of Virginia. Growers who are unsure of Palmer amaranth's resistance status in their field should assume resistance to these herbicides. Additionally, Palmer amaranth resistant to group 14 herbicides is documented in North Carolina (Heap 2020).

### Identification

Palmer amaranth has linear cotyledons (figure 1). Egg-shaped leaves occur on long petioles (leaf stalks). Palmer amaranth can be distinguished from other pigweed species such as redroot pigweed (*Amaranthus retroflexus*), spiny amaranth (*Amaranthus spinosus*), and common waterhemp (*Amaranthus tuberculatus* var *rudis*) by the length of the mature petioles, which are as long or longer than the leaves themselves (figure 2). Flowers occur on a terminal spike up to 1 ½ feet in length (figure 3). Male and female flowers are found on different plants.



Figure 1. Palmer amaranth seedlings. (Eric Scruggs, Virginia Tech)

### Weed Management Tactics

Management of Palmer amaranth must consist of a multi-faceted approach involving prevention, cultural, mechanical, and chemical weed control in order to ensure adequate control and mitigate herbicide resistance.

### Prevention

Prevention is the first step in an effective weed management program. Preventing the introduction of weed seed into fields, as well as preventing the spread of weed seed from one field to another is crucial. Cleaning equipment, especially those capable of harboring high number of seeds, such as, strip till rigs and cotton harvesters should be cleaned properly before moving to another field in order to prevent seed movement. Other examples include preventing the introduction of weed seed to new area through materials such as animal feed and contaminated seed.



Figure 2. Fully developed Palmer amaranth leaves showing the length of the petiole (leaf stalk) which is as long or longer than the leaf. (Ben Beale, Univ. of Maryland).



Figure 3. Tall terminal flower spike, characteristic of Palmer amaranth.

## Cultural

Cultural weed management tactics rely on creating the best possible environment for the crop to succeed, thereby increasing the crop's ability to compete with weeds. Cultural weed management tactics include crop rotation, which can facilitate the use of herbicides with different sites of action, proper soil fertility and pH, adjusting seeding rate, and many others. One of the most effective cultural

tactics for weed management is the use of a cover crop (figure 4). A successful cover crop will create enough biomass to provide weed suppression by creating a layer of plant residue on the soil surface. Growers should strive to maximize cover crop biomass.



Figure 4. High residue rye cover crop prior to cotton planting. (Wykle Greene, Virginia Tech)

## Mechanical

Mechanical weed control involves tactics such as tillage and hand-removal. Research has shown that deep tillage (moldboard plow) conducted every 3-4 years can reduce pigweed emergence up to 73% by burying seeds at a depth where they are unable to germinate (Farmer et al. 2017). However, annual deep tillage can be counterproductive for Palmer amaranth control by bringing buried seeds that are still viable to the soil surface where they are able to germinate.

Hand-pulling is also a method of mechanical weed control which can be utilized in specific situations in which other methods are not feasible such as localized weed escapes, and late season infestations prior to harvest. Palmer amaranth is capable of re-rooting, so make sure to remove pulled plants from the field.

## Herbicides

Herbicide programs must include a comprehensive spray plan which utilizes **multiple, effective sites of action** in order to manage Palmer amaranth. Including multiple, effective sites of action in every herbicide application is necessary in order to

maximize control and minimize the risk of resistance development.

Starting weed free at planting is essential, whether accomplished by tillage or herbicide. A burndown herbicide application prior to cotton planting is critical to starting clean and allowing the best chance possible for a good cotton stand to develop. If weeds have emerged between the burndown herbicide application and planting, a second burndown applied at planting is necessary.

It is also essential to apply a preemergence herbicide either at burndown or at planting in order to provide residual Palmer amaranth control for the developing stand of cotton. Residual herbicides typically provide about 4 weeks of Palmer amaranth control. Therefore, it is recommended to include a residual herbicide with postemergence applications. All postemergence applications should be made to weeds before they reach 4 inches in height. Frequent scouting is necessary to achieve timely applications, as Palmer amaranth can grow up to 1 inch per day.

The herbicide programs listed below assume that Palmer amaranth present is resistant to both glyphosate and ALS-inhibiting herbicides. These herbicides still provide control of other weeds that may be present, so include as necessary for their control. Consult the Pest Management Guide: Field Crops (456-016) publication for more information on controlling other weeds in cotton.

## References

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## Pesticide Precautions

Select and use all pesticides carefully. Before using any pesticide, read the instructions printed on the label of its container; follow those instructions, heed all cautions and warnings, and note precautions about residues. Store pesticides in their original containers. Store them where children and animals cannot get to them — away from food, feed, seed, and other materials that could become harmful if contaminated. Dispose of empty pesticide containers in the manner specified on their labels. See your doctor if symptoms of illness occur during or after use of any pesticide.

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Weed control rating: 10 = 95-100% control, 9 = 85-95%, 8 = 75-85%, 7 = 65-75%, 6 = 55-65%.

Table 1. Preplant Burndown.

<b>Apply (SOA #):</b>	<b>With One of the Following (SOA #):</b>	<b>Efficacy Rating:</b>
Gramoxone (22)		9
	2,4-D (4)	9
	Xtendimax/Engenia/Fexapan (4)	8+
Liberty (10)		8+
	2,4-D (4)	9
	Xtendimax/Engenia/Fexapan (4)	9
Direx (7)		9
	2,4-D (4)	9
	Xtendimax/Engenia/Fexapan (4)	8+
Valor SX (14)		8
	2,4-D (4)	9
	Xtendimax/Engenia/Fexapan (4)	8+

Ratings are based on labeled application rates and weed size or growth stage.  
Treatments are rated only for control of vegetation existing at the time of application.  
Observe plant-back intervals for all products. Intervals vary by product and cotton variety.  
Observe all label restrictions and precautions.

Table 2. Preemergence.

*If Valor was applied at burndown, do not apply Reflex preemergence as this may lead to cotton injury. Similarly, if Direx was applied burndown, do not apply again preemergence.*

<b>Apply <u>two</u> of the following (SOA #):</b>	<b>Rate (fl oz/A)</b>	<b>Efficacy Rating:</b>
Prowl H2O OR Prowl 3.3 (3)	16-64 OR 19.2-57.6	8
Cotoran (7) OR Direx (7)	24 OR 12-16	8
Brake (12)	16	8
Reflex (14)	10-12	9+
Warrant (15)	32-40	9

Rates for preemergence herbicides vary based on soil type.  
Observe all label restrictions and precautions.

Table 3. Postemergence.

Cotton trait	Apply one of the following (SOA #):	Rate (A)	Efficacy Rating
Enlist	Enlist One (4)	1.5-2 pts.	8+
Xtendflex	Xtendimax/Engenia/Fexapan (4) Tavium* (4+15)	12.8 oz./22 oz./22 oz. 56.5 oz.	8+
glufosinate tolerant (Liberty Link and XtendFlex)	Liberty (10)	32 oz.	8+
<b>ADD ONE OF THE FOLLOWING RESIDUAL HERBICIDES</b>			
any	Dual Magnum (15)	1-1.33 pts.	8+
	Outlook (15)	16-21 oz.	8
	Warrant (15)	1.5 qt.	8

Liberty (glufosinate) can be tank-mixed with 2,4-D OR dicamba, depending on the cotton variety (Enlist OR Xtendflex).

Efficacy rating = 9 for these tank-mixtures.

\*Tavium contains Dual Magnum (S-metolachlor) so there is no need to tank-mix with a residual herbicide.

Observe all label restrictions and precautions.

Table 4. Post-Directed.

Apply (SOA #):	Rate (A)	Efficacy Rating
MSMA 6 (17)	2.67 pts.	6
Cotoran (7)	1 qt.	8+
Direx* (7)	0.4-0.8 pts.	8+
Reflex* (14)	1-1.5 pts.	9
Valor SX* (14)	0.5-1 oz.	8+
Zidua SC (15)	1.25-3.5 fl oz	9

\*Cotton must be at least 6 inches tall for Reflex, Direx, and Valor SX.

Observe all label restrictions and precautions.

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