



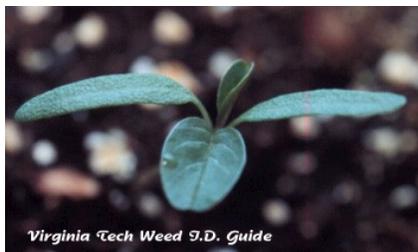
Prevention and Control of Palmer Amaranth in Soybean

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Palmer amaranth (*Amaranthus palmeri*), a member of the "pigweed" family, is one of the most troublesome weeds in many southern row crops. Seed can germinate all season and plants can grow to over 6 feet in height. Plants have either male flowers that shed pollen or female flowers that can produce up to 600,000 seed per plant. One Palmer amaranth per meter of row can reduce soybean yield 32%.



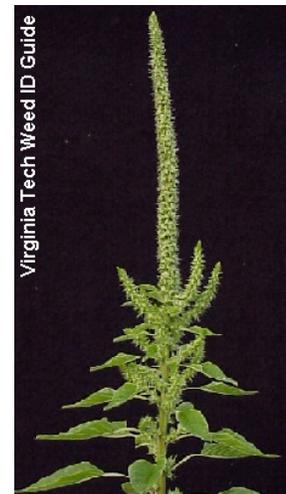
Virginia Tech Weed ID Guide



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In Virginia, Palmer amaranth is increasingly a ubiquitous weed. Its spread can be rapid because of custom harvesting, failing to clean vehicles and equipment after exiting infested fields, and failing to hand remove escapes. More troublesome is that extensive and repeated use of the same herbicide site of action has led to herbicide resistance. Glyphosate (group 9) resistant Palmer amaranth has been observed in most of Virginia. Palmer amaranth resistant to ALS-inhibiting herbicides (group 2) also occurs Virginia, but it not as widespread as glyphosate resistance at this time. Growers are encouraged to assume that all Palmer amaranth is glyphosate-resistant; treating it as such will help ensure resistant populations do not spread.

Palmer amaranth is threatening Virginia's cropping systems. Aggressive steps are necessary to minimize its spread and delay the spread and development of herbicide resistance. No longer can growers settle for the easiest, least expensive, or short-term (single-season) control strategies. Soybean weed management must quickly become a carefully planned and integrated control program that preserves herbicide and genetic (i.e. Roundup Ready®) technologies. For effective and long-lasting Palmer amaranth control, one needs to look 3 to 5 years into the future and not focus solely on herbicides.

Best weed management practices for prevention and control of Palmer amaranth:

- Integrate crop rotation and herbicide site of action rotation
- Diversify in-season herbicide sites of action
- Closely monitor fields before and after herbicide application
- Completely control weeds in noncrop areas
- Clean harvest and tillage equipment
- Remove escapes before seed production

Of those tactics listed, integrating herbicides of different sites of action will have the greatest benefit within the soybean

growing season. This diversification can be accomplished by including a soil residual herbicide with the burndown application, using soil-applied residual herbicides at planting, and tank-mixing postemergence herbicides. Many appropriate residual treatments for Palmer amaranth control are prepackaged mixtures of two or more herbicide site of action (refer to Table 5.1 in the Pest Management Guide for prepackaged mixtures). Recommendations for controlling Palmer amaranth in Roundup Ready® soybeans are listed in the table below. Care should be taken to identify residual treatments that are most efficacious for the overall weed infestation, and to avoid use of ALS-inhibiting herbicides (group 2) where it is suspected or confirmed that Palmer amaranth also exhibits resistance to this chemistry. All glyphosate applications to Palmer amaranth need to include a second site of action, regardless if resistant biotypes are present or not.

Key points for glyphosate resistant Palmer amaranth control:

- **Start clean.** Do not plant into existing weeds.
- **Use a residual herbicide** applied preplant or preemergence. Including a residual herbicide in postemergent applications is recommended.
- **Timing of application.** Spray before weeds reach four inches in height. Treating larger weeds accelerates herbicide resistance development and will result in less control.
- **Use the full, labeled rate.** Cutting rates reduces weed control efficacy and increases the potential to develop herbicide resistance.
- **Diversity sites of action.**
- **Don't ignore escapes.** Devastating populations can build up quickly. Hand removal or control tactics that include crop destruction are worth the effort and cost in the long-term.

Control in LibertyLink® soybeans: Palmer amaranth control with herbicides in LibertyLink® soybeans is essentially the same as in Roundup Ready® soybeans, just replace postemergence glyphosate with Liberty. Liberty is effective at controlling glyphosate resistant Palmer amaranth, as well as glyphosate resistant horseweed or marestail (*Conyza canadensis*) and common ragweed (*Ambrosia artemisiifolia*) when applied to weeds at the appropriate growth stage (generally less than 4 inches tall). Liberty may not completely control some grass weeds, so a preemergent herbicide that is effective on grasses is important. Liberty is a contact herbicide and does not translocate like glyphosate, so good spray coverage is key. A spray volume of 20 gallons per acre is recommended. Air Induction nozzles are not recommended. Lastly, Liberty should NOT be applied early in the morning or late in the evening. Research shows that Liberty is most effective when applied two hours after sunrise or two hours before sunset.

Control in conventional soybeans: Palmer amaranth control in conventional soybeans is essentially the same as in Roundup Ready® soybeans without postemergence glyphosate. Since broad-spectrum postemergence herbicide options are not available, even more emphasis is placed on preplant and preemergence residual herbicides. Grassy weed control herbicides such as Poast or Select may also be necessary.

Diversify sites of action: To effectively rotate herbicide sites of action and thus mitigate herbicide resistance, one cannot rely on herbicide product names. Rather, site of action group numbers indicate a product's site(s) of action. These numbers are listed in the table below or can be found on most herbicide product labels. Whenever possible, do not apply the same number twice in a row and apply various sites of action. Also, make sure the herbicide is effective for controlling the target weed. If resistance to ALS-inhibiting herbicides is expected, do not apply group 2 herbicides.

Herbicide programs for Palmer amaranth control in Roundup Ready® soybeans.¹

FULL-SEASON			
	Early preplant burndown. Choose an option below:	Preemergence.² Choose an option below:	Postemergence. Two applications may be necessary. Choose the option that describes your situation:
Option 1: no residual herbicide with early preplant burndown	glyphosate (9) with one of the following: 2,4-D ³ (4) Clarity ³ (4) OR gramoxone (22) with one of the following: 2,4-D ³ (4) Clarity ³ (4) OR Liberty (10) with one of the following: 2,4-D ³ (4) Clarity ³ (4)	Choose one of the following: Authority Elite (14, 15) Authority MTZ (14, 5) ⁴ Boundary (15, 5) ⁴ Prefix (14, 15) ⁵ OR Choose one of the following and apply with Dual Magnum (15), Intro (15), or Zidua (15): Canopy (2, 5) ⁴ metribuzin (5) ⁴ Linex (7) or Lorox (7) OR Choose one of the following and apply with Prowl (3) Authority XL (14, 2) or Sonic (14, 2) Canopy (2, 5) ⁴ Envive (14, 2) Valor SX (14) Valor XLT (14, 2) Zidua (15)	No Palmer amaranth emerged, choose one: glyphosate (9) glyphosate (9) with Dual Magnum (15) or Warrant (15) if Dual Magnum not previously applied Palmer amaranth is 4 inches tall or less and is resistant to ALS-inhibiting herbicides, choose one: Flexstar GT (9, 14) ⁵ Glyphosate (9) with one of the following: Cobra (14) Flexstar (14) ⁵ Storm (14, 6) Reflex (14) ⁵ Ultra Blazer (14) Palmer amaranth is 4 inches tall or less and is not resistant to ALS-inhibiting herbicides (2), choose one: STS or BOLT varieties glyphosate (9) with one of the following: Harmony SG (2) Pursuit (2) Sceptor (2) Synchrony XP (2) Non-STS or non-BOLT varieties glyphosate (9) with one of the following: Pursuit (2) Sceptor (2)
	Option 2: residual herbicide with early preplant burndown	Apply one of the following with the early preplant burndown options above: Envive (14, 2) Valor SX (14) Valor XLT (14, 2) Sharpen (14)	Choose one of the following or combine two with different sites-of-action: ² Boundary (15, 5) ⁴ Canopy (2, 5) ⁴ Dual Magnum (15) Intro (15) Linex (7) or Lorox (7) metribuzin (5) ⁴ Outlook (15) Prowl (3)

DOUBLE-CROP	
Preemergence: apply with gramoxone (22) or Liberty (10) with an option below: Choose one of the following: Authority Elite (14, 15) Authority MTZ (14, 5) ⁴ Boundary (15, 5) ⁴ Prefix (14, 15) ⁵ OR Choose one of the following and apply with Dual Magnum (15), Intro (15), or Zidua (15): Canopy (2, 5) ⁴ metribuzin (5) ⁴ Linex (7) or Lorox (7) OR Choose one of the following and apply with Prowl (3) Authority XL (14, 2) or Sonic (14, 2) Canopy (2, 5) ⁴ Envive (14, 2) Valor SX (14) Valor XLT (14, 2) Zidua (15)	Postemergence. Two applications may be necessary. Choose the option that describes your situation: No Palmer amaranth emerged, choose one: glyphosate glyphosate (9) with Dual Magnum (15) or Warrant (15) if Dual Magnum not previously applied Palmer amaranth is 4 inches tall or less and is resistant to ALS-inhibiting herbicides (2), choose one: Flexstar GT (9, 14) ⁵ Glyphosate (9) with one of the following: Cobra (14) Flexstar (14) ⁵ Storm (14, 6) Reflex (14) ⁵ Ultra Blazer (14) Palmer amaranth is 4 inches tall or less and is not resistant to ALS-inhibiting herbicides (2), choose one: STS varieties glyphosate (9) with one of the following: Harmony SG (2) Pursuit (2) Sceptor (2) Synchrony XP (2) Non-STS or non-BOLT varieties glyphosate (9) with one of the following: Pursuit (2) Sceptor (2)

applications of a PPO-inhibiting (14) herbicide per season. Tradenames listed are registered trademarks of their respective owners. This is not a product endorsement.

² If weeds were not completely controlled or have emerged since preplant burndown, add gramoxone (22) or Liberty (10) to the options listed.

³ For full season plantings: Planting intervals for 2,4-D and Clarity are: 2,4-D at 1.0 pt/A 15 days, 1 qt/A 30 days; Clarity 0.5 pt/A, 1 inch of rain/irrigation and 14 days.

⁴ Product contains metribuzin; some soybean varieties are sensitive to metribuzin.

⁵ Fomesafen is an active ingredient in Prefix, Flexstar, Flexstar GT, and Reflex. Only one application of fomesafen is allowed per year.