

WEED MANAGEMENT IN COTTON

Effective weed management is one of many critical components of successful cotton production. Because cotton does not compete well with weeds, especially early in the season, a given number of weeds will reduce cotton yield more than corn or soybean yield. Weeds also may interfere more with harvesting of cotton and can reduce lint quality because of trash or stain.

Crop Rotation

Crop rotation aids in the management of nematodes and diseases. Additionally, it can be a significant component of a weed management program. Crop rotation allows the potential use of herbicides with different modes of action on the same field in different years. By rotating cotton with other crops and selecting a herbicide program for the rotational crop that effectively controls the weeds that are difficult to control in cotton, one can reduce or prevent the buildup of problem weeds. **Crop rotation and properly planned herbicide rotation are also critical components of a herbicide resistance management strategy.**

When selecting a herbicide program for crops preceding cotton, consider rotational restrictions for the various products. This information can be found on herbicide labels. Many of the commonly used herbicides in other crops do not carry over to cotton. However, labels for products listed below contain significant rotational restrictions for cotton.

Authority First	Finesse Grass & Broadleaf	Python
Authority MTZ	Finesse	Scepter
Cadre	Lightning	Spartan
Extreme	Pursuit	

Similarly, several cotton herbicides including Cotoran, diuron, Envoke, and Staple have rotational restrictions to other crops.

Cultivation

Cultivation has traditionally been a significant component of cotton weed management programs. In addition to controlling weeds, cultivation may improve early season cotton growth in tight or crusted soils. On most soils, however, cultivation is of no value beyond weed control.

As better weed management technology has become available, the need for cultivation has decreased. Most growers have successfully eliminated cultivation, and many have converted to reduced-till systems. Eliminating cultivation reduces equipment and labor demands and the subsequent weed flushes, moisture loss, and root damage associated with the practice.

Unfortunately, herbicide resistance in weeds is forcing Georgia growers to return to cultivation as a component of their weed management programs.

Planning a Herbicide Program

Before selecting one or more herbicides, you should know what weeds are present or are expected to appear, the soil characteristics (such as soil organic matter and texture), the capabilities and limitations of the various herbicides, the weeds controlled by these herbicides, and how to best apply them.

Application rates for soil-applied herbicides depend on soil texture and organic matter content. Failure to adjust application rates for these soil characteristics may result in poor weed control or crop injury.

Weed Mapping

The first step in a weed management program is to identify the problem. This is best accomplished by weed mapping. Survey the fields each fall and record on a field map the species and population levels present. Species present in the fall will likely be the predominant problems during the following year. You can better plan a herbicide program if you know ahead of time what species to expect. Additionally, by referring to weed maps over a period of two or three years, you can detect shifts in the weed populations and make adjustments in the herbicide program to deal with changes that occur.

In-Season Monitoring

During the first 8 weeks after planting, check fields at least weekly to determine the need for postemergence herbicides or cultivation. After eight weeks, check fields periodically to evaluate the success of the weed management program and to determine the need for preharvest control measures. If weeds are controlled for the first ten weeks, any later emerging weeds will seldom become problems. Proper weed identification is necessary because different weed species respond differently to various herbicides. Contact your local Extension office for aid in weed identification.

Weed Management in Conventional Cotton Varieties

Very little non-transgenic cotton is now being grown in Georgia. Growers planting conventional cotton varieties can find detailed information on weed management in the *2008 Georgia Pest Control Handbook* or in Appendix VI of this Production Guide.

Weed Management in Liberty Link Cotton

Liberty Link refers to transgenic cotton resistant to the herbicide glufosinate, which is sold under the trade name Ignite 280.

Timing of Application

Liberty Link cotton tolerance to Ignite is excellent. Ignite can be applied overtop of Liberty Link cotton from emergence until the early bloom stage without concern over injury or fruit shed. On cotton larger than about 10 inches, a semi-directed application may be preferred in order to obtain better coverage on weeds under the cotton canopy.

The optimum weed size for treatment with Ignite 280 varies, depending on the weed species and growing conditions. The label is most restrictive on pigweed, Palmer amaranth, tropic croton, spurred anoda, velvetleaf, Florida beggarweed, and annual grasses. Palmer amaranth should be no more than 2 inches tall and the other species mentioned should be no more than 3 inches tall. Goosegrass should be 2 inches or less. Under dry or other stressful conditions, Palmer amaranth and all annual grasses should be 2 inches or smaller when treated.

Application Equipment

Ignite 280 behaves much like a contact herbicide. Hence, good spray coverage is necessary. The label recommends flat-fan nozzles, 30 to 60 psi, and a minimum of 15 gallons per acre spray volume. Drift-reducing nozzles, such as air-induction nozzles that are commonly used to apply glyphosate, are not appropriate for Ignite 280 applications. Drift-reducing nozzles produce large droplets which may not give adequate spray coverage for a contact herbicide.

Need for Soil-Applied Herbicides

A preemergence application of Prowl and/or Cotoran, Direx, Staple, or Reflex or a preplant incorporated application of Prowl or Treflan is recommended for Liberty Link cotton. These herbicides would help control annual grasses, pigweed species, and/or Florida pusley, the common weeds that can be difficult to control with Ignite.

Tank Mixes With Ignite 280 Applied Overtop of Liberty Link Cotton

Staple LX can be mixed with Ignite 280 applied overtop. The typical rate of Staple LX would be 1.3 to 1.7 fluid ounces per acre to improve control of larger pigweed species. Also, if activated by rainfall, Staple will provide residual control or suppression of sensitive species such as pigweeds. The Staple LX rate can be increased to 2.6 fluid ounces per acre to improve control of troublesome weeds. Staple will not control biotypes of palmer amaranth resistant to ALS herbicides (see Appendix VI).

Dual Magnum can be tank mixed with Ignite 280 applied overtop to cotton 3 inches or larger until 100 days prior to harvest. Dual Magnum will not improve control of emerged weeds. If activation is timely, it will provide residual control of annual grasses and pigweed species.

Do not tank mix both Dual Magnum (or generic metolachlor) and Staple with Ignite!

Directed Herbicides in Liberty Link Cotton

Ignite 280 can be directed to Liberty Link cotton up to the early bloom stage. The Ignite label specifies a maximum of 43 fluid ounces per application and a maximum seasonal use of 87 fluid ounces. Ignite 280 can be directed alone or mixed with Aim, Caparol, Direx, or Staple. Additionally, any conventional directed herbicide can be applied to Liberty Link cotton.

Difficult-to-Control Weeds in Liberty Link Systems

Florida pusley. Ignite has little activity on Florida pusley and successful management will depend on the use of an effective soil-applied herbicide.

Pigweed species. Pigweed species, including Palmer amaranth, can be controlled by Ignite 280. However, timing of application to pigweed species is critical, especially under dry conditions. An at plant herbicide system with residual control is strongly encouraged. Use of an at plant herbicide will make the timing of application of Ignite much less critical. Staple may also be mixed with Ignite to improve control of emerged pigweed, as long as the pigweed is not resistant to ALS herbicides (see Appendix VI).

Goosegrass and other annual grasses. In general, Ignite 280 is more effective on broadleaf weeds than grasses. Timing of application to grasses, and especially goosegrass, is critical. Two applications of Ignite are normally needed to control goosegrass. A soil-applied

herbicide, such as Prowl or Treflan incorporated or Prowl or Cotoran preemergence, can help tremendously in controlling goosegrass and other annual grasses. Dual Magnum mixed with Ignite will not improve control of emerged grasses, but it can provide residual control. This can be important in control of goosegrass as this grass often emerges later in the season.

Ignite 280 should not be tank mixed with postemergence grass-control herbicides. These tank mixes are very antagonistic (reduced grass control). If additional grass control is needed, any of the grass-control herbicides (Assure II, Fusilade DX, Poast, Select, Select max) can be applied 3 days before or 7 days after Ignite 280.

Nutsedge. Ignite burns nutsedge but the weed usually grows back. Adequate nutsedge control can often be obtained with Ignite 280 followed by Envoke and a directed MSMA application.

Dayflower and Doveweed. Ignite will not control spreading dayflower. This weed can be controlled with Staple LX applied postemergence at 2.6 fluid ounces per acre or directed herbicide combinations containing MSMA. Postemergence herbicides should be applied when spreading dayflower shoots are less than 3 inches. Ignite has some activity on dove weed; however, the weed usually grows back. Gramoxone, applied under a hood, is very effective on dove weed. Additionally, preliminary results indicate that Dual Magnum if applied before dove weed germination and Valor plus MSMA directed to emerged dove weed can be effective.

Tropical Spiderwort. Ignite is not very effective on tropical spiderwort. In Liberty Link cotton where spiderwort is present, the use of Cotoran applied at planting, Cotoran plus MSMA plus Dual Magnum early directed, and Direx or Valor plus MSMA at layby would be in order. Additionally, cultivation or hooded applications of Gramoxone also may be required.

Weed Management in Roundup Ready Cotton

Roundup Ready cotton is any variety of transgenic cotton containing the gene that imparts resistance to the herbicide glyphosate (Roundup and other brands). Roundup Ready Flex cotton was commercially introduced in 2006. This new generation of Roundup Ready technology has better expression of the resistance trait in the reproductive tissue of the plant. Roundup Ready Flex technology allows for higher glyphosate application rates and later overtop applications. Roundup Ready technology was grown on more than 98 percent of Georgia's acreage in 2007.

Comparing Glyphosate Formulations

A number of brand names and formulations of glyphosate are available (Appendix V). Glyphosate products are formulated as isopropylamine salts and potassium salts. Products vary in their concentration of active ingredient. Labels for some brands direct the user to add nonionic surfactant. Other brands are "loaded formulations," meaning additional surfactant is not necessary. Read the label of the brand used to determine need for surfactant.

The best way to compare various glyphosate products and application rates is on the basis of acid equivalence (a.e.). See Appendix V for assistance in determining the rate of formulated product that gives the desired rate in pounds acid equivalent.

The higher application rates allowed on Roundup Ready Flex cotton may occasionally lead to contact burn on cotton foliage. This burn is usually minor, but severe burn has occasionally been noted. Roundup Original Max, Roundup PowerMax, and Roundup WeatherMax are formulated to reduce this potential for foliar burn. Other brands of glyphosate are currently not registered for overtop application to Roundup Ready Flex cotton beyond the four-leaf stage.

Timing of Application: Roundup Ready (non-Flex) Varieties

Most brands of glyphosate can be applied overtop of Roundup Ready cotton any time from cotton emergence until the fourth true-leaf stage of the crop (or fifth true leaf no larger than a quarter coin). The label-suggested rate for annual weeds is 0.56 to 0.75 pound acid equivalent per acre, depending on weed size. Registered brands of glyphosate can be applied twice overtop of Roundup Ready cotton as long as the two applications are at least 10 days apart, two nodes of new growth have occurred between applications, and the second application is made before the cotton exceeds the four-leaf stage.

Labels of glyphosate brands registered for application to Roundup Ready cotton prohibit over-the-top application on cotton larger than the four-leaf stage except in salvage situations. Glyphosate applied overtop of cotton larger than the four-leaf stage can and often does cause significant fruit abortion.

If application is desired on cotton larger than four leaves, glyphosate can be directed until layby. Two directed applications can be made per season. The maximum rate per application is 0.75 pound acid equivalent per acre. Glyphosate labels caution users to be especially careful to minimize contact with the cotton plant when directing on cotton larger than the four-leaf stage. Sloppily directed applications of glyphosate (40 to 50% up the plant) have caused significant fruit abortion and reduced yield in multiple trials conducted in Georgia. Thus, growers are advised to minimize contact with the crop as specified on the label when directing glyphosate.

Timing of Application: Roundup Ready Flex Varieties

Glyphosate may be applied overtop or directed to Roundup Ready Flex varieties any time from cotton emergence until seven days prior to harvest. The maximum rate for any single application between crop emergence and the 60% open boll stage is 1.13 pounds acid equivalent (a.e.) per acre (32 fluid ounces of Original Max, PowerMax, or WeatherMax). A total of 4.5 pounds a.e. per acre (4 quarts Original Max, PowerMax, or WeatherMax) can be applied during this time frame. An additional 1.55 pounds a.e. per acre can be applied from the 60 percent open boll stage until seven days prior to harvest.

Need for Soil-Applied Herbicides

A major decision growers face when planting Roundup Ready cotton is whether to use soil-applied herbicides. Extensive Georgia research has compared weed management with glyphosate in Roundup Ready cotton with and without various soil-applied herbicides. Except for fields with Florida pusley and glyphosate-resistant Palmer amaranth, excellent season-long weed control can be obtained without use of soil-applied herbicides.

However, weed resistance to glyphosate is a very serious threat (see “Herbicide Resistance Management”) and a key component of a resistance management strategy is to utilize multiple herbicide modes of action. Thus, use of preemergence or preplant incorporated herbicides are strongly encouraged. These herbicides will not only aid in resistance management but also make timing of the first glyphosate application much less critical.

Should replanting be necessary where soil-applied herbicides have been used, it is best to run the planter back in the original drill without any soil preparation if soil conditions permit. In this case, do not apply any additional residual herbicides. If weeds have emerged, glyphosate or Gramoxone can be applied for burndown. Gramoxone or Aim will control small emerged cotton.

If reworking the seedbed is necessary, use shallow tillage such as light disking. Do not apply additional preplant-incorporated herbicides. If the original preemergence herbicide was broadcast, do not apply any more. If the preemergence herbicide was originally banded, a second preemergence banded application at the minimum rate for the soil type would be in order. Do not re-bed without first disking. Re-bedding without disking can lead to severe injury.

Over-the-Top Tank Mixes with Glyphosate

Staple LX can be mixed with glyphosate and applied overtop of Roundup Ready cotton from the cotyledonary stage through the four-leaf stage. Staple LX plus Roundup Original Max, Roundup PowerMax, or Roundup WeatherMAX can be applied to Roundup Ready Flex cotton from the cotyledonary stage until 60 days prior to harvest. Staple LX is typically applied at 1.3 to 1.7 fluid ounces when tank mixed with glyphosate. Salvage applications do allow increased rates of Staple (see label).

A mixture of glyphosate plus Staple will improve control of hemp sesbania, morningglory (except tall morningglory), spreading dayflower, tropical spiderwort, and glyphosate-resistant Palmer amaranth as compared with glyphosate alone. Staple also may give some residual control of susceptible weeds such as pigweed species. Palmer amaranth resistant to Staple and other ALS inhibitors (see Appendix VI) is present in MANY Georgia fields.

A mixture of glyphosate plus Staple may injure cotton. Applied overtop, Staple often causes temporary yellowing of the cotton bud. Research has demonstrated that cotton recovers quickly, and there is seldom an adverse effect on yield or maturity. On occasion, however, Staple applied overtop can cause moderate to severe injury. The potential for significant injury from Staple appears to be greater when the herbicide is applied during or shortly before a period of cool temperatures and when dew is present on the cotton at time of application. Other stresses such as wet weather, seedling disease, or thrips damage may worsen injury.

Envoke at 0.1 oz of product per acre can be mixed with Roundup Original Max, PowerMax, or WeatherMAX and applied overtop of ONLY Roundup Ready FLEX cotton. Labels allow this mixture to be applied overtop of cotton between the 5- and 12-leaf stage. However, Georgia research strongly indicates that applications be made to cotton between the 8- and 12-leaf stage only. Some injury and plant stunting will likely occur; thus, this mixture should

be tried on limited acreage until a grower is comfortable with the mixture. Envoke mixed with glyphosate will improve control of nutsedge, hemp sesbania, and larger *Ipomoea* morningglory (will not enhance smallflower morningglory control) compared to glyphosate alone.

Dual Magnum can be applied overtop of Roundup Ready cotton that is at least 3 inches tall until 100 days prior to harvest. Mixtures with glyphosate can be applied overtop of two- to four-leaf Roundup Ready cotton. The application window is much wider on Roundup Ready Flex cotton, but the glyphosate plus Dual Magnum mixture should be applied well before canopy closure to ensure that the Dual Magnum is deposited on the soil in the row middles.

Crop injury from glyphosate plus Dual overtop is typically minor, with necrotic speckling noted on leaves contacted. This injury is temporary; no speckling on later-emerging leaves, no stunting, and no adverse effect on yield or maturity have been noted. The exception has been when additional adjuvants are included in the mixture or when applications are made when heavy dew is on the cotton or when the weather is extremely hot and humid.

Mixing Dual Magnum with glyphosate will have little affect on emerged weeds by glyphosate. However, if timely rainfall for activation is received, Dual Magnum can provide residual control of most annual grasses (suppression of Texas panicum), pigweed species (including Palmer amaranth), doveweed, and tropical spiderwort (control for 21 to 35 days), and suppression of yellow nutsedge and spreading dayflower. Dual Magnum mixed with glyphosate may also broaden the window of application for directed herbicides on Palmer amaranth.

Generic brands of metolachlor are available. Growers should be aware that some generics (Brawl and Medal are exceptions) are not the same as Dual Magnum. Metolachlor is a mixture of four stereo-isomers. Two of the isomers (referred to as *S*-metolachlor) are herbicidally active whereas the other two isomers (referred to as *R*-metolachlor) have little herbicidal activity. Labels for most generic brands refer to the active ingredient as “metolachlor”, meaning it is the mixture of active and inactive isomers. The active ingredient in Dual Magnum is “*S*-metolachlor”, the active isomers. Georgia research has shown that “metolachlor” products applied at the same rate as “*S*-metolachlor” products will likely not provide the same length of residual control. The “metolachlor” product use rate would need to be increased by 50 percent to get the same activity as “*S*-metolachlor”.

Sequence is a prepackaged mixture of the potassium salt of glyphosate and *S*-metolachlor. Applied at 2.5 pints per acre, Sequence is equivalent to 0.7 lb acid equivalent of glyphosate plus 1 pint of Dual Magnum.

Glyphosate versus Other Directed Herbicides

In Roundup Ready cotton or Roundup Ready Flex cotton, you have the option of directing either glyphosate or a traditional herbicide combination. In some experiments, better broadleaf weed control has been observed when traditional directed herbicides were used. The use of a traditional directed herbicide also can help in weed resistance management. However, if grasses are a predominant problem and they are larger than one inch, glyphosate may be the more effective option. If one decides to use glyphosate, mixing other labeled herbicides with glyphosate is

encouraged thereby possibly improving postemergence weed control, providing residual weed control, and assisting in resistance management.

Directed Tank Mixes with Glyphosate

Potential tank-mix partners with glyphosate applied postemergence-directed include Aim, Caparol, diuron (Direx, others), Dual Magnum, Envoke, ET, Staple, Suprend, and Valor.

Aim and ET are very effective on morningglory, and when mixed with glyphosate will improve control of larger morningglory and Florida pusley compared to glyphosate alone. Additionally, Aim will provide excellent control of emerged tropical spiderwort that is four inches or less. Cotton should be at least 16 inches tall, and the spray must be directed precisely to the woody portion of the stem. Spray contact with green stem tissue will cause injury. Neither product provides residual control.

Caparol or diuron mixed with glyphosate will improve morningglory control compared to glyphosate alone. Caparol at 2 pints or Direx at 1.5 pints will provide some residual control of small-seeded broadleaf weeds, such as pigweed, if activated by rainfall. Direx is usually more effective on Palmer amaranth. Cotton should be at least 12 inches tall before directing Caparol or Direx at these rates. Occasionally, mixing Caparol or Direx with glyphosate will reduce grass control by glyphosate. This is most likely to occur under dry growing conditions when grasses are large. Do not reduce the glyphosate rate when tank-mixing.

Dual Magnum mixed with glyphosate will have little affect on control of emerged weeds by glyphosate. However, if Dual Magnum is activated by rainfall, it will provide residual control of annual grasses (Texas panicum is only suppressed), pigweed species, doveweed, and tropical spiderwort, and suppression of yellow nutsedge. This combination can be directed to cotton that is at least 3 inches tall through 80 days prior to harvest.

Envoke mixed with glyphosate will improve control of nutsedge, hemp sesbania, and larger *Ipomoea* morningglory (will not enhance smallflower morningglory control) compared to glyphosate alone. Cotton should be at least 6 inches tall. Preliminary research indicates Envoke has more residual activity on broadleaf weeds than originally thought. Palmer amaranth resistant to Envoke and other ALS inhibitors is present in many Georgia fields.

Staple LX mixed with glyphosate will improve control of hemp sesbania, morningglory (except tall morningglory), spreading dayflower, tropical spiderwort, and glyphosate-resistant Palmer amaranth as compared with glyphosate alone. Staple also may give some residual control of susceptible weeds such as pigweed species. Palmer amaranth resistant to Staple and other ALS inhibitors is present in many Georgia fields.

Suprend is a mixture of the active ingredients in Caparol and Envoke. Suprend mixed with glyphosate will improve control of larger morningglory and nutsedge. Is also will provide residual control of susceptible broadleaf weeds. Cotton should be at least 8 inches tall when directing Suprend.

Valor SX mixed with glyphosate will improve control of dove weed, larger morningglory, florida pusley, and tropical spiderwort compared to glyphosate alone. Cotton should be at least 16 inches

tall and the stem should be completely “woody” before this combination is precisely directed to the bottom 1 to 2 inches of the cotton stem. Add nonionic surfactant at 1 qt per 100 gal spray solution if glyphosate brand requires adjuvant. DO NOT use crop oil concentrate, methylated seed oil, organo-silicone adjuvants, or any adjuvant product containing these. Valor, if activated by rainfall, will provide excellent residual control of pigweed species including Palmer amaranth, Florida pusley and many other broadleaf weed species. Valor has a very favorable rotational package, see label.

Weeds Hard to Control with Glyphosate

Bermudagrass: The most effective method to manage severe bermudagrass populations is a fall application of glyphosate followed by glyphosate or postemergent graminicides in the following crop. Postemergence graminicides (Select, Fusilade DX, Assure II) may be more effective than glyphosate in controlling immature bermudagrass with runners less than 6 inch.

Doveweed: Glyphosate will not control doveweed. Dual Magnum will control doveweed well if the herbicide is applied and activated before doveweed germination. Gramoxone applied with a hooded sprayer will also control doveweed. And, directed applications of Valor plus MSMA, Valor plus glyphosate, and diuron plus glyphosate appear to be fairly effective.

Florida pusley: Florida pusley can be controlled by glyphosate but ONLY if applied when the weed is very small (1 inch or less) and under favorable growing conditions; multiple applications are often necessary. One SHOULD use a preplant incorporated or preemergence herbicide. Both yellow herbicides and Cotoran control this weed if applied properly and activated by rainfall.

Hemp Sesbania: Hemp sesbania is very difficult to control with glyphosate after the first true leaf. When hemp sesbania is expected to be a problem, soil applied herbicides such as Cotoran are in order. Follow with a glyphosate plus Staple postemergence application and then a postemergence-directed application of a traditional herbicide combination. Combinations containing Cobra, Envoke, or Suprend would be a good option for the directed application. Envoke applied overtop of cotton would also be an option but the sesbania may be greater than 3 inches when the label allows Envoke to be applied topically to cotton.

Morningglory: One application of glyphosate usually will not adequately control morningglory. It will, however, halt growth of small morningglory so that the weed can be taken out with cultivation, a second application of glyphosate, or a later application of a conventional directed herbicide. Cotoran or Staple applied preemergence also will aid in control of morningglory. For morningglory (except the species tall morningglory) 3 inches or larger, a tank mix of glyphosate plus Staple is more effective than glyphosate alone. Envoke also is very effective on *Ipomoea* morningglory but should only be mixed with glyphosate and applied to Roundup Ready FLEX cotton between the 8- and 12-leaf stage.

At time of layby or directed applications, conventional chemistries such as MSMA plus Caparol, Cobra, diuron, Layby Pro, Suprend, or Valor would be more effective than glyphosate. However if one chooses to use glyphosate, the addition of Aim, Caparol, diuron, Envoke, ET, Staple, Suprend, or Valor would be beneficial (see labels for application timings and cotton sizes).

Nutsedge: Two applications of glyphosate at 0.75 pound acid equivalent per acre normally control yellow and purple nutsedge. Good results also have been obtained with glyphosate at 0.75 pound acid equivalent applied overtop followed by a directed application of MSMA at 2.5 pints per acre or Envoke at 0.15 ounce per acre. In severely infested fields, best results will be obtained with two overtop applications of glyphosate followed by a directed application of glyphosate, MSMA, Envoke, or Suprend. Do not mix MSMA with glyphosate and apply overtop of cotton.

Volunteer Roundup Ready corn. Assure II, Fusilade DX, or Select may be mixed with glyphosate and applied overtop to control Roundup Ready corn in Roundup Ready cotton. Suggested rates include the following: 5 or 8 ounces of Assure II on corn up to 18 or 30 inches, respectively; 6 ounces of Fusilade DX on corn up to 24 inches; or 4 to 6 ounces of Select on corn up to 12 or 24 inches, respectively; or 8, 10, or 12 oz of Select Max on corn up to 8, 18, or 24 inches, respectively. Alternatively, these herbicides may be applied overtop alone later in the season. See labels for these products concerning maximum corn size and use of adjuvants when applying alone or mixed with glyphosate.

Volunteer Roundup Ready soybeans. Cotoran applied preemergence may provide adequate control. Staple alone typically does not adequately control volunteer soybean. However, Staple applied to three- to four-trifoliolate soybean followed by a directed application of Caparol, diuron, or Suprend plus MSMA may provide adequate control. The most effective option to control volunteer soybean is Envoke applied overtop to soybeans with less than six trifoliolate leaves (see www.cotton.org/journal/2005-09/2/upload/jcs09-102.pdf). Envoke may not control soybean that is taller than about 12 inches.

Managing Tropical Spiderwort in Roundup Ready Cotton

Tropical spiderwort is a noxious, exotic, invasive weed that has spread quickly and has become a serious pest in many Georgia production areas. Increased prevalence of tropical spiderwort in Georgia may be attributed in part to 1) adoption of weed management programs that lack residual herbicides and 2) adoption of reduced-tillage production systems. Additionally, the rapid spread of this pest has been influenced by the spread of birds including doves.

The following 3 tables are suggestions for the management of different levels of tropical spiderwort infestations in Georgia Roundup Ready cotton. ***Refer to Appendix IV or pest control handbook for herbicide rates and proper cotton sizes at time of application.***

Table 1. Managing **SEVERE** Infestations of Tropical Spiderwort in Roundup Ready (RR) Cotton.*

Preemergence	Postemergence (1- to 4-leaf cotton)	Layby Directed ²
(Planting before May 10) Use at-plant herbicide appropriate for other weeds	Glyphosate + Dual Magnum ¹ (12 oz/A) (Spiderwort should be less than 1 inch and the Dual must completely cover the soil)	Diuron + MSMA + Dual Magnum (8-12 oz/A)
(Planting after May 10) Prowl ³ + Cotoran		

*Deep turning the land will provide fair control of spiderwort. This practice may be needed in addition to herbicides in some fields.

1. Dual Magnum contains S-metolachlor. The generic brands Brawl and Medal also contain S-metolachlor. Other generic brands contain metolachlor, a mixture of R and S isomers. Per unit of product, brands containing S-metolachlor provide longer control.
2. Diuron+MSMA+Dual is often a little more effective than glyphosate+Aim+Dual because of additional residual control provided by Diuron. In areas where hooded applications are available, glyphosate + Valor + Dual would be similarly effective.
3. Prowl will not provide control of spiderwort but will suppress other weeds.

Table 2. Managing **MODERATE** Infestations of Tropical Spiderwort in RR Cotton.

Preemergence	Postemergence (1- to 4-leaf cotton)	Layby Directed
(Planting before May 10) Use at-plant herbicide appropriate for other weeds	Glyphosate + Dual Magnum ¹ (12 oz/A) (Spiderwort should be less than 1 inch and the Dual must completely cover the soil)	diuron + MSMA or Glyphosate + diuron or Glyphosate + Aim + Dual Magnum (8-12 oz/A)
(Planting after May 10) Prowl ² + Cotoran		

1. Dual Magnum contains S-metolachlor. The generic brands Brawl and Medal also contain S-metolachlor. Other generic brands contain metolachlor, a mixture of R and S isomers. Per unit of product, brands containing S-metolachlor provide longer control.
2. Prowl will not provide control of spiderwort but will suppress other weeds.

Table 3. Managing **LIGHT** Infestations or **DELAYING ARRIVAL** of Tropical Spiderwort in RR Cotton.

Preemergence	Postemergence (1- to 4-leaf cotton)	Layby Directed
Use at-plant herbicide appropriate for other weeds	Glyphosate + Dual Magnum ¹ (16 oz/A) (Spiderwort should be less than 1 inch and the Dual must be able to completely cover the soil)	Valor + MSMA Direx + MSMA Glyphosate + Valor Glyphosate + Direx

1. Dual Magnum contains S-metolachlor. The generic brands Brawl and Medal also contain S-metolachlor. Other generic brands contain metolachlor, a mixture of R and S isomers. Per unit of product, brands containing S-metolachlor provide longer control.

Late-Season Application

Current glyphosate labeling allows for a late-season application to Roundup Ready cotton after 20 percent of the bolls have cracked. Research to date has shown no adverse effects when glyphosate is applied overtop Roundup Ready cotton two weeks after the last effective bloom date (see www.cotton.org/journal/2005-09/2/upload/jcs09-110.pdf). A preharvest glyphosate application can be made to Roundup Ready Flex cotton seven or more days ahead of harvest.

Postemergence-Overtop Herbicides - Any Variety

Envoke can be applied overtop of cotton with a minimum of five leaves up to 60 days prior to harvest. Directed application is encouraged on cotton larger than 10 inches to ensure better spray coverage on weeds below the crop canopy. Envoke controls or suppresses nutsedge plus a number of broadleaf weeds that are less than 4 inches in height. Note that Envoke does not control smallflower morningglory, jimsonweed, prickly sida, spreading dayflower, or tropical spiderwort, and it is not very effective on tropic croton and usually Palmer amaranth.

Envoke and Staple have the same mode of action. Hence, Palmer amaranth resistant to Staple will not be controlled by Envoke. Palmer amaranth resistant to both Staple and Envoke are now common across Georgia.

Cotton will sometimes be injured by Envoke applied overtop. Injury is expressed as yellowing in the growing point and shortened internodes. Some degree of crop response can almost always be expected. In most cases, injury is relatively minor and the crop recovers without an adverse effect on yield or quality. On occasion, however, moderate to severe injury has been observed. Smaller cotton appears to be injured more than larger cotton. Other factors contributing to crop injury are unknown. Growers are encouraged to not apply Envoke to cotton with less than seven leaves and to not apply the herbicide to cotton under stress from wet or dry weather or thrips. Also, carefully follow label directions for adjuvant usage, and do not tank mix Envoke with other herbicides (other than Staple, see label) when applying overtop cotton. Tank mix Envoke with only those insecticides specifically mentioned on the Envoke label. Tank mixes of Envoke and mepiquat chloride are discouraged.

Tank mixes of Envoke with Assure II, Fusilade DX, Poast, Poast Plus, Select or Select Max should be avoided. Separate applications of Envoke and the grass-control herbicides by at least 3 days if the grass-control herbicide is applied first or 5 days if Envoke is applied first.

Staple LX can be applied overtop of cotton from the cotyledonary stage until 60 days before harvest. Two applications per year are allowed as long as the total applied per season does not exceed 5.1 fluid ounces.

If applied in a timely manner, Staple controls many broadleaf weeds. Note that Staple applied postemergence does not adequately control lambsquarters, ragweed, sicklepod, spurge, tall morningglory, or tropic croton. Timing of application is critical. Most susceptible broadleaf weeds should not be taller than 3 to 4 inches. Prickly sida must be 1 inch or less for acceptable control. Palmer amaranth should be 2 inches or less. Palmer amaranth resistant to Staple is now common across Georgia.

Tank mixes of Staple LX with Assure II, Fusilade DX, Poast, Poast Plus, Select or Select Max are not recommended because antagonism (reduced grass control) is often observed. When making

sequential applications of Staple and a postemergence grass-control herbicide, apply the Staple at least 5 days before or 3 day after application of the grass-control herbicide.

Grass-control herbicides. Assure II, Fusilade DX, Poast, Poast Plus, Select, and Select Max can be applied overtop of cotton from emergence through mid-season. These products control annual and perennial grasses but are ineffective on nutsedge and broadleaf weeds. All of these products are safe on cotton and are effective when applied to small grasses under good growing conditions. However, Poast, Poast Plus, Select, and Select Max tend to be more effective over a range of annual grass species and environmental conditions. When using any of these herbicides, follow label directions for application rates, application methods, use of adjuvants, and optimum grass size for treatment. Tank-mixing broadleaf herbicides such as Staple or Envoke with these postemergence grass-control herbicides is not recommended.

Postemergence-Directed Herbicides - Any Variety

A number of herbicide combinations are available for directed application to any variety of cotton and include the following: Caparol plus MSMA, Cobra plus MSMA, Cobra plus Direx plus MSMA, Cotoran plus MSMA, Direx plus MSMA, Layby Pro plus MSMA, Linex plus MSMA, Suprend plus MSMA, and Valor SX plus MSMA. Dual Magnum, Aim, and ET may be mixed with some of these herbicide combinations. Although Staple and Envoke could be used at layby, we encourage using alternatives to reduce the potential for further resistance development.

The postemergence-directed herbicides listed above are primarily for annual broadleaf weeds and nutsedge. MSMA in these mixtures will control annual grasses less than 1.5 inches. Except for Aim, ET, MSMA, and Cobra plus MSMA, the options listed above will also provide some residual control of sensitive weeds.

See comments in Appendix VI and herbicide labels for minimum cotton size to treat, maximum weed size, application directions and precautions, and rotational restrictions.

Perennial Broadleaf Weeds

Perennial broadleaf weeds, such as horsenettle, trumpetcreeper, common milkweed, and hemp dogbane, are primarily a problem in no-till situations. Soil-applied herbicides will not control perennial broadleaf weeds, and, with the exception of horsenettle, conventional postemergence-directed herbicides are ineffective. Acceptable control of horsenettle has been obtained with postemergence-directed herbicide combinations containing MSMA. Two applications of MSMA or a combination containing MSMA will be needed for acceptable control. Other species can be suppressed or controlled in non-Roundup Ready cotton by glyphosate applied with a hooded sprayer. Harvest-time applications of glyphosate are also an option to suppress perennial weeds for the following year (see "Preharvest Herbicide Application").

Perennial broadleaf weeds can be suppressed or controlled with multiple applications of glyphosate applied to Roundup Ready cotton. Later applications are generally more effective on perennials, and two applications are more effective than one. Adequate spray coverage should be obtained on low-growing perennials such as trumpetcreeper and horsenettle with standard directed sprayers.

Curly dock is best controlled by a preplant application of Harmony Extra.

Perennial broadleaf weeds can be suppressed or controlled in corn grown in rotation with cotton. In corn, an early postemergence application of Banvel or Clarity alone or mixed with Accent followed by a lay-by application of Banvel or Clarity is most effective. Alternatively, glyphosate or a tank mix of 2,4-D plus Banvel can be applied to infested spots after corn harvest.

Preharvest Herbicide Application

Preharvest herbicide applications are of questionable value in most cases. Desiccating mature weeds likely will not increase harvesting efficiency nor reduce harvesting losses. The major exception would be fields heavily infested with viney weeds such as morningglory and cowpea. Problems with extraneous green matter in harvested cotton are probably overstated. Lint staining from weeds has not been voiced as a significant problem in spindle-picked cotton. Desiccating weeds will more likely increase rather than decrease trash in cotton because gins can remove green plant parts more easily than finely ground, desiccated plant parts. However, if present in large quantities, extraneous green matter can increase the potential for overheating, rot, and stain if the cotton is packed into a module and the module is not properly monitored.

There are no established guidelines for determining when the level of weed infestation justifies a preharvest herbicide application. The information below is based on general observations.

Annual Weeds

Aim or ET. These herbicides are also registered for use as defoliant. Good desiccation of morningglory and cocklebur have been observed with excellent spray coverage. Results on pigweed species have been inconsistent but generally not acceptable. These products will not desiccate grasses or sicklepod. See labels regarding use of adjuvants.

Glyphosate. In non-Roundup Ready cotton, tank-mix 0.75 to 1.5 pounds acid equivalent of glyphosate when at least 60 percent of the bolls are open. The glyphosate should be applied at least 10 days before anticipated harvest. Glyphosate-defoliant combinations generally have been effective on annual grasses, common ragweed, lambsquarters, pigweed, cocklebur, tropic croton, cowpea, and sicklepod. In most cases, cotton leaf regrowth suppression has been observed on non-Roundup Ready cotton.

In Roundup Ready cotton, apply glyphosate after 20 percent of the bolls have cracked. Research in Georgia has shown no adverse effect on Roundup Ready cotton from glyphosate applied 14 days after the last effective bloom date (see www.cotton.org/journal/2005-09/2/upload/jcs09-110.pdf). Remember that glyphosate will not suppress regrowth on Roundup Ready cotton. Glyphosate can be applied in Roundup Ready Flex varieties seven or more days ahead of harvest regardless of the percentage of open bolls.

Gramoxone. Either add 2 to 6 oz of product with standard defoliant or apply after cotton defoliation. When applying after cotton defoliation and at least 80 percent of the bolls are open, the remaining bolls expected to be harvested are mature, and most of the cotton leaves have dropped, apply 1.9 pints of Gramoxone Inteon or 1.3 pints of Gramoxone Max. Broadcast the Gramoxone in a minimum of 20 gallons of water per acre and add 1 pint of nonionic surfactant per 100 gallons of water. Initiate harvest as soon as leaves are toughened (the “green” is removed)

but before foliage becomes brittle. Gramoxone will desiccate most annual weeds with Florida pusley being an exception.

Perennial Weeds

Glyphosate can be applied in the fall to control or suppress perennial weeds for the following year. For johnsongrass control, glyphosate at a rate of 0.75 to 1.5 pounds acid equivalent per acre may be tank-mixed with the defoliant. Apply when at least 60 percent of the bolls are open. Alternatively, glyphosate may be applied after defoliation. Application after defoliation may be preferred in rank cotton to improve spray coverage. Additionally, a separate application of glyphosate allows treatment of only the infested areas of a field, thus reducing herbicide cost. For other perennial weeds, such as bermudagrass, nutsedge, trumpet creeper, horsenettle, common milkweed, and hemp dogbane, glyphosate-defoliant tank mixes are not recommended. If you need to control these weeds, defoliate the cotton as usual. Apply the glyphosate after most of the cotton leaves have dropped. Suggested application rates are 2.25 pounds acid equivalent per acre for nutsedge, trumpet creeper, common milkweed, and bermudagrass, and 3 pounds acid equivalent for horsenettle and hemp dogbane. To reduce costs, spot-spray only infested areas.

Glyphosate should be applied at least 7 to 10 days before the first killing frost.

Herbicide Resistance Management

Herbicide resistance in weeds is not a new problem. The threat posed by herbicide resistance has, however, recently been elevated to a much higher level. Horseweed and common ragweed resistant to glyphosate is scattered across the country and Palmer amaranth resistant to glyphosate and/or ALS herbicides have been confirmed in numerous Georgia counties.

In previous years, growers with herbicide-resistant weeds were fortunate to have new herbicides (specifically, new mechanisms of action) come into the marketplace before the problem became overwhelming. That will not be the case in the foreseeable future; new modes of action are simply not on the horizon. It is therefore imperative that growers begin to take herbicide resistance management very seriously in an attempt to maintain usefulness of current products.

What Causes Resistance?

Herbicide resistance is the inherited ability of a biotype of a weed to survive and reproduce following exposure to a dose of herbicide normally lethal to the wild type. Herbicides do not cause resistance. Rather, herbicides select for resistance naturally occurring in the population. Greater reliance on a particular herbicide, or group of herbicides, with the same mechanism of action puts greater selection pressure on any resistant individuals that may be in the population. A shift to conservation tillage and a corresponding decrease in tillage have led to greater reliance on herbicides and greater potential problems with resistance.

Resistance Management Strategies

There are two prerequisites for resistance. First, one or more individuals possessing genes conferring resistance must be present in the population. Second, selection pressure resulting from extensive use of a herbicide to which these rare individuals are resistant must be exerted on the population. Growers have no way to know if a few plants carrying resistance are present on their

farm. Hence, the only way to prevent a buildup of resistant plants is to utilize management systems that reduce selection pressure on any resistant individuals that may be present.

Greater than 98 percent of cotton in Georgia is planted to Roundup Ready varieties. A similar percentage of soybean and an increasing percentage of corn is also being planted to Roundup Ready varieties. Glyphosate is obviously being applied to this acreage, and it is often being applied multiple times. In many cases, growers have relied almost exclusively on glyphosate for weed control. Extensive reliance on a single mechanism of action (the mechanism by which the herbicide kills susceptible plants) over that much acreage puts tremendous selection pressure on any resistant weeds that may be in the population.

A key component of a resistance management strategy is to integrate herbicides with different mechanisms of action into the cropping system. Appendix VIII is included as an aid for growers to select herbicides with various mechanisms of action. The table lists brand names and active ingredients of herbicides used in agronomic crops. In addition, there is a numeric code for each mechanism of action. An effective resistance management strategy will incorporate herbicides having three or more mechanisms of action in cotton. Additionally, growers are encouraged to minimize their reliance on ALS-inhibiting herbicides as these chemistries are extremely vulnerable to resistance.

Cotton growers can incorporate the recommended diversity in modes of action into a glyphosate-based management program by using soil-applied residual herbicides, tank mixing another herbicide with glyphosate applied postemergence, and using alternatives to glyphosate or at least a glyphosate tank mix at layby. Use of full rates of glyphosate, even in tank mixes, is encouraged. Crop rotation can aid in resistance management if herbicide mechanisms of action for the rotational crop are wisely selected. Where practical, cultivation would also be a very effective component of a resistance management strategy.

Glyphosate-Resistant Horseweed

Glyphosate-resistant horseweed (also called marestail) has been confirmed in adjacent states to the west and north. Horseweed emerges in the fall and will often be in a rosette stage and large enough for identification in February. Pictures of small horseweed and identifying characteristics can be found at www.ppws.vt.edu/scott/weed_id/erica.htm.

It is critical that glyphosate-resistant horseweed be controlled before planting cotton; options to control this weed after Roundup Ready or conventional cotton emergence is very limited. Glyphosate-resistant horseweed can be controlled by tank mixes of glyphosate plus 0.95 pound a.e. of 2,4-D (2 pints of typical 3.8 lb a.e./gal formulation) or glyphosate plus 0.5 pint of Clarity. The tank mix with 2,4-D at this rate should probably be at least 45 days ahead of planting. Cotton planting must be delayed at least 21 days after the accumulation of 1 inch of rainfall following Clarity application.

Horseweed that germinates in the fall can be controlled by winter burndown programs including 2,4-D or Clarity. However, plants that emerge late in the spring after burndown can become problematic. Valor can be added in the burndown mixture to provide residual horseweed control

assuming the herbicide contacts the soil. Cotoran appears to be the most effective at plant herbicide option, Gramoxone needs to be added with Cotoran to control any emerged plants.

Ignite 280 at 29 ounces per acre will also control horseweed if applied when daytime temperatures exceed 75 degrees F. Ignite 280 is an option to control spring-emerging horseweed at planting time or in situations where growers have failed to follow one of the programs previously outlined. Ignite 280 can be applied anytime prior to cotton planting. It is critical that Ignite 280 be applied under warm conditions.

Glyphosate-Resistant Palmer Amaranth

Palmer amaranth is Georgia's most problematic weed in cotton. One Palmer amaranth per 20 row feet can reduce cotton yield 7 percent, and a single female plant has produced 430,000 seeds when competing with cotton for an entire season.

Growers have relied heavily on glyphosate to manage this weed. In 2005, Palmer amaranth resistance to glyphosate was confirmed in Georgia. Resistant populations can not be controlled by glyphosate at any practical rate, if at all. Growers who have resistant Palmer amaranth must adopt aggressive management programs. More importantly, growers who do not have resistance must delay its arrival as there are ***no economical management programs for fields infested with glyphosate-resistant Palmer amaranth.***

Palmer amaranth is a dioecious plant, meaning there are separate male and female plants. Hence, it is an obligate outcrosser; pollen must move from male to female plants for seed production to occur. It is unknown how far this pollen can move and be viable, but rapid spread of glyphosate-resistant Palmer amaranth via pollen movement is eminent. That implies that excellent control of existing glyphosate -resistant and -susceptible populations is necessary to slow its spread.

In formulating a resistance management program for Palmer amaranth and glyphosate, growers must keep foremost in their minds the need to prevent further selection for ALS resistance (Staple, Envoke, Cadre, etc.). Palmer amaranth resistant to both glyphosate and ALS-inhibiting herbicides is being confirmed at one Georgia location. Such cross resistance is disastrous to cotton producer as Staple is the only herbicide available for overtop applications to Roundup Ready cotton to control emerged glyphosate-resistant Palmer amaranth. Hence, Staple and Envoke should be used in Roundup Ready cotton to control Palmer amaranth (and other weeds) only when other options are not suitable. Additionally, ALS inhibitors should be avoided when possible in crops grown in rotation with Roundup Ready cotton.

Below, Tables 1 and 2 are herbicide management programs for glyphosate-resistant Palmer amaranth while tables 2 and 3 are programs strongly encouraged to delay the onset of resistance. Also to help delay resistance, growers need to diversify crop production practices, including crop rotation and use of herbicides with different mechanisms of action (Appendix VI).

For growers who are growing cotton in dryland production areas infested with glyphosate-resistant Palmer amaranth, the use of an Ignite-based programs (Table 2) would be more effective

than Roundup Ready programs if rainfall does not occur within 3 days of applying the at plant herbicide applications in Roundup Ready programs.

Table 1. Managing Glyphosate-Resistant Palmer Amaranth in Roundup Ready (RR) Cotton.*

Preplant Incorporated (PPI) or Preemergence (PRE)	Postemergence (1- to 4-leaf cotton)	Layby Directed
Dryland Production Prowl or Treflan PPI + Reflex PRE ¹	Glyphosate + Dual Magnum ⁴ <i>(no Palmer emerged)</i>	MSMA + Direx MSMA + Layby Pro MSMA + Suprend ³ MSMA + Valor
Irrigated Production Diuron, Prowl ² , or Staple ³ + Reflex PRE or Diuron + Staple ³ PRE	OR Glyphosate + Staple ³ <i>(Palmer 1-2")</i>	

*Hand weeding, cultivation, and/or application of Gramoxone mixtures with hooded sprayers will likely be needed.

1. In dry land production, the addition of diuron, Cotoran, or Staple with Reflex PRE may improve control once activated by rainfall. For those growing a dryland crop using conservation tillage, an Ignite-based program is strongly encouraged (see Table 2).
2. Incorporated applications of Treflan or Prowl will be more consistent than PRE applications.
3. Make only one application of an ALS-inhibiting herbicide (Staple, Envoke, Suprend) per season. Will not control ALS-resistant Palmer.
4. Dual Magnum contains S-metolachlor. The generic brands Brawl and Medal also contain S-metolachlor. Other generic brands contain metolachlor, a mixture of R and S isomers. Per unit of product, brands containing S-metolachlor are more effective on Palmer amaranth and other weeds. Sequence contains a mixture of glyphosate + S-metolachlor.

Table 2. Managing Glyphosate-Resistant or Sensitive Palmer amaranth in Liberty Link cotton.*

Preemergence (PRE)	Postemergence (1- to 4-leaf cotton)	Layby Directed
Diuron, Prowl ¹ , or Staple ² + Reflex PRE or Diuron or Prowl + Staple ² PRE	Ignite or Ignite + Dual Magnum ³ <i>(Palmer < 2 inch)</i>	MSMA + Direx MSMA + Layby Pro MSMA + Suprend ² MSMA + Valor
	Ignite + Staple ² <i>(Palmer < 4 inch)</i>	

* Cotton cultivar must be resistant to Ignite 280 (glufosinate) herbicide or serious crop injury can occur.

1. Incorporated applications of Treflan or Prowl will be more consistent than PRE applications.
2. Make only one application of an ALS-inhibiting herbicide (Staple, Envoke, Suprend) per season. Will not control ALS-resistant Palmer.
3. Dual Magnum contains S-metolachlor. The generic brands Brawl and Medal also contain S-metolachlor. Other generic brands contain metolachlor, a mixture of R and S isomers. Per unit of product, brands containing S-metolachlor are more effective on Palmer amaranth and other weeds. Sequence contains a mixture of glyphosate + S-metolachlor.

Table 3. Managing MODERATE to HEAVY Glyphosate-Sensitive Palmer Infestations in RR Cotton.

Preemergence (PRE)	Postemergence (1- to 4-leaf cotton)	Layby Directed
Cotoran, Diuron or Prowl ¹ PRE	Glyphosate + Dual Magnum ³	MSMA + Direx MSMA + Layby Pro MSMA + Suprend ² MSMA + Valor
	Glyphosate + Staple ²	Glyphosate + Direx ⁴ Glyphosate + Layby Pro ⁴ Glyphosate + Suprend ² Glyphosate + Valor
Prowl PRE + Cotoran, Diuron, Staple ² or Reflex PRE	Glyphosate as needed	

1. Incorporated applications of Treflan or Prowl will be more consistent than PRE applications.
2. Make only one application of an ALS-inhibiting herbicide (Staple, Envoke, Suprend) per season. Will not control ALS-resistant Palmer.
3. Dual Magnum contains S-metolachlor. The generic brands Brawl and Medal also contain S-metolachlor. Other generic brands contain metolachlor, a mixture of R and S isomers. Per unit of product, brands containing S-metolachlor are more effective on Palmer amaranth and other weeds. Sequence contains a mixture of glyphosate + S-metolachlor.
4. Mixing Direx or Layby Pro with glyphosate may reduce grass control by glyphosate, especially when grasses are large and conditions are dry.

The programs suggested for fields with known glyphosate-resistance are expensive, but a very aggressive program will be required to control glyphosate-resistant Palmer amaranth and to slow its spread. Note that Staple is recommended to control emerged glyphosate-resistant Palmer amaranth. This reliance on Staple emphasizes the need to prevent further ALS resistance. Also remember that Ignite will only control very small (less than 2 inch) Palmer amaranth.

Herbicide programs suggested for Roundup Ready cotton in fields where glyphosate resistance in Palmer amaranth is currently not suspected is somewhat less aggressive than the program suggested for fields infested with glyphosate resistance. However, the program contains more herbicide applications and types of herbicide chemistry than many growers are accustomed to using. It is imperative that growers follow such a program to reduce reliance on glyphosate and to slow further selection for glyphosate resistance.

Also, it is imperative that glyphosate-resistant Palmer amaranth be controlled in crops rotated with cotton, and this should be done with minimal reliance on ALS inhibitors. Because Staple is critical in a program to control glyphosate-resistant Palmer amaranth in cotton, it is a grower's best interest to prevent or at least slow further selection for ALS resistance.