

Weed Management in Texas Cotton



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GENERAL PRACTICES

A key component in successful cotton production is the effective management of weeds. The cotton plant is not particularly competitive with many weed species, especially early in the season. Research has shown that even light infestations of weeds during this period of time can significantly impact cotton yields. Weeds can also create difficulties during harvest and negatively impact lint quality due to staining and increased foreign material in the lint. This publication describes key points to consider when managing weeds in cotton as well as current recommendations for control.

HERBICIDE RESISTANCE

Herbicide resistant weeds are naturally occurring biotypes of a species with the inherited ability to survive and reproduce despite exposure to a herbicide that previously was effective for controlling the species. The term biotype describes plants within a weed species that may look exactly alike but have biological traits uncommon to the population as a whole. The development of resistance is accelerated when weed control measures rely heavily upon chemical control and without including cultural, mechanical, and biological weed control measures. There are currently 259 species (151 dicots and 108 monocots) of herbicide resistant weeds globally ([Heep, 2019](#)). Weeds confirmed to be herbicide resistant in Texas include perennial ryegrass (ALS inhibitors), barnyardgrass (PSII inhibitor), [Palmer amaranth](#) (PS II inhibitors and EPSP synthase inhibitors), kochia (ALS inhibitors), johnsongrass (ALS inhibitors), [tall or common waterhemp](#) (EPSP synthase inhibitors), and common sunflower (EPSPS synthase inhibitors)([Heep, 2019](#)). Other types of resistance in these and other weed species is under investigation. Of these herbicide resistant weed cases, glyphosate resistant Palmer amaranth and common waterhemp (commonly known as pigweed or carelessweed) are the most troublesome in Texas cotton due to the widespread reliance upon glyphosate alone for weed management. These weeds are capable of producing in excess of 600,000 seed per female plant and can spread rapidly throughout a region once established. Below are a few key points to consider for managing these herbicide resistant weeds.

Prevention and Management of Resistant Weeds

a. Diversify crop production practices

Crop rotation is one of the most significant components of effective weed management in cotton. In addition to helping with nematode and disease management, crop rotations allow the use of additional herbicide mechanisms of action.

b. Cultivation

Once a mainstay of weed management in cotton, cultivation has declined significantly with the commercialization of glyphosate and glufosinate tolerant cotton varieties. However, with the rise of glyphosate resistant weeds in cotton production, cultivation is once again a viable weed management tool in many operations.

c. Use the recommended rate, timing of application, and spray volume.

When applying any herbicide, be sure to use the full labeled rate of that product and apply at the proper time. Many postemergence herbicides are only effective when applied to very small weeds. If applied too late or at too low an application rate, weed escapes can be expected. The efficacy of non-systemic herbicides, such as glufosinate (Liberty), is highly dependent upon obtaining thorough

spray coverage as is stated on the product label. Good spray coverage is achieved by applying the recommended carrier volume and using the appropriate spray nozzle.

d. *Avoid using a single effective mechanism of action in your herbicide program*

Herbicide mechanism of action describes the way that a herbicide controls susceptible weed species. Currently, there are 12 herbicide mechanisms of action available for use in cotton (Table 1). It is important to target problematic weed species with at least two different mechanisms of action, and to change herbicide programs from year to year (Figure 1). The Weed Science Society of America (WSSA) has devised a numbering system for classifying herbicide mechanisms of action into groups. Often, these group numbers can be found on product labels. All herbicide recommendations in this publication will include the WSSA group number(s) for each herbicide. Use of the WSSA numbering system should be a simpler approach for understanding the herbicide mechanism of action.

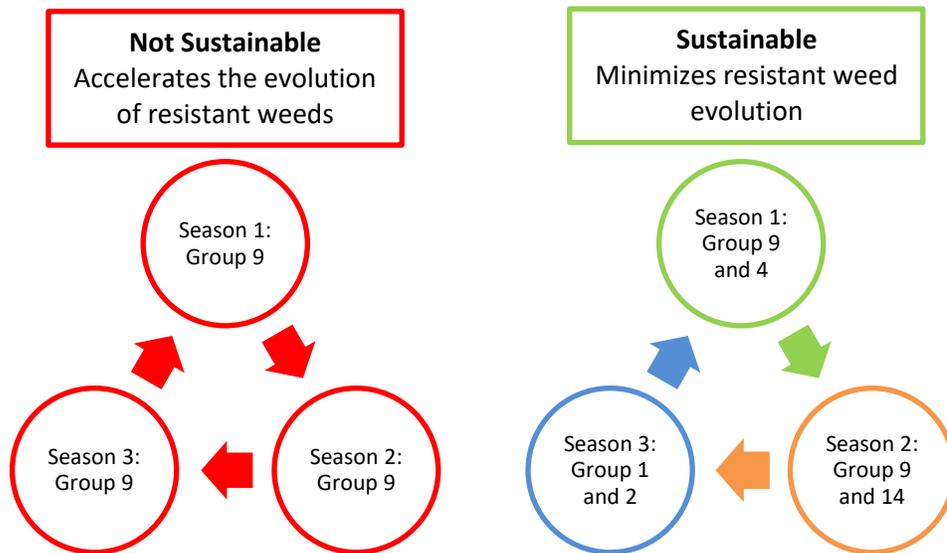


Figure 1. Example of the sustainability of utilizing multiple herbicide sites of action and rotating these from season to season (adapted and modified from wssa.net).

Table 1. Mechanism of action of herbicides labelled for use in cotton

Mechanism of Action	WSSA Group #	Representative products
ACCCase inhibitors	1	Assure II, Fusilade DX, Poast Plus, Select Max
ALS inhibitors	2	Envoke, Express, FirstShot, Harmony, LeadOff, Staple
Microtubule assembly inhibitors	3	Prowl, Treflan
Synthetic auxins	4	2,4-D, Enlist Duo, Enlist One, Clarity, XtendiMax, Engenia, FeXapan,
	5	Caparol,
Photosystem II inhibitors	7	Cotoran, Direx, Karmex, Linex, Layby Pro
EPSP synthase inhibitors	9	Roundup (glyphosate)
Glutamine synthetase inhibitors	10	Liberty
Carotenoid biosynthesis inhibitors	12	Brake FX, Solicam DF
	13	Command
PPG oxidase inhibitors	14	Aim, Cobra, ET, Goal, Reflex, Resource, Sharpen, Valor
VLCFA inhibitors	15	Dual Magnum, Warrant, Zidua, Outlook
Unknown	17	MSMA
Photosystem I inhibitors	22	Gramoxone SL

e. *Keep records of weed populations and herbicide application*

Good record keeping helps to plan an effective prevention program for herbicide resistant weeds. It also helps to avoid using the same herbicide mechanism of action each year. If a herbicide program failed to control a weed or weeds, that program should be avoided in the field where the failure(s) were observed. Repeated applications of the same herbicide will only serve to increase herbicide resistant weeds.

f. *Scout herbicide failures following spraying*

Weeds which survive a herbicide application may be the result of application errors and are not necessarily resistant weeds. Herbicide failure can be caused by poor spray coverage, incorrect timing of applications, “washing-off” of postemergence herbicides by rainfall, or adverse environmental conditions such as poor soil moisture, low humidity, or extreme temperatures. When weed control failures occur, check to see if spatial patterns exist in the field. If surviving weeds are present in “streaks” across the field, this may be the result of an application error. If the distribution of surviving weeds is scattered or “patchy”, this may indicate the presence of a herbicide resistant biotype. If resistant weeds are suspected, it can be confirmed by collecting seeds of the suspected resistant weeds and having a legitimate screening trial conducted on them to determine resistance. A few “red flags” of herbicide resistant weeds are: (1) if the same herbicide has been repeatedly applied in the same field, (2) the same weed species are repeatedly found surviving in the same location of the field, and (3) if dead (susceptible) plants can be found at the same location as the surviving weeds and these dead plants were at the same stage of growth at application.

For management strategies for glyphosate resistant pigweeds, please refer to the AgriLife Extension publication, ['4-step Program for Managing Glyphosate Resistant Pigweeds in Texas Cotton'](#).

CULTURAL CONTROL

Field Selection

Growth of cotton seedlings is slow because of the perennial nature of cotton, which devotes much of its energy into root development rather than shoot growth. The first 10 weeks after planting is the critical time of weed management until cotton seedlings become competitive against weeds (Buchanan and Burns, 1970). Weed management becomes easier if a clean field with little weed infestation is selected. It is important to know the field characteristics such as soil test results, fertility, insect/disease management history, and weed population and infestation level. Understanding the field characteristics improves efficacy and efficiency of weed management programs.

Prevention

Weed management should be conducted not only within the field, but also around the fields, ditch banks, and fence lines. The weeds around the field can produce prolific amounts of seeds and spread the infestation into the field. It also provides refuge for insects, diseases, and nematodes. It is important to thoroughly clean equipment and clothes to prevent the transport of weed seeds into other fields, especially in the case of pigweed (or carelessweed).

Seedbed Preparation

It is beneficial to take advantage of rain or apply irrigation to allow for weed germination before seedbed preparation. Seedbed preparation should be conducted after controlling the weed seedlings. Cotton requires a moist and firm seedbed with good seed-to-soil contact. Proper seedbed preparation allows cotton seeds to germinate rapidly, resulting uniform seedling emergence. A uniform cotton stand is more competitive against weed infestation.

Row Direction

Row direction can influence the amount of sunlight available to weeds. When rows are arranged in a north-south direction, there may be greater shading of the middles. However, importance should be placed on the other preventative measures as row direction is dependent upon other management factors, such as the available length of row, slopes, and equipment.

Row Spacing

Canopy closure occurs earlier with narrower rows (< 15 in) and solid planting as compared to wider rows (> 40 in) and skip row patterns. Narrower row spacing provides higher weed suppression as compared to the wider row spacing due to the greater canopy coverage; however, narrow row spacing requires more resources such as soil moisture and nutrients than wide row spacing. Row spacing should be properly adjusted to the available resources to ensure maximum plant growth and production.

Quality Seed

Use of weed-free seeds is essential to reduce introduction of new weed species and weed infestation in the planting row. High quality seeds also provide advantages such as seedling disease resistance, high germination percentage, reduced risk for replanting, rapid and uniform seedling

emergence, and easier decision making for weed, insect, and disease control. All these advantages help to produce a competitive cotton stand against weed infestation.

Variety Selection

Unlike wheat seeds, cotton seeds cannot be saved for the following years due to the patented herbicide tolerant and insect protection traits of recent cotton varieties unless conventional seeds are used. Over 90% of Texas cotton producers purchase certified seeds each year with single and double stacked herbicide tolerant traits. It is critical that producers know problematic weeds in their fields so that the appropriate herbicide tolerant varieties may be selected.

Planting Date

Cotton planting is best determined by soil temperature since adequate soil and air temperature improves growth rate and seedling vigor, producing a competitive cotton stand against weed infestations. Favorable soil conditions for cotton seed germination include high soil oxygen concentration, adequate soil moisture, and soil temperatures above 64°F ([Boman and Lemon, 2005](#)). Optimum planting date can be determined by measuring the soil temperature at 8-inch depth every day until the 10-day average temperature becomes 65°F. Cotton planted early with low soil temperature extends the growing season; however, this also increases risk of stand establishment failure by slow growth, weak seedling vigor, and weak competitiveness against weeds.

Seeding Rate

Planted seeds and seedlings are exposed to a severe environment, where often only a fraction of planted seed will become mature plants ([Gwathmey et al., 2010](#)). Cotton planted at too low a seeding rate increases the risk for non-uniform or thin stands, resulting in yield loss and reduced harvest efficiency. Cotton planted at too high a seeding rate increases competition among cotton plants for water, nutrients, and sunlight, resulting in low seedling vigor. Proper seeding rate adjusted to the field condition produces a vigorous and uniform stand. Good seedling establishment is critical for successful weed management.

Crop Rotation

Crop rotation will help reduce target weed populations gradually. Each crop has its own planting and growing windows, life-cycle, rooting depth, leaf orientation, and nutrient and moisture requirements. These cultural, biological, and seasonal differences modify the favorable conditions for weeds created under continuous cotton production, thus negatively influencing the growth and reproduction of some weed species. Crop rotation also allows for rotating herbicides to target problematic weed species. In addition, crop rotation has been observed to have a positive effect on lint yield. Cotton lint yield was 18 to 44% higher in the cotton-sorghum rotation system than the continuous cotton system when evaluated at Halfway, Texas. The positive effect of the rotation on lint yield was even more pronounced in the water stressed environment of an 8-year study conducted by Texas A&M AgriLife Research ([Bordovsky et al., 2011](#)).

Field Scouting

Pre-, mid-, and post-season field scouting is highly recommended to keep records of weed species and infestation level. Refer to a publication prepared by Texas A&M AgriLife Extension, [Weed Identification: Using Plant Structures as a Key](#), for help when scouting fields for problematic weeds.

PREPLANT BURNDOWN

A key component to effective weed management is to start with a clean field. This can be achieved by normal tillage operations and herbicide incorporations in conventionally tilled fields, or through the use of preplant burndown herbicides. Many herbicide options are available for controlling emerged weeds prior to planting as well as providing residual control of weeds until planting. Always be aware of plant back (crop rotation) restrictions to avoid crop damage. Refer to Table 2 for current recommendations for preplant burndown herbicides.

WEED MANAGEMENT AT PLANTING

Often, the most competitive weeds are those that emerge before or at the same time as the crop. This is particularly true in cotton, which tends to have a slower growth rate as a seedling as compared to other crops. These early-season weeds are very effective at competing for the same consumable resources such as water, nutrients, and sunlight that the cotton seedling needs for healthy growth. If these weeds are not controlled, significant yield losses can be expected. With effective early season weed control, the yield potential of the crop is protected. Thus, it is important to apply residual herbicides (herbicides with soil activity) just prior to, or at planting. These herbicides will control weeds before they emerge, reducing the need for postemergence herbicides later in the season. It is important to note that rainfall, irrigation, or mechanical incorporation is needed with these residual herbicides to move them into the soil and activate them. Refer to Tables 3 and 4 for recommendations for preplant incorporated (PPI) and preemergence (PRE) herbicides.

POSTEMERGENCE WEED CONTROL

Weeds that emerge during the season must be controlled either by cultivation or chemical means. Several herbicide options exist for postemergence (POST) weed control. When applying POST herbicides, it is vital to apply them at the proper timing, as many POST herbicides will only be effective if applied to very small weeds. This is especially true for the pigweeds or carelessweeds. In addition to POST herbicides, there are many herbicides available for over-the-top or directed spray applications that will provide residual control of weeds. Post directed applications take advantage of the effectiveness of a particular herbicide on weeds that might be injurious to the crop. Directional or hooded spray applications accomplish this practice in addition to providing residual control, depending on the herbicide. Ideally, POST herbicides will be applied in a tank mix with a residual partner to control emerged weeds as well as to provide extended residual control. For emerged grass weeds, several highly effective control options exist with the graminicide (grass-specific herbicides) such as Assure, Fusilade, Poast, and Select. When applying these grass-specific herbicides, avoid tank mixtures with Liberty 280 SL, which have been shown to result in reduced grass control. Additionally, tank mixes of the grass herbicides and Staple or Envoke should also be avoided. Refer to Tables 5, 6, and 7 for current recommendations for postemergence over-the-top, post-directed, hooded, and wick or wiper applied herbicides.

POST-HARVEST WEED MANAGEMENT

After harvest, there can be a substantial amount of time left for weed growth and development before temperatures drop to a level unfavorable for warm season weed growth, particularly in south Texas. Thus, weed control strategies must be implemented to prevent the production of additional weed seed that will become problems during the next season. In conventionally tilled fields, tillage operations provide good control of emerged annual weeds; however this disturbance also brings new seeds up to the soil surface. In the absence of tillage, herbicides must be used for weed control. Similar to chemical weed management strategies during the growing season, herbicide programs after harvest should include both postemergence and preemergence herbicides to control weeds already present and provide residual weed control later into the year. In addition, the post-harvest period provides an excellent opportunity to reduce populations of perennial weeds that might be present at this time. Application of postemergence systemic herbicides at this time can greatly enhance translocation of the herbicide to the root system of perennial plants, improving chances for their elimination. When choosing a residual herbicide to apply after harvest, pay close attention to any plant-back restrictions on the product label.

Table 2. Preplant burndown herbicide options

Weeds Controlled	Product, Rate/A, Active Ingredient	Group #	Time to Apply	Notes
Annual and perennial broadleaf weeds	2,4-D (6 lb ai/gal) 0.66 to 2.66 pt (2,4-D)	4	Postemergence to weeds, prior to planting	Allow at least 30 days after application and at least 1 in rainfall or irrigation within a 24-hr period before planting cotton.
Selected broadleaf weeds, refer to label	Aim EC up to 1.6 fl oz (carfentrazone-ethyl)	14	Postemergence to weeds, prior to planting	For best performance, apply to actively growing weeds less than 4 inches tall or rosettes less than 3 inches in diameter. May be tank mixed with glyphosate, glufosinate, paraquat, 2,4-D, or dicamba.
Henbit, seedling dock	Caparol 4L 1.2 – 1.6 pt (prometryn)	5	Fall or winter, preemergence or postemergence to small weeds	Use in Gulf Coast and Blacklands only. For best results, apply before weed emergence. If henbit has emerged but is less than 4 to 6 inches tall, add a surfactant or emulsifiable oil. For winter weed control only; additional herbicides will be needed for spring and summer weed control.
Annual and perennial broadleaf weeds	Clarity 8.0 fl oz (dicamba)	4	Fall or winter when weeds are 2 – 4 leaf stage and rosettes are less than 2 in. across	Do not apply in regions that average less than 25 in. precipitation annually. Plant cotton only after a minimum of 1 inch of rainfall or overhead irrigation and 21 days after application.
Many annual grass and broadleaf weeds, refer to label for weed-specific rates	Direx 4L 0.8 – 1.6 qt (diuron)	7	Preemergence or postemergence to weeds less than 2 in tall, 15 to 45 days prior to planting	If applying to emerged weeds, add a nonionic surfactant. Complete any planned tillage prior to application, as tillage operations immediately after application may cause crop injury.

Table 2 continued. preplant burndown herbicide options

Many broadleaf weeds	Engenia 12.8 fl oz (dicamba)	4	Postemergence to weeds, prior to planting	For use in XtendFlex (dicamba tolerant) cotton. Do not apply more than 12.8 fl oz/A in a single application, do not exceed 25.6 fl oz/A total preplant and preemergence. Do not exceed 51.2 fl oz/A per year total. Apply to actively growing weeds less than 4 inches tall. Tank mix partners and spray nozzles for application are limited, see www.engeniatankmix.com for more details. Do NOT mix with AMS or UAN. Many application requirements exist, refer to label before using.
Many grass and broadleaf weeds	Enlist Duo 3.5 – 4.75 pt (glyphosate + 2,4-D)	9, 4	Postemergence to weeds	For use in Enlist (2,4-D tolerant) cotton. See label for approved spray nozzles. Tank mix partners are limited, visit www.enlisttankmix.com no more than 7 days before applying to see approved tank mixes. Apply to actively growing weeds up to 6 inches tall. Do not apply more than 14.25 pt/A total per season. Many application restrictions apply, see label before using.
Many broadleaf weeds	Enlist One 1.5 – 2.0 pt (2,4-D)	4	Preplant through preemergence	For use in Enlist (2,4-D tolerant) cotton. See label for approved spray nozzles. Tank mix partners are limited, visit www.enlisttankmix.com no more than 7 days before applying to see approved tank mixes. Apply to actively growing weeds up to 6 inches tall. Do not apply more than 6.0 pt/A total per season. Many application restrictions apply, see label before using.
Horseweed, henbit, shepherd's purse	Envoke 0.10 to 0.15 oz (trifloxysulfuron)	2	Early preplant	Currently labelled in Texas only for areas east of I-35 for preplant uses. For other regions, refer to the label for specific restrictions. Apply alone or in tank mixtures for residual control or suppression, at least 90 days prior to planting cotton.

Table 2 continued. Preplant burndown herbicide options

Selected broadleaf weeds, refer to label	ETX 0.3 – 1.25 fl oz (pyraflufen-ethyl)	14	Postemergence to weeds, prior to planting	Apply in a minimum of 10 gallons water /A by ground and 5 gallons water /A aerially. For better results, add 1.0 to 2.0 % crop oil concentrate to spray solution. Use the higher COC rate for larger labelled weeds or in low moisture conditions.
Annual broadleaf weeds	Express 0.25 oz (tribenuron-methyl)	2	Postemergence to weeds, prior to planting	Apply when the majority of weeds have emerged and are actively growing. Allow 14 days after application before planting cotton. Stressful conditions may weaken cotton and result in crop injury.
Many broadleaf weeds	FeXapan plus VaporGrip Technology 22 – 44 fl oz (dicamba)	4	Postemergence to weeds, prior to planting	For use in XtendFlex (dicamba tolerant) cotton. Apply in a minimum of 10 gallons of water per acre. Do not exceed 44 fl oz/A total preplant and preemergence. Do not exceed 88 fl oz/A per year. Best results are achieved when weeds are less 4 inches tall at application. Tank mix partners and spray nozzles for application are limited, see www.fexapanapplicationrequirements.dupont.com for more details. Do NOT mix with AMS or UAN. Many application requirements exist, refer to label before using.
Many grass and broadleaf weeds	Flexstar GT 3.5 3.5 – 5.3 pt (fomesafen + glyphosate)	14, 9	Postemergence to weeds, prior to planting	Only labelled for use in Texas for areas east of U.S. Highway 77 and north of State Road 239, including all of Calhoun County. On medium or fine textured soils, allow a minimum of 21 days after application before planting. Moisture is required to activate this herbicide for residual activity.
Annual broadleaf weeds	FirstShot SG 0.5 – 0.8 oz (thifensulfuron-methyl + tribenuron-methyl)	2	Postemergence to weeds, prior to planting	Allow 14 days after application before planting cotton. May be tank-mixed with other herbicides to control additional weeds.

Table 2 continued. Preplant burndown herbicide options

Many species, refer to label	Glyphosate products rates vary; refer to label (glyphosate)	9	Postemergence to weeds, prior to planting	Allow at least 2 weeks after application before tillage. Where glyphosate resistant weeds are present, add a tank mix partner to control emerged weeds and provide residual control. Never store, mix, or spray in galvanized or unlined steel tanks (except stainless steel).
Selected broadleaf weeds, refer to label	Goal 2XL 1.0 – 2.0 pt (oxyfluorfen)	14	Preemergence or postemergence to weeds	Some residual control may be expected. Apply to weed seedlings not exceeding four true leaves. Fallow beds should be worked thoroughly to a minimum depth of 2.5 inches before planting. Do not apply within 7 days of planting
Emerged annual weeds and topkill suppression of perennials	Gramoxone SL 2.0 2.5 – 4.0 pt (paraquat)	22	Postemergence to weeds 1 to 6 inches tall, prior to planting	Before planting, prepare land to allow maximum weed and grass emergence before treatment. Plant with minimal soil disturbance. No residual control with this herbicide. Apply in at least 10 gal water /A by ground plus 1.0 qt nonionic surfactant per 100 gal spray solution or 1 gal crop oil concentrate per 100 gal spray solution. At lower spray volumes, use a drift control or spray deposition adjuvant. Check label for tank mix options.
Annual broadleaf weeds	Harmony SG 0.3 – 0.5 oz (thifensulfuron)	2	Postemergence to weeds, prior to planting	May be tank mixed with 2,4-D or glyphosate herbicides for increased control. Allow at least 7 days after application before planting cotton, tank mixtures with other herbicides may increase the time needed before planting. Stressful conditions may weaken cotton and result in crop injury.
Many annual broadleaf weeds, refer to label	LeadOff 1.5 – 2.0 oz (thifensulfuron-methyl + rimsulfuron)	2	Preemergence or postemergence to weeds, prior to planting	For 1.5 oz rate, allow at least 30 days before planting cotton. For rates of 1.5 to 2.0 oz, allow 60 days before planting. Add a nonionic surfactant to spray mixture. Multiple tank mix partners are available, refer to label for more information.

Table 2 continued. Preplant burndown herbicide options

Many annual broadleaf and grass weeds; refer to label	Liberty 280 SL 29 – 43 fl oz (glufosinate)	10	Postemergence to weeds in fallow fields, post-harvest, before planting, or before emergence of cotton	Spray coverage is critical for performance, apply in at least 15 gal water /A by ground or 10 gal water /A aerially. If a single application exceeds 29 fl oz/A, the seasonal use may not exceed 72 fl oz/A, otherwise the seasonal maximum is 87 fl oz/A. Make applications between dawn and 2 hours before sunset with warm, humid conditions for improved performance. Make sequential applications 10 to 14 days apart as needed.
Many broadleaf weeds	Panther D 2.0 pt (flumioxazin + 2,4-D)	14, 4	Postemergence to actively growing broadleaf weeds in the 2- to 4-leaf stage or less than 2 inches across	Following application, a minimum of 1 inch of rainfall or irrigation, and 30 days must pass before planting cotton. Do not use preplant to cotton on coarse textured soils where organic matter is less than 1%, or in areas where annual average rainfall is less than 25 inches.
Annual and perennial broadleaf and grass weeds, as well as sedges; refer to label	Sequence 2.0 – 3.5 pt (glyphosate + S-metolachlor)	9, 15	Postemergence to weeds	Do not apply to sand or loamy sand soils. Maximum of 2.5 pt/A on sandy soils and 3.5 pt/A on medium and fine soils. If heavy rainfall occurs immediately after planting, crop injury may occur, especially where poor drainage occurs or the seed slit has not been properly closed.
Selected broadleaf weeds, refer to label	Sharpen 1.0 fl oz (saflufenacil)	14	Postemergence to actively growing weeds	For maximum efficacy, use the recommended adjuvants, including MSO + AMS or MSO + UAN. Allow 42 days after application before planting cotton. In areas with less than 25 inches of annual rainfall, allow 42 days before planting after 1 in of rainfall or irrigation is received . Do not apply to sandy soils with less than 1.5% organic matter. Commonly used as a tank mix partner with glyphosate to broaden weed spectrum in West Texas.

Table 2 continued. Preplant burndown herbicide options

Selected weeds, see label	Valor SX 2.0 – 4.0 oz (fall burndown) 1.0 – 2.0 oz (spring burndown) (flumioxazin)	14	Preemergence or postemergence to weeds, prior to planting.	If weeds are emerged, include a tank mix partner. In conventional tillage, allow at least 30 days and 1 inch rainfall or overhead irrigation between application and planting. In strip-till or no-till, allow at least 14 days and 1 inch of rainfall or irrigation between application and planting. Include a crop oil concentrate or methylated seed oil with spray solution.
Many broadleaf weeds	XtendiMax with VaporGrip Technology 22 – 44 fl oz (dicamba)	4	Postemergence to weeds, prior to planting	For use in XtendFlex (dicamba tolerant) cotton. Apply in a minimum of 10 gallons of water per acre. Do not exceed 44 fl oz/A total preplant and preemergence. Do not exceed 88 fl oz/A per year. Best results are achieved when weeds are less 4 inches tall at application. Tank mix partners and spray nozzles for application are limited, see www.xtendimaxapplicationrequirements.com for more details. Do NOT mix with AMS or UAN. Many application requirements exist, refer to label using.

Table 3. Preplant-incorporated herbicide options

Weeds Controlled	Product, Rate/A, Active Ingredient	Group #	Time to Apply	Notes
Many annual grasses and small-seeded broadleaf weeds	Prowl 3.3 EC 1.2 – 4.8 pt (pendimethalin)	3	Immediately before planting or up to 60 days prior to planting	Incorporate as soon as possible and no later than 7 days after application. For incorporation, use an implement capable of uniform incorporation 1 to 2 inches deep. Two-pass incorporation will give more consistent results.
Many annual grasses and small-seeded broadleaf weeds	Prowl H ₂ O 1.0 – 4.0 pt (pendimethalin)	3	Up to 60 days before planting	Incorporate uniformly into the upper 1 to 2 inches of the soil by rainfall, sprinkler irrigation, or mechanical incorporation. Two-pass incorporation will give more consistent results. Do not apply to soils with more than 3% organic matter.
Many annual grass and broadleaf weeds	Solicam DF 1.25 – 2.5 lb (norflurazon)	12	Minimum of 30 days before planting	Must be incorporated by tillage, irrigation, or rainfall before weeds germinate. In Texas, this product may be applied preplant only in areas east of Interstate 35.
Many annual grasses and small-seeded broadleaf weeds	Treflan 4 EC (4 lb ai /gal) 1.0 – 2.5 pt (trifluralin)	3	Anytime from Oct 15 until planting	Incorporate with a double disk, power incorporator, field cultivator, rolling cultivator, or bed conditioner. The first incorporation should occur within 24 hours after application. Make a second pass with ground driven equipment. Rolling cultivators and bed conditioners should only be used on course to medium textured soils. Ground may be left flat or bedded over winter. If land is left flat, take care during spring bedding operations to prevent turning up untreated soil. Do not apply in the fall to soils that are wet, in poor condition, or subject to flooding. In Brazoria, Calhoun, Chambers, Fort Bend, Galveston, Harris, Jackson, Jefferson, Liberty, Matagorda, Orange, Waller, and Wharton Counties, rates of 1.5 to 3.0 pt/A can be used. Do not use on any crop grown in Pecos or Reeves counties.

Table 3 continued. Preplant-incorporated herbicide options

Many annual grasses and small-seeded broadleaf weeds	Treflan TR-10 5.0 – 12.5 lb (conventional tillage) 5.0 – 20.0 lb (conservation tillage) (trifluralin)	3	Fall or spring until planting	Two-pass incorporation required, with the first pass occurring within 24 hours after application. For better results, delay the second incorporation at least 5 days after the first and run equipment in a different direction than the first incorporation. Do not use on any crop grown in Pecos or Reeves Counties.
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Table 4. Preemergence herbicide options

Weeds Controlled	Product, Rate/A, Active Ingredient	Group #	Time to Apply	Notes
Many annual grasses and small-seeded broadleaf weeds	Brake 16 to 32 fl oz (fluridone)	12	Preemergence	If applying less than 21 fl oz, another residual herbicide must be tank mixed with this product. A minimum of 0.5 inches of rainfall or overhead irrigation is recommended for optimal weed control.
Many annual broadleaf weeds and some annual grasses, refer to label for weed-specific rates	Caparol 4L 1.6 – 4.8 pt (prometryn)	5	Preemergence	Do not use on sand or loamy sand. Rainfall or irrigation is required after application to obtain good weed control. Avoid broadcast applications to cotton planted in furrows more than 2 in deep. Band applications should not be wider than the bottom of the furrows. Cotton may be replanted through treated soil, but do not re-apply product. Do not use in glandless cotton varieties to avoid crop injury. Do not use on sand or loamy sand.
Annual grasses and broadleaf weeds	Command 3ME 1.33 – 3.33 pt (clomazone)	13	Preemergence	Disulfoton or phorate organophosphate insecticides must be applied in-furrow with the seed at planting with at least 0.75 lb ai as a crop safener, or crop injury will occur. Injury may occur on sandy soils. Off-site movement of Command can cause foliar whitening of some plants. Avoid spraying within 300 ft of desirable plants
Many annual grasses and broadleaf weeds, refer to label for weed-specific rates	Cotoran 4L 2.0 – 4.0 pt (fluometuron)	7	Preemergence, at planting, or after a preplant incorporated application of Prowl or Treflan	Activity may be delayed or reduced during dry weather. Do not plant crops other than cotton within 6 months of the last application. Do not use on sand, loamy sand, or fine sandy loam soils nor on cotton planted in furrows. Do not feed foliage from treated fields or gin trash to livestock. A suspensibility agent may be necessary.

Table 4 continued. Preemergence herbicide options

Many annual grasses and some small-seeded broadleaf weeds	Dual Magnum or Dual II Magnum 1.0 – 1.33 pt (S-metolachlor)	15	Preplant incorporated or preemergence	Do not apply to sand or loamy sand soils. Do not apply to furrow-planted cotton. Apply preemergence or incorporate no more than 1 inch deep before, at, or after planting. Plant cotton at least 1 inch deep on fine soils and 1.5 inch deep on medium or coarse soils. For best control of yellow nutsedge, apply preplant incorporated. Do not use in Gaines county, TX.
Many annual grass and broadleaf weeds, refer to label for weed-specific rates	Direx 4L 0.8 – 2.2 qt (diuron) or Karmex 80 DF 1.0 – 2.75 lb (diuron)	7	Preemergence	Use on sandy loam or heavier soils. Do not apply to sand or loamy sand soils. Cotton may be replanted through the treated band, or rework beds before replanting. Do not use on soils containing less than 1.0% organic matter. Do not use as a preplant or preemergence treatment where soil-applied organophosphate insecticides are used because of the potential for severe crop injury.
Many grass and broadleaf weeds	Flexstar GT 3.5 3.5 – 5.3 pt (fomesafen + glyphosate)	14, 9	Preemergence	Only labelled for use in Texas for areas east of U.S. Highway 77 and north of State Road 239, including all of Calhoun County. Do not apply to medium or fine textured soils as crop injury may occur. Moisture is required to activate this herbicide for residual activity. The glyphosate component of this product will control emerged weeds.
Annual grasses and small-seeded broadleaf weeds	Prowl H ₂ O 1.0 – 4.0 pt (pendimethalin)	3	Preemergence	Apply at planting or up to 2 days after planting

Table 4 continued. Preemergence herbicide options

Annual broadleaf weeds, suppression of some annual grasses	Reflex 1.0 – 1.5 pt (fomesafen) or Sinister 0.7 - 1.05 pt (fomesafen)	14	Preemergence	<p>Apply only to coarse textured soils, as crop injury may occur on medium and fine soils. Only labelled for use in Texas for areas east of U.S. Highway 77 and north of State Road 239, including all of Calhoun County.</p> <p>FIFRA Section 24(c) label (Sinister ONLY): May be used west of Hwy 277 from Wichita Falls to Anson, and north of Hwy 180 to the NM and OK state lines. Includes Fisher, Scurry, Borden, and Dawson counties. Apply 0.7 pt/A. A minimum of 13 inches of irrigation must be applied through August 31 in overhead irrigated cotton. Rotational restrictions vary depending on irrigation availability, see 24(c) label for more details.</p>
Grasses and small-seeded broadleaf weeds	Sequence 2.5 – 3.5 pt (S-metolachlor + glyphosate)	15, 9	Preplant or preemergence	<p>Do not apply on sand or loamy soils. Do not exceed 2.5 pt/A on sandy loam soils, or 3.5 pt/A on medium and fine soils. Do not apply in Gaines County. If heavy rainfall occurs soon after application, crop injury may occur, especially where water stands or where the seeding slit was not properly closed.</p> <p>For areas in TX east of Interstate 35: Only use in areas with 35 inches or more annual rainfall, unless irrigation is available for incorporation.</p> <p>For areas in TX west of Interstate 35: Do not use on soils with more than 65% sand. This product should only be used as part of a program in sequence with Prowl, or in combination with Caparol 4L.</p>
Many annual grass and broadleaf weeds	Solicam DF 1.25 – 2.5 lb (norflurazon)	12	Preemergence	<p>Do not apply to sandy or loamy sand soils. Can be combined with diuron, fluometuron, or prometryn for a broader spectrum of weed control, see the label for more information. Do not apply preemergence aerially.</p>
Selected broadleaf weeds, see label for weed-specific rates	Staple LX 1.3 – 2.1 fl oz (pyrithiobac)	2	Preemergence	<p>Do not apply to sandy or loamy sand soils. Can be combined with diuron, fluometuron, or prometryn for a broader spectrum of weed control, see the label for more information. Do not apply preemergence aerially.</p>

Table 4 continued. Preemergence herbicide options

<p>Postemergence control of many broadleaf weeds. Preemergence activity on many grass and broadleaf weeds.</p>	<p>Tavium 56.5 fl oz (dicamba + S-metolachlor)</p>	<p>4, 15</p>	<p>Preplant or preemergence</p>	<p>For use in XtendFlex (dicamba tolerant) cotton: For emerged broadleaf weeds, apply as a broadcast spray to weeds less than 4 inches in height. Do not use on sand or loamy sand soils. Do not exceed 113 fl oz per acre per year. Tank mix partners and spray nozzles for application are limited, see www.taviumtankmix.com for more details. Do not use in Gaines County. Do NOT mix with AMS or UAN. Many application requirements exist, refer to label before use.</p>
<p>Many annual grasses and some small-seeded broadleaf weeds</p>	<p>Warrant 1.25 – 2.0 qt/A (acetochlor)</p>	<p>15</p>	<p>Preemergence</p>	<p>See label for appropriate rate based on soil texture. Broadcast apply and do not incorporate. Crop injury may occur under cool conditions and saturated soils. Do not exceed 4 qt/A for the season.</p>
<p>Many annual grass and broadleaf weeds.</p>	<p>Warrant Ultra 48 – 60 fl oz (acetochlor + fomesafen)</p>	<p>15, 14</p>	<p>Preplant or Preemergence</p>	<p>May only be applied preplant to medium or fine-textured soils, with a minimum of 0.5 inch of rainfall or irrigation, and 21 days before planting cotton. May only be applied preemergence to coarse textured soils. Only labelled for use in Texas for areas west of U.S. Highway 77 to State Road 230, including all of Calhoun County.</p>

Table 5. Postemergence over-the-top herbicide options

Weeds Controlled	Product, Rate/A, Active Ingredient	Group #	Time to Apply	Notes
Annual and perennial grasses including barnyardgrass, bermudagrass, large crabgrass, johnsongrass, junglerice, and Texas millet	Assure II 5.0 – 12.0 fl oz (quizalofop)	1	Postemergence to actively growing grasses	Applications must include either 1% v/v crop oil concentrate or 0.25% v/v nonionic surfactant. Do not cultivate treated grasses 7 days prior to application or 7 days after application. Do not apply within 80 days of harvest. Use a minimum of 10 gal water /A under non-arid conditions, and 15 gal water /A under arid conditions.
Selected annual broadleaf weeds including Palmer amaranth, common cocklebur, Venice mallow, morningglory, lanceleaf sage	Cotoran 4L 2.0 – 4.0 pt (fluometuron)	7	Postemergence when cotton is at least 3 in. tall and weeds are less than 2 in.	Include up to 0.50 % v/v surfactant to improve activity. Do not feed foliage or gin trash to livestock. May be combined with MSMA or DSMA for enhanced weed control to cotton from 3 in. tall to first bloom. West Texas: Do not use on sandy, loamy sand, or fine sandy loam soils. Do not use on furrow-planted cotton.
Many grasses and small-seeded broadleaf weeds	Dual II Magnum 1.0 – 1.33 pt (S-metolachlor)	15	Postemergence to cotton, before weeds emerge	Over-the-top applications must be made no later than 100 days before harvest. Will need mechanical incorporation, rainfall, or overhead irrigation for activation. Do not use in Gaines County, TX
Many broadleaf weeds	Engenia 12.8 fl oz (dicamba)	4	Postemergence up to 90 days after planting, or mid-bloom (per 24(c) SLN label in TX	Only for use in XtendFlex (dicamba tolerant) cotton: Do not apply more than 12.8 fl oz/A in a single application, do not exceed 51.2 fl oz/A total per season. Apply to actively growing weeds less than 4 inches tall. Tank mix partners and spray nozzles for application are limited, see www.engeniatankmix.com for more details. Do NOT mix with AMS or UAN. Many application requirements exist, refer to label before using.

Table 5 continued. Postemergence over-the-top herbicide options

Many grass and broadleaf weeds	Enlist Duo 3.5 – 4.75 pt (glyphosate + 2,4-D)	9, 4	Postemergence when cotton is emerged until mid-bloom stage to small, actively growing weeds	Only for use in Enlist (2,4-D tolerant) cotton. See label for approved spray nozzles. Tank mix partners are limited, visit www.enlisttankmix.com no more than 7 days before applying to see approved tank mixes. Apply to actively growing weeds 3 to 6 inches tall. Do not apply more than 14.25 pt/A total per season. Many application restrictions apply, see label before using.
Many broadleaf weeds	Enlist One 1.5 – 2.0 pt (2,4-D)	4	Postemergence when cotton is emerged until mid-bloom stage to small, actively growing weeds	For use in Enlist (2,4-D tolerant) cotton. See label for approved spray nozzles. Tank mix partners are limited, visit www.enlisttankmix.com no more than 7 days before applying to see approved tank mixes. Apply to actively growing weeds up to 6 inches tall. Do not apply more than 6.0 pt/A total per season. Many application restrictions apply, see label before using.
Selective control of grasses, sedges, and broadleaf weeds including Palmer amaranth and annual morningglory (red, ivyleaf)	Envoke 0.10 – 0.15 oz (trifloxysulfuron)	2	Postemergence when cotton has reached at least 5 true leaves	Do not apply within 60 days of harvest. For over-the-top applications, do not tank mix with any other herbicide, fertilizer, or additive other than NIS as unacceptable crop injury may occur. Refer to label for region specific recommendations for Texas.
Many broadleaf weeds	FeXapan plus VaporGrip Technology 22 fl oz (dicamba)	4	Postemergence up to 90 days after planting, or mid=bloom (per 24(c) SLN label in TX	For use in XtendFlex (dicamba tolerant) cotton: Best results are achieved when weeds are less 4 inches tall at application. Do not exceed 88 fl oz per acre total from crop emergence to 7 days prior to harvest. Tank mix partners and spray nozzles for application are limited, see www.fexapanapplicationrequirements.dupont.com for more details. Do NOT mix with AMS or UAN. Many application requirements exist, refer to label before using.

Table 5 continued. Postemergence over-the-top herbicide options

Many annual and perennial grass weeds, including barnyardgrass, bermudagrass, large crabgrass, johnsongrass, junglerice, and Texas millet	Fusilade DX 6.0 – 24 fl oz (fluazifop)	1	Postemergence to actively growing grasses, refer to label for specific size requirements	Do not apply more than 48 fl oz/A per season. Do not apply after boll set. Do not harvest within 90 days of application. Do not cultivate from 7 days before to 7 days after application. Cultivation 2 to 3 weeks after application may provide enhanced grass control.
Many annual and perennial grass weeds, including barnyardgrass, bermudagrass, large crabgrass, johnsongrass, junglerice, and Texas millet	Fusion 6.0 – 24.0 fl oz (fluazifop + fenoxaprop)	1	Postemergence to actively growing grasses	For areas east of I-35, use rates of 6.0 – 12 fl oz. For areas west of I-35, rates are 8.0 – 24 fl oz. Do not apply more than 24 fl oz/A per season. Do not apply to cotton after boll set. Do not harvest within 90 days of application. For more region-specific instructions, refer to product label.
Many grasses and broadleaf weeds	Liberty 280 SL 29 – 43 fl oz (glufosinate)	10	Postemergence over-the-top to glufosinate-tolerant cotton	Use only on glufosinate-tolerant cotton. Consult label for weed-specific rates and tank mix combinations. Efficacy is increased with actively growing weeds. Apply in a total spray volume of at least 10 gal/A, 15 to 20 gal/A may be needed with dense weed/crop canopies. If a single application exceeds 29 fl oz/A, the seasonal use may not exceed 72 fl oz/A, otherwise the seasonal maximum is 87 fl oz/A. The addition of ammonium sulfate may improve weed control. West Texas: small weeds, 43 fl oz/A, and favorable environmental conditions are recommended.
Many grasses and broadleaf weeds	Glyphosate products rates vary, refer to label (glyphosate)	9	Postemergence to actively growing weeds	Use only on glyphosate-tolerant cotton. Where glyphosate resistant weeds are present, add a tank mix partner to control emerged weeds and provide residual control. Never store, mix, or spray in galvanized or unlined steel tanks (except stainless steel).

Table 5 continued. Postemergence over-the-top herbicide options

Selected grasses, broadleaf weeds, and sedges. Refer to label	MSMA 6 Plus 2.66 pt (MSMA)	17	Postemergence over-the-top when cotton is 3 to 6 inches high or up to early first square stage	One application of 2 pounds ai/A is allowed per season, except when salvage operation is needed. A second application of 2 pounds ai/A is allowed for salvage operations 1 to 3 weeks after the first application. Do not feed treated foliage to livestock. Some burning and reddish discoloration of foliage may occur.
Many annual grass and broadleaf weeds including Palmer amaranth and common waterhemp. Also controls rice flatsedge and yellow nutsedge.	Outlook Up to 21 fl oz (dimethenamid-P)	15	Postemergence to cotton from 1 st true leaf to mid-bloom, before weeds emerge	Do not apply on coarse soils classified as sand with less than 3% organic matter, and where groundwater is less than 30 feet deep. Do not apply more than 21 fl oz. No preharvest interval. Outlook may cause temporary injury to cotton if high rainfall and saturated conditions occur during early seedling development.
Many annual and perennial grass weeds, including barnyardgrass, bermudagrass, large crabgrass, johnsongrass, junglerice, and Texas millet	Poast 1.0 – 2.5 pt (sethoxydim)	1	Postemergence to actively growing grasses	Do not apply more than 7.5 pt/A per season. Do not cultivate within 5 days before or 7 days after application. Cultivation no sooner than 7 days after application may improve season-long control. Refer to label for weed-specific use rates.
Annual grasses and small-seeded broadleaf weeds	Prowl H ₂ O 1.0 – 2.0 pt (pendimethalin)	3	Postemergence to cotton, before weeds emerge	Only apply over-the-top to cotton between the 4- and 8-leaf stages of growth. Applications may cause temporary injury to cotton. Postemergence applications will be most effective when rainfall or overhead irrigation is received after application. May be tank mixed with glyphosate on glyphosate-tolerant cotton, and with glufosinate on glufosinate-tolerant cotton.
Many annual and perennial grass weeds, including barnyardgrass, bermudagrass, large crabgrass, johnsongrass, junglerice, and Texas millet	Select 2EC 6.0 – 16.0 fl oz (clethodim) or Select Max 9 – 32 fl oz (clethodim)	1	Postemergence to actively growing grasses	Use a crop oil concentrate at 1% v/v. Do not apply a broadleaf herbicide within one day after application of Select or reduced grass control may result. Do not cultivate treated grasses 7 days before or after application.

Table 5 continued. Postemergence over-the-top herbicide options

Broad spectrum of annual and perennial weeds, preemergence activity on grasses and small-seeded broadleaf weeds	Sequence 2.5 – 2.75 pt (glyphosate + S-metolachlor)	9, 15	Postemergence up to 10 leaf stage	Use only in Roundup Ready Flex cotton. If rainfall or irrigation is not received within 7 days of application, residual control may be reduced. Do not exceed 2.5 pt/A on cotton with less than 5 leaves. Do not harvest within 100 days of application. Do not include ammonium sulfate. Do not use in Gaines County.
Many annual broadleaf weeds including Palmer amaranth and annual morningglory, see label for weed-specific rates	Staple LX 2.6 – 3.8 fl oz (pyrithiobac)	2	Postemergence to most weeds when they are 1 -2 inches tall, refer to label	Use a nonionic surfactant at a rate of 0.25 – 0.5% v/v, or a crop oil concentrate at 1.0 – 2.0% v/v. For areas west of Highway 83 on sand or loamy sand soils with less than 1.0% organic matter, limit applications to one in-season application of a band of no more than one-third the row width. If replanting cotton is necessary, plant outside the treated band.
Postemergence control of many broadleaf weeds. Preemergence activity on many grass and broadleaf weeds.	Tavium 56.5 fl oz (dicamba + S-metolachlor)	4, 15	Postemergence up to 60 days after planting, or 6-leaf cotton	For use in XtendFlex (dicamba tolerant) cotton: For emerged broadleaf weeds, apply as a broadcast spray to weeds less than 4 inches in height. Do not exceed 113 fl oz per acre per year. Tank mix partners and spray nozzles for application are limited, see www.taviumtankmix.com for more details. Do not use in Gaines County. Do NOT mix with AMS or UAN. Many application requirements exist, refer to label before use.
Preemergence activity on annual grasses and small-seeded broadleaf weeds	Warrant 1.25 – 2.0 qt (acetochlor)	15	Postemergence to cotton, before weeds emerge and cotton reaches first bloom	Optimum timing and rate is 2- to 3-leaf cotton prior to weed emergence at 1.5 qt/A. For emerged weeds, add a postemergence herbicide. If no rainfall or irrigation occurs within 10 days, shallow incorporation will be necessary. Do not mix with fertilizer, as severe crop injury may occur.

Table 5 continued. Postemergence over-the-top herbicide options

Many broadleaf weeds	XtendiMax with VaporGrip Technology 22 fl oz (dicamba)	4	Postemergence up to 90 days after planting, or mid=bloom (per 24(c) SLN label in TX	For use in XtendFlex (dicamba tolerant) cotton: Best results are achieved when weeds are less 4 inches tall at application. Do not exceed 88 fl oz per acre total from crop emergence to 7 days prior to harvest. Tank mix partners and spray nozzles for application are limited, see www.xtendimaxapplicationrequirements.com for more details. Do NOT mix with AMS or UAN. Many application requirements exist, refer to label before using.
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Table 6. Post-directed or hooded herbicide options

Weeds Controlled	Product, Rate/A, Active Ingredient	Group #	Time to Apply	Notes
Common lambsquarter, ivyleaf and pitted morningglory, redroot pigweed, velvetleaf, and common waterhemp	Anthem Flex 1.4 – 3.8 fl oz (pyroxasulfone + carfentrazone)	15, 14	Postemergence as a directed spray to cotton from 6 in. tall to first bloom, or apply at layby.	Apply to common waterhemp less than 2 in. tall, morningglory up to 3 leaves, and lambsquarter up to 3 in. tall. For other labelled weeds, apply before they reach 4 in. in height. The use of an adjuvant is recommended for consistent control.
Annual grasses and broadleaf weeds including cocklebur, devil's claw, common lambsquarter, morningglory, pie melon, and pigweeds	Caparol 4L 1.6 – 3.2 pt (prometryn)	5	Postemergence as a directed spray when cotton is at least 12 in. tall and weeds are less than 2 in. tall	In the High Plains, 1.6 to 2.4 pt/A is sufficient. Do not treat cotton that is stressed due to drought, cultivator damage, or fertilizer applications. When applying to emerged weeds, add 2 qt surfactant per 100 gal of spray solution. Do not use in the Rio Grande Valley.
Many annual broadleaf weeds, including Palmer amaranth, devil's claw	Cobra 12.5 fl oz (lactofen)	14	Postemergence directed to cotton over 6 to 8 in. tall, or apply at layby.	The addition of 2 pt nonionic surfactant or 0.5 to 1.0 pt crop oil concentrate per 100 gal of spray solution consistently enhanced weed control. Refer to label for specific application instructions for individual weed species.
Many annual grasses and broadleaf weeds, refer to label for weed-specific rates	Direx 4L 0.4 – 0.6 qt (diuron) or Karmex 80DF 0.25 – 0.5 lb (diuron)	7	Postemergence directed after cotton is 6 to 12 in. tall, as needed up to 2 applications	Spray young, actively growing weeds less than 2 in. tall. Provides residual control of many weeds. Add a surfactant to spray solution. See label for weed and rate specifics.
Selected annual grasses and broadleaf weeds including cocklebur, morningglory, pigweed, smellmelon	Envoke 0.10 – 0.25 oz (trifloxysulfuron)	2	Postemergence directed to cotton over 6 in. tall	Add nonionic surfactant at 0.25% v/v or crop oil concentrate at 0.5 to 1.0% v/v. Do not harvest for 60 days after application. Refer to label for region specific recommendations for Texas.

Table 6 continued. Post-directed or hooded herbicide options

Annual broadleaf weeds including cocklebur, lambsquarter, morningglory, pigweed	Fierce 3 oz (flumioxazin + pyroxasulfone)	14, 15	Postemergence through hooded or shielded sprayers after cotton is 6 in. tall, or at layby after cotton is 16 in. tall.	Only for use in no-till and minimum till. Apply to actively growing weeds at the proper stage of growth as indicated on the label. May be combined with MSMA, diuron, or glyphosate. Most effective when applied under sunny conditions at temperatures above 65°F.
Many grass and broadleaf weeds	Flexstar GT 3.5 3.5 pt (fomesafen + glyphosate)	14, 9	Postemergence directed to cotton from 6 in. tall through layby	Only for use in Roundup Ready Flex cotton. Only labelled for use in Texas for areas east of U.S. Highway 77 and north of State Road 239, including all of Calhoun County. Moisture is required to activate this herbicide for residual activity. The glyphosate component of this product will control emerged weeds.
Annual grasses and broadleaf weeds including cocklebur, devil's claw, lambsquarter, morningglory, pie melon, pigweed	Goal 2XL 1.0 – 2.0 pt (oxyfluorfen)	14	Postemergence directed to cotton 6 to 8 in. tall	For optimal control, apply 2.0 pt/A to actively growing weeds with no more than 4 true leaves. Weeds at the 2 to 3 leaf stage can usually be controlled at the 1.0 pt/A rate. Do not use hollow cone nozzles.
Annual grasses and broadleaf weeds including cocklebur, devil's claw, lambsquarter, morningglory, pie melon, pigweed	Linex 4L 1.0 – 3.0 pt (linuron)	7	Postemergence directed to cotton at least 12 in. tall	Rates vary based up on the height of cotton, refer to label for more instructions. Add 1.0 pt surfactant for each 25 gal of spray solution.
Selected grasses, broadleaf weeds, and sedges. Refer to label	MSMA 6 2.66 pt (MSMA)	17	Postemergence directed to cotton between 3 in. tall and first bloom.	Apply at 40 gal water/A. If regrowth occurs, a second application may be made 1 to 3 weeks after the first. Do not apply after first bloom. Do not feed treated foliage to livestock.

Table 6 continued. Post-directed or hooded herbicide options

Preemergence control of many annual grasses and small-seeded broadleaf weeds, postemergence control of broadleaf and some grass weeds	Prefix 2.0 – 2.33 pt (S-metolachlor + fomesafen)	15, 14	Postemergence directed to cotton at least 6 in. tall	Apply to broadleaf weeds with 2 to 4 true leaves in a minimum of 10 gal water/A. Add a nonionic surfactant at 0.25 to 0.50% v/v or a crop oil concentrate at 1.0% v/v. Do not add liquid nitrogen fertilizer. In Texas, only use in areas east of U.S. Highway 77 and north of State Road 239, including all of Calhoun County.
Annual grasses and small-seeded broadleaf weeds	Prowl H2O 1.0 – 4.0 pt (pendimethalin)	3	Postemergence directed to cotton after layby	Rate of 1 to 3 pt/A on conventional or minimal tillage, 2 to 4 pt/A on no-till. Check label for maximum labelled rates based upon soil texture.
Annual and perennial grass and broadleaf weeds	Glyphosate products rates varied, refer to label (glyphosate)	9	Postemergence using hooded sprayers to non-glyphosate tolerant cotton	Apply in 20 to 30 gal water/A. Extreme care must be taken to prevent contact of glyphosate with foliage of non-glyphosate tolerant cotton.
Annual broadleaf weeds, suppression of some annual grasses	Reflex 1.0 – 1.5 pt (fomesafen) or Sinister 0.7 - 1.05 pt (fomesafen)	14	Postemergence directed to cotton from 6 to 12 inches tall, or as a layby to cotton with at least 4 inches of bark on stem	Apply only to coarse textured soils, as crop injury may occur on medium and fine soils. Only labelled for use in Texas for areas east of U.S. Highway 77 and north of State Road 239, including all of Calhoun County. FIFRA Section 24(c) label (Sinister ONLY): May be used west of Hwy 277 from Wichita Falls to Anson, and north of Hwy 180 to the NM and OK state lines. Includes Fisher, Scurry, Borden, and Dawson counties. Apply 0. pt/A. A minimum of 10 inches of irrigation must be applied following application through August 31 in overhead irrigated cotton (application may be made up to July 10). Rotational restrictions vary depending on irrigation availability, see 24(c) label for more details.

Table 6 continued. Post-directed or hooded herbicide options

Sedges and broadleaf weeds	Permit 0.66 – 1.33 oz (halosulfuron)	2	Postemergence using hooded sprayer any time after cotton emergence until row closure by cotton	Provides both preemergence and postemergence weed control of susceptible species. For control of emerged weeds, treat when actively growing and 1 – 3 in. in height. Add a nonionic surfactant at 0.25 to 0.50% v/v. Do not apply more than 1.33 oz per season.
Selected broadleaf weeds, grasses, sedges	Suprend 1.0 – 1.5 lb (prometryn + trifloxysulfuron)	5, 2	Postemergence directed to cotton at least 6 in. tall	For use in picker and Pima cotton varieties only. Do not apply in the Rio Grande Valley. Do not apply within 60 days of cotton harvest. Do not exceed 2.7 lb/A Suprend per season.
Annual grasses and small-seeded broadleaf weeds	Treflan 4EC 1.0 – 2.0 pt (trifluralin)	3	Postemergence directed to cotton from 4 leaf stage to layby	Soil incorporate using one pass of a sweep-type cultivator or a properly adjusted rolling cultivator. Do not harvest within 90 days of application.
Many annual broadleaf weeds	Valor SX 1.0 – 2.0 oz (flumioxazin)	14	Postemergence directed through hooded or shielded sprayers, or directed spray at layby	For hooded or shielded sprayer applications, apply only to cotton that is at least 6 in. tall. Layby applications may be made after cotton reaches 16 in. height. Only use a nonionic surfactant. Crop oil concentrates or methylated seed oils may result in severe crop injury.
Many annual broadleaf weeds	Warrant Ultra 48 – 65 fl oz (acetochlor + fomesafen)	15, 14	Postemergence directed to cotton from 6 inches tall through layby.	Apply in a minimum of 15 gallons of water per acre. Shields or hoods should be used for application to cotton from 6 to 12 inches tall. For control of emerged weeds, include 0.25 to 0.5% v/v nonionic surfactant or 0.5 to 1.0% crop oil concentrate. Only labelled for use in Texas for areas west of U.S. Highway 77 to State Road 230, including all of Calhoun County.

Table 6 continued. Post-directed or hooded herbicide options

Annual grasses, sedges, and annual broadleaf weeds	Zidua 0.75 – 2.1 oz (pyroxasulfone) Zidua SC 1.25 – 3.5 fl oz	15	Postemergence directed to cotton between 5 leaf stage and first bloom	Some cotton injury may be observed when Zidua is applied under stressful conditions. Will only control weeds emerging after application. Do not use on coarse textured soils.
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Table 7. Wick or wiper applied herbicide options

Weeds Controlled	Product, Rate/A, Active Ingredient	Group #	Time to Apply	Notes
Many annual and perennial grass and broadleaf weeds	Roundup WeatherMAX 33-75% solution (glyphosate)	9	When weeds are at least 6 in. above the cotton crop.	Do not wipe any closer than 2 in. above the cotton crop. As weed density increases, reduce speed. Wiping a second time in the opposite direction may improve control. Do not use wiper when weeds are wet. Oversaturation of wiper may cause dripping which will injure the crop. Concentration used is highly dependent on the wick or wiper device chosen, consult manufacturer.

Table 8. Rotational restrictions.

Product Name	Active ingredient(s)	Cotton	Corn	Grain Sorghum	Soybean	Wheat
Aim EC	carfentrazone-ethyl	anytime	anytime	anytime	anytime	anytime
Anthem Flex	pyroxasulfone carfentrazone-ethyl	0 - 2 months*	anytime	6 months*	anytime	0 - 1 month*
Assure II	quizalofop	anytime	120 days	120 days	anytime	120 days
Brake	fluridone	anytime	10 -18 months*	10 - 18 months*	2 - 12 months*	8 - 12 months*
Caparol 4L	prometryn	anytime*	12 months	12 months	12 months	12 months
Clarity	dicamba	21 days/8 fl oz*	anytime	15 days	14 days/8 fl oz*	22 days/8 fl oz
Cobra	lactofen	anytime	anytime	anytime	anytime	anytime
Command 3ME	clomazone	anytime*	9 months	0 months	anytime	12 months
Cotoran 4L	fluometuron	anytime	8 months	9 months	9 months	3 months
Direx 4L	diuron	anytime*	next spring	next spring	next spring	12 months
Dual II Magnum	S-metolachlor	anytime	anytime	anytime*	anytime	4.5 months
Engenia	dicamba	anytime (DT) 42 days (non-DT)*	anytime	28 days	anytime (DT) 28 days (non-DT)	28 - 42 days*
Enlist Duo	2,4-D glyphosate	anytime (Enlist) 30 days (non-Enlist)	anytime	**	anytime (Enlist) 30 days (non-Enlist)	**
Enlist One	2,4-D	anytime (Enlist) 30 days (non-Enlist)	anytime	**	anytime (Enlist) 7 - 14 days (non-Enlist)	**
Envoke	trifloxysulfuron	7 months*	7 - 22 months*	7 - 22 months*	7 - 10 months	3 months
ETX	pyraflufen-ethyl	anytime	anytime	1 day	anytime	anytime
Express	tribenuron-methyl	14 days*	14 days*	14 days*	7 days*	anytime
Fexapan XtendiMax	dicamba	anytime (DT) 0 - 180 days (non-DT)	0 - 120 days*	0 - 120 days*	anytime (DT) 28 days (non-DT)*	22 - 35 days/22 floz
Fierce	flumioxazin pyroxasulfone	45 days - 1 month	7 days - 1 month	18 months	anytime	1 month
FirstShot SG	thifensulfuron-methyl tribenuron-methyl	14 days	14 days	14 days	7 days*	anytime

Table 8 continued. Rotational restrictions.

Product Name	Active ingredient(s)	Cotton	Corn	Grain Sorghum	Soybean	Wheat
Flexstar GT 3.5	fomesafen glyphosate	anytime	10 months	10 months	anytime	4 months
Fusilade DX	fluazifop	anytime	60 days	60 days	anytime	60 days
glyphosate products	glyphosate	anytime	anytime	anytime	anytime	anytime
Goal 2XL	oxyfluorfen	7 days	10 months	10 months	7 days	10 months
Gramoxone SL 2.0	paraquat	anytime	anytime	anytime	anytime	anytime
Harmony SG	thifensulfuron- methyl	7 days	anytime	anytime	anytime	anytime
LeadOff	thifensulfuron- methyl rimsulfuron	1 - 10 months*	anytime	10 months	1 - 10 months	3 months
Liberty 280 SL	glufosinate	anytime	anytime	180 days	anytime	70 days
Linex 4L	linuron	anytime	anytime	anytime	anytime	4 months
Outlook	dimethenamid-P	4 months	anytime	anytime*	anytime	4 months
Panther D	flumioxazin 2,4-D	30 days*	15 - 30 days*	30 days*	15 days	30 days
Permit	halosulfuron	4 months	1 month	2 months	5 - 9 months*	2 months
Poast	sethoxydim	anytime	30 days	30 days	anytime	30 days
Prefix	S-metolachlor fomesafen	1 month	10 moths	10 moths	anytime	4.5 months
Prowl H ₂ O	pendimethalin	anytime	**	4 - 12 months	anytime	4 - 12 months
Reflex	fomesafen	anytime	10 months	10 months	anytime	4 months
Sequence	glyphosate S-metolachlor	anytime	anytime	anytime*	anytime	4.5 months
Sharpen	saflufenacil	1.5 months*	anytime	anytime	0 - 1 month*	anytime
Solicam DF	norflurazon	30 days	24 months	24 months	45 days - 12 months*	24 months
Staple LX	pyrithiobac	anytime	9 - 24 months*	10 - 24 months*	10 months	4 months
Suprend	prometryn trifloxysulfuron	7 months	7 months	7 months	7 months	3 months
Tavium	dicamba S-metolachlor	anytime (DT) 42 days (non-DT)*	4 months	6 months	anytime (DT) 28 days (non-DT)*	4.5 months
Treflan 4 EC	trifluralin	anytime	12 - 18 months	12 - 18 months	anytime	12 - 18 months
Valor SX	flumioxazin	14 days - 4 months*	7 days - 4 months*	30 days - 4 months*	0 - 4 months*	30 days - 4 months*
Warrant	acetochlor	anytime	anytime	anytime*	anytime	4 months

Table 8 continued. Rotational restrictions.

Product Name	Active ingredient(s)	Cotton	Corn	Grain Sorghum	Soybean	Wheat
Warrant Ultra	acetochlor fomesafen	1 month	10 months	10 months	anytime	4 months
Zidua	pyroxasulfone	1 - 2 months*	anytime	6 months	anytime	1 month

*additional details specified, please refer to label

**rotation not specified on label, please refer to local Extension experts or company representatives for guidance

PHOTOGRAPHS OF COMMON WEEDS

Balloonvine

Cardiospermum halicacabum

Annual vine sprawling and trailing. Leaves alternate, usually twice alternately compound. Leaflets toothed and lobed. Flowers about 4 mm long with 4 petals. Fruits inflated (balloon-like).



Barnyardgrass

Echinochloa crus-galli

Annual summer grass. Leaf sheath and blade hairless with no ligule or auricles. Stems flattened. Spikelets 3 to 4 mm long.



Field bindweed

Convolvulus arvensis

Perennial trailing vine with deep root. Gray-green pubescence. Simple, alternate leaves, usually lanceolate in shape. Flowers typically white with five fused petals.



Browntop panicum

Urochloa fasciculatum

Annual summer grass. Spreading or erect growth forms possible. Ligules of hairs approximately 1 mm long. Panicles with appressed branches.



Common cocklebur

Xanthium strumarium

Summer annual. Smooth, waxy cotyledons lanceolate in shape. Alternate leaves triangular or ovate in shape with a rough, sandpaper texture.



Common sunflower

Helianthus annuus

Summer annual. Ovate cotyledons. Alternate simple leaves with rough texture and hairs. Leaves with serrate margins tapered to a point.



Cutleaf groundcherry

Physalis angulata

Summer annual. Mostly without hairs. Leaves ovate to ovate-lanceolate with toothed margins. Pale yellow flowers 5-sided. Stem angled in cross-section and hollow.



Devil's-claw

Proboscidea louisianica

Low, bushy summer annual. Odiferous and covered with glandular hairs. Leaves alternate or opposite and mostly ovate in shape. Yellow five-lobed flowers. Fruit a fleshy curved pod, splitting into two "claws" after desiccation.



Hophornbeam copperleaf

Acalypha ostryifolia

Erect annual, freely branched. Long-petioled leaves, nearly glabrous. Leaves alternate with finely toothed margins.



Horseweed

Conyza canadensis

Winter or summer annual. Smooth, spatulate cotyledons. Early leaves with entire margins, later leaves crowded around the stem with entire or toothed margins and often hairy.

**Ivyleaf morningglory**

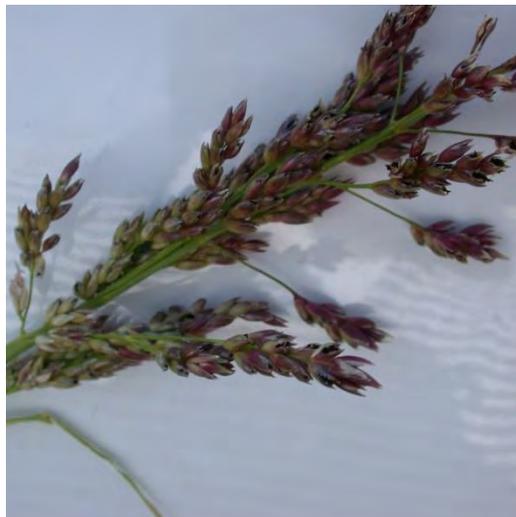
Ipomoea hederacea

Annual twining vine with pubescent stems. Leaves typically 3-lobed, occasionally without lobes. Funnel-shaped flowers (corolla), typically light blue with white or yellow centers.

**Johnsongrass**

Sorghum halepense

Perennial grass. Leaf sheath and blade hairless with no auricles. Large membranous ligules with jagged margins. Oval, shiny seed. May also reproduce via rhizomes.



Junglerice

Echinochloa colona

Summer annual grass. Very similar in appearance to *E. crus-galli* (barnyardgrass). Leaves may exhibit several purple bands across them.

**Kochia**

Bassia scoparia

Summer annual. Narrow, oblong cotyledons with many soft, fine hairs. Leaves alternate and simple with many hairs, and without petioles.

**Lanceleaf sage**

Salvia reflexa

Slightly hairy annual reaching 1 to 1.5 ft tall. Opposite leaves lanceolate with toothed or entire margins and short petioles. Stems square in cross-section. Flowers with blue to white petals.



Yellow nutsedge

Cyperus esculentus

Perennial, colonial sedge. Stems triangular in cross-section. Leaves arranged in ranks of three and gradually form a pointed tip. Rhizomes sometimes with tubers forming at the ends.



Purple nutsedge

Cyperus rotundus

Perennial, colonial sedge. Stems triangular in cross-section. Leaves arranged in ranks of three and form a more rounded tip than *C. esculentus* (yellow nutsedge). Rhizomes may form chains of tubers along their length.



Palmer amaranth

Amaranthus palmeri

Dioecious summer annual. Cotyledons linear and without hairs. Leaves mostly glabrous. Petioles often longer than leaf blades. Faint white chevron markings may be present on leaves.



Parthenium ragweed

Parthenium hysterophorus

Annual broadleaf resembling the appearance of western ragweed. Seedling forms a basal rosette, which later grows to 0.5 – 1.5 m tall. Stems longitudinally grooved with stiff hairs. Later leaves are alternate and deeply divided. Flowers are white and form in numerous clusters.

**Puncturevine**

Tribulus terrestris

Prostrate annual broadleaf. Leaves pinnately compound and opposite. Leaflets pubescent at the midvein and margins above, densely pubescent below. Flowers with 5 yellow petals. Fruit is a spiny capsule.

**Common purslane**

Portulaca oleracea

Sprawling summer annual. Cotyledons linear and without hairs. Opposite leaves which are smooth and spatulate. Leaves and stems are succulent.



Prostrate spurge

Chamaesyce prostrata

Sprawling, prostrate annual. Leaf blades broadly elliptic, with short or no petioles, and arranged opposite. Leaves folding together at night or under poor conditions. Broken tissue exudes a milky sap.



Russian thistle, tumbleweed

Salsola tragus

Bushy annual. Stems may have red-purple streaks. Leaves are filiform. Flowers lack petals and are subtended by a pair of spiny bracts. The plant dries and breaks off at the base in the fall, forming a round “tumbleweed.”



Sharppod morningglory

Ipomoea trichocarpa

Perennial vine with twining, climbing stems. Leaves alternate with pubescence, typically 3-lobed or heart-shaped (chordate). Flowers usually red to red-purple with a dark red center.



Silverleaf nightshade

Solanum elaeagnifolium

Perennial broadleaf. Stems and leaves have a silver appearance due to many stellate hairs. Stems may be densely prickly. Leaves are linear. Flowers blue-purple, occasionally white.



Texas blueweed

Helianthus ciliaris

Perennial with slender rhizomes. Stems and leaves with a blue-green cast. Leaves are mostly opposite, lanceolate, with short petioles. Ray flowers yellow, disk flowers reddish-bronze.



Texas panicum

Urochloa texana

Annual grass, spreading to erect in growth habit. Ligules of hairs approximately 1 mm long. Broad, hairy leaves. Panicles with appressed branches. Similar in appearance to *U. fasciculata* (browntop panicum), except for slightly shorter pubescence on leaves.



Common waterhemp

Amaranthus rudis

Summer annual. Linear cotyledons. Leaves narrowly ovate to lanceolate, alternate, and waxy in appearance. Plant without hairs. Petioles may be shorter than leaves.



Woollyleaf bursage

Ambrosia grayi

Perennial reaching 6 to 24 inches tall. Pinnately lobed leaves, opposite in arrangement, with a gray cast due to dense pubescence. Fruit becomes a bur after maturity.



Velvetleaf

Abutilon theophrasti

Summer annual. Each cotyledon differs in shape; one is ovate, while the other is chordate (heart-shaped). Both cotyledons with entire margins and covered in short hairs. Stems are densely hairy. Leaves chordate, and alternate with soft, velvety hairy surfaces.



**Department of Soil and Crop Sciences
Texas A&M AgriLife Extension Service
Texas A&M University**

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