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The purpose of this document is to list and describe common herbicide inputs for cotton weed management on the Texas Southern High Plains. This document will be a “work in progress” for the entire 2015 growing season and will be updated with common input times during the growing season (please note the revised date on the upper right hand corner of this document and replace older versions with the newer ones). Herbicide application “timing” will be the main headings in this document. An exhausted list of herbicide inputs is not the goal of this document, but the focus will be on commonly used herbicides in this region. Please use these recommendations as a guide, and consult the herbicide labels (<http://www.cdms.net/>) for complete details regarding rates, rotational restrictions, use of adjuvants, recommended carrier volumes and spray tip selections, etc. Although the majority of this document will be information extracted from herbicide labels, additional comments that fine-tune label recommendations will be added. If you have questions, please contact the authors below. In addition, four weed management videos were created in 2015 that focus on weed management of Palmer amaranth. Video title and links are listed below:

1. History and Biology of Palmer amaranth <http://youtu.be/QbA45TgJEgg>
2. Weed Control prior to Emergence <http://youtu.be/-OeD0p1YPQg>
3. Control of Weeds after Emergence <http://youtu.be/cFgZbPD8Dhs>
4. New Technologies for Weed Management <http://youtu.be/22kDZkVZ4IE>

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Cotton Weed Management on the Texas Southern High Plains

PREPLANT BURNDOWN OPTIONS

One of the initial “keys” to effective, season-long weed management is to start clean. In conventional tillage, normal land preparation practices and herbicide incorporation, followed by a rodweeder prior to planting should provide a clean start for uniform crop emergence and allow the crop to “get a head start” on the weeds. For growers in some type of reduced or no-tillage system, the use of tillage is replaced by burn down herbicides prior to or at planting. In this semiarid region, there are plant back restrictions to be aware of to avoid crop damage after planting. Below are a number of herbicide options labeled for preplant weed control.

Roundup (glyphosate) is a Group 9 herbicide based on the mode of action classification system of the Weed Science Society of America. The following information was obtained from the Roundup PowerMax label (<http://www.cdms.net/LDat/ld8CC010.pdf>) .

USE INSTRUCTIONS. This product may be applied before, during or after planting cotton, but prior to crop emergence (unless it’s a Roundup Ready Flex or Glytol cotton variety).

TANK MIXTURES. This product may be tank-mixed with 2,4-D, Valor or Rowel, and FirstShot prior to planting (see restrictions on the 2,4-D, Valor or Rowel, and FirstShot label). This product may also be tank-mixed with several herbicides and applied prior to emergence (see preemergence section) or postemergence (see postemergence section). Normal use rates of this product are 22 to 32 ounces.

Allow at least 1 to 2 weeks from application before any tillage operation is used to ensure adequate uptake and translocation.

2,4-D (a group 4 herbicide). Specific time, rate, and irrigation restrictions are essentially impossible to find on 2,4-D labels. In general, applications made prior to March 1 with any moisture accumulation (0.5 inches) should be enough to effectively dissipate the herbicide prior to planting. According to the Weed Management in Texas Cotton guide (ESC-008, 3/14), wait a minimum of 30 days following the application and a minimum of 1 inch rainfall or irrigation within a 24 hr period. A “normal use rate” of 2,4-D formulated at 4 pounds per gallon is 1 to 2 pints per acre. 2,4-D + glyphosate is an effective preplant burndown treatment to control winter weeds such as mustard, shepherdspurse, henbit, and horseweed, and early emerging summer annuals such as kochia and Russian thistle.

Clarity. Do not use as a preplant burndown in this area. According to the Clarity label (<http://www.cdms.net/LDat/ld797012.pdf>), do not make applications in regions with less than 25 inches of average annual precipitation.

Gramoxone Inteon. Gramoxone Inteon (paraquat) is a restricted use pesticide due to acute toxicity, so appropriate Personal Protective Equipment (PPE) is critical when handling, mixing, and spraying this herbicide. Use 2.5 to 4.0 pint prior to, during or after planting, but before crop emergence. Since this is a contact-type herbicide, thorough coverage on weeds 1- to 6-inches in height is important for effective control. The use of flood-type nozzles may result in reduced weed control because of inadequate spray coverage. According to the label, “when spraying less than 20 gallons of spray carrier per acre, use only flat fan nozzles...” and use a nonionic surfactant or crop oil concentrate. Gramoxone Inteon may be tank mixed with several herbicides that have residual control, including Caparol, Cotoran, Cotton-Pro, Diuron, Dual Magnum, and Prowl. Follow mixing order instructions on the label and maintain constant agitation. One of Gramoxone Inteon’s greatest strengths is the control of Russian thistle (tumbleweed) to help “start clean”.

Valor, Rowel (flumioxazin, group 14 herbicide). According to the Valor label (<http://www.cdms.net/LDat/ld3LL041.pdf>) and Rowel (<http://www.cdms.net/ldat/ldC2U000.pdf>) labels, apply up to 2 ounces of product plus a tank mix partner (glyphosate) if weeds have emerged. Thirty days and 1 inch of rainfall or overhead irrigation must occur between application and planting in conventional tillage (21 days in no-till or strip-till when 1.5 to 2 ounces of product is used, or 14 days if 1 ounce is used). Include MSO or crop oil concentrate (COC).

Firstshot (thifensulfuron + tribenuron). According to the FirstShot label (<http://www.cdms.net/LDat/ld87I008.pdf>), apply 0.5 to 0.8 ounce/A as a burndown treatment to control emerged weeds prior to planting or 0.5 to 0.6 ounce/A when used in tank mixture with other herbicides like glyphosate or 2,4-D. There is a 14 day interval between application and planting. An additional 7 days must be added when used on light textured soils (sands, loamy sands and sandy loams). An additional 7 days must be extended when used on high pH soils (>7.9).

Aim EC. Aim may be used as a burndown treatment in cotton no later than one (1) day after planting. Use rates are weed species (and weed size) specific and range from 0.5 to 2.0 fluid ounces per acre. Make applications to actively growing weeds up to 4-inches in height or 3-inches in rosette diameter. A nonionic surfactant (0.25% v/v), crop oil concentrate (1 to 2% v/v), or methylated seed oil is required. Aim may be tank mixed with other preplant burndown herbicides such as glyphosate (Roundup), glufosinate (Liberty), paraquat (Gramoxone Inteon), and 2,4-D.

ET. ET may be used as a burndown treatment in cotton for control of several broadleaf weeds. For best results, use ET on weeds less than 4 inches in height, or rosettes less than 3 inches in diameter. Use rates range from 0.5 to 2.0 fluid ounces per acre. Use the higher rates and spray volumes for control of larger weeds. Make applications to actively growing weeds up to 4-inches in height or 3-inches in rosette diameter. The addition of a nonionic surfactant (0.25%

v/v) or crop oil concentrate (1% v/v) is recommended for optimum control. ET must be tank mixed with another foliar active broadleaf herbicide for complete control of most broadleaf weeds. For **ETX**, use 0.3 to 1.25 fluid ounces per acre.

PREPLANT INCORPORATED OPTIONS

Trifluralin. The following information was found in the Trifluralin 4 EC Herbicide label by Helena Chemical Company (<http://www.cdms.net/LDat/ld4AR000.pdf>). Trifluralin may be applied using water liquid fertilizer as the carrier, or impregnated on dry bulk fertilizer. Broadcast application rates range from 1 to 2 pints/A and are based on soil texture (1 to 1.5 pints in coarse soils, 1.5 to 2 pints in medium soils, 2 pints in fine soils). Use higher rates within the rate range where greater weed populations are anticipated. To prevent loss of herbicidal activity, it must be incorporated within 24 hours after application.

The soil surface should be smooth to allow for uniform application and incorporation. Apply when the soil moisture is sufficient to allow the breakup of large clods and uniform mixing during the incorporation process. Soil compaction and/or non-uniform incorporation may occur if the soil is excessively moist.

In a soil bedding culture, trifluralin should be incorporated 2 to 3 inches in the final seedbed. If the application is made prior to bedding, apply and incorporate one time with recommended equipment. The bedding operation serves as the second incorporation. Do not expose untreated soil during post-bedding operations such as planting since removal of treated soil during planting may allow weed seed germination and establishment in the drill row. When applications are made after bedding, knock off the beds to planting height before application, and incorporate with recommended equipment that will conform to the shape of the bed. Again, do not expose untreated soil.

Use incorporation equipment capable of uniformly mixing the herbicide into the top 2 to 3 inches of the final seedbed. Improper incorporation may result in erratic weed control and/or crop injury. Incorporation equipment will mix Trifluralin 4 EC approximately half as deep as the equipment is set to operate. For example, a disc set to cut four inches deep will mix the herbicide within the top two inches of soil.

A tandem disc should be set to cut 4 to 6 inches and run at 4 to 6 MPH. A field cultivator should be set to cut 3 to 4 inches and operated at a minimum of 5 MPH. A rolling cultivator should be set to cut 2 to 4 inches and run at 6 to 8 MPH. Rolling cultivators are adequate for use on coarse and medium soils. With most equipment and methods of application, a second incorporation is required and may occur any time before planting. The second incorporation should be in a different direction, and to avoid bringing untreated soil to the surface, should not be deeper than

the first. No information is listed for stalk cutters, which suggests that these are questionable implements for herbicide incorporation.

Apply and incorporate after January 1 when soil can be worked and is in a condition which allows thorough mixing to insure uniform incorporation. Ground cover, such as crop residues and existing weeds, can interfere with uniform soil incorporation. A manageable level of ground cover will allow uniform incorporation into the top 2 to 3 inches of soil. Excessive ground cover and crop residues should be reduced by appropriate soil tillage prior to application. Break up clods using tillage equipment prior to application.

Spread the fertilizer/chemical mixture with properly calibrated application equipment. Be certain the material is applied uniformly to the soil surface. Trifluralin 4 EC should be incorporated 2 times with impregnated on dry bulk fertilizer. The first incorporation should occur within 24 hours after application. The second application should be delayed 3 to 5 days after the first and be completed prior to planting

Trifluralin 4 EC may be applied by chemigation. Apply in sprinkler irrigation equal to 0.5 to 1 inch of water. Our experience suggests that a minimum of 1 inch of water should be used.

Prowl (pendimethalin). The following information was obtained from the Prowl 3.3 EC label (<http://www.cdms.net/LDat/ld867008.pdf>). Prowl 3.3 EC may be applied by ground or air and subsequent must take place within 7 days after application by rainfall, sprinkler irrigation, or mechanical tillage prior to weed seedling emergence. Use rates range from 1.2 to 4.8 pints/A depending on soil texture and tillage (conventional or minimum tillage: 1.2 to 2.4 pints/A in coarse soils, 1.8 to 2.4 pints/A in medium soils, 2.4 to 3.6 pints/A in fine soils; No-tillage: 1.8 to 2.4 pints/A in coarse soils, 2.4 to 3.6 pints/A in medium soils, 3.6 to 4.8 pints/A in fine soils). Incorporate into the upper 1 to 2 inches of soil up to 60 days before planting. Water or sprayable fluid fertilizer (such as 32-0-0 or 28-0-0) may be used as the carrier. Apply using 10 or more GPA water or 20 or more GPA liquid fertilizer (or 5 or more GPA by air). Prowl 3.3 EC may also be impregnated on dry bulk fertilizer. Use an implement capable of giving uniform incorporation. For surface incorporation, uniformly apply as a broadcast or banded treatment and incorporate within 7 days using 1 to 2 inches using sprinkler irrigation or shallow mechanical incorporation. A two-pass incorporation usually results in a more consistent result.

For use in minimum tillage or no-tillage systems, apply Prowl 3.3 EC alone or in tank mixes up to 45 days before planting. **Prowl H2O** (<http://www.cdms.net/LDat/ld6CT007.pdf>) may be preplant surface applied up to 15 days prior to planting, up to 60 days prior to planting and incorporation, and applied via chemigation. Rates range between 1 to 4 pints/A depending on soil texture and tillage.

PREEMERGENCE OPTIONS

The need for a preemergence herbicide at planting involves several factors. Larger-seeded annual broadleaf weeds (e.g. morningglory, common cocklebur, sunflower) are not effectively controlled by preplant incorporated herbicides such as trifluralin or pendimethalin. The need for additional soil-applied herbicides is an effective strategy for resistance management because these work differently to control glyphosate-resistant Palmer amaranth when compared to glyphosate and dinitroaniline herbicides and the concept of “over-laying” residual herbicides will help extend weed control longer into the growing season. These herbicides are also critical in non-transgenic cotton where postemergence herbicide options are limited. Areas with intense weed pressure will benefit from soil applied preemergence herbicides regardless of the use of transgenic varieties. It is well-documented that early-season weed control is critical for uniform crop stands and to eliminate early season weed competition for limited resources such as water and nutrients. The use of a preemergence herbicide will provide a good start to weed management, especially in the event that a timely postemergence application cannot be made.

Herbicides applied preemergence are generally applied prior to emergence of both the weed and the crop, although crop tolerance may allow some preemergence herbicides to be applied after crop emergence. The length of soil activity varies by herbicide, herbicide rate, rainfall/irrigation, soil texture, soil organic matter, and pH. Since these factors vary for each herbicide, it is very important to carefully follow label instructions and make sure that your soil type allows for the use of the preemergence herbicide in question. All preemergence herbicides applied to the soil need rainfall or irrigation for activation. There is potential, however, for crop injury when soil-applied herbicides are used on sandy textured soils. Many of the preemergence herbicides are not labeled in coarse-textured soils. In general, the effectiveness of preemergence herbicides is largely based on moisture to move (activate) the herbicide in the soil into the zone where the weed seeds germinate.

Options for herbicides that may be applied preemergence in cotton are given below along with some general comments for each herbicide option. For complete information, please see the complete herbicide label (<http://www.cdms.net/>).

Caparol (prometryn) is a Group 5 herbicide. It may be applied at planting and provides good control of several broadleaf weeds including lambsquarter, annual morningglory, malva, and purslane. This herbicide will provide additional control of Palmer amaranth compared with the use of a dinitroaniline herbicide used alone because of the overlaying effect from two residual herbicides with different modes of action. The use rate is based on soil texture: (1.6 pints - sandy loam; 2.4 pints – loam, sandy clay loam; 3.2 pints – other clay soils). **DO NOT USE ON SAND OR LOAMY SAND SOILS.** In burndown situations where weeds are present but the cotton has not yet emerged, this herbicide may be tank mixed with a burndown herbicide (Roundup, Liberty, Gramoxone Inteon) in both Roundup Ready and conventional cotton for improved control of existing weeds.

Cotoran (fluometuron) provides good broad-spectrum control of several annual broadleaf and some grass weeds including annual nightshade, Venice mallow, and spurred anoda and has activity on common cocklebur and morningglory. In west Texas, **DO NOT USE COTORAN ON SAND, LOAMY SAND, OR FINE SANDY LOAM SOILS,** and do not use on cotton planted in

furrows. Broadcast rates of Cotoran vary by soil texture (use 3.2 pints in loam, silty clay loam, silt loam, silt, sandy clay loam, and clay loam soils; use 4 pints in clay, clay loam, silty clay loam, silty clay, sandy clay, and sandy clay loam soils).

Diuron (Direx, Karmex) applied at planting controls many annual broadleaf weeds and some grass weeds. DO NOT USE ON SAND OR ON SOILS WITH LESS THAN 1% ORGANIC MATTER AS CROP INJURY MAY RESULT. IN TEXAS WEST OF I-35, DO NOT APPLY TO LOAMS SANDS OR SANDY LOAM SOILS (PARTICULARILY WHERE THEY HAVE BEEN DEEP PLOWED TO CHANGE TEXTURE). Use rates are based on soil texture (use 1.5 pints on loam, silt loam, and silt soils; use 2 pints on sandy clay loam, clay loam, silty clay loam, and sandy clay soils; use 3 pints on silty clay and clay soils). Use rates following trifluralin used preplant should be reduced to 1 pint on loams sand soils, 1.5 pints on sandy loam, loam, silt loam, and silt soils, and 2 to 3 pints on sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay soils. Injury may occur if Diuron 4L is used in conjunction with soil-applied organic phosphate pesticides.

Dual Magnum (Dual II Magnum, Cinch, Metolachlor) controls annual grasses and small-seeded broadleaf weeds including Palmer amaranth, and has good activity on yellow nutsedge. DO NOT USE ON SANDS AND LOAMY SAND SOILS. DO NOT USE IN GAINES COUNTY, TEXAS. Rates of Dual Magnum vary by soil type. In area 2 (Texas), use 1 pint on sandy loams, 1.0 to 1.33 pints on medium soils, and 1.33 pints on fine soils. Do not use on sand and loamy sand soils.

Warrant (acetachlor) will control grasses and small-seeded broadleaf weeds including Palmer amaranth. Use 1.25 to 2 quarts, and the optimum rate is 1.5 quarts. Broadcast rates per acre in soils with less than 1.5% organic matter are based on soil texture. Apply 1.25 to 1.6 quarts in coarse soils, 1.25 to 1.7 quarts in medium soils, and 1.25 to 1.9 quarts in fine soils. Although there is a label for coarse soils, potential cotton injury may occur under these conditions.

Prowl (pendimethalin products) in addition to preplant incorporated applications, this herbicide may be applied at planting or up to 2 days after planting. The addition of Prowl at planting will improve annual grass and small-seeded broadleaf weed control. Rates vary by soil texture. In conventional or minimum tillage, rates range from 1 to 3 pints (coarse – 1 to 2 pints, medium – 2 pts, fine – 3 pts), whereas use rates in no-till range from 2 to 4 pints (coarse – 2 pts, medium – 3 pts, fine – 4 pts) where irrigation is needed shortly after application to ensure herbicide activation. Rainfall, sprinkler irrigation, or shallow mechanical incorporation within 7 days after application is required to move this product into the upper soil surface where the weed seeds germinate

Staple LX applied preemergence has good activity on many small-seeded broadleaf weeds such as Palmer amaranth and annual morningglories. Do not use on cotton planted in furrows and on soils with less than 0.5% organic matter. DO NOT USE ON COARSE SOILS SUCH AS SANDS OR LOAMY SANDS. Staple LX use rates range from 1.3 to 2.1 fluid ounces per acre. Use the higher rate for harder to control weeds and/or in fields where dense populations of weeds occur. Staple LX may be used alone or in combination with Caparol, Cotoran, or Direx broaden the spectrum of residual activity compared to any of these herbicides applied alone. These are

especially effective combinations for use in non-transgenic cotton where postemergence options are limited. Consult the label for plant back restrictions to several crops including corn and sorghum.

Since product labels change from year to year, always carefully read and follow label recommendations for a variety of information, including herbicide rate, adjuvant use, interval restrictions between application and planting, or other application restrictions.