UNIVERSITY OF GEORGIA
EXTENSION

Cotton Defoliation in Georgia

John Snider, Professor
Lavesta Hand, Assistant Professor

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Cotton defoliation is a complex production decision with many chemical options to consider. Harvest aids are utilized to prepare the crop for machine harvest, and timely defoliation and harvest of cotton can reduce weathering losses (yield and quality) and decrease trash in the lint. A basic knowledge of crop development and maturity as well as an understanding of the physiological effects of harvest aids on cotton plants is necessary in making decisions concerning defoliation.

Harvest Aid Functions

Harvest aids have four functions. Based on the time of year defoliation is occurring, all processes may not be necessary for cotton harvest. It's important to understand these processes to determine appropriate products and rates. These four functions are (a) removal of mature foliage, (b) removal of juvenile foliage, (c) boll opening, and (d) regrowth suppression.

The first two processes are considered defoliation. Defoliation is a natural plant process—but in a cotton crop, leaf drop does not occur simultaneously throughout the canopy. To facilitate a timely harvest, producers must manipulate the plant to drop its leaves over a short period of time.

Auxin and ethylene are the two plant hormones involved in defoliation. Auxin promotes growth and prevents abscission, whereas ethylene is a ripening hormone that promotes abscission. Leaves fall from the plant once ethylene moves from the leaf to the base of the petiole to activate cell-wall-degrading enzymes that form the abscission layer. The ratio of auxin and ethylene concentration in the leaf is based on leaf age. Younger leaves have higher concentrations of auxin while older leaves have higher concentrations of ethylene. This makes older leaves more conditioned for defoliation, while young leaves might be more difficult to remove. Although higher rates of defoliants might be necessary to remove juvenile growth, this could also lead to leaf sticking—where the leaf desiccates and remains on the plant. Increased ethylene from defoliants can hasten boll opening, and regrowth suppression is necessary to prevent follow-up applications to control regrowth. Manipulating these hormones with harvest aids will facilitate the leaf abscission process and allow for suppression of boll opening and regrowth.

Types of Defoliants

There are two main types of defoliants for cotton: herbicidal and hormonal. Herbicidal defoliants injure the leaf, stimulating the production of ethylene. Hormonal defoliants increase the ethylene concentration in the leaves without causing injury. Specific examples of each type can be found below.

Herbicidal defoliants

Tribufos (Folex)—Injures leaf below the cuticle, causing stress and stimulating ethylene production.

PPO-inhibiting herbicides [Aim (carfentrazone-ethyl), ET (pyraflufen-ethyl), Resource (flumiclorac), Blizzard (fluthiacet-methyl), Sharpen (saflufenacil), and others]—Degrades cell membranes, causing ethylene production.

Hormonal defoliants

Ethephon (Prep, others)—Increases production of ethylene, leading to leaf drop and accelerated boll opening. Other ethephon-containing products include Finish 6 Pro (ethephon plus cyclanilide) and FirstPick (ethephon plus urea sulfate).

Thidiazuron (Dropp, Freefall, others)—Enhances the production of ethylene and inhibits auxin transport. Primarily used for juvenile growth removal and regrowth suppression. Ginstar is a premix of thidiazuron plus diuron.

Defoliation Timing

Determining **when** to defoliate your cotton crop is of the utmost importance because defoliation timing can impact both yield and fiber quality. Poor defoliation reduces fiber quality; early defoliation reduces yield and micronaire; and late defoliation increases the likelihood of boll rot and reductions in yield and quality from weathering. Additionally, lower temperatures later in the season can cause suboptimal defoliant performance.

There are three primary ways to determine crop maturity and defoliation timing:

1. **Percent open boll**—60% to 75% open boll (60% in a uniform crop ONLY)
2. **Sharp knife test**—Using a sharp knife, cut into the uppermost boll that has a chance of contributing to yield. The cotton should string out when the boll is cut; the seeds should be fully developed, with a brown seed coat, and visibly developed cotyledons

inside the seed.

3. **Nodes above cracked boll** (NACB)—observing four NACB or less. There is a relationship between the percent open boll and the number of nodes between the uppermost first position cracked boll and the uppermost first position harvestable boll. That relationship is illustrated in Figure 1.

Figure 1. Relationship Between NACB and Percent Open Bolls.
A scatter plot showing an inverse relationship between percent open boll and N A C B with a fitted linear regression line and equation.

Y = 10.441 - 0.105X; F = 861*; df=154
*Denotes significance at the *P* = 0.01 level.

% Open Bolls	30	40	50	60	70	80	90	100
NACB	7.3	6.2	5.2	4.1	3.1	2.0	1.0	0

Nodes from the uppermost first sympodial position cracked boll to the uppermost harvestable boll (NACB) vs. percent open boll in harvest timing studies conducted at the University of Georgia Coastal Plain Experiment Station in 1998, 1999, and 2000.

Graph adapted from "Losses in yield, quality, and profitability of cotton from improper harvest timing," by C. W. Bednarz, W. D. Shurley, and W. S. Anthony, 2002, *Agron. J., 94*(5), p. 1006 (https://doi.org/10.2134/agronj2002.1004).

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events: [], plugins: { legend: { display: false, }, }, scales: { x: { title: { display: true, text: 'Percent Open Boll', font: { size: 15 } }, }, y: { title: { display: true, text: 'NACB', font: { size: 15 } } } } } });

Defoliant Applications

Most defoliants do not translocate through the plant, making spray coverage extremely important. To ensure adequate spray coverage, growers must use the proper spray pressure, ground speed, and nozzle size for the appropriate application volume (according to label instructions). Much attention has been given to defoliation using auxin nozzles (i.e., nozzles labeled for 2,4-D and dicamba applications), and there have been concerns about adequate spray coverage. A study conducted across the cotton belt found that sprayer output (GPA) was far more important in defoliation than nozzle type. Higher GPA results in greater defoliation, with a good output target being 15 GPA.

Many growers across the state of Georgia have participated in the Using Pesticides Wisely training over the past few years. Although this training primarily has to do with the use of 2,4-D and dicamba, these lessons should not be dismissed when applying other pesticides. Care should be taken to prevent off-target movement of defoliants, particularly around sensitive crops and urban areas, as the effects of defoliant drift are readily apparent.

When defoliating, only treat the acres you anticipate harvesting in the next 10 to 14 days. Rain occurring after application can affect defoliant activity, so weather forecasts should be consulted before application. In Table 1, some of the more common defoliants are listed with their rates, rain-free periods, PHIs, and expected activity. This table also can be found in the *2021 Mid-South Cotton Defoliation Guide* (https://cottoncultivated.cottoninc.com/2021-mid-south-cotton-defoliation-guide/)

Table 1. Use pattern and expected activity for defoliants and desiccants.

Harvest aid[1]	Labeled broadcast rate/acre (oz unless noted)	Max. use per season (oz)	Rain-free period (hr)[2]	Preharvest interval (days)	Estimated min. temp. (°F)	Mature leaves	Juvenile growth	Regrowth prevention	Boll opening
Thidiazuron SC	1.6–6.4	9.6	24	5	65	Excellent	Excellent	Excellent	None
Ginstar	6.4–16	16	12	5	60	Excellent	Excellent	Excellent	None
Folex 6	16-24	24	1	7	60	Excellent	Fair	Poor	None
Aim	0.5–1.6	3.2	8	7	55	Excellent	Excellent	Poor	None
Display	1.0	2	8	7	55	Excellent	Excellent	Poor	None
ET	1.5–2.75	5.5	1	7	55	Excellent	Excellent	Poor	None
Sharpen	2.0	2.0	1	5	55	Excellent	Excellent	Poor	None
Etdephon	21–42	42	6	7	60	Fair	Poor	Poor	Excellent
Finish 6 Pro	21–42	42	6	7	60	Excellent	Poor	Fair	Excellent
Glyphosate	11–44	44	4	7	55	Fair	Fair	Excellent	None
Desiccants									
Paraquat	3.1–32	32	0.5	3	55	Fair	Excellent	Poor	Fair
Sodium Chlorate	4.5 lb active ingredient	N/A	24	7	55	Fair	Fair	Poor	None

1. Addition of spray adjuvants may enhance defoliation during cold temperatures or when leaves are tough from drought-stressed conditions. However, adjuvants may increase leaf desiccation during the early season when temperatures are warm.
2. Expected rain-free periods are estimates only and may not be exact. Other conditions, including temperature, moisture, and crop status, will play a role in product performance.
3. Only for varieties that are not glyphosate (Roundup Ready Flex; Glytol/Liberty Link) tolerant.

From "2021 Mid-South Cotton Defoliation Guide," by T. B. Raper, B. Pieralisi, D. K. Miller, D. O. Stephenson, M. Foster, Tyler Sandlin, S. Brown, and B. Robertson, 2021, University of Tennessee Extension, p. 8 (https://cottoncultivated.cottoninc.com/2021-mid-south-cotton-defoliation-guide/). Copyright 2021 by the MidSouth Cotton Specialists' Working Group.

Specific Recommendations

For particular defoliant tank-mixture recommendations, refer to the cotton section in the latest edition of the *Georgia Pest Management Handbook* (https://extension.uga.edu/publications/detail.html?number=SB28-16). In the defoliant section of the handbook, recommendations are broken up by "season"—the relative range of temperatures at and around the time of application—and expected defoliant activity.

Although there are many options when choosing defoliants, one of the most common tank

mixtures is a three-way mix of ethephon (Prep, others), thidiazuron (Dropp, others), and tribufos (Folex/Def). Rate recommendations based on temperature at and in the time surrounding defoliation can be found in Table 2. For more information on these and any recommendations and how to incorporate them into your operation, please contact your local UGA County Extension Agent.

Table 2. UGA "three-way" defoliation mixtures.

Season	Temperatures in °F	Broadcast rate per acre in fluid ounces		
		Ethephon (Prep 6S C)	Thidiazuron (Dropp 4S C)	Tribufos (Folex 6EC)
Early season	highs > 90, lows > 70	21–24	1.6–3.2	6–12
Mid-season	highs 80–89, lows 60–70	24–32	2–2.3	8–12
Late season	highs < 80, lows < 60	32–42	X	16–20

Note. X Indicates that this product is not suggested for these environmental conditions.
Ethephon: Rates increase with cooler temps.
Thidiazuron: Rates increase with cooler temps; rates also increase with more regrowth potential. Activity is lessened when low temperatures are less than 65 °F for 3 days.
Tribufos: Increase rate with cooler temps. When rates are too high for conditions, leaf desiccation may occur.

Weed Management at Defoliation

In cases where weeds are present at harvest, note that some defoliants also have herbicidal activity on certain weeds. Table 3 lists some of those options. These treatments should be followed by desiccants to further prepare the cotton crop for harvest, including products containing paraquat or sodium chlorate.

Table 3. Options for harvest-aid weed management.

Herbicide	Broadcast rate per acre	Remarks and precautions (The rates below are given in the broadcast amount per acre unless otherwise noted)
carfentrazone ethyl Aim 2.0EC	1 fl oz	Add 1% v/v crop oil. Effective on morning glory, coffee senna, and tropical spiderwort.
carfentrazone-ethyl + fluthiacet-methyl Display 2.05EC	up to 1 fl oz	Limited data, adhere to label restrictions, use precaution.
glyphosate Roundup Powermax 3 5.88S, others	up to 2.5 pints	Use in combination with defoliants

Herbicide	Broadcast rate per acre	Remarks and precautions (The rates below are given in the broadcast amount per acre unless otherwise noted)
Gramoxone Inteon 2S	3–5 fl oz	damage to unopened bolls.
paraquat pyraflufen ethyl Gramoxone 3S, others ET 0.208EC	1–4 fl oz 1.5 oz	Use in combination with standard defoliation applications. May cause crop desiccation and Add 0.5% v/v crop oil when temperatures are above 90 °F. Add 1% v/v crop oil when temperatures are 89 °F or below. Effective on morning glory. Label allows rate to be increased to 2.75 fl oz/acre.

The permalink for this UGA Extension publication is https://fieldreport.caes.uga.edu/publications/C1281/cotton-defoliation-in-georgia/

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