

CHOOSING HARVEST AID CHEMICALS FOR ARIZONA COTTON

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A variety of harvest aid chemicals exist that can be used to prepare cotton for harvest and can be classified into six main categories: defoliants, desiccants, defoliants/desiccants, boll openers/conditioners, boll openers/defoliants, and defoliation enhancers. These chemicals are applied to enhance the natural process of defoliation and boll opening, so a cotton crop should be heading towards senescence but still physiologically active at the time of application (Ayala and Silvertooth, 2001).

All harvest aid chemicals available for Arizona cotton production systems are listed in Table 1 (as of 11/2011). **Defoliants** are chemicals that impact plant hormonal balances to enhance natural plant senescence and to cause the leaves to fall off. Defoliant activity is highly temperature dependent. But in general, most defoliants need about two weeks to remove leaves from cotton plants. **Desiccants** are chemicals that normally dehydrate and kill the leaves within one to several days. They are often applied after defoliants to remove the remaining leaves and/or kill juvenile growth or young tissue at the growing points of the mainstem and lateral branches. Note that desiccants can injure unopened bolls and that sodium chlorate (a desiccant/defoliant) cannot be mixed with ethephon-containing products. Chemicals that inhibit regrowth can reduce young, green tissue that may occur at the axillary positions along the mainstem, typically towards the bottom of the plant.

Boll openers/conditioners are applied with defoliants to enhance boll opening, improving the harvest efficiency. This can increase the chance of a once-over picking and reduce costs. These ethephon-based products release ethylene, increase additional ethylene synthesis, and promote formation of abscission zone (Hutmacher et al., 2003). **Boll openers/defoliants** are premix or combination products that include ethephon with another compound and can increase percentage of open bolls and reduce vegetative regrowth at the same time. Endothall is a **defoliation enhancer** that is not effective as a defoliant when used alone, but can be added to other defoliants/desiccants to increase early leaf drop (Hutmacher et al., 2003). The expected activities of these chemicals based on results from University of Arizona

field trials and manufacturer's recommendations are listed in Table 2 (Norton and Borrego, 2005; Norton and Borrego, 2006; Norton and Hatch, 2007).

In general for most harvest aid chemicals, application rate should be lower when the temperature is warmer and higher when it is cooler. A rule of thumb is to use low rates when accumulated heat units (86/55F) in the next 14 days are expected to be over 300 (equivalent to having ~90°F days and ~70°F nights), medium rates when the heat units are expected to be 200-300 (~80°F days and ~60°F nights), and high rates when the heat units are expected to be less than 200 (~70°F days and ~40°F nights) (Silvertooth, 2001a; Silvertooth, 2001b).

Other factors affecting defoliation include plant N status and the amount of honeydew from late-season whitefly, aphid, or mealybug infestations on leaves at the end of the season. Research has found that leaf petiole nitrate-N concentrations greater than 3,000 ppm, excess available water, and large amounts of honeydew from insects can lead to defoliation problems (Silvertooth, 2001a). The goal is to make sure plant leaves can absorb harvest aid chemicals and N and water both are depleted to a point where efficient defoliation is possible.

Preparing cotton for harvest depends on many factors including plant-water and plant-N status, maturity and natural senescence processes, weather conditions, timing, and product choice and rates. When using these harvest aid chemicals, growers should consult chemical labels and manufacturers for more detailed descriptions on personal protective equipment (PPE), application rate, plantback restrictions, and other important information.

References & Other Readings

- Ayala, F. and J.C. Silvertooth. 2001. Physiology of cotton defoliation. <http://cals.arizona.edu/pubs/crops/az1240.pdf>.
- Hutmacher, R.B., R.N. Vargas, S.D. Wright, and B.A. Roberts. 2003. Harvest aid materials and practices for California cotton. <http://anrcatalog.ucdavis.edu/pdf/4043e.pdf>.

Table 1. Harvest aid chemicals available to Arizona cotton production systems.

Product	AI	AI (lb/gallon)	Rate (oz/acre)	Season limit (oz/acre)
Defoliants				
Aim EC ⁸	carfentrazone-ethyl	2	up to 1.6	3.2
Aim EW ⁸	carfentrazone-ethyl	1.9	up to 1.6	3.2
Resource ²⁰	flumiclorac pentyl ester	0.86	6-8	14
Blizzard ⁵	fluthiacet-methyl	0.91	0.5-0.6	1.25
ET ¹⁵	pyraflufen ethyl	0.21	1.5-2.75	5.5
Daze 4SC ¹ , Freefall SC ¹⁶ , Klean-Pik 500SC ¹² Thidiazuron 4 SC ^{2, 13}	thidiazuron	4	3.2-6.4	9.6
Dropp SC ³ , Takedown SC ¹¹	thidiazuron	4	1.6-6.4	9.6
Daze 50WP ¹ , Dropp 50WP ³ Thidiazuron 50 WSB ¹³	thidiazuron	0.5††	0.2-0.4‡	0.6‡
Dropp Ultra ³ , Ginstar EC ³ , Ginmaster ¹¹ Redi Pik 1.5EC ¹² , Thidiazuron-Diuron EC ¹³ Thidiazuron-Diuron SC ²	thidiazuron + diuron	1*	6.4-16	16
Def 6 ³	tribufos	6	21-32	40
Desiccants / Defoliants				
2lb Sodium Chlorate ⁷ , First Choice ¹¹	sodium chlorate	1.84	192-384	↓
Defol 5 ⁶	sodium chlorate	5	77-154	154
Defol 6W ⁶	sodium chlorate	6	64-96	↓
Defol 750 ⁶	sodium chlorate	7.5	51-102	154
Poly-Foliant 5 ¹⁴	sodium chlorate	5.4	128-192	↓
Desiccants				
Bonfire ¹⁹ , Firestorm ⁵ , Gramoxone Max ¹⁸ Paraquat Concentrate ¹⁷ , Parazone 3SL ¹² , Quik-Quat ⁶	paraquat dichloride	3	3.7-10.7	21
Gramoxone Inteon ¹⁸	paraquat dichloride	2	8-16	32
Boll Openers / Conditioners				
Boll Buster ¹¹ , Boll'd ¹ , Ethepon 6 ² , HarvestPro ¹⁰ , Prep ³ , Setup 6SL ¹² , Super Boll ¹⁶	ethephon	6	21-43	43
Flash ⁹	ethephon	3	32-86	86
Boll Openers / Defoliants				
Finish 6 ³	ethephon + cyclanilide	6†	21-43	43
Finish 6 Pro ³	ethephon + cyclanilide	6††	21-43	43
Cotton Quik ¹⁶ , First Pick ¹⁶	ethephon + urea sulfate	2.28**	96-112	112
Defoliation enhancers				
Accelerate ⁴	endothall	0.52	16-24	↓
AI, active ingredient		††, 0.375 lb/gallon cyclanilide		
Oz, ounces		‡, lb (dry formulation)		
*, 0.5 lb/gallon diuron		††, lb/lb (dry formulation)		
***, 2.28 lb/gallon urea sulfate		↓, Not specified		
†, 0.75 lb/gallon cyclanilide				

- 1, AgriSolutions
- 2, Arysta LifeScience North America
- 3, Bayer CropScience
- 4, Cerexagri-Nisso
- 5, Chemtura Corporation
- 6, Drexel Chemical Company
- 7, Fertilzona
- 8, FMC Corporation
- 9, Helena Chemical Company
- 10, Independent Agribusiness Professionals

- 11, Loveland Products
- 12, Makhteshim Agan of North America
- 13, Micro Flo Company
- 14, Moore Agricultural Products
- 15, Nichino America
- 16, Nufarm Americas
- 17, Solera Source Dynamics
- 18, Syngenta
- 19, United Phosphorus
- 20, Valent

Table 2. Expected activities of harvest aid chemicals when used alone (based on results from University of Arizona field trials and manufacturer's recommendations).

Harvest aid chemicals	Defoliation of mature leaves	Control of regrowth	Control of regrowth	Effect on juvenile growth
Carfentrazone-ethyl	●	○	x	●
Thidiazuron + Diuron	●	●	x	●
Thidiazuron	●	●	x	●
Tribufos	●	○	x	○
Flumiclorac pentyl ester	●	○	x	●
Pyraflufen ethyl	●	○	x	●
fluthiacet-methyl	●	◐	x	●
Sodium Chlorate	◐	○	x	◐
Paraquat	x	○	○	●
Ethephon	◑	○	●	○
Ethephon + Cyclanilide	◐	◑	●	◐
Ethephon + Urea sulfate	◐	◑	●	◐
Endothall*				

●Excellent, ◐Excellent to fair, ◑Fair to poor, ○Poor, x No activity

* Endothall is usually considered as an "additive" material that can be added to defoliant and desiccants to increase early leaf drop, but it is not effective when used alone (Hutmacher et al., 2003).

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