

## University of Missouri Extension

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# Cotton Harvest Aids

**David W. Albers**  
State Extension Specialist-Cotton

**Fred Fishel**  
Pesticide Application Trainer Supervisor,

**Jill B. Mobley**  
Research Specialist

### Note

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Removing leaves and opening bolls with harvest aids are important components of a management plan for producing high-quality cotton fiber. When not properly managed, harvest aids may reduce yield and quality. Some of the benefits of defoliation include:

- Increases exposure of bolls to sunlight, which causes faster drying and opening.
- Picking operations can begin earlier in the day due to faster drying.
- Reduces trash and green leaf stain (improves grades).
- Reduces boll rot.

By properly managing the time of defoliation, the crop can be prepared for a timely harvest, which is critical in Missouri's short season environment. The number of suitable hours for harvest operations decreases rapidly during the fall. With timely harvest, earlier stalk destruction can occur as an essential part of insect and disease management. The objective of this publication is to provide information on proper defoliation techniques and the available harvest aids on the market today.

## Timing of defoliation

Do not defoliate too early. Micronaire reduction, reduced oil content of seed, lower seed viability and yield reduction may occur. Some of the more traditional methods for determining time of defoliation include:

- Boll firmness.
- Percent open bolls.
- Seed coat coloration.
- Heat unit accumulation.
- Visual assessment.

Defoliation time can be planned earlier in the season by using plant mapping techniques. When plants reach the stage of 4 to 5 nodes above white flower (NAWF), they have reached the end of the effective boll loading period or "cutout." Knowing that approximately four to six weeks or 750 to 850 heat units will be required for boll maturity, a producer can then begin to make harvest aid decisions. Recent research has demonstrated that

cotton can be defoliated with no loss in yield or quality when 3 to 4 nodes with harvestable bolls are present above the uppermost, first position cracked boll. Plant mapping techniques will be most useful in fields that have uniform stands, early fruiting initiation and high fruit retention.

These techniques should not replace visual verification of crop maturity status, however. The general practice is still to wait until at least, on average, 60 percent of the bolls are open prior to applying any harvest aid materials. Another excellent check of crop maturity is to cut the top bolls that you hope to harvest. If these bolls have a dark-colored seed coat and the seed is no longer jelly-filled but has developed well-defined cotyledons, then the fiber on that boll is mature and safe for harvest aid application. Use of the 60 percent rule and boll inspection in conjunction with plant mapping techniques will aid a producer in making proper crop termination decisions.

**Note**

Don't hurry a harvest aid decision and make a mistake that may cost yield and fiber quality

## End of season scenarios

For a cotton crop to reach maturity in a timely matter requires more than just good harvest aids. The crop requires management for timely cutout and maturity from the time it is planted. A good date to reach cutout in Missouri is Aug. 10, since blooms formed after that date have a much smaller chance of maturing; not enough heat units are received during most seasons. Blooms formed before Aug. 10 have a much greater chance of maturing. In fact, under average conditions at Portageville, Mo., blooms that open on Aug. 1 should, on average, mature between Sept. 10 and 20, while an Aug. 10 bloom won't be mature until Oct. 1 or later. The accumulation of heat units in October is very minimal, so little boll growth and maturity is possible during that month in most years.

Managing end-of-season decisions is determined by a combination of crop maturity, temperatures suitable for harvest aids to work, and good field conditions for picking 10 to 14 days after the harvest aids were applied. In general, harvest aids (defoliants and boll openers) work best when the average temperatures stay above 60 degrees Fahrenheit. September is the prime defoliation period, with average temperature remaining above 60 degrees Fahrenheit for most of the month (Table 1). After mid-October the chances of receiving temperatures suitable for defoliants and boll openers drops to less than 1 in 3. The rainfall pattern during September and October is variable, but early October appears to be drier than the other weeks. Cotton harvest during early October could take advantage of the slightly drier pattern.

**Table 1**

Temperature and rainfall pattern during September and October at Portageville, Mo

Month	Days suitable for fieldwork*	Chance of receiving > 59 degrees Fahrenheit	Average minimum temperature	Average maximum temperature	Weekly rainfall
September	First week: 5.45	100 percent	64 degrees Fahrenheit	74 degrees Fahrenheit	0.81 inch
	Second week: 5.55	100 percent	62 degrees Fahrenheit	72 degrees Fahrenheit	0.85 inch
	Third week: 5.36	92 percent	60 degrees Fahrenheit	70 degrees Fahrenheit	0.87 inch
	Fourth week: 5.27	84 percent	56 degrees Fahrenheit	67 degrees Fahrenheit	1.00 inch

October	First week: 5.65	73 percent	50 degrees Fahrenheit	63 degrees Fahrenheit	0.53 inch
	Second week: 5.63	65 percent	49 degrees Fahrenheit	61 degrees Fahrenheit	0.82 inch
	Third week: 4.15	31 percent	46 degrees Fahrenheit	58 degrees Fahrenheit	0.85 inch
	Fourth week: 4.21	26 percent	44 degrees Fahrenheit	55 degrees Fahrenheit	0.69 inch
	Fifth week: 4.09		45 degrees Fahrenheit	57 degrees Fahrenheit	0.84 inch

**\*Days suitable for field work is averaged from 12 years of data for southeastern Missouri. Temperature probabilities are an average for 26 years in Portageville, Missouri.**

## Picking the best harvest aid material

Environmental conditions at the time of defoliant application and for three to five days following can have a tremendous influence on the effectiveness of these chemicals. Under conditions of high sunlight, temperature and relative humidity, defoliants are most active. A night temperature of at least 60 degrees Fahrenheit is particularly important. Early research indicates that defoliation proceeds twice as rapidly at 95 degrees Fahrenheit than at 77 degrees Fahrenheit. Most harvest aids need minimum temperatures above 55 to 65 degrees Fahrenheit for optimal performance. If temperatures drop below this level, then leaf drop and boll opening will be slowed. High relative humidity is important for lower evaporation and transpiration will allow better absorption of the chemical defoliant into the leaf.

Each harvest aid material has its own strengths and weaknesses and should be used with conditions and at rates that will produce the desired defoliation and boll opening. The condition of the crop and the weather forecast are important factors when selecting a defoliant. Table 2 provides a description of the commonly used harvest aids for Missouri.

**Table 2**  
Description of harvest aid materials

Product (formulation)	Description	Rates
Def 6 or Folex (6 pounds a.i. per gallon)	Defoliant used over a broad range of conditions. Reduce rates if temperatures are warm (85 degrees Fahrenheit or higher) to avoid "stuck" leaves. Is very effective when used in combination with Prep.	1.33 to 2 pints per acre
Harvade (5 pounds a.i. per gallon)	Defoliant that removes leaves while still green, but can also help dry up morningglory vines in the field. Always use with crop oil concentrate.	0.5 pint per acre + 1 pint crop oil conc.
Dropp (50 percent a.i. WP)	Defoliant that works best in warm weather (average temperature near 70 degrees Fahrenheit). Effectively suppresses regrowth. Cool weather activity can be improved when used in combination with Prep. Activity may also be increased by using ammonium sulfate or silicone-based spray adjuvant.	0.2 to 0.4 pounds per acre
Prep (6 pounds a.i. per gallon)	Boll opening compound that also causes some defoliation. This compound typically should be applied after defoliants or tank-mixed with defoliants. Should not be applied until all harvestable bolls are mature to avoid reducing yield and fiber quality. Allow 14 to 21 days between application and harvest for complete boll opening.	1.33 to 2.67 pints per acre

Starfire (1.5 pounds a.i. per gallon)	A desiccant material with active ingredient paraquat. Can help open bolls. Needs to be used in combination with a defoliant. <b>Restricted Use Pesticide.</b>	4 to 6 ounces per acre in combination with other defoliants
Quick Pick (3.1 pounds a.i. per gallon)	A desiccant material that can help improve defoliation when used in combination with defoliants and Prep.	1 pint per acre in combinations
Sodium Chlorate (6 pounds a.i. per gallon)	A desiccant that can defoliate cotton, but causes some "stuck" leaves.	4.5 pound per acre or 3 quarts per acre

## Picking the right harvest aid strategy

Defoliation is as much an art as a science, since many variables of crop and weather conditions interact in the final performance measured in terms of leaf drop, regrowth, boll opening, yield and fiber quality. To simplify the decision somewhat, we will discuss only the variables that can be readily recognized or controlled.

### Canopy/crop size

One of the first considerations is how large a canopy of leaves needs to be removed. If the crop is taller than 40 to 45 inches tall, some difficulty may be experienced in removing all the leaves with one application of a defoliant. If a tall crop is not ready to defoliate until late September or October when the temperatures are not conducive for quick leaf drop and boll opening, then higher rates and spray volume may be needed. These conditions are also conducive to boll rot. Managing for final plant height to equal row spacing has been shown to result in less yield loss to boll rot. A plant of manageable size should result in better spray coverage and more effective defoliation.

### Leaf/crop maturity

If the leaves have remained green or new young leaves have been added to the plant after cutout, then care should be given to avoid "sticking" leaves by applying too high a rate of defoliant. The greatest potential problem is experienced with warm temperatures (greater than 85 degrees Fahrenheit) for areas of the field that have remained green. It may also be possible to reduce the rate of harvest aid if the canopy has matured and already experienced some natural leaf aging with warm temperatures.

### Temperature

The activity of defoliants depends largely on the temperature experienced during the period three to five days after the material is applied. Average temperatures above 60 to 65 degrees Fahrenheit greatly enhance defoliant activity. Some materials such as Def, Folex, Harvade and Sodium Chlorate can defoliate cotton leaves under cool conditions, while Dropp is extremely sensitive to cool conditions. When cool conditions are encountered, a combination of materials is recommended, typically a defoliant and a boll opener. The effectiveness of harvest aids under both warm and cool conditions are summarized in Table 3.

**Table 3**

Effectiveness of harvest aids for defoliation, boll opening and regrowth control under warm and cool conditions in Missouri

Defoliant/rate	Cool conditions (less than 60 degrees Fahrenheit average)		Warm conditions (more than 65 degrees Fahrenheit average)	
	Defoliant <sup>1</sup>	Boll opening <sup>1</sup>	Defoliant <sup>1</sup>	Boll opening <sup>1</sup>
Def or Folex 1.3 pint per acre	7	6	9	8
Dropp 0.2 pound per acre	3	6	9	8

Harvade 0.5 pint per acre + Crop Oil 1 pint per acre	7	6	9	8
Prep 1.5 to 2 pints per acre	5	7	8	9
Prep 1.5 to 2 pints per acre + Def or Folex 1.3 pints per acre	8	7	9	9
Prep 1.5 to 2 pints per acre + Harvade 0.5 pint per acre + Crop Oil 1 pint per acre	8	7	9	9
Prep 1.5 to 2 pints per acre + Dropp 0.1 to 0.15 pounds per acre	8	7	9	9
Prep 1.5 to 2 pints per acre + Quick Pick 1.0 pint per acre	7	7	9	9
Starfire 4 to 6 ounces per acre + Harvade 0.5 pint per acre	8	6	8	9
Sodium chlorate 3 quarts per acre	7	7	8	8

<sup>1</sup>Ratings for defoliation and boll opening on a scale of 0 = none to 9 = excellent.

### Yield potential

Under conditions of above-average yield potential and profitability, using a combination of a defoliant and boll opener, e.g. Prep + Def or Folex, can provide a rapid, thorough defoliation and opening of bolls for a large first harvest. Using a combination approach is more expensive, but if the potential return of high-quality lint is in the field, this approach will permit the greatest return. In contrast, if the potential yields are not great for a crop that has experienced water stress, then using a less expensive harvest aid strategy should provide the greatest economic return.

### Picking once or twice

Complete defoliation and boll opening generally permit quicker harvest of cotton with less trash. The cost of a combination of Prep and a defoliant that can produce once-over harvest is \$30 per acre less expensive than a second harvest operation. The fiber harvested with the once-over strategy is typically of higher quality and value.

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### Related MU Extension publications

- G4268, Cotton Plant Development and Plant Mapping  
<http://extension.missouri.edu/publications/DisplayPub.aspx?P=G4268>

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