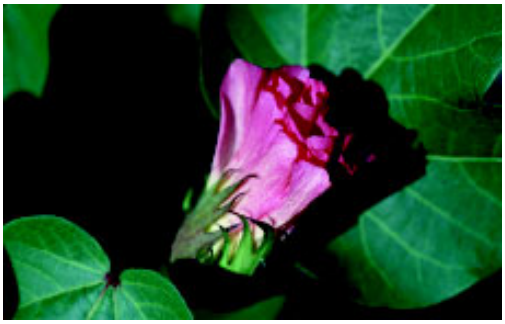


Suggested Guidelines for

Plant Growth Regulator Use

on Louisiana Cotton

LSU AgCenter
Research & Extension

Introduction

The plant growth regulator mepiquat has been labeled for use in cotton since the 1980s. Mepiquat-containing products have been widely used as a means of restricting plant height. Other potential benefits of mepiquat can be less susceptibility to boll rot, increased early fruit retention, enhanced earliness, less lodging of plants and increased harvest efficiency. Potential risks associated with its use are a reduced ability to withstand season-long stress, slower canopy closure and inducement of early cutout.

Methods and philosophies for the use of mepiquat in cotton vary widely. This publication explains the effect of mepiquat-containing products on cotton growth and development and suggests some guidelines for its use that will increase the likelihood of realizing the benefits and minimizing the risks.

What is Mepiquat?

Plant growth is promoted by naturally occurring plant hormones, one of which is gibberellic acid. Mepiquat is an anti-gibberellin that inhibits cell expansion but not cell division. Cotton is a perennial plant, continuing to grow vegetatively while producing fruit. Mepiquat can restrict vegetative growth, inducing the plant to direct more carbohydrates into reproductive organs. This effect on cotton can be either positive or negative. If redirection of carbohydrates into fruiting structures occurs early in plant development, early cutout can be induced and overall plant growth may be overly restricted. Conversely, if vegetative growth is restricted well into the bloom period, increased fruit retention can be realized while also obtaining the benefits associated with less rank growth.

Mepiquat applications usually result in shorter plants; however, mepiquat will not shrink cotton, nor will it place squares and bolls that have already abscised back on the plant. Mepiquat is not thought to be readily translocated through the plant.

Mepiquat-containing products are sold under a variety of trade names and formulations: Pix Plus, Pix Ultra, Pentia, Mepex, Mepex Ginout, Mepichlor and Mepiquat Chloride.

Why is Mepiquat Used?

Rank growth of cotton plants can be problematic because of an increase in boll rot, a decrease in harvest efficiency, less penetration of insecticides into the canopy and difficulty in scouting. Therefore, keeping plants to a manageable size in a sub-tropical climate such as Louisiana has some benefits. Mepiquat also can enhance earliness because it redirects carbohydrates away from vegetative growth to reproductive growth. Yield enhancements directly related to mepiquat are rare. Therefore, mepiquat should be used as a management tool only.

What are the Expected Results?

The overall effect of mepiquat on plant growth and development depends on growing conditions after it is applied. Many years of research in Louisiana and other states show that the most consistent effect is a reduction in plant height compared to untreated cotton. Replicated research in Louisiana has indicated that positive yield responses directly related to mepiquat applications are rare. Therefore, its use and utility should be viewed as a management tool to reduce the likelihood of rank growth and boll rot incidence, while increasing picker efficiency, insecticide deposition and scouting efficiency. These responses can have an overall positive effect on the manageability of the crop. Conditions favoring growth (adequate fertility, rainfall, etc.) typically increase the likelihood of realizing positive plant responses and benefits. Conversely, growing conditions that are abnormally dry, excessively wet, lack adequate fertility, etc. increase the likelihood that early cutout will be induced, vegetative growth will be overly restricted and yield will be reduced.

Mepiquat responses depend on rate. Increasing rates usually result in greater suppression of growth, although the actual response is also related to plant size and growth stage. Pre-bloom cotton is more sensitive to mepiquat than flowering cotton. The later in the bloom period, the less sensitive cotton is to mepiquat. Excessive applications to pre-bloom cotton are the most likely to induce early cutout. Likewise, low rates applied to cotton in mid- or late-bloom are unlikely to be effective.

Cotton plants that have recently received an application of mepiquat are often greener than non-treated plants. This is the result of thickening of the leaves and concentration of chlorophyll and is a purely aesthetic response.

Available Mepiquat-containing Products

Mepiquat chloride was originally sold as Pix. Since patent restrictions have expired, several formulations of mepiquat have become available. All except Pentia contain mepiquat chloride. Some may contain other ingredients such as Bacillus cereus, Mepex Gin Out contains kinetin and Pentia is formulated as mepiquat pentaborate. In all cases, the active molecule is the mepiquat ion. Limited experience in Louisiana suggests that plant absorption of Pentia may be faster than with other products and the Pentia label allows for a shorter rain-free period. Current suggestions for mepiquat use, however, do not reflect a need for a separate rate structure among products.

Use of Surfactants and Tankmixes

The use of a surfactant is not required on product labels; however, the addition of a non-ionic, or silicone-based surfactant may decrease the rain-free period slightly. Read and follow all label directions closely.

Variety Responses to Mepiquat

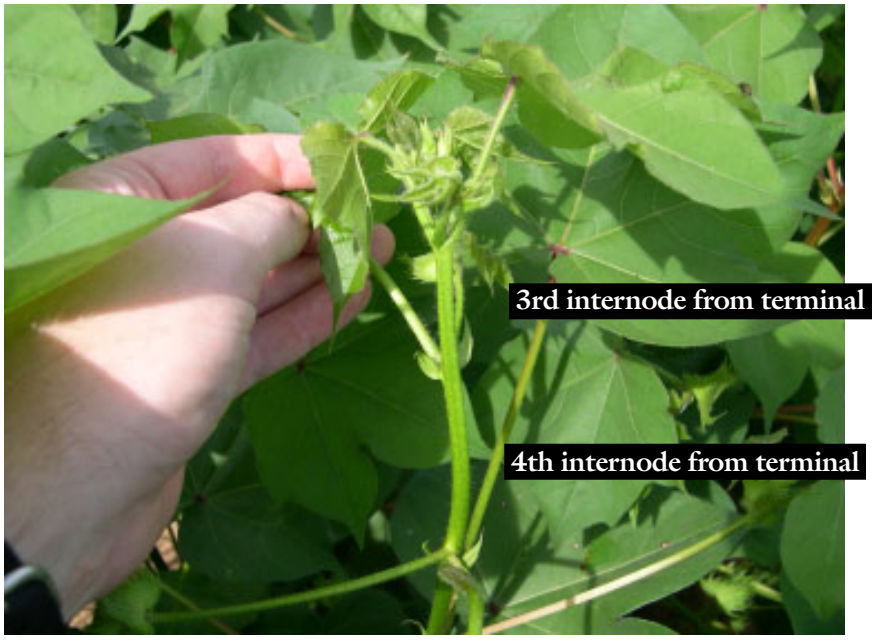
It has been well established that excessive applications of mepiquat to pre-bloom cotton are at the greatest risk of early cutout. This is especially true of early maturing, short-stature varieties. Recent introductions and widespread acceptance of tall, full-season varieties has caused many to become more aggressive with mepiquat applications and rates, particularly to pre-bloom cotton. Research in Louisiana does indicate that tall, full-season varieties are more tolerant of pre-bloom applications and the risk of early cutout is lessened.

In the case of tall, full-season varieties, a safe window to apply mepiquat in which it can be highly effective at managing growth appears to be between two weeks before bloom and first bloom, roughly the 10- to 12-node stage of growth. Applications before that stage are not suggested and should be made with caution.

Regardless of variety or growth stage, mepiquat applications should be made based on plant growth and only when favorable growing conditions following applications are anticipated.

Plant Monitoring

The basis of any plan to use mepiquat as a management tool should be plant monitoring. Critical growth parameters to model are plant height, height to node ratio, the length of the third and fourth internodes from the terminal, and fruit retention on first- and second-position sites. Monitoring should begin around match head square (8-10 nodes) and extend through late bloom. Never apply mepiquat based solely on cotton stage of growth, the calendar date or because your neighbor has. Base applications on current plant growth characteristics and the anticipated continued growth rate based on current and expected growing conditions for the next seven to 10 days.



Suggested Guidelines

Strategies for use of mepiquat vary widely, leading to confusion over the best approach. With that in mind, the following guidelines have been developed in an attempt to help with decision making. The tables are a guide for three different strategies. They have been developed based on data generated over time in Mississippi, Alabama, North Carolina and Louisiana. Experience with field history, local growing conditions and varieties should be used, too.

Low Rate Multiple Strategy

The low rate multiple strategy requires frequent monitoring and allows a grower to "spoon feed" mepiquat and react quickly to growing conditions and possibly tankmix mepiquat with other crop protection chemicals. Because of the low rates suggested, the risk of early cutout is probably less with this strategy than others. Applications and decisions, however, must be timely.

These tables are a point system. For example, using the FIRST SQUARE table, if you had excellent moisture, a stalk height history of 50 inches, first square on June 20 and a short variety, you would accumulate 1, 2, 1 and 0 points – a total of 4 points. The total number of points is the number of ounces of mepiquat to apply. In this example, the grower would apply 4 ounces.

The greatest advantage of the low rate multiple strategy is that the risks associated with mepiquat are minimized. But, timeliness is critical and more frequent plant monitoring is required. This strategy may work best in fields without a history of rank growth and with shorter varieties. Controlling plant height in tall, full-season varieties, particularly when planted on stronger soils and with excessive fertility, may be difficult with this strategy because of the low rates.

First Square

	Points / oz per care			
	-1	**0**	**1**	**2**
Moisture		fair	excellent	
Stalk height history	< 36 inches	36-44 inches	44-48 inches	> 48 inches
Date of first square		before June 5	after June 5	
Variety		short/medium	Tall	

If score less than 3, do not apply.
If soil moisture is limiting, do not apply.
Do not exceed 4 ounces.

10 to 14 Days After First Square

	Points / oz per acre			
	-1	**0**	**1**	**2**
Moisture		Fair	excellent	
Stalk height history	< 36 inches	36-44 inches	44-48 inches	> 48 inches
First position square retention		>75%	<75%	
Prior mepiquat applied		>3 oz	0-3 oz	
Height to node ratio	<1.4	1.4-1.7	>1.7	

If score is less than 3, do not apply.
If soil moisture is limiting, do not apply.

Early Bloom (50% of the plants have initiated flowering)

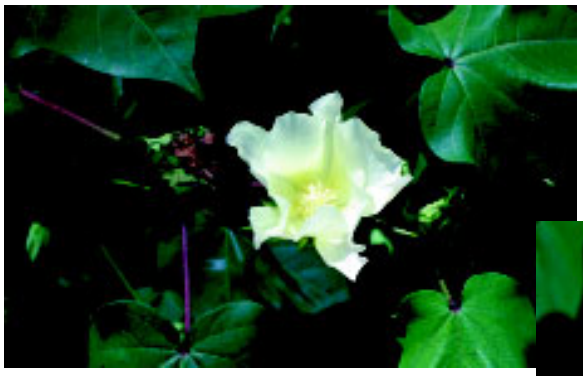
	Points / oz per acre			
	-1	**0**	**1**	**2**
Moisture	fair	good	excellent	
Plant height	< 20 inches	20-24 inches	> 24 in	
Fruit retention		>75%	50-75%	<50%
Prior mepiquat applied	> 8 oz	5-8 oz	3-5 oz	none
Internode length*	<1.5 in.	1.5-2 in.	2-3 in.	>3 in.

If nodes above white flower (NAWF) are less than 7, do not apply.
If score is less than 3, do not apply.
If soil moisture is limiting, do not apply.
* The largest of the internodes below the third and fourth mainstem leaf.

10 to 14 Days After Early Bloom

	Points / oz per acre				
	-1	**0**	**1**	**2**	**4**
Moisture	fair	good	excellent		
Nodes above white flower		decreasing	same		increasing
Fruit retention		>75%	50-75%	30-50%	<30%
Prior mepiquat applied	> 8 oz	5-8 oz	3-5 oz	none	
Internode length*	<1.5 in.	1.5-2 in.		2-3 in.	>3 in.

If nodes above white flower (NAWF) are less than 5.5, do not apply.
If score is less than 3, do not apply.
If soil moisture is limiting, do not apply.
* The largest of the internodes below the third and fourth main stem leaf.



Modified Early Bloom Strategy

Monitoring for the modified early bloom strategy begins 10-14 days after the first square becomes visible. Timeliness is important with this approach. Before bloom, plant height and height to node ratio are critical for making a decision. At early bloom (when 50% of the plants have initiated flowering), plant height and the length of the third and fourth internode from the terminal should be monitored closely. Record an average of each parameter from the field, and apply the results to the appropriate table.

The modified early bloom strategy is a compromise between the low rate multiple strategy and higher use rates. Some producers may not be able to be as timely as the low rate multiple strategy requires on all of their acreage and also may not be able to time the early bloom application accurately. This strategy allows producers to be reactive to growing conditions over a long period and to make appropriate application decisions. As with all application strategies, plant monitoring is critical.

10-14 Days After First Square

	Plant Height		
	<17 inches	**17-20 inches**	**>20 inches**
	Suggested mepiquat use rate per acre		
Height to node ratio> 1.85	4 oz	6 oz	8 oz
Internode > 2.25 inches*	4 oz	6 oz	8 oz
Do not apply if soil moisture is limiting.			

* The largest of the internodes below the third or fourth main stem leaf from the top. In fields with a history of rank growth, this threshold can be reduced to 2 inches.

Early Bloom - Use this chart if mepiquat has been applied earlier.

	Plant Height			
	<24 inches	**24-27 inches**	**27-30 inches**	**>30 inches**
	Suggested mepiquat use rate per acre			
Plant height > 24 inches	0 oz	6 oz	9 oz	12 oz
Internode > 2.25 inches*	6 oz	6 oz	9 oz	12 oz

Do not apply if soil moisture is limiting.
Do not apply if nodes above white flower (NAWF) are less than 7.
* The largest of the internodes below the third or fourth main stem leaf from the top. In fields with a history of rank growth, this threshold can be reduced to 2 inches.

Early Bloom - Use this chart if mepiquat has not been applied.

	Plant Height			
	<24 inches	**24-27 inches**	**27-30 inches**	**>30 inches**
	Suggested mepiquat use rate per acre			
Plant height > 24 inches	0 oz	8 oz	12 oz	16 oz
Internode > 2.25 inches*	8 oz	8 oz	12 oz	16 oz

Do not apply if soil moisture is poor.
Do not apply if nodes above white flower (NAWF) are less than 7.
* The largest of the internodes below the third or fourth main stem leaf from the top. In fields with a history of rank growth, this threshold can be reduced to 2 inches.

10-14 Days After Early Bloom

	Pix applied at early bloom	
	> 8 oz	0-8 oz
	Suggested mepiquat use rate per acre	
Internode <2.25 inches*	0 oz	0 oz
Internode 2.25-3.5 inches*	8 oz	12 oz
Internode > 3.5 inches*	12 oz	16 oz

Do not apply if soil moisture is limiting.
Do not apply if nodes above white flower (NAWF) are less than 5.5.
* The largest of the internodes below the third or fourth main stem leaf from the top.

Early Bloom Strategy

This is a point system. The early bloom strategy may be appropriate for situations in which timeliness before bloom is not possible. This strategy provides criteria for making one application to larger cotton; therefore, suggested rates may be slightly higher than other methods. For tall varieties and highly productive soils, rates can be adjusted to be slightly higher. Similarly, rates can be adjusted lower for shorter varieties on soils with less inherent growth potential. Early bloom is defined as when 50% of the plants have initiated flowering.

At early bloom, the four criteria on the left of the table should be evaluated. Points are given for each criterion. The total number of points is then applied to the second table for a suggested Pix amount. For example, if you had adequate soil moisture, an internode length of 2.6 inches, 80% retention and 24-inch cotton, then you would have 1, 2, 1 and 1 points, for a total of 5. This suggests a rate of 10-14 ounces of mepiquat. For a given range of rates, factors that would favor the higher rates are a history of rank growth, tall varieties, high nitrogen or the desire to schedule a field early for defoliation and harvest. Factors that favor the lower rates are low fertility, short varieties or a desire to schedule the field for later defoliation and harvesting.

The advantage of the early bloom strategy is that only one application is made, but it must be made as close to bloom as possible. Delaying a decision using this strategy until a few weeks into the bloom period will likely reduce its effectiveness. Conversely, the rates suggested may be excessive in pre-bloom cotton, particularly with shorter, early-season varieties.

Early Bloom

	Points			
	0	1	2	3
Soil moisture	poor	Adequate	excellent	
Internode length*	< 2 in.	2-2.5 in.	2.5-3 in.	> 3 in.
Fruit retention		>75%	50-75%	<50%
Plant height	<20 in.	20-26 in.	>26 in.	

* The largest of the internodes below the third and fourth main stem leaf.

Suggested amount of mepiquat per acre

Accumulated Points	oz/acre mepiquat
0-3	NONE
4-5	10-14 oz
6-8	16-20 oz
9-10	Crop is delayed badly. Consider high rates of mepiquat to control vegetative growth. Yield is likely to be affected adversely at this point.

NOTE - Use extreme caution when making applications in limiting soil moisture conditions. Unless moisture stress is alleviated, mepiquat will not be warranted.

Visit our Web site:
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Author:
Sandy Stewart, Assistant Professor and Cotton Specialist

Louisiana State University Agricultural Center, William B. Richardson, Chancellor
Louisiana Agricultural Experiment Station, David J. Boethel, Vice Chancellor and Director
Louisiana Cooperative Extension Service, Paul D. Coreil, Vice Chancellor and Director
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