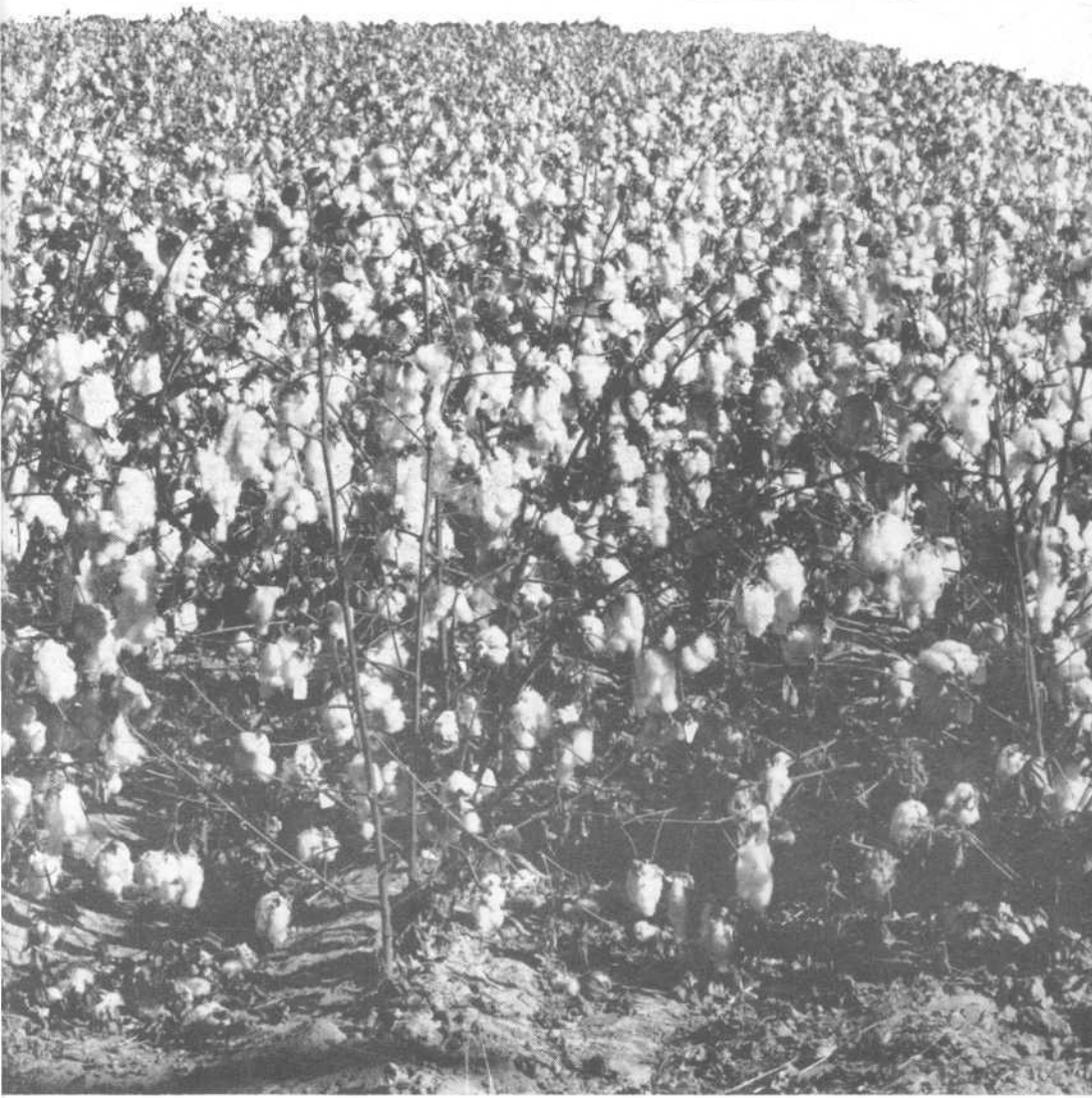
Defoliating Cotton In Arizona

1954



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Defoliating Cotton In Arizona, 1954

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What About Defoliation?

"Should I defoliate my cotton?" This question is sometimes difficult to answer when the only known factors are: (1) someone thinks the leaves should be removed, and (2) there is a chemical at hand labeled "defoliant".

Guesswork in the practice of chemical defoliation frequently results not only in a poor job, but in a lowering of yield and grade, or damage to the use qualities of both fiber and seed. Under some circumstances the grower should be urged not to defoliate, just as strongly as he is urged to defoliate under conditions where an economic gain is indicated.

Experimental studies have revealed several obstacles which may interfere with an ideal job of defoliation. Successful use of chemical defoliants requires knowledge of the condition and maturity of the plant, the characteristics and proper rate of chemical defoliants, and many other considerations.

This publication should be considered as a general interpretation of research and practical experience on the subject of chemical defoliation. It is intended to serve as a guide for use by growers and agricultural specialists, and should not be taken as a strict recommendation for all cotton growers to practice defoliation.

Why Defoliate Cotton?

Perhaps the most urgent need for defoliation is to clear the way for machine harvesting. Machine harvesting is more efficient in well defoliated fields of cotton. Plants are free of leaves which may clog the spindles of mechanical pickers. Good defoliation also eliminates a source of green stain to lint and reduces dry-leaf trash.

Defoliation usually allows earlier first picking and tends to increase picker efficiency on the first picking. In addition, defoliated fields are often more attractive to hand pickers.

The increased aeration in defoliated fields retards boll rot and often prevents further deterioration of seed and fiber.

Defoliation has been recognized as an important aid in the cotton insect-control problem. Leaf removal lowers populations of damaging insects, particularly aphids.

Removal of the leaves hastens drying and promotes uniform opening of mature bolls.

Lodged plants tend to straighten up after defoliation. This facilitates either machine or hand picking.

The following benefits may be gained **in rank cotton** from the correct use of bottom defoliation, which is done in late summer to remove the lower leaves:

1. Increase in the rate of boll opening.
2. Reduction in boll rot.
3. Late season method of partial grass or weed control.
4. Elimination of more than one defoliant application to rank cotton when defoliants are applied later in the season.

What Factors Help in Defoliation?

During Growing Season

Good defoliation depends in part on how the crop is handled. Some of the factors to be considered are given below.

1. Well leveled land is desirable.

2. An ample but not too dense plant population and even stands are needed to promote uniform plant development and boll maturity.

3. Ample soil fertility is important. Good defoliation, however, is difficult if high amounts of nitrogen are available at the time of defoliant application. Nitrogen should be low or exhausted at this time.

4. An ample supply of soil moisture should be maintained throughout the growing season to ensure a continuous even growth rate.

5. Effective insect control throughout the growing season is essential to efficient defoliation.

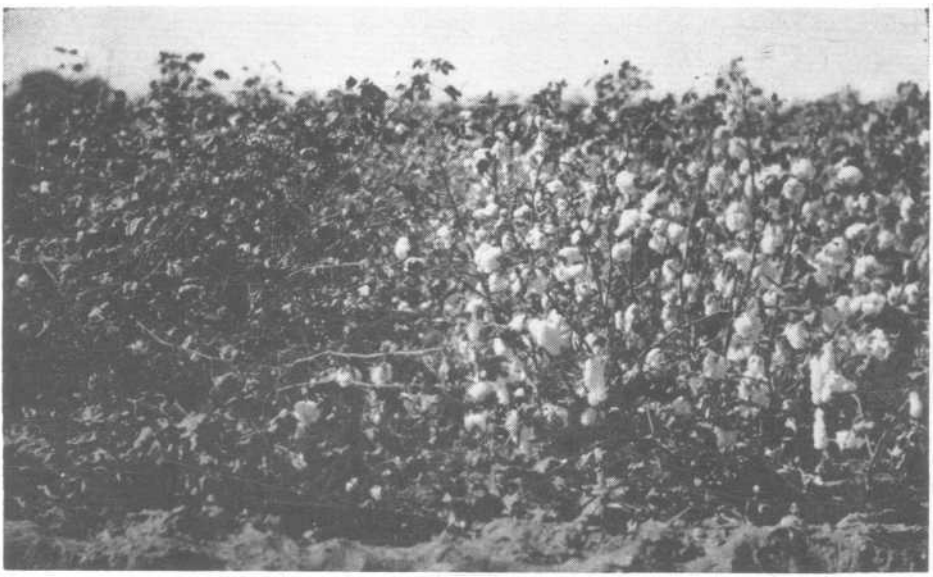
6. Weed control throughout the season is an important factor. Weeds present at picking time interfere with defoliant dispersal and picking efficiency.

Time of Application

Perhaps the most important single factor to be considered is the timing of the defoliant application. Premature applications may damage grade and cause losses in both yield and quality of seed and lint if there is a high percentage of immature bolls and squares at the time of defoliant application. If defoliants are applied when bolls are mature, there is little evidence of injury to yields or quality of either lint or seed.

In Arizona, where cotton is grown under irrigation, growers must choose a period to defoliate that is late enough to prevent a loss in yield or fiber damage and yet not so late that plants will be dry to a point where lack of activity seriously limits or prevents defoliation. Due to the many factors involved, it is difficult to set a definite date after the last irrigation at which to defoliate cotton.

The condition of the plant at the time of defoliant application is the key to efficiency—not some specific date on the calendar.



This picture is of experimental plots in which boll maturity was varied. Irrigation, fertilization, planting date, etc. were exactly the same. The plants were defoliated at the same rate per acre.

Plants on the right show good defoliation. These plants had bolls that were mature at the time of defoliant application.

Bolls on the plants at the left were immature at the time the defoliant was applied. These plants show poor defoliation.

Condition of the Plant

Defoliants should be applied to mature plants. Experience indicates that most of the bolls should be mature (not necessarily open), or at least 35-40 days of age.

Two rules-of-thumb tests by which to determine when bolls are sufficiently mature for defoliation are:

1. Bolls feel firm (cannot be dented) when pressed between thumb and forefinger.
2. Bolls cannot be sliced easily with a sharp knife.

Active plants are necessary for efficient defoliation. The leaves must be in a condition of activity that will allow the proper degree of reaction to the defoliant. There must be sufficient activity to allow for the processes that lead to eventual separation and fall of the leaves.

The leaves of the plant should show no signs of wilt. Do not delay defoliation until the leaves are toughened by age or drought. Plant and leaf moisture content influence defoliation efficiency. Tough, dry leaves require more chemical for activation.

Water-stressed plants are hard to defoliate. Therefore, it is important to maintain soil moisture so that an ample supply is present in the soil at the time of defoliation. However, proper precaution should be taken, as too much water from a late irrigation may retard plant maturity.

Additional Factors

Harvesting: Leaf fall usually begins a few days after defoliant application, but from one to two weeks are usually required for maximum defoliation. For machine harvesting, applications should be timed so that picking can begin shortly after defoliation. If picking is delayed too long, second growth can interfere with picking efficiency. A good practice is to defoliate only as much cotton as can be picked in a reasonably short period of time in order to avoid possible weather damage and second growth.

Weather conditions: Temperatures should be moderately high, particularly at night, without rapid changes from hot to cold. High humidity also is desirable because it contributes to development of a leaf surface condition more reactive to defoliants. The efficiency of some dust defoliants depends on high humidity. Spray type defoliants are often more efficient if applied when humidity is moderately high. High winds interfere with defoliant application of dust and spray defoliants, although very slight breezes may improve distribution.

Application: Airplanes have been used extensively for applying defoliants, and the majority of the defoliant applications in Arizona have been accomplished by this means. In recent years a number of high-clearance rigs and tractor-

mounted sprayers have been introduced. Such equipment has proved to be essential for bottom defoliation.

Adequate ground equipment for the application of dust defoliants to the lower leaves has not been developed. Therefore, only a spray-type defoliant is recommended for bottom defoliation. A dust tends to billow up in the turbulence created by the tractor and dust blower, and may result in removal of the upper leaves at a time when they are still needed to mature the top crop.

Whatever the means of application, each leaf that is to shed must receive a covering of the defoliant.

Factors Affecting Defoliation

Factors	Conditions That Favor	
	Good Defoliation	Poor Defoliation
Field conditions	Land level	Land not level
Stands	Stands uniform	Stands poor
Growth history	Growth rate uniform, continuous Good control of insects and weeds Plants erect	Growth rate irregular Poor control of insects and weeds Plants lodged
Nutrients	Fertility ample throughout season Nitrogen depleted at time of defoliation	Fertility low throughout season Nitrogen level high at time of defoliation
Soil moisture at end of season	Adequate	Too low or too high
Leaves	No signs of wilt Not toughened Mature but active	Wilted Toughened Either immature or inactive
Maturity	Bolls mature Little or no second growth	Bolls immature Too much second growth
Temperature	High, during day and night	Low, or rapidly changing from hot to cool
Humidity	Moderate to high	Low
Wind	None or low	High, continuous

What About Defoliants and Desiccants?

Shedding of mature cotton leaves is a natural process. Leaf shedding takes place as a result of new cell growth at the base of the cotton leaf stalk where it joins the branch or stem. This takes place in what is termed the abscission region.

The above picture shows good results when all of the factors for good defoliation, as given on page 7, were present. (Sacaton Experiment Station, 1952.) A defoliant (Shed-A-Leaf) at the rate of 7 pounds per acre was used.

The development of cells in a thin layer across this region eventually causes separation of the leaf from the plant. This is defoliation. It can be brought on by a mineral deficiency, disease, a light frost, or by drought. Defoliation can also be artificially induced through the use of chemical defoliants.

Both defoliants and desiccants have been used to advantage, but these two quite different types of formulations have led to some confusion of terminology. The terms "defoliant" and "desiccant" are not synonymous, although both materials are essentially contact herbicides.

The term "defoliant" properly should be applied only to those chemical compounds which bring about abscission or leaf drop, and not to those compounds which cause a rapid drying of the leaves without causing efficient defoliation. A "desiccant" is a chemical compound which acts primarily as a drying agent of plant tissue.

No single defoliant is best for use under all conditions. The action of defoliants may vary from mild

to severe tissue destruction at effective rates. Some defoliants have a broader dosage range than others, and the grower must decide whether it suits his purpose better to drop a high percentage of leaves with a mild defoliant or to cause the leaves to dry up but not necessarily fall off by using a desiccant or a defoliant at increased dosage rates.

Desiccation can at times be accomplished with high rates of the best defoliants. Therefore, determination of the proper rate is just as important as the choice of the defoliant. Most of the defoliants now available can cause burning and "freezing-on" of foliage at excessive rates, or give incomplete leaf fall at low rates. Basically, "freezing" and subsequent drying out of leaves is sometimes more dependent on killing the abscission region than any other phase of chemical action.

Desiccants may cause some defoliation. However, the action of the desiccant on the leaves is usually so rapid that leaves are killed and "frozen" to the stalk before defoliation can occur. Desiccants usually react more quickly than defoliants. Drying may be complete in 2 or 3 days, whereas a period of 8 to 14 days is usually necessary for maximum leaf drop to take place following the application of a defoliant.

Proper timing of application is much more important when using desiccants. As a desiccant usually stops all plant activity, most of the bolls should be mature. The loss of immature bolls is usually greater when a desiccant is applied to immature plants.

A desiccant is not recommended for bottom defoliation as the danger of losing immature bolls is increased. The main purpose of bottom defoliation, as the name implies, is to remove the lower leaves —not to "freeze" them to the plant.

Desiccants usually are recommended for late season application, and can be used to advantage when mature plants are so inactive and dried out that they do not respond properly to the chemicals that require high activity for efficient defoliation. Where gins have the proper cleaning equipment, dry trash is considered less undesirable than green leaves. Therefore, proper use of desiccants can be advantageous under some conditions.

In general, a desirable defoliant is one which can be applied effectively and evenly, has a broad dosage tolerance, will cause efficient leaf removal, and is sold at a reasonable price.

A list of available defoliants and desiccants and their most effective rates can be found on pages 14 and 15. Defoliants and desiccants are not listed as such since desiccant materials may carry a label or trade name that uses the term "defoliant".

In general, the most widely used active ingredient in desiccants has been pentachlorophenol. This pentachlorophenol concentrate is usually diluted with diesel oil before application. A material that is listed in the chemical column of the table as pentachlorophenol implies that this material is primarly a desiccant, and defoliants and desiccants can be distinguished in this manner.

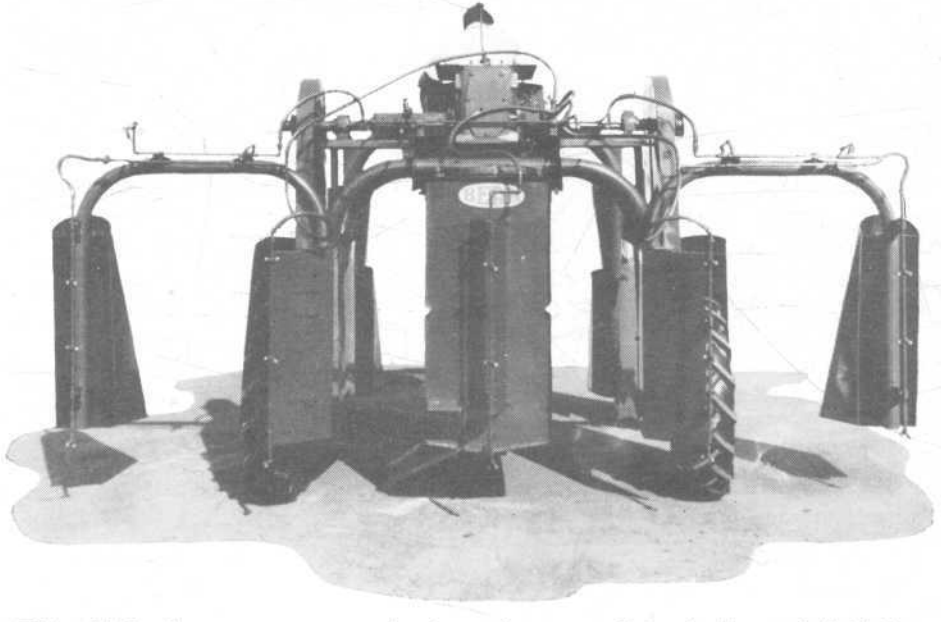
What About Bottom Defoliation?

The practice of bottom defoliation has proved to be advantageous in cotton that is rank, tall, and exhibits a heavy canopy of foliage. Under these conditions the damp environment sometimes found near the bottom of the plants delays boll opening and favors boll rot. Consequently, harvesting is delayed, yield is decreased, and grades are lowered.

Correct and efficient use of bottom defoliation has proved to be beneficial as a means of offsetting or correcting some of the above mentioned detrimental factors in efficient cotton production. Some of the advantages of bottom defoliation, as determined by experiments throughout the state for the past three years, are outlined as follows:

1. The rate of boll opening is usually increased following bottom defoliation, sometimes allowing the grower to make a first picking as much as two weeks earlier than could otherwise be expected. This is of considerable importance when a grower wants to get an early bottom crop picked either by hand or machine.

In many instances, successful machine harvesting of the bottom crop has followed bottom defoliation. Usually from 2 to 5 of the top rows of spindles were removed and replaced by plugs. The bottom bolls then could be picked without dam-



This high-clearance spray rig is a type used in bottom defoliation. (Rear view shows shields for wheels and spray nozzles.)

Picture courtesy Food Machinery & Chemical Corp.

age to the top crop of green unopened bolls.

This increase in the rate of opening of mature bolls, which usually allows earlier picking, generally helps the grower to get the cotton out at its best grade. Early picking tends to level the flow of seed cotton to the gins and helps to prevent a jam-up later in the gin yards.

2. Reduction in the amount of boll rot in bottom defoliated fields also is important. Reduction in the amount of boll rot has in some instances resulted in a substantial increase in yield.

In the picture above, note the spray pattern used in bottom defoliation. The lower third of the cotton plant is being covered.

3. In tall cotton, the defoliant does not always reach the lower leaves when complete defoliation is attempted, often necessitating a second application at additional expense. The second application may be omitted in bottom defoliated fields, thus accomplishing a saving in time as well as in cost.

4. Another advantage is the use of bottom defoliation to control late season grass and weed development. It has been noted that most of the weeds in bottom defoliated fields were either killed or retarded in growth. Bottom defoliation can be of importance in eliminating or retarding the growth of weeds that interfere with picking efficiency. Therefore, bottom defoliation might be used in some cases as a substitute for late cultivation.

Most of the bottom leaves are essentially mature at an early date and contribute little toward development of the top crop. Therefore, bottom defoliation is not detrimental to the immature bolls in the upper half of the plant if proper precaution is taken to confine the defoliant application to the lower leaves.

Since bottom defoliation is done at a time when plant activity is high and the defoliant is applied to mature leaves, nearly complete removal of these lower leaves can be expected with good placement of defoliants at effective rates, as shown in the table, pages 14 and 15.

Although the practice of bottom defoliation has its advantages, certain precautions must be taken. These advantages are expected only in cotton that is rank and tall with a heavy canopy of foliage.

The spray pattern should be directed toward the mature bolls in the lower part of the plants. If the spray pattern is allowed to contact the immature bolls or squares in the upper part of the plants, excessive shedding of squares or immature bolls may occur, with possible damage to the fiber of remaining immature bolls.

Several experiments conducted at the Sacaton experiment station have shown that a loss in yield may be expected when defoliants are applied to squares or immature bolls. In one experiment, total lint yield was reduced 52 percent when defoliants were applied too high on the plants at a time when most of the bolls were immature. A loss of 34 percent occurred when defoliants were applied before the lower bolls were mature even though the spray was confined to the proper low zone. Therefore, boll maturity should be carefully considered in deciding when to apply chemical defoliants.

As a matter of fact, the maturity of the lower bolls is perhaps the most important factor in determining when to bottom defoliate. It is recommended that the lower bolls be at least 35-40 days of age; that is, 35-40 days from time of flowering. In Arizona the lower bolls usually attain this age during August or early September. Here again the general rules-of-thumb may be used to determine when bolls are sufficiently mature for defoliation. (Refer to page 6)

A number of high-clearance spray rigs have been used successfully in bottom defoliation applications. However, adequate ground equipment for the application of dust defoliants to the lower leaves has not been developed. Therefore, only a spray type defoliant is recommended for bottom defoliation.

A desiccant is not recommended in bottom defoliation practices due to the greater chance of damaging immature bolls. The main purpose of bottom defoliation, as the name implies, is to remove the lower leaves and not to freeze them to the plant.

A single cotton plant that has been bottom defoliated.

What Precautions Should be Taken?

- No defoliant is recommended that is not labeled as to contents of the active ingredients.
- Do not use new and untried chemicals for defoliation without first consulting your local County Agricultural Agent.
- Observe the instructions and precautions printed on the label of defoliant packages. Some defoliants may be toxic and should be handled with care.
- Defoliants vary as to corrosive action. Equipment should be thoroughly cleaned after use to prevent corrosion.
- Avoid breathing defoliant dusts and fumes. Avoid contact of defoliant with eyes or skin.
- Guard against drift into adjacent crops. Defoliants are not selective.
- Complete coverage of the foliage is necessary for good defoliation. Flagmen help to give more uniform distribution when an airplane is used.
- Wetting agents often increase efficiency. Use the type of wetting agent recommended by the manufacturer or distributor of the defoliant.
- Apply defoliants lengthwise of the rows and not across the field.
- Ground machinery should be equipped with fenders to reduce damage to the crop.
- Should any unusual illness occur after working with defoliants, consult a doctor at once.

Defoliants and Rates

Chemical	Active Ingredient (Pct)	Trade Name	Acre Rates
Dust Defoliants			
Calcium cyanamide	57	AERO Cyanamid Special Grade	30-40 lbs.
Spray Defoliants			
Sodium chlorate (with sodium pentaborate)	40	Shed-A-Leaf	7-10 lbs.
Sodium chlorate (sodium & ammonium borates)	37.5 62.5	CHEM-FROST	7-12 lbs.
Sodium chlorate	40	Stauffer chlorate-borate Defoliant	7-10 lbs.
Sodium chlorate	40	Defoliant No. 1	8-12 lbs.
Sodium chlorate (plus fire retardant)	40	General Chemical Sure-Drop Defoliant	7-9 lbs.
Sodium chlorate	40	Tumbleaf	7-10 lbs.
Sodium chlorate (with magnesium chloride)	42.66	Shed-A-Leaf "M"	7-10 lbs.
Sodium chlorate (plus fire retardant)	4.75	DE-Leaf	10-15 gals.
Monosodium cyanamide	85	AERO Cyanamid, Soluble	7-12 lbs.
Sodium ethyl xanthate	85	S.E.X.	6-10 lbs.
Magnesium chlorate *(Equivalent to 63% magnesium chlorate, hexahydrate)	40*	Magron	2½ to 3½ qts. in 5 to 10 gals. water
Magnesium chlorate (hexahydrate)	58	Penco De-Fol-Ate	7-10 lbs.
Magnesium chlorate (hexahydrate)	58	Niagara MC Defoliant	7-10 lbs.
Magnesium chlorate (anhydrous)	17.5	Magclor Defoliant	2 gals. in 10 gals. water

Defoliants and Rates (Cont.)

Chemical	Active Ingredient (Pct)	Trade Name	Acre Rates
Magnesium chlorate (plus non-borate fire suppressant)	15	General Chemical E-Z Off Liquid Defoliant	1¾ to 2½ gals.
Potassium cyanate	92	General Chemical Potassium Cyanate Defoliant	6-12 lbs.
Endothal	6.3	Niagarathal DF Spray	4-5 qts.
Endothal	6.3	Penco Endothal Defoliant	4-5 qts.
Penthachlorophenol	2	Allsprays Cotton Defoliant	6-10 gals.
Penthachlorophenol	40	Golden Harvest	Dilute 1 to 5 with #2 diesel oil and apply diluted solution 3-5 gals.
Penthachlorophenol (in combination with mixed alkyl phenols)	90	Alphenol (90) Cotton Defoliant	Dilute 1 to 9 with #2 diesel oil and apply diluted solution 5-7 gals.
Penthachlorophenol (in combination with mixed alkyl phenols)	45	Alphenol (45) Cotton Defoliant	4-6 qts. per acre diluted in enough water (5-10 gals.) to give good coverage

Trade names are used in this guide only for the purpose of identification. Other defoliants may be available in Arizona and are not omitted intentionally.