UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION

COTTON GUIDELINES

DEFOLIATION AND HARVEST AID RECOMMENDATIONS *(update for August 2001)*

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WHY DEFOLIATION DECISIONS ARE IMPORTANT

Defoliation is the last operation in the production cycle where management practices can have a big impact on profit. These final decisions including timing of applications, which harvest aid materials to use, consideration of the impacts of crop vigor, boll load and distribution, water and nutrient status on "readiness" and efficacy of harvest aids, and likely impacts of weather conditions prevailing at and after the time of applications. These factors together can strongly impact overall harvest efficiency, fiber quality, and therefore lint value. The tight economics of cotton production today dictate that growers do all that's possible to properly set up the crop for effective, reduced-cost defoliation that still protects lint quality and price.

2001 Conditions and Comments. For a year in which poor early-season weather conditions led to many predictions of a late crop, most fields have shown good steady growth and have had adequate time to reach a solid cutout in fields where soil water and nitrogen were properly drawn down in the late season. With the desperate need to control input costs due to poor commodity prices this year, it is worthwhile to review some recommendations regarding harvst aid timing decisions and recent results from University of CA tests on harvest aid performance. Some more in-depth descriptions of past research trial results are also available at this web site by going to past issues of the "California Cotton Review" newsletter (see August 2000 and September 1999 issues available on this web site in the "Publications" section). Particularly if fall weather at defoliation time remains warm and plants are well prepared with relatively uniform boll loads and good cutout, there are some lower cost materials to consider and some one application timing materials that have performed well in recent field trials (see tables of data provided with this report).

In order to limit the possibility of additional problems with defoliation and fiber quality, consider some past experiences when scheduling your harvest operations this year. Consider that in varieties where in 2000 some concerns arose (and fiber discounts were charged) due to seed coat fragment problems, there was some evidence that problems could be reduced or even eliminated by avoiding harvest of those varieties during the hottest, driest part of the harvest season. Even though growers experiencing seed coat fragment discounts were only a small portion of total acreage of affected varieties, it might be worth a

little effort to consider picking other varieties during earlier, hot and drier weather. Some of the October 2000 rains also pointed out that some of the newer varieties are not particularly "storm-proof", with cotton trailing out more following rain in some varieties when compared with others. Those varieties might be better candidates for earlier harvests that could avoid some of the probability for fall rains.

IMPORTANCE OF PROPER TIMING FOR HARVEST AID APPLICATIONS

Defoliation decisions will have to be made on a field-by-field basis due to the wide range of crop maturities experienced within and across fields, and the impacts of weather and crop conditions that prevail at the time when the crop is acceptably mature for harvest preparation. Fields that have gone through a relatively even vegetative cutout and have a good boll load will be much easier to defoliate than fields with a non-uniform fruit set (for example, early and late bolls and a poor middle crop) or where there is substantial late vegetative growth due to factors such as late plantings, late irrigations or high late-season soil nitrogen.

Timing and techniques for determining boll maturity

Generalizations. Understanding of the sequence of boll maturation and knowledge of how to assess boll maturity are necessary in order to effectively use any of the following approaches to assess proper timing for harvest aid applications. The standard recommendation is to apply defoliation treatments when 95% of green bolls are mature or when 65% of expected harvestable bolls are open. A mature green boll cannot be easily cut with a sharp knife. The seed coat of seeds within mature bolls also has a tan color as opposed to the milky white color in immature bolls. In California, counting nodes above cracked bolls (NACB) is the recommended technique to determine the proper application timing. If defoliation is delayed until the recommended NACB, fiber quality and yield will not be affected

Specific Factors to Consider. Different approaches to the assessment of boll maturity and crop readiness for harvest aid applications will be reviewed in the following discussion. In the late-season, not all green bolls will have the right conditions and adequate time to mature and open prior to harvest aid applications, so it is important to be able to assess both boll maturity and the amount of time and heat units required to finish out and open mature bolls. Mature harvestable bolls have the following general characteristics:

- Difficult to slice boll open across the future lines of the boll wall even with a sharp knife
- Hard to "dent" or depress the boll wall with your fingers when pressing on it
- Seed coats range from yellowish to tan, even dark tan in color (in mature bolls, no seeds will have the milky-white seed coat color seen in immature bolls)
- When boll is cut open, lint can begin to string out rather than feeling wet
- Gelatinous material around seeds is mostly or completely gone

Percent Open / Assessment of Mature Bolls:
This approach has been in use for many years across the U.S. cotton belt, and it involves specific percentages of (a) mature green bolls; or (b) open bolls for harvest aid applications:

- 90 to 95 percent of the green bolls are "mature" as defined above
- 60 to 65 percent of the expected harvestable bolls are open is used as a target for defoliant application
- 80 to 85 percent of the expected harvestable bolls are open is used as a target for desiccant applications

There are advantages and disadvantages to use of this approach. Examples can be used to identify problems with this approach, including the following two examples: (1) a crop set over an extremely long

time period; versus (2) a compressed boll setting period. With the crop set over a long period, it would be possible to have a poor set of mid-canopy bolls, with bolls split between early-season and late-season bolls. Under this circumstance, it could be too early to defoliate even with 60 percent open bolls, since a significant part of the crop is in late-maturing bolls. In a crop with a compressed boll setting period, with bolls set early, on most successive fruiting branches, and with a relatively early vegetative cutout, it could be safe to defoliate at much less than 60 percent open boll. Under these types of situations, other evaluation techniques can prove useful. The following discussion addresses some other useful relative indicators of readiness for harvest aid applications.

Sharp Knife Technique / Seed Development Evaluations:
In this method, seed and lint development and appearance are evaluated as a tool to assess maturity. This technique is called the "sharp knife" method by many people since it requires cutting bolls expected to be "mature" in half (perpendicular to the carpel wall suture lines) with a sharp knife. The evaluation technique can involve both: (a) ability to cut through the lint and (b) seed maturity. More "mature" fibers can be more easily cut with a sharp knife. This characteristic can be used as an index of boll maturity, but this can be fairly imprecise since knives differ in "sharpness", and this is at best a "relative" term difficult to quantify. Inspection of the seeds for maturity can be done more consistently once the bolls are cut in half, and this can be done without removing the seeds from the boll. Seeds in mature bolls will have the characteristics mentioned at the beginning of this section. If the seeds remain immature, they will have the following characteristics:

- Appearance of "free" water in the boll
- "Jelly-like" appearance in material around seeds in the boll
- Seed coat still white instead of tan or brown
- Cotyledons white instead of green

If cutting bolls is used as an estimate of boll maturity, efforts must be made to cut bolls of different ages / positions on the plant to gain a field average when assessing uppermost bolls likely to mature and open.

Nodes Above Cracked Boll (NACB) Approach
This technique is based upon the idea that bolls will "crack" open (split along the boll suture lines) and be ready for harvest in roughly the same sequence that flowers were produced on the plant (ie. there will be a fairly regular progression in opening of bolls from the bottom of the plant towards the top). A discussion of the NACB approach can be found in the September, 1998 issue of the "California Cotton Review" newsletter also available in the "Publications" section of this website. In general, the recommended time that harvest aid applications can be made on Acala and CA Upland varieties is 4 NACB and for Pima 3 NACB. If defoliant applications are timed to match these stages of boll opening in the crop, fiber quality and yield will not be affected. The first step is to determine the last first position boll on the main stem that you determine will be carried all the way to harvest, and begin counting down the stem to the first cracked boll (boll starting to open and dry). The number of nodes above cracked boll will be calculated as the node position difference between that uppermost last boll to carry to harvest and that of the uppermost first position cracked boll.

Fields best-suited to this approach are those in which plant populations are moderate to high, and where plant populations and growth are relatively uniform. The NACB approach is less easy to use in fields or with varieties where a high proportion of the boll set is on vegetative branches, or where there are large gaps in position of fruit on the plant. When retained bolls are not evenly distributed within the plants (due to pest impacts or weather-related problems), there can be special cases to consider when evaluating the use of NACB for determining defoliation timing. Particularly when there are late-season boll losses, the last harvestable boll on the plant may not be in the first position on the fruiting branch.

FACTORS TO CONSIDER IN SELECTING A DEFOLIATION STRATEGY

Growers need defoliants with different modes of action to insure continued best results under a variety of environmental and crop conditions. However, it also is important to consider the importance of prevailing environmental and crop conditions in determining a cost-effective approach for each field.

Weather Conditions. It might seem a straight-forward decision to determine what to use and how much to spend on harvest preparation, but factors such as crop late-season vigor, nitrogen status, and water status can exert a big influence on success in defoliation. In many years, the often dominant factor going into each harvest season is typically hard to guess, and that is, the weather. Efficacy of harvest aids with different chemistries, the importance of adjuvants, and the need for repeat applications can be strongly influenced by both the weather (primarily temperature) as well as by crop vigor and levels of water or nutrient stress. Defoliants are much more effective when temperatures are warm, with daytime high temperatures greater than 80F. In general, earlier harvests, with longer, warmer days, are much more effective and time efficient and allow much more picker "power" than during the shorter, cooler and possibly wet days of November. Earlier harvests also make it easier to help preserve fiber quality.

Crop Vigor and Boll Load Impacts. In general, most harvest aids will do best, often even with lower labeled rates, in fields with a uniform boll load, strong cutout and little late-season vegetative growth. Choices become more complicated in fields with low and/or extended boll loads, where non-uniform cutout and rank vegetative growth have to be considered. For a more thorough discussion of the relationships between crop condition (cutout, rankness of growth, relative boll load) and choice of approach for harvest aid applications, see the August, 2000 issue of the "CA Cotton Review Newsletter" available through your University of CA Cooperative Extension county office or on this website.

Harvest Aid Chemical Choices. Primary defoliant materials are generally limited to the organosphosphate (OP) defoliants (DEF / Folex), or sodium chlorate, Ginstar and Dropp. Despite ongoing discussions about restricting the use of organophosphate (OP) defoliants in cotton, University studies have shown these materials provide some of the most consistent results year after year. Long-term UC studies, however, have identified some specific conditions which influence the performance of some materials versus others. With OP's, best results are usually obtained when they're applied in combination with ethephon. In University studies, Dropp when used alone has been more inconsistent in performance, especially with Acala Upland varieties. Sodium chlorate and Ginstar, when applied at high rates in combination with warm to hot temperatures, can cause leaves to freeze or desiccate on the plant.

Multiple applications of sodium chlorate can be used effectively for defoliation under some conditions, but it is most often used as a second application following an OP to desiccate remaining leaves before harvest. There are many defoliant enhancers, such as Accelerate, Cotton-Aid, Harvade and Starfire. Under some situations - rank growth, poor boll set, excessive moisture and/or nitrogen - these enhancers will increase efficacy when used in combination with Ginstar or OP's.

Types of Cotton. Types of cotton and perhaps even varieties must also be considered before making defoliation decisions. Types of cotton widely grown in the San Joaquin Valley have been divided into three basic categories.

Acala –The exceptional fiber quality of approved Acalas and the environmental conditions of the SJV have, to some degree, “insulated” the CA cotton crop from costly fiber quality penalties associated with too-early applications of harvest applications. Cotton merchants in today’s markets may not be as forgiving with lower quality fibers. Most of the Acala defoliation studies have been conducted using the Acala Maxxa variety. The mix of varieties which constitute the "Approved Acalas" increasingly represent

a range of growth types and leaf characteristics, so some differences in ease of defoliation can be expected across cotton represented in the Approved Acalas.

CA Upland – The cotton varieties that have been given the "CA Upland" designation are all Upland-type cottons. Although these varieties are of the same genus and species (Gossypium hirsutum) of our Acalas, they represent a much broader range of genetic material and plant type. It may be important to be aware of the effects of defoliation on fiber quality when preparing some potentially lower quality cottons for harvest. Significant mistakes (such as early pre-treatment or defoliant applications) made on an Upland variety with some borderline quality characteristics could significantly affect the value of that fiber. All indications and experiences through 2000 suggest that the CA Uplands should be much easier to defoliate than Pima and at least comparable to or with some varieties, significantly easier and cheaper to defoliate than the approved Acala varieties. As more research and field experience is obtained, growers and consultants should be able to have more confidence regarding use of lower chemical application rates, less need for sequential applications, and an overall lower input cost approach in defoliating CA Uplands.

Pima – Because of its more indeterminate growth characteristics, Pima is more difficult and costly to defoliate than upland varieties. Higher rates and sequential applications are usually needed to thoroughly desiccate remaining leaves. Some European mills have reported the presence of arsenic in Pima samples from the San Joaquin Valley due to excessive rates of cacodylic acid. A single application of cacodylic acid at label rates should avoid this problem. Select an alternative to cacodylic acid if additional treatments for desiccation are needed. Most of the Pima defoliation studies have been conducted using the Pima S-7 variety.

Putting all this information together, we can make some generalizations:

BETTER CONDITIONS FOR COST-EFFECTIVE HARVEST AID APPLICATIONS OCCUR WITH:

- moderate to high air temperatures (daytime temperatures > 80°F; night time temperatures > 50°F)
- Complete defoliant coverage on plants (good penetration of applied materials within the canopy)
- Relatively low plant and soil nitrogen levels
- Soil water levels moderate (plants not growing luxuriantly due to high soil water availability, but not water-stressed to the point where leaves would be inactive in gas exchange)
- Relatively uniform crop development and fruit distribution; maturity & distribution of crop uniform
- Weeds and insects under reasonable control

CONDITIONS WHERE DEFOLIATION IS MORE DIFFICULT:

Abnormal fruiting patterns, such as good early set followed by poor middle set leads to a situation where growers are likely to attempt to also set a late crop in order to make a more acceptable yield. Harvest aid decisions are more complicated under these scenarios, since any efforts to delay defoliation to allow maturation of late bolls also puts early bolls at greater risk for lint losses and changes in quality associated with time of lint exposure to weathering. Efforts to maintain cotton production late into the growing season are typical with cotton varieties suited to a long growing season, particularly when early- and mid-season fruit retention is limited and late-season fruit is important to final yield potential.

Fields subject to repeated water stress and drying winds will tend to have thicker waxy cuticles (leaf surface wax) when compared with leaves grown in a less stressful environment where soil water and atmospheric conditions have higher water levels. Increased levels of this surface wax can significantly inhibit uptake of harvest aid chemicals, and the impacts of these stress periods are not completely relieved by a late-season irrigation or rain. Plant water status during the period leading up to harvest aid applications can influence efficacy of applied materials. Under conditions where these plant stress conditions have been more prevalent, there may be more benefit to addition of wetting agents, including non-ionic surfactants.

LIKELY CROP AND WEATHER SITUATIONS, AND WHAT TO CONSIDER

There are at least a couple of scenarios where treatments would be most likely to be cost effective based on field tests and observations. The following are two general situations:

Condition 1 – Fields with uniform and/or heavy boll load, abrupt cutout, and warm temperatures >80°F at time of defoliant application with warm weather expected after applications.

- Under this condition, lower labeled rates of most defoliants are effective.
- There is less potential for regrowth, less need for early glyphosate applications unless preharvest weed control is needed.
- Ginstar treatments should give effective single shot defoliation. Def and Folex should be effective.
- Ethephon treatments for boll opening may be less critical, however, Ethephon tank mixes will be useful in areas with aphids or whiteflies for faster leaf drop.
- If a second treatment is needed, Chlorate / Starfire / cacodylic acid applied alone or in combination will be more effective than under condition 2.

Condition 2 – Late plantings, rank growth, and/or low boll retention in Upland and Pima cotton.

- Under these conditions, defoliant performance is reduced. Regrowth and boll opening are also a common concern. Therefore, pre-treatments with Ginstar, Dropp, Prep, and Roundup will enhance defoliation.
- Sequential applications will usually be required. Higher rates are usually required on the second application to defoliate or desiccate remaining leaves.

General guidelines suggest being aware of the impacts of weather conditions and crop water and nutrient status on the efficacy of harvest aid materials. Chemical defoliant efficacy is enhanced greatly at temperatures in excess of 80°F (daytime highs) and 50°F (nighttime lows). If lower temperatures are expected during the first 7-10 days after defoliant application, changes in chemical choice and application rates may be required. It is also beneficial to aim for moderate plant water status and low plant nitrogen levels to improve efficacy of defoliants. High plant water or nitrogen status tends to encourage rank vegetative growth that is difficult to defoliate and increases the likelihood of significant regrowth. Too much water stress at defoliation (i.e. leaf water potential lower than 25 bars, leaves wilted during much of the day, closed stomata) generally reduces “receptiveness” of the leaf surfaces to the herbicidal activity of many harvest aids.

RESEARCH SUMMARIES ON DEFOLIATION / DESICCATION PERFORMANCE IN HARVEST AID TRIALS IN RECENT YEARS

Growers need defoliants with different modes of action to insure continued best results under a variety of environmental and crop conditions. Primary defoliant materials are generally limited to the organophosphates (OP) defoliants (Def, Folex) or sodium chlorate, Ginstar, and Dropp. Despite ongoing discussions about restricting the use of OP defoliants in cotton, University studies have shown these materials provide some of the most consistent results year after year. Long-term UC studies, however, have identified some specific conditions that influence the performance of some materials vs. others. With OP's, best results are usually obtained when they’re applied in combination with ethephon. In University studies, Dropp when used alone has been more inconsistent in performance, especially with Acala Upland varieties. Sodium chlorate and Ginstar, when applied at high rates in combination with warm to hot temperatures can cause leaves to freeze or desiccate on the plant. Multiple applications of sodium chlorate

can be used effectively for defoliation under some conditions, but it is most often used as a second application following an OP to desiccate remaining leaves before harvest. There are many defoliant enhancers, such as Accelerate, Cotton-Aide, Harvade, and Starfire. Under some situations – rank growth, poor boll set, excessive moisture and/or nitrogen - these enhancers will increase efficacy when used in combination with Ginstar or OP's.

Pima Harvest Aid Trials - Research Summary (1995-2000)

Pima, because of its more indeterminate growth characteristics, is more difficult and costly to defoliate than Upland varieties. Higher rates and sequential applications are usually needed to thoroughly desiccate remaining leaves. Several treatments were evaluated at the University of CA West Side Research and Extension Center on Pima S-7 between 1995 and 2000. It should be understood that performance of some materials may be somewhat different at other locations with different soil types, plant vigor, depth of crop rooting, and end-of-season soil water and nutrient levels. However, the West Side REC location is representative of responses seen with Pima cotton under strong growth, high yield conditions, so should give a good relative indication of likely harvest aid performance. Table 1 lists the treatments that provided the most consistent defoliation / desiccation performance 14 – 21 days after treatment.

Table 1. Perfomance ratings of various harvest aid treatments applied to **Pima cotton** (variety S-7) at a clay loam soil site located at the West Side Research and Extension Center (Fresno County) during the years 1995 though 2000. Performance of various treatments are expressed as average percent defoliation and average percent desiccation ratings performed at specific time periods (14 to 21 days after treatment (DAT). Cost of materials applied on a dollar cost per acre basis only reflect material cost (not total application costs), and were based upon a phone survey of product retailers done in summer of 2000.

Treatment (or combination of treatments)	Defoliation Rating (14 to 21 DAT) ** (percent)							Desiccation Rating - average for 1995-2000	Material Costs
	1995	1996	1997	1998	1999	2000	Aver. 1995-2000	(percent)	($ per acre (year 2000)
Prep (2 pt) + Dropp (0.3 lb) **B.*** Ginstar (10 oz), or NaClO3 (1 gal Defol 5) + Harvade (8 oz), or Starfire (21 oz), or NaClO3 + Folex , or NaClO3 + Cotton-Aide (1.3 pt)	63	38	63	58	43	Not in test	53 ***	67	43 - 56
Ginstar (13 oz) + Prep (2 pt) **B.** NaClO3 (1 gal Defol 5) + Starfire (21 oz)	70	34	75	50	35	49	52	69	51
Ginstar (6 oz) **B.** Ginstar (10 oz)	61	39	73	41	57	46	53	68	28
Dropp (0.3 lb)+Agridex (1 pt) **B.** Ginstar (13 oz)	65	38	Not in test	Not in test	Not in test	Not in test	52 ***	50	45
Cotton Quik (3.5 qt) + Ginstar (13 oz)	Not in test	85	72	50	Not in test	41	62 ***	75	51
Ginstar (13 oz)	58	38	77	51	43	48	53	65	23

* Note that **B.** indicates a sequential, second application of materials made 7 days after the initial treatment. ** DAT = days after treatment *** not in tests all years

Acala Harvest Aid Trials - Research Summary (1996 - 2000)

Table 2 summarizes some of the Acala treatment results for 1996 through 2000. Some of the 1999 data was not included because of field variability. This table reemphasizes the difference that each season has on performance of pre-harvest aids. The field conditions that produced the results in 1997 and in 2000 were more representative of condition 1 as previously described, whereas the conditions that produced results in 1996 and 1998 are more representative of condition 2 described above. Table 2 also gives some

Table 2. Perfomance ratings of various harvest aid treatments applied to **Acala cotton** (variety CPCSD "Maxxa") at a clay loam soil site located at the West Side Research and Extension Center (Fresno County) during the years 1996 though 2000. Performance of various treatments are expressed as average percent defoliation assessed at specific time periods (14 to 21 days after treatment (DAT). Cost of materials applied on a dollar cost per acre basis only reflect material cost (not total application costs), and were based upon a phone survey of product retailers done in summer of 2000.

Treatment (or combination of treatments)	Defoliation Rating (14 to 21 DAT) ** (percent)						Material Costs
	1996	1997	1998	1999	2000	Average 1996-2000	($ per acre (year 2000)
Folex (2 pt) + Prep (2 pt) **B.** * NaClO3 (1 gal Defol 5) + Starfire (21 oz)	86	88	92	75	80	84	42
Folex (2 pt) + Prep (2 pt) + Agridex (1 pt)	82	55	79	77	79	74	30
Ginstar (6 oz) **B.** Ginstar (8 oz)	74	95	60	Not in test	Not in test	76 ***	25
Prep (2 pt) **B.** Ginstar (8 oz)	60	Not in test	31	Not in test	Not in test	46 ***	29
Def (2 pt) + Accelerate (1 pt)	55	60	Not in test	Not in test	Not in test	58	16
Ginstar (10 oz)	36	70	50	72	74	60	18
NaClO3(1 gal)+Starfire (11oz) **B.** NaClO3 + Starfire (11oz)	21	65	55	65	69	55	23
Def (2pt) + Agridex (1 pt)	55	52	33	55	Not in test	49 ***	15
Accelerate(1.5 pt)+ Folex(2pt)	59	53	Not in test	Not in test	Not in test	56 ***	18
Harvade(8 oz) + Def (2 pt) **B.** NaClO3(1 gal) + Starfire (21 oz)	Not in test	83	80	Not in test	68	77 ***	32
Harvade (8 oz) + Ginstar(6 oz) **B.** NaClO3 (1 gal) + Starfire (21 oz)	Not in test	92	82	Not in test	Not in test	87 ***	30
Finish (2 pt) + Ginstar (6 oz)	Not in test	Not in test	Not in test	Not in test	79	79 ***	-
Finish (2 pt) + Folex (2 pt)	Not in test	Not in test	Not in test	Not in test	85	85 ***	-

* Note that **B.** indicates a sequential, second application of materials made 7 days after the initial treatment. ** DAT = days after treatment *** not in tests all years
general costs for Upland defoliation options based upon year 2000 data. A grower must select a treatment that will perform the best under his or her field conditions. Material cost, number of applications needed, efficacy, local crop, soil and weather conditions, and plant-back restrictions all play a role in determining which treatments to use.

MANAGEMENT PRACTICES INFLUENCING TRASH CONTENT GOING INTO THE GIN

Many of the following conditions can cause problems with incomplete leaf "drop", leading to difficulties in making decisions on the need for additional treatments as well as problems with harvest that result in difficult-to-clean lint susceptible to higher losses in yield and fiber quality:

- cool temperatures during approximately the 3 to 7 day period following harvest aid applications - Since defoliants essentially are used to speed up a natural process of development of an abscission layer and deterioration of leaf tissue, this process is temperature-sensitive with most chemical materials. Cool weather following harvest aid applications generally reduces both uptake of the chemicals and the rate of response, leading to reduced efficacy of applied materials
- plant water stress, low humidity conditions - Water stress prior to defoliant applications can negatively impact efficacy of applied chemical defoliants. Both low air humidity levels and plant water stress encourage development of a waxy layer on leaves that inhibits uptake of many defoliant chemicals. Particularly when water stress conditions exist for a prolonged period (ie. weeks), leaves form a thicker waxy cuticle. A stressed plant with depressed growth tends to respond less to applied harvest aid materials than a less-stressed plant that still is using some water and exhibits some growth
- rapidly growing plants - Plants with high vegetative vigor (due to late planting, low fruit retention) can be difficult to defoliate. These plants tend to have higher levels of the auxin and gibberellin hormones, both of which can interfere with abscission of leaves
- high water and nitrogen levels - High soil water availability or high late-season soil and plant nitrogen levels typically produce large, vigorously-growing plants that are more resistant to defoliation, and more prone to higher rates of leaf regrowth
- hairy leaf varieties - Varieties with significantly higher number of leaf hairs have in the past been less common in California cotton production, the introduction of new Pima and Upland varieties in the late 1990's may change this trend. Hairy leaf varieties in other areas of the U.S. have had significantly higher trash content at harvest
- cultural practices, delayed harvests, environmental conditions that encourage regrowth - Young, meristematic leaf tissue does not typically develop an abscission layer to allow leaf drop. Due to the danger of this high water content tissue staining seedcotton, regrowth typically must be chemically desiccated prior to harvest
- inadequate harvest aid chemical application rates - Uneven performance of harvest aids is more common with lower-than-recommended application rates. Particularly with large,vigorous plants with low to moderate fruit retention, poor chemical distribution or low rates can result in poor defoliation. Plants with good fruit retention and moderate or lower leaf area can still defoliate reasonably well even with reduced application rates due to the better penetration of applied chemicals into the leaf canopy.
- High chemical application rates - Higher-than-recommended application rates for many defoliant/desiccant materials can cause rapid death of leaf tissue, preventing formation of a leaf abscission layer and leaf drop. Leaves tend to be "stuck" on the plant with this application problem. With many chemicals, more effective leaf drop is achieved with multiple applications at a lower rate.