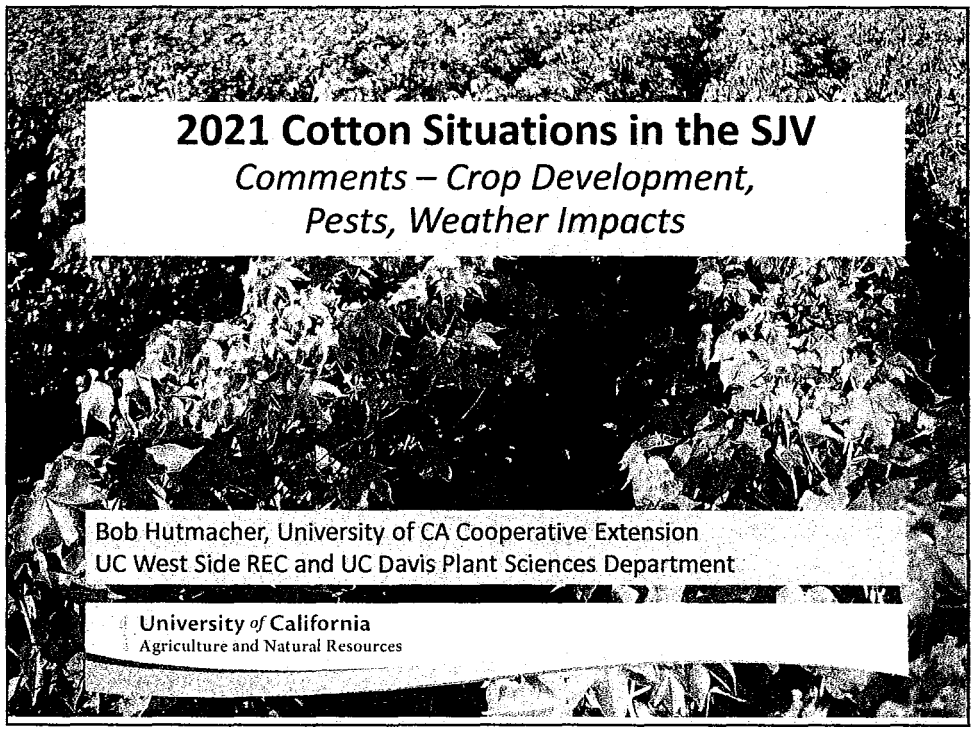


2021 Situations impacting crop production
(is 2021 a fairly "normal" year so far?)

- Very limited water allocations or access to groundwater resulted in cotton acreage ranging from quite stressed at times during season to reasonably well-watered – depending on local situations
- In most areas, early season weather improved late March and through April, resulting in many timely plantings. Some later plantings mostly in areas with stand establishment problems
- Little winter rain, but some in March likely contributed to some area with early lygus that carried over from winter weeds - worse than average lygus pressure during squaring in some areas (location-dependent / not everywhere)

2021 Situations *(weather issues?)*

- ✓ **Heat Units** for the 2021 cotton growing season differed significantly from long-term averages (as often happens)
  - ✓ *heat units above average for multiple months* this year
  - ✓ cooled a bit early May but only for 1-2 week period
  - ✓ June, July were hotter (higher average daily highs and lows, higher heat unit accumulations) versus long-term averages
- ✓ Multiple periods of ultra-high temperatures & some high night-time temperatures – occurred in June, July and now August
- ✓ **Windy** weather in mid-to-late May in some areas contributed to drying upper soil, beating up seedlings in some areas

Plant & Environmental Factors
with potential to make whitefly problems worse

- ✓ *Later planting dates (shift growth stages* to later in year, extend late summer/fall period where protection from SLWF needed)
- ✓ *Hotter mid and late-summer* weather (more heat units)
- ✓ *Proximity to other crops that host whiteflies* earlier in season
- ✓ *Heavy weed pressure in cotton or neighboring fields* (especially weeds supporting high SLWF pop'ns (ground cherry, bindweed, nightshade, lambsquarter, etc.)
- ✓ *Limited mid and later season beneficial insect* populations (either due to natural conditions or prior spray choices)

Heat Units

(base 60F, long-term average, 2021, 2020) at West Side REC

HEAT UNITS (60F)	Long-Term Average	2020	2021
March	**81**	***55***	***74***
April	***151***	***153***	***208***
May	***295***	***354***	***351***
June	***396***	***461***	***541***
July	***558***	***585***	***708***
August	***533***	***629***	***265*** *(thru 8/14 only)*
September	***306***	***446***	
October	***231***	***295***	

Notes / comments on early season issues

- ✓ As in recent years, early issues with **thrips**, almost all in susceptible Uplands – didn't persist long, few or no treatments
  - ✓ Worst affected were non-CA Uplands, lesser-affected were locally-bred Uplands, least impacted were Pimas
- ✓ Most areas checked, observations were that **mites** were not widespread early problem most areas (some miticides applied)
- ✓ **In 2021, Lygus** were a locally moderate to serious issue starting as early as mid-May (squaring) and into June (10+ counts/50 sweeps and up) in some SJV areas visited – observations were that populations & damage lessened later toward early to peak bloom many areas (other observations?)

Sugars Found on Plants - *Characteristics*

Some basics on sugars that can occur on plant tissues:

- Plant-based naturally occurring sugars
  - Always found on plants, some impacts of environment and cultivar on concentrations, but more predictable
  - Predominantly glucose, detectable using relatively simple tests
  - Less variability, more "normal" for mills to deal with
- **Insect-related sugars** (such as those related to aphid, SLWF) - Some basics on the dominant sugars in honeydew of aphid and silverleaf whitefly (SLWF)
  - The components of "honeydew" of concern are mostly excess sugars that insects pass rather than fully metabolize:
  - For instance, after Silverleaf Whitefly (SLWF) extract what they need (mostly proteins) when feeding from plant tissue, they excrete excess sugars
  - More variable an occurrence, so hard to know when to test for them
  - more expensive & difficult to detect and quantify than glucose, plant sugars
  - Dominant sugars in honeydew are different for SLWF than for aphids

Sugars Found on Plants - *Characteristics*

Some basics on sugars (continued):

- **Whitefly honeydew:**
  - **Multiple sugars, but *dominant sugar = Trehalulose***
  - **Trehalulose has a lower melting point (about 50C), and those temps occur during processing in mills**
  - **Also is less water-soluble so harder to wash off with water (rain or sprinkling)**
- **Aphid honeydew:**
  - **Multiple sugars, but *dominant sugar = Melezitose***
  - **Melezitose has a much higher melting point (around 130C) less likely to be reached in the milling process**
  - **This sugar is more water-soluble**

Crop Management – Defoliation Options?

What can you do when you get to late season ?

- ✓ **Often near defoliation timing,** can be tempting to think that first harvest aid application effectively ends concerns with aphid or SLWF management .... But that is not necessarily true. Field Scouting for late-season issues with SLWF and aphids needs to continue maybe as much as 10+ days after first harvest aid application if the pests are present in large #'s
- ✓ Some areas could require "cleanup" sprays prior to and even after 1st harvest aid applications if pests persist during this open-boll period prior to leaf desiccation and leaf abscission.
- ✓ Used to mention that organophosphate-defoliants (Def/Folex) had some insecticidal activity that could help with late pest cleanup ... but so few users of these products anymore?

Can waiting for Rain or late sprinkler irrigations help?

- ✓ **Past Research** *(Larry Godfrey, Jay Bancroft, Pete Goodell, Bob Hutmacher, others)* would suggest:
  - ✓ If plagued with **persistent aphid problems** (instead of whitefly), at least possible that a moderate rainfall or irrigation event (0.5 inch or so minimum) could help wash off honeydew since aphid honeydew more water-soluble)
  - ✓ **SLWF honeydew** is much less water-soluble and has a melting point that makes it more problematic, harder to wash off with rain or irrigation once it is on the plant tissue and especially the cotton lint
  - ✓ While rain or sprinklers might help with a mild/moderate problem associated with aphids, don't count on them to provide adequate help if a SLWF honeydew problem exists

University of California Cooperative Extension (August 2021)
revision of 2015 Field Check – Hutmacher and Wright

COTTON FIELD CHECK - *University of California Cooperative Extension*

Preparing the Cotton Crop for Harvest

Steve Wright, Bob Hutmacher, Dan Munk, Mark Keeley
UCCE Tulare and Kings Counties, UCD Plant Sci. Dept, West Side REC; UCCE Fresno Co.

Although it is one of the last management decisions in the cotton production cycle, defoliation timing and application can be critical for production of a profitable crop. Improper defoliation timing will compromise both cotton yield and fiber quality. In light of the premiums and discounts possible for fiber quality characteristics the proper use of harvest aid chemicals is of considerable importance. This Field Check will review some of the crop, chemical and environment considerations that can impact efficacy of harvest aid efforts in San Joaquin Valley cotton.

Nitrogen Nutrition Status of Plants

- Influences vegetative growth, vigor and new vegetative growth, and maturity and extent of natural senescence at time of defoliation
- High nitrogen concentrations in plant tissue delay abscission zone formation in leaf petioles, and can delay breakdown of boll carpel wall sutures

Crop Water Status

- Water stress significant enough to cause afternoon leaf wilt at the time of defoliation tends to reduce response to harvest aid chemicals
- Wilted leaves tend to delay absorption
- Increasing water stress hastens boll opening, but sufficient moisture must remain for defoliants to activate the abscission layer to drop leaves

Proper Timing of Chemical Applications

- Can help reduce duration of time you need to control aphids and whiteflies that can cause sticky cotton
- This can provide some economic incentives to defoliate and harvest earlier in some situations
- Earlier but appropriate timing for harvest aid applications can allow harvests to happen during better weather, with more hours for harvest and less chance of rain-causes fiber damage
- Improper timing – reduction of fiber quality and yield
- There is no set calendar date for harvest aids, based on field-level conditions, projected weather impacts, boll readiness for harvest, and likelihood and value of waiting for late-developing bolls

Influence of Crop Conditions on Harvest-Aid Chemicals

Crop conditions that can impact harvest aid decisions and performance range from:
Fields with uniform and/or heavy boll load with abrupt cutout (conditions that generally make defoliation easier, with lower chemical rates and fewer total applications)
… and at the other extreme …
Late plantings and/or low boll retention, fields with rank growth in Upland and Pima varieties due to excess water and/or nitrogen combined with uneven, reduced fruit retention (in late fields, temperatures at harvest aid application timing are often lower, and the above conditions generally make defoliation more difficult, requiring multiple chemical treatments, sometimes at higher rates).

The following are guidelines based on information from multi-year field research trials:
The effectiveness of defoliation varies each season and often from field to field depending on nitrogen status of the crop, boll load, irrigation termination, temperatures, and soil types. Guidelines were developed to manage two basic scenarios: (SITUATION ONE) cotton fields with a high boll load for the size of plant and amount of leaf area, early vegetative cutout and more advanced and even boll maturation, irrigation termination and nitrogen depletion well-synchronized; and (SITUATION TWO) cotton fields with a later-maturing, more unevenly

distributed boll load, large amount of leaf area for the boll load, and even some rank growth problems and more potential for regrowth. Obviously, fields can be somewhere in between these two situations and that can require other adjustments and considerations based on current and upcoming weather conditions and past experiences with defoliation in the field.

SITUATION ONE - Factors to consider when selecting a defoliation strategy
In fields with a heavy boll load, fairly abrupt vegetative cutout at a fairly early date, these fields can be ready for the start of harvest aid applications while temperatures are still warm (highs >80° F).

1. Ginstar/Adios treatments usually give effective defoliation. Lower rates (4-6 oz/ac should be effective for Acala's and 5-8 oz/ac on Pima). Def and Folex in combination with ethephon (such as Prep, Cotton Quick, Finish or others) are effective and can be useful in helping with later-maturing bolls. It is better to start with the lowest rate of Ginstar/Adios to be effective and have to come back than to freeze the leaves due to a high rate which is more likely to occur with 90 F plus temperatures..
- Standard rates of chlorate plus paraquat, ET, or Shark as secondary treatments are generally effective. ET or Shark should be included as part of the first and second applications for suppression of annual morningglory.

SITUATION TWO - Factors to consider when selecting a defoliation strategy
A different situation leading up to harvest aid applications can occur when you have multiple crop and environmental factors that make it more difficult to get defoliation started on plants. Defoliation cab be more difficult and harvest aid chemical performance more uneven and less effective under conditions of low bottom boll retention, rank vegetative growth (associated with poor boll set, or excess late season soil nitrogen or irrigation water), or with cool temperatures during and in the week after first harvest aid application. In these circumstances, it is often difficult to achieve many of the conditions identified below in the table "Best Conditions for Effective Defoliation". As the season progresses more into cooler weather periods, it becomes more important to consider factors such as "minimum temperatures for optimum performance" of harvest aid chemicals shown below.

Best Conditions for Effective Defoliation

- Moderate to high air temperatures (day time > 80 F; night time > 60 F)
- Relatively low plant & soil nitrogen levels
- Soil water levels moderate (plants can't be water stressed)
- Uniform crop development; crop at cutout
- Weeds, insect & disease – under control
- Complete defoliant coverage – good penetration within the canopy

Minimum temperatures for optimum performance

	Degrees F
• Sodium Chlorate	50
• Paraquat	<50
• Tribufos	55-60
• Dimethipin	55
• Ethephon	60
• Thidiazuron	65

*Night temperatures above 60°F are best for defoliation, below 60°F will generally slow defoliation

With more vigorous plants with a high proportion of later-maturing bolls, it may be desirable to consider some different practices to improve chances for acceptable defoliation, desiccation, achieve better control of regrowth, and to improve chances of getting later-maturing bolls to open. Growers need to look at the calendar, judge the likelihood that good weather will continue, and decide which bolls they really can afford to wait for. Under these circumstances, pre-treatments of Ginstar/Adios or ethephon can be very helpful, and typically, sequential applications will be required. The first application of these materials are applied with the goal of opening up the canopy (removing a first wave of leaves). Higher rates are typically required on second applications to defoliate or

desiccate remaining leaves (and also often because temperatures have gone down by the time of later applications). A couple of strategies to consider under these conditions include:

Strategy One: UCCE studies demonstrated benefits in defoliation and boll opening by applying a pre-treatment of 4-6 oz/ac of Ginstar/Adios at about 40 percent open boll or 6 (NACB) followed by later treatments (at 4 NACB) of: (1) Ginstar at 6-8 oz; or (2) Ginstar/Adios in combination with a boll opener material (such as Prep, Cotton Quick, Finish or others); or (3) Def/Folex plus a boll opener. Ginstar/Adios rates should be adjusted if changes in air temperatures occur at application or are anticipated in the days following application. In many cases in both Acala and Pima, a final application of sodium chlorate and Paraquat or Shark or ET will also be useful in desiccating remaining leaves and improving opening of last-remaining bolls. Applying ethephon at 6 NACB slightly reduced yield and micronaire compared to 4 NACB but may be necessary to hasten harvest.

Strategy Two: Another approach for vigorous, late-maturing cotton fields, particularly when there are concerns that the fields are just not making progress in opening up bolls, involves use of glyphosate as a pre-treatment in non RR varieties. Results showed some advantages in earlier opening of later-developing bolls with the glyphosate pre-treatments. Glyphosate should not be applied before about 8 NACB for these pre-treatments in Acala varieties, since the research showed yield losses of 5 to 12% with earlier applications at 10 NACB. Ginstar/Adios has been effective on late maturing Pima if it does not appear to be changing in maturity. If and when cotton moves closer to the 6 NACB the start with the pretreatments of Ginstar or Ginstar plus ethephon.

In making decisions regarding approaches to consider and chemicals to use, some factors to think about can be summarized in the table below.

	Advantages	**Considerations/Disadvantages**
Ginstar, Adios	Generally effective, limited odor, some regrowth control	Crop rotation restrictions; adjust rates according to prevailing temperatures
Def/Folex+ ethephon	Generally effective, good warm & cool weather performance, can help with whitefly management	Odor, spray restrictions
Sodium chlorate + paraquat Shark, ET	Less effective cheap, warm-cool weather performance Replacement for above and cheap, broadleaf control	Salt affects a minor consideration

Pay attention to the calendar, the weather, and consider how much risk you want to take in choosing a final harvest date. Consider these steps:

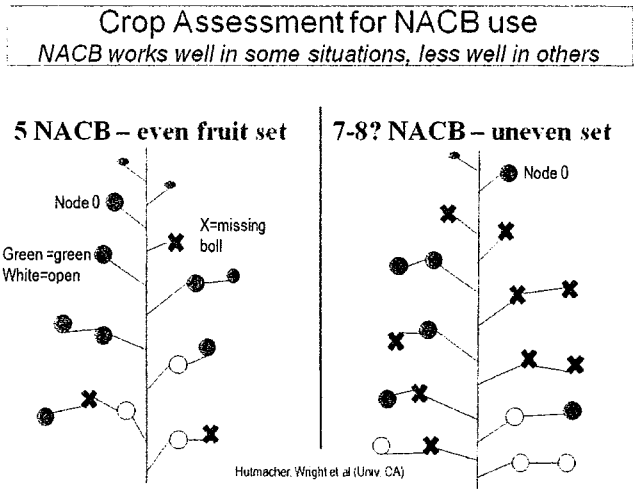
1. Keep an eye on predicted trends in the weather.
2. Consider your own experience with how many days of harvest will likely be needed from harvest of your first field to the last field.
3. Decide what you think is the last harvest date you consider to be an acceptable risk.
4. Count back about 21-28 days from those desired harvest dates, and start with your defoliation program in earliest fields even if nodes above cracked bolls or % open values are not quite at your targets.

University Acala and Upland cotton defoliation trials in the 1980's and 1990's suggest that, on the average,

defoliations initiated at 8 nodes above cracked boll (NACB) could result in yield losses of about 5 to 7 % when compared with initiation at 4 NACB, while those initiated at 6 NACB would reduce yields 2 to 3%. However, those same studies acknowledged that when a very large percentage of the total crop consists of bolls on the upper 6 to 9 fruiting branches, losses from early defoliant applications can be substantially more (over 10%). Particularly under circumstances of mostly a mid-canopy and top-crop, the closer you can get to 4 to 6 NACB prior to first defoliant application, the lower the yield loss.

NACB Technique – *Recommended Defoliation Timing*

- In diagram on the right, green circles are green (unopened) bolls; white circles are cracked open bolls
- When plants on average area at 3 Nodes Above Cracked Boll (Pima)
- When plants on average are at 4 Nodes Above Cracked Boll (Upland)



Harvest Aid Considerations if White Flies a Threat - Vigorous, Late-Maturing Fields in SJV

In a year like this one, with some repeated observations of persistent mid- to late-season silverleaf whitefly in some areas, there may be advantages to stepping up the timing of harvest aid application timing to start removing leaves that encourage continuing populations of whitefly and aphids. If you are not likely to gain a large amount of yield waiting for late bolls on plants, the advantages of limiting whitefly populations and sticky cotton potential likely outweighs the value of yield gains. Approaches to consider could include:

A. Treatments starting at 6 NACB (40% OB) as a pre-treatment of 3-6 oz of Ginstar/Adios treatments or 3-6 oz of Ginstar, Adios treatments plus a boll opener (more aggressive) Start even at 8 NACB in Pima. You may need to go even earlier on Pima if the crop is not maturing due to cold weather.

B. Treatments starting at 3-4 NACB (50-65% OB) with Ginstar, Adios at 5-10 oz; in combination with a boll opener material (such as Prep, Cotton Quick, Finish); or Def/Folex or ET, Shark, plus a boll opener or Sodium Chlorate plus paraquat. Some studies have shown whitefly populations reduced even more with use of Def/Folex instead of other materials.

C. In many cases in both Acala & Pima, a final app. of chlorate & Paraquat, Shark, or ET will also be useful in desiccating remaining leaves & improving opening of last-remaining bolls. Shark or ET app. will also help dry remaining broadleaf weeds.