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In This Issue

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STICKY COTTON CONTAMINATION:
San Joaquin Valley Growers Can Prevent and Avoid the Problem By Being Proactive

Peter B. Goodell

The San Joaquin Valley (SJV) has developed and promoted high quality cotton for over 50 years. This well deserved reputation is based on providing cotton lint that is free from contaminants, natural or man-made. Insect produced honeydew is an ever-present threat to our reputation for quality and our future.

This special issue of California Cotton Review is dedicated to promoting a better understanding of the causes of sticky cotton and how to prevent it. The University of CA Cooperative Extension and an industry alliance of local and national organizations are providing this special issue to ensure that the San Joaquin Valley cotton industry continues to have the tools and information needed to produce high quality cotton lint in 2002 and beyond. California Cotton Growers and Ginners Association, the National Cotton Council, and University of California, Cooperative Extension are recognized for their contributions in mobilizing the industry to respond to this threat.

Sticky cotton is the result of sugars being deposited on the cotton lint. The source of sugar can be natural plant sugar or the sugars can result from the excretions, or "honeydew" of specific insect pests. Within the SJV, data available indicates that insect honeydew is responsible for most sticky cotton problems. The specific insect pests, cotton aphid and silverleaf whitefly, are currently thought to produce the majority of honeydew that results in sticky cotton complaints from the mills. Sticky cotton is considered a major contaminate able to greatly disrupt operations in cotton spinning mills. Even low levels of insect sugars can cause excessive wear on spinning machinery and slow down high-speed spinning processes. Mills employing modern spinning practices and equipment have little or no tolerance for sticky cotton, and to limit their exposure might avoid specific merchants and ginners that they associate with the problem.

San Joaquin Valley cotton growers and industry live by their reputation for consistent high quality, and a stigma associated with sticky cotton could damage or even destroy that reputation. The sustainability of the SJV cotton industry is dependent on our ability to consistently deliver high quality cotton lint. During much of the 1990's, Arizona growers generally suffered 3 to 4 cents per pound discounts based on the perception that they produced sticky cotton. Efforts to restore damaged reputations for producing high quality cotton are time-consuming, costly and difficult.

This issue includes the basics needed for a review of the state of our knowledge for monitoring and managing aphids and whitefly in SJV cotton. Our commitment to producing quality cotton free from contaminates will ensure our reputation into the future.

Support for this publication is provided by California Cotton Growers through their Cotton Incorporated State Support Program.

STICKY COTTON:
Frequently Asked Questions

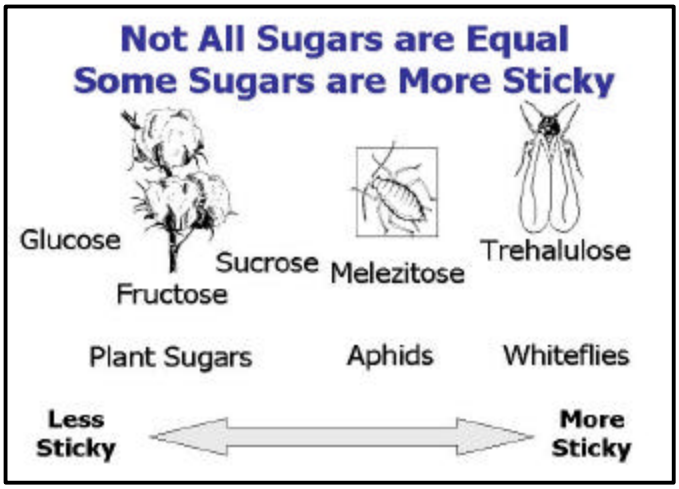
Peter B. Goodell, Larry D. Godfrey

Why should I be concerned about whitefly and aphid late in the season?

Whiteflies and aphids are the most important source of sugar contaminants on cotton lint. Allowing populations of these insects to build up, feed and deposit honeydew on exposed lint can result in cotton being rejected by merchants or mills. All the hard work in developing the plant and protecting the yield can be lost if the lint is not protected from honeydew.

Why do aphids and whitefly produce honeydew?

Whitefly and aphids feed directly in the phloem (food-conducting tissue) of plants. Phloem transports materials produced through photosynthesis and some other plant processes throughout the plant. These sucking insects tap into the plant's "plumbing", directly drawing out these materials. They pass most of the liquid out, after modifying the sugars and taking out nitrogen. The insect excrement is called honeydew, which drifts downward and deposits on the lint.



Are all sugar contaminants the same?

There are many sources of sugars, including natural plant sugars. Plant sugars usually cause a sticky problem when immature lint is subjected to freezing. Fructose, sucrose, and glucose are common plant sugars. Insects produce more complex sugars with different species producing distinctive sugars. Cotton aphid produces melezitose while trehalulose is associated with silverleaf whitefly. Sugars can vary in the stickiness problems they cause, with trehalulose causing worse problems in mills than other plant or insect sugars.

Can we detect different types of sugars?

Cotton lint is not routinely inspected for specific sugars. Stickiness can be a characteristic of contaminated lint that adheres to equipment, and relative problems are influenced by many factors including sugar type, quantity, and distribution, as well as ambient conditions, such as temperature and humidity. Testing equipment has been available for several years to detect sugar levels. The sticky cotton thermodetector or high-speed stickiness detector is designed to caramelize sugar on lint with the number of resulting specks counted. The number of specks is related to mini-card stickiness. The greater the number of specks, the stickier the cotton.

Generally a speck count of 10 or greater is a cause for concern. To distinguish individual sugars requires analytical chemistry facilities, and generally, these analyses are not currently being conducted.

Why can't sticky cotton be blended?

In some cases this is already being done by the mills but it takes time and should be unnecessary if we take a proactive approach. Some estimates suggest that it takes 29 clean bales to completely dilute the effects of 1 sticky bale. Thus, it doesn't take much sticky cotton to threaten the reputation of ginning area. Every grower must take responsibility to maintain the quality of their cotton and support each other in maintaining the quality reputation of the entire ginning community.

Where can I learn more about sticky cotton and its sources?

The cotton industry has developed a four-page pamphlet that provides much more detail entitled *Sticky Cotton Sources & Solutions.* This publication is available from local county extension offices or on the web at:

http://ag.arizona.edu/crops/cotton/insects/wf/stickycss.pdf.

SILVERLEAF WHITEFLY SAMPLING PLANS IN COTTON

Peter B. Goodell

Adult sampling plan[1] for decision making:

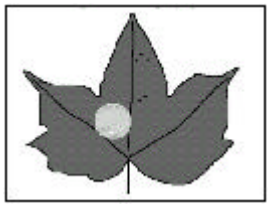
- Identify species (do not use these guidelines for control with greenhouse or banded wing whiteflies)
- Sample 30 leaves
- Sampling unit: 5th main stem leaf from the terminal
- Leaves should be turned to count the number of whitefly adults per leaf (keep shadow off the plant)
- Count only silverleaf whitefly, *Bemisia argentifolii*
- 3 adults per leaf equals an infested leaf
  (See chart below for how adult counts translate into infestation estimates)
- After sampling 30 leaves the percentage of infested leaves will be calculated:
  % infested = number of infested leaves times 100 divided by 30 (the number of leaves sampled)
- Thresholds:
  57% infested leaves equals 5 adults per leaf
  82% infested leaves equals 10 adults per leaf
- Field edges and centers may be treated as separate sampling units

Silverleaf Whitefly Adult Presence/Absence Counts and relationship to Infestation Estimates

Threshold (adults/leaf)	Infested Leaves*
1	14%
2	28%
3	39%
4	49%
5	**57%**
6	64%
7	70%
8	75%
9	79%
10	82%

Nymph sampling plan[2] for decision-making:

- Nymph counts are necessary for the proper use of Insect Growth Regulators (IGR's)
- Sample 30 leaves. Collect leaves at random
- Sampling unit: 5th main stem leaf from terminal
- Wedge the leaf disk between the central and left-side main veins. Leaf disk = size of quarter, or size of a large hand lens



- If any large nymphs present (3rd and 4th instars) within the leaf disk, score leaf as infested
- If 40% of leaves infested, this corresponds to 1 large nymph per leaf, the nymphal component of the threshold for IGR use is satisfied.

Nymph Presence/Absence

Threshold (nymphs/leaf)	Infested leaves
0.5	26%
1.0	**40%**
1.5	52%

General sampling rules:

- Sample greater than 50 feet from the field edge.
- Zig-zag through the field randomly selecting plants.
- Avoid sampling plants being sweep-sampled.
- For adults, sampling in the morning is suggested, , particularly in mid-summer.

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[1] *From: Univ. Arizona Guidelines (IPM Series No.2) Naranjo, Ellsworth, Diehl, Dennehy*

[2] *From: Univ. Arizona Guidelines (IPM Series No. 6) Naranjo, Ellsworth, Diehl.*

SILVERLEAF WHITEFLY MANAGEMENT STRATEGIES FOR SAN JOAQUIN VALLEY COTTON

Peter B. Goodell, Larry D. Godfrey

Selection of a management strategy requires assessment of crop growth stage and characteristics of the developing population of whiteflies. Proper sampling methods to assess whitefly nymph and adult populations are important, as the counts impact action thresholds and the choice of control materials.

The **Insect Growth Regulators (IGRs)** [1] are an integral component of whitefly management in the SJV. Some general properties of these materials are outlined below:

Knack - (pyriproxyfen)

- metamorphosis inhibitor, juvenoid
- activity @ pupation
- affects embryogenesis
- sterilization of adults
- translaminar activity (local movement into the leaf)
- 21 - 31 day residual

Courier – (buprofezin)

- chitin synthesis inhibitor
- activity @ each molt
- vapor phase activity
- 14 - 21 day residual

[1] NOTE: both materials act mainly on immature stages, therefore, nymphs should be present prior to treatment

SITUATION I:
INITIAL (INTERNAL) BUILDUP

Control Materials to Consider:
IGR's (KNACK & COURIER)

Action Threshold:
5 adults per leaf **AND** 1 nymph per leaf disk

Special Concerns:
IGR's do not provide quick knockdown, are most effective when all whitefly stages are present, and when populations are beginning to increase. Use only one application of each IGR per season (rotate to another if more than one IGR needed). Generally, these materials are slower acting, activity may take 7 days.

SITUATION II:
GRADUAL INVASION BY ADULTS [2]

Control Materials to Consider:
NON-PYRETHROIDS (Examples: Endosulfan, Ovasyn, Provado, Centric)

Action Thresholds:
5 Adults per leaf

Benefits of this Approach:
Some products are less disruptive to natural enemies. There will be some adult knockdown, and some control of other pests (lygus, aphids) with this approach

Special Concerns:
Limit the use of materials in any one pesticide class.

SITUATION III:
HEAVY MIGRATION (lint exposed)

Control Materials to Consider:
PYRETHROIDS + NON-PYRETHROIDS

Action Threshold:
5 adults per leaf

Benefits of this Approach:
Quick knockdown of adults, effective in controlling "hot spots" in fields

Special Concerns:
Early use of these materials significantly impacts natural enemies. Early use also may increase resistance and reduce effectiveness later in the season when protection of lint is a must.

[2] Whenever possible, ground applications of control materials are recommended

COTTON APHID MANAGEMENT RECOMMENDATIONS FOR THE SAN JOAQUIN VALLEY

Larry Godfrey, Peter B. Goodell

Cotton aphids have the potential to deposit significant amounts of honeydew on exposed lint and detrimentally influence lint quality. Aphid populations can develop rapidly, and conversely, population levels can decline over a few days under some conditions due to the actions of predators, parasites and some environmental factors. Therefore, effective sampling and frequent field monitoring are invaluable for aphid management.

Management Summary

- **Late-Season Threshold** (for minimizing stickiness) is 10-15 cotton aphids per leaf
- **Sample Unit** (where to sample on the plants?) 5th main stem node leaf (counting from the top of the plant with the uppermost leaf greater than or equal to 1inch diameter)
- **Sample Rules** – zigzag through field randomly selecting leaves; sample at least 4 areas per field
- **Estimate number of aphids on leaf** – Be sure to examine leaf closely for early instar aphids

Management Considerations

1. Alternate insecticide applications among materials from different classes
2. Anticipate higher aphid populations in fields with high levels of nitrogen, including residual carry over nitrogen in the soil from the previous crop
3. Expect more aphid problems on late-planted cotton, intensify field monitoring
4. Expect more aphid problems on Pima cotton, intensify field monitoring
5. Monitor fields closely for aphid populations ~14 days following applications of broad-spectrum insecticides such as pyrethroids.
6. Manage crop for earliness, terminate and harvest crop in a timely manner, limit regrowth
7. Slight rainfall (0.25") or overhead irrigation does help alleviate stickiness

Some Key Questions to Consider:

1. When do I move from the mid-season to late-season threshold?

A key point in an aphid management scheme is when one moves from a mid-season threshold of 50-75 aphids per leaf to the late-season threshold of 10-15 aphids per leaf. This switch should be done as soon as there is any exposed lint, when the first bolls begin to crack open

2. Do mid-season aphid populations guarantee I will have late-season aphids?

Aphid populations can be very erratic and changeable. For instance, in 2000, some of our plots had high July populations (up to 300 per leaf) but there were no aphids after boll opening. In 2001, July populations never exceeded 25 per leaf but aphid population densities increased in September. While there can be some general trends for a region, populations seem to vary field-to-field and certainly across years.

3. Will defoliation remove a problematic aphid population?

Effectively desiccating the crop and removing all leaves and preventing regrowth will largely prevent aphid build-up. However, given uncertainties of defoliation success and environmental conditions after harvest aid applications, one should not rely solely on these materials to eliminate insect populations. Bringing pests under threshold levels before defoliation is recommended.

4. How do I sample for aphids after defoliation?

Since the applicable leaf for sampling will be removed by the defoliant, examine any green tissue, especially plant terminals and any regrowth. Significant aphid populations can develop on very small amounts of tissue and produce quantities of honeydew that can result in sticky cotton..

OTHER RESOURCES ON WHITEFLY, APHID & STICKY COTTON *(in print or on the web)*

- Pest Management Guidelines www.ipm.ucdavis.edu
- Univ. ov CA Whitefly page www.uckac.edu/whitefly
- Sticky Cotton Sources&Solutions *(printed copies available from Pete Goodell or Farm Advisors) OR available on the web:* http://ag.arizona.edu/crops/cotton/insects/wf/stickycss.pdf
- Management of Silverleaf Whitefly (*printed copies available from Pete Goodell or Farm Advisors)*
- Insecticide Resistance Mgmt. Guide http://anrcatalog.ucdavis.edu/pdf/8033.pdf
- Arizona information http://ag.arizona.edu/crops/cotton/insects

SUMMARY OF INSECTICIDE MANAGEMENT GUIDELINES FOR SILVERLEAF WHITEFLY AND COTTON APHID

These guidelines are based on best experience for consistent control results during the past few years. Local conditions may vary and may affect control. Consult with qualified experts for best control experiences in your area, check and follow label instructions and check with the Agricultural Commissioner in your area before making applications.

Insecticide resistance management guidelines for cotton aphids. (Updated July, 2002)

Insecticide Class	Seedling Cotton	Squaring to Boll Crack [1]	Boll Opening to Harvest
Organophosphate	Dibrom, Metasystox-R [2], Thimet at planting	Metasystox-R(if not used previously) Or Lorsban [2] or Dibrom	Lorsban (if not used previously) In combination with Curacron Or other classes
Carbamate	Temik at planting	Temik [3] sidedress	Lannate / Furadan [5]
Chloronicotinyl	Gaucho Seed Treatment Provado	Provado (if not used previously) Centric Assail	Centric (if not used previously) Assail (if not used previously)
Organochlorine	Endosulfan [2, 4]	Endosulfan [2, 4] (if not used previously)	Endosulfan [2, 4] (if not used previously)
Amidene		Ovasyn [2]	

[1] Tank mixes of insecticides from two different classes may improve aphid control and may help control other arthropod pests that may be present during this period.
[2] Applicable for lower aphid densities and ground application, consider tank mixes with Provado for high densities or for aerial application
[3] If a significant aphid population is present, a foliar insecticide may also be required during the period when Temik is being activated
[4] There are several products available and restrictions may be different between them. Check th)e label and contact Agricultural Commissioner if uncertain about any local restrictions.
[5] Section 18 applied for as in prior years and may be approved for late July use. Check with Agricultural Commissioner for status of use.

Insecticide resistance management guidelines for silverleaf whitefly. (Updated July, 2002)

Chemical Class	Initial Buildup	Gradual Invasion	Exposed Lint [2]
Insect growth regulator [1]			
Chitin synthesis inhibitor	Courier		
Metamorphosis inhibitor	Knack		
Chloronicotinyl		Centric, Assail	
Organochlorines		Endosulfan [3]	Endosulfan [3]
Amidene		Ovasyn [4]	
Pyrethroid			Capture
Pyrethroid + organochlorine			Pyrethroid + Endosulfan
Pyrethroid + organophosphate / carbamate			Danitol+Orthene or Curacron or Vydate or Lannate

Notes: Read and follow the label when using any insecticide.
[1] Use one type of IGR only once during the season
[2] Late season heavy migrations options depend upon the length of control desired and previous insecticide use. Tank mixes maybe required in many areas to adequately protect lint.
[3] There are several products available and restrictions may be different between them. Check the label and contact Agricultural Commissioner if uncertain about any local restrictions
[4] For use in tank mix depending on pest complex present

LATE-SEASON AGRONOMIC PRACTICE CONSIDERATIONS

Bob Hutmacher

Making decisions on late-season crop management requires trips to the field for objective evaluations of the condition of the crop, and a realistic assessment of potential for additional late fruiting cycle bolls and their relative contribution to yield. This information then needs to be balanced against the risks and input costs associated with delays in readiness of the crop for harvest (more irrigation, potential for higher harvest aid and pest control costs, and damage to crop quality). This type of analysis is even more critical in light of low commodity prices, high input costs, and concerns regarding how to avoid late-season conditions that could lead to sticky cotton.

Decisions On the Last Bloom Date To Try To Carry To Maturity. Depending on type of cotton and varietal differences in boll characteristics, late-season blooms require about 750 to 850 or more heat units (DD60) to mature to harvestable bolls (see article in June, 2002 CA Cotton Review mentioned on this page). It is important to keep this heat unit requirement in mind, along with the fact that daily heat units typically change fairly quickly as weather cools during the final boll maturation periods of August through October.

As an example, using long-term averages for heat unit accumulations at Shafter, Kern County, blooms from dates shown on the table below would require the time shown to accumulate 850 heat units & mature and crack open a late-season boll:

Bloom date of last bloom to carry out to maturity	Estimated date at which 850 DD_{60} accumulated (boll matures, could open)
8 / 01	9 / 26
8 / 08	10 / 07
8 / 16	10 / 24
8 / 24	11 / 12

Heat unit accumulations typically are lower as you go further north in the SJV, requiring more days to mature and open bolls. The decision to try for higher yields by going for those mid- and late-August blooms can significantly increase your exposure to late-season pests and extra management costs.

UCCE Farm Advisors and Specialists have recently provided (in the *California Cotton Review)* some fairly detailed discussions, with examples, regarding ways to estimate:

- **Final Irrigation Decisions** (in: *California Cotton Review*, Vol. 60, August, 2001)
- **Time and Heat Unit Requirements to Mature Bolls** (*California Cotton Review*, Vol.63, June, 2002)

These articles can be accessed on the University of CA cotton web site: http://cottoninfo.ucdavis.edu or you can contact your county UCCE Farm Advisor for a copy**.**

Counting Bolls for a Relative Assessment of "Top Crop" Potential. Although counting bolls is not always a good way to get a solid yield estimate, it can be useful to estimate whether or not a top crop can contribute significantly to yield. Although bolls vary in size with position on the plant and environmental conditions, particularly late-season, you can roughly translate boll counts to yield using the following:

Type of Cotton	average # bolls per foot equal to about 1 bale/acre 30" row spacing	40" row spacing
Acala	8.5 (7 to 10.5) *	11 (9 to 13.5)
Pima	21 (18 to 24)	28 (25 to 31)

* average shown (range of values shown in parentheses)

Using the above table, for example: If the late "top crop" is about 3 late-season bolls per foot in 40" row spacing Acala, this would equal about an extra 0.27 bales (3 bolls per foot divided by the 11 bolls needed per foot to equal 1 bale/acre.

What plant & cultural factors can have the most impact ? Soil and plant factors that can impact late-season vigor, attractiveness of cotton to late-season pests, and potential for leaf regrowth following harvest aid applications include:

- High soil and plant water status and nitrogen levels (encourages added node & fruiting site development, can keep plants more attractive to pests)
- Higher node for the first fruiting branch (tends to delay maturity, increases vigor of vegetative growth)
- Greater than usual number of vegetative branches (bolls develop and mature later on these branches)

Harvest aid application decisions also can have important impacts on efficacy and speed of leaf desiccation and abscission, and on the potential for development of regrowth that can support insect pests while maturing lint is exposed. Based on last year's experiences, if high pest populations are present near defoliation time, it may not be enough to just defoliate the crop to control aphids and whiteflies, as leaf abscission and regrowth control both take time.

COTTON FIELD DAYS / CONSERVATION TILLAGE FIELD DAY— 2002

September 17 SHAFTER REC FIELD DAY *(contact Brian Marsh for details—phone number on back of newsletter)*

September 19 WEST SIDE REC COTTON FIELD DAY / held this year in combination with CONSERVATION TILLAGE FIELD DAY *(contact Dan Munk or Jeff Mitchell for details)*