

Whitefly

Silverleaf whitefly (SLW) or B biotype – *Bemisia tabaci*

SLW is a major pest due to contamination of cotton lint by honeydew and resistance to many insecticides. Greenhouse whitefly (*Trialeurodes vaporariorum*) and Australian Native whitefly (*Bemisia tabaci*) are present in cotton but not considered pests, as their honeydew secretions do not cause problems for textile processing, and they are both susceptible to many of the insecticides used to control other pests.

Damage symptoms

SLW adults and nymphs cause contamination of lint through their excretion of honeydew. Silverleaf whitefly honeydew is considered to be worse than aphid honeydew because the main sugar in SLW honeydew, trehalulose, has a lower melting point and during the processing stage, can cause machinery to gum up and overheat.

Sampling

Sample for Species and Population.

Species: Verify which whitefly species are present before implementing any management strategies. Species composition may change rapidly during the season due to factors such as insecticide applications and climate. If large increases in population occur, this probably indicates the predominance of SLW. Consider insecticide application history for the crop as a clue to species composition.

Greenhouse whitefly can be visually differentiated from *Bemisia tabaci* by comparing their wing shape in adults and the presence/absence of hairs on the nymphs (see photographs this page).

The different biotypes of *Bemisia tabaci* cannot be distinguished by eye. While other biotypes of *Bemisia tabaci* such as Q-biotype haven't been detected in widespread monitoring of Australian cotton, it is important to continue to check for their presence. A molecular test is needed. This test and the industry's resistance monitoring program are being conducted by entomology staff at Qld DAFF, Toowoomba.

Collect a minimum of 50 4th instar whitefly from cotton leaves across the whole sampling area (i.e. do not collect nymphs from only 1 or 2 leaves).

Population: Once you have confirmed the presence of SLW, effective sampling is the key to successful management.



Note the gap between wings for SLW (left) compared with overlapping wings for Greenhouse whitefly (right). (Richard Lloyd, Qld DAFF)



Note absence of hairs on SLW nymph (left) compared to presence on Greenhouse whitefly (right). (Richard Lloyd, Qld DAFF)

Frequency

Sampling should commence at flowering and occur twice weekly from peak flowering (1300 Day Degrees).

1. Define your management unit

- A management unit can be a whole field or part of a field – no larger than 25 ha.
- Each management unit should have a minimum of 2 sampling sites.
- Sample 10 leaves/site (20 leaves/management unit).

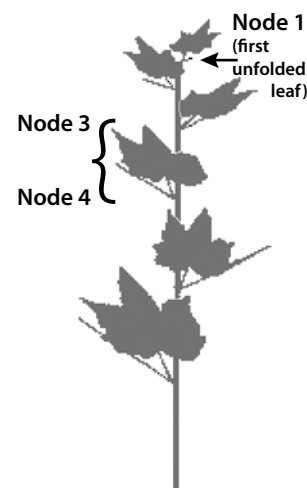
2. Choose a plant to sample

- Move at least 10 m into the field before choosing a plant to sample.
- Choose healthy plants at random, avoiding plants disturbed by sweep sampling.
- Take only one leaf from each plant.
- Sample along a diagonal or zigzag line. Move over several rows, taking 5–10 steps before selecting a new plant.

3. Choose a leaf

- From each plant choose a mainstem leaf from either the 3rd, 4th or preferably the 5th node below the terminal of the plant, as shown in the diagram.

Estimate Whitefly Abundance



Adults

Binomial sampling (presence/absence) is highly recommended as it is less prone to bias than averaging the number of whitefly/leaf.

Score leaves with 2 or more whitefly adults as 'infested'. Score leaves with 0 or 1 whitefly adults as 'uninfested'.

Calculate the percentage of infested leaves.

Nymphs

- Nymph abundance is not used in the Threshold Matrix. Use it as supporting information only.
- The presence of large nymphs on leaves at 6, 7 and 8 nodes below the plant terminal validate the assumptions about SLW population dynamics that underpin the spray thresholds. As leaves are assessed for SLW, they can be picked and used to monitor populations of aphids and mites.

Thresholds

For SLW, there are separate thresholds for early season suppression, control and for knockdown late in the season. Thresholds are based on rates of population increase relative to the accumulation of day degrees and crop development. A Threshold Matrix has been developed to assist in the interpretation of population monitoring data. Frequent population monitoring is essential in order to use the Threshold Matrix effectively (see page 29).

The SLW threshold matrix is designed to manage a population that builds gradually in the crop and hence follows a predictable growth trajectory. Large populations of adult silverleaf whitefly migrating into cotton crops will therefore reduce the reliability of the threshold matrix. This can occur if SLW adults leave crops that have been defoliated and seek new hosts. Decisions for management need to consider time of season, time to defoliation and evidence of honeydew. If the crop is maturing early in warmer conditions that the chance that eggs laid by immigrating whitefly will develop into nymph populations that could contaminate lint is high, where as if the crop is maturing later, when it is cooler this is less likely. Similarly, the closer to defoliation that the influx occurs the lower risk that a nymph population will have time to develop. Finally, honeydew on leaves is a good indicator of potential lint contamination. Once there is significant honeydew on lower leaves some remedial action should be taken to prevent contamination of bolls. In the worst case scenario, where cotton lint has been contaminated with honeydew, delaying harvest may assist in breaking down honeydew or expose the crop to rainfall that will remove most of the honeydew. However, if conditions remain dry reduction in the amount of honeydew on bolls will be slow, and there is a risk that contaminated cotton may still have sufficient honeydew to result in substantial penalties if harvested.



Parasitised SLW nymph. (Zara Hall, formerly Qld DAFF)

LATE SEASON SLW MASS IMMIGRATION SCENARIO DECISION CASE STUDY

Crop with low or no SLW experiences a mass immigration of SLW adults	>3 wks till leaf drop	Eggs may have time to develop to nymphs that could produce honeydew	Little or no honeydew on leaves in lower canopy	Monitor
	<2 weeks till leaf drop	Too little time for nymph population to develop so manage adults.	Heavily speckled leaves in lower canopy	Control (Admiral® or Movento®)
			Little or no honeydew on leaves in lower canopy	Monitor
			Heavily speckled leaves in lower canopy	Knockdown &/or defoliate early &/or delay picking if bolls contaminated

Key beneficial insects

Several species of whitefly parasitoids and parasites have been observed in Australia including several species of *Encarsia* and *Eretmocerus*. Predators of nymphs include big-eyed bugs, pirate bugs, lacewing larvae and ladybeetles.

Species verification and resistance monitoring

Sending collections to Qld DAFF Toowoomba

Pack the leaves in a paper bag and then inside a plastic bag. Pack this in an esky with an ice brick that has been wrapped in newspaper. Send by overnight courier to;

Richard Lloyd
Qld DAFF
203 Tor Street, Toowoomba QLD 4350
Phone (07) 4688 1315

Ensure samples are clearly labelled and include the following information:

Collector's Name

Phone No.

Farm Name

Fax No.

Email address.....

Field Postcode

Region (e.g. Gwydir).....

Date of collection /..... /.....

Comments

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Selecting an insecticide

Natural enemies can play a vital role in the successful management of whitefly. Avoid early season use of broad spectrum insecticides, particularly synthetic pyrethroids and organophosphates. Currently there are few products registered for the control of whitefly in cotton in Australia. The SLW threshold matrix identifies the optimum strategic times for use of these limited products.

Resistance profile – SLW

When silverleaf whitefly was first identified in Australia in 1994 it already possessed resistance to many older insecticide groups. Four products all with different modes of action are currently registered for control of SLW in cotton. Refer to the SLW Threshold Matrix, page 29, for industry recommendations on the best way to utilise these products with the lowest risk of developing resistance. The SLW Threshold Matrix is designed to minimise the need to intervene with chemical control as well as to delay the development of resistance. Currently there are low levels of resistance to Admiral and Bifenthrin and no resistance to Pegasus and Movento. Compliance with the IRMS will ensure the limited products available for SLW control will remain efficacious into the future. To delay the development of resistance, ENSURE ONLY A SINGLE APPLICATION OF ADMIRAL OCCURS WITHIN A SEASON.

WIDESPREAD, HIGH LEVELS OF RESISTANCE	WIDESPREAD, LOW/MOD LEVELS OF RESISTANCE
pyrethroids (SP)	Insect Growth Regulators (IGRs)
CROSS RESISTANCE	
There is cross-resistance between other pyrethroids and Bifenthrin.	

Overwintering habit

Whitefly does not have an overwintering diapause stage. It relies on alternative host plants to survive. Generation times are temperature dependent, slowing down during winter months. From Biloela north, the winter generation time is 80 days, while in the Macintyre, Gwydir and Namoi valleys, generation time increases to 120 days.

Alternative hosts

The availability of a continuous source of hosts is the major contributing factor to a severe whitefly problem. Even a small area of a favoured host can maintain a significant whitefly population.

Preferred weed hosts include; sow thistle, melons, bladder ketmia, native rosella, rhynchosia, vines (cow, bell and potato), rattlepod, native jute, burr gerkin and other Cucurbitaceae weeds, Josephine burr, young volunteer sunflowers, Euphorbia weeds, poinsettia and volunteer cotton.

In cotton growing areas the important alternative crop hosts are soybeans, sunflowers and all cucurbit crops. Spring plantings of these crops may provide a haven for SLW populations to build up in and then move into cotton. Autumn plantings of these crops may be affected by large populations moving out of cotton. Do not plant cotton near good SLW host crops such as melons. Destroy crop residue from all susceptible crops immediately after harvest.

Minimising winter hosts, particularly sowthistle, is important in reducing the base population at the start of the cotton season. Smaller base populations will take longer to reach outbreak levels and reduce the likelihood that a particular field will need to be treated.

Further Information:

Qld DAFF, Toowoomba

Jamie Hopkinson: 07 4688 1152.

Richard Lloyd: (07) 4688 1315.

Paul Grundy: (07) 4688 1533 or 0427 929 172

Qld DAFF, Emerald

Richard Sequeria: (07) 4983 7410 or 0407 059 066.



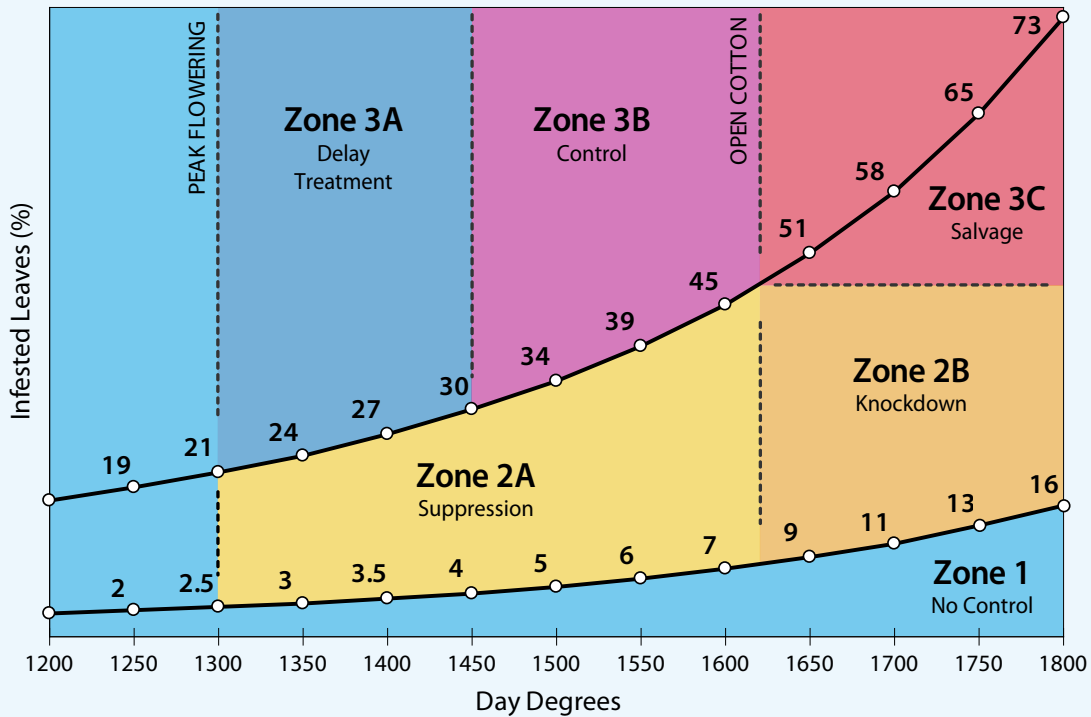
Silverleaf Whitefly Threshold tool on www.cottassist.com.au

TABLE 9: Control of silverleaf whitefly

Active ingredient	Concentration and formulation	Application rate of product	Comments
Silverleaf whitefly <i>Bemisia tabaci</i> B-biotype			
Bifenthrin	100 g/L EC 250 g/L EC	0.8 L/ha 0.32 L/ha	The adult stage should be targeted. Do not spray crops with a high population of the juvenile stages. Thorough coverage of the crop canopy is essential. Do not apply more than 2 applications per crop.#
Diafenthiuron	500 g/L SC	0.6 or 0.8 L/ha	Apply when population densities are 10–20% leaves infested. Suppression may not be satisfactory once population densities exceed 25% infestation, or when high numbers of adults are invading from nearby fields.#
Paraffinic oil	792 g/L SC	2% V/V (min 2L per sprayed ha)	Most effective when targetting low, early season populations. Apply in a minimum of 100 litres per hectare for ground applications. Multiple applications are more effective.
Pyriproxyfen	100 g/L EC	0.5 L/ha	Ensure thorough coverage. Apply when industry recommended thresholds are exceeded. If a second spray is required observe a two week retreatment interval. DO NOT apply more than twice in one season.
Spirotetramat	240g/L SC	0.3–0.4L/ha + Hasten Spray Adjuvant 1.0L/ha	Use the higher rate when periods of high pest pressure or rapid crop growth are evident, and when crops are well advanced. Do not re-apply within 14 days. Do not apply more than 2 applications per crop. Spirotetramat may not control silverleaf whitefly adults and eggs, however a decline in the total silverleaf whitefly population will occur over time as the juvenile stages are controlled.

#See label for instructions to minimise impact on bees.

SLW THRESHOLD MATRIX



NOTES

Sampling protocol	Sample 20 leaves 3rd, 4th or 5th node below the terminal/25 ha weekly from first flower (777 DD) and twice weekly from peak flowering (1300 DD). Convert to % Infested leaves. Infested leaves are those with 2 or more adults. Uninfested leaves are those with 0 or 1 adult.
Day Degrees	Daily Day Degrees (DD) are calculated using the formula; $DD = [(Max\ ^\circ C - 12) + (Min\ ^\circ C - 12)] \div 2$ For day degree information from your nearest SILO weather station visit www.cottassist.com.au For a mid-September planting in Emerald, long term average weather data predicts the duration of Zone 3A is 9 days, Zone 3B is 11 days and Zone 3C is 14 days.
Zone 1 No Control	Insecticide use is not warranted for fields with low SLW densities. In this zone the risk of yield loss or lint contamination is negligible, even when populations are sustained throughout flowering and boll fill.
Zone 2A Suppression	This Zone represents a wide window of opportunity for the most economic and low-risk control of SLW. Conventional (non-IGR) insecticides, such as diafenthiuron (Pegasus), can control or provide useful suppression of low-medium density populations. Movento can control a wide range of nymphal population densities.
Zone 2B Knockdown	Lint contamination can result from uncontrolled medium density populations in-crops with open bolls. Early action in Zone 2A can prevent the need for higher-risk remedial action in Zone 2B. Pegasus may be effective for remedial control (knockdown) of population densities up to 45% infested leaves in Zone 2B. (NOTE: The Pegasus label indicates that the product may not give satisfactory control of populations >25% infested leaves. This is based on an overseas sampling model. For Australian conditions this equates to ~45% infested leaves). Efficacy will depend upon coverage and environmental conditions. For higher densities approaching the Zone's upper boundary, an application of Zone 3B products may ultimately be required.
Zone 3A Delay Treatment	Controlling high density populations before 1450 DD is not recommended due to the likely resurgence of the population and need for additional control to protect lint from honeydew. Delay control until Zone 3B.
Zone 3B Control	Where populations are mid to high density, targeting an application when the crop is between 1450 and 1650 DD, (allowing the product to be come active prior to the onset of boll opening), greatly reduces the risk of lint contamination and the need for further controls. IGR products such as pryiproxfifen, trade name Admiral, and non-IGR products such as Spirotetramat (trade name Movento), are effective in this zone. ENSURE ONLY A SINGLE APPLICATION OF ADMIRAL OCCURS WITHIN A SEASON. Delaying IGR use beyond 50% infested leaves or 1650 DD can result in yield loss, lower efficacy of the IGR and significant lint contamination. Do not apply more than 2 applications of Movento within a season. Use the higher rate when periods of high pest pressure or rapid crop growth are evident, when longer residual control is desired or when crops are well advanced.
Zone 3C Salvage	Once the populations exceeds 50% leaves infested, the use of an IGR by itself is unlikely to prevent lint contamination due to the inherent time delay in population decline following application. Rapid knockdown of the population using a conventional insecticide is required before applying the IGR (or similar). The lack of insecticides offering robust knockdown of SLW at high densities make this a 'high risk' zone.

Check the APVMA website for other control options that may become available in cotton under permit – www.apvma.gov.au