

# Cotton insects

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## Strategies to manage aphids in cotton

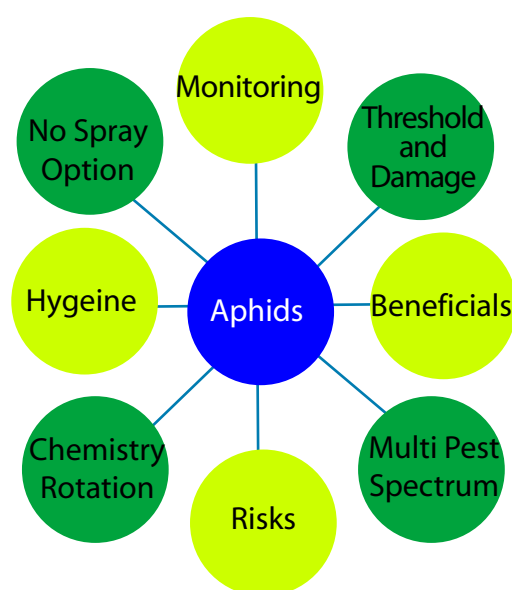
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Aphids, once a secondary pest in cotton are now a major problem for growers in some regions. Problems associated with aphid in Australian cotton include vectoring of cotton bunchy top disease if present in the crop, yield reductions from uncontrolled early season infestations and late season effects of honeydew on fibre quality.

### Principles

1. Overwintering hosts
2. Varietal selection
3. Sowing
4. Sampling and thresholds
5. Predators
6. Rotation

### Aphid Management



### Introduction

This is a companion document to “Aphid Ecology in Cotton” available from the Cotton CRC web site.

### Aphid life cycle and resistance

Resistance management for aphids is different to that for other pests that reproduce sexually. There is no mating of susceptible aphids with resistant aphids to dilute the resistance in a population as is the case with *Helicoverpa*.

Aphid populations in a region will consist of a number of different clones. These clones will appear identical but as there is no sexual reproduction the clones are essentially

separate sub-populations. Different clones may display differences in biological features, for instance a degree of specialisation toward a particular type of host plant. They can also vary in their resistance to insecticides.

When aphids are treated with an insecticide (aphicide) the aphids of resistant clones survive and those of susceptible clones die. This leaves a population that is highly resistant which can continue to develop rapidly in the field. Due to the clonal nature of aphid populations, one field can have resistant aphids while the adjacent field can have susceptible aphids.

It is likely that there are a range of resistant and susceptible clones in a region. Normally when resistance develops in an insect population there is some penalty in growth or reproduction in that population. In the absence of insecticide selection the resistant individuals are not favoured, though this is not always the case. Recent studies with resistance strains of cotton aphid have found no evidence of a fitness penalty.



Cotton Catchment Communities CRC

## Insecticide resistance in aphids in cotton

### Cotton aphid

Cotton aphids are collected from cotton regions and tested for resistance to insecticides each year. Collections have found aphids resistant to organophosphates, some carbamates, endosulfan and pyrethroids. The most common resistance is to the carbamate pirimicarb, and this also confers cross resistance to dimethoate and omethoate, both older organophosphates (OPs).

This means that if a dimethoate (OP) spray fails then a pirimicarb spray will also fail. This resistance is patchy within regions and inconsistent between years. In fact resistance can vary between fields within a farm and within a single field through the season. Aphid clones resistant to pirimicarb are not necessarily resistant to all other carbamates, and they are not resistant to aldicarb, which is sometimes used at planting. There is also moderate resistance in some populations to other OPs such as profenofos and chlorpyrifos methyl, though this is a different mechanism to the resistance to dimethoate/omethoate. Aphid strains have also been collected that are resistant to pyrethroids and endosulfan, but fortunately these are rare.

### Green peach aphid

This species is widely resistant to dimethoate / omethoate, profenofos and pirimicarb. However, resistance levels are generally fairly low in comparison to resistant cotton aphid clones. These insecticides may provide adequate control of green peach aphids where they will not control resistant cotton aphid. It is therefore important to distinguish between cotton aphid and green

peach aphid in the field (See Aphid Ecology in Cotton information sheet for identification diagram).

### Strategies to manage aphids

Aphids, cotton aphid in particular, are emerging as a difficult pest to manage due to resistance and their potential as a vector of Cotton Bunchy Top disease (CBT). In the light of these issues, aphid management needs to be reviewed to ensure that sensible thresholds are used and that the efficacy of aphicides is maintained.

There are no silver bullets for managing aphids, instead a number of integrated control tactics are recommended to help reduce aphid numbers and manage resistance.

To reduce the use of expensive chemistry and to prevent flaring of secondary pests, management will need to encompass an awareness of resistant populations, chemistry choice and rotation, crop hygiene and controlling overwintering hosts.

### Control of winter aphid hosts

Aphids are able to overwinter on a number of other host crops and weeds. There is a risk that resistant clones could use these hosts to persist on farm through winter. Farm gardens can also provide habitat and host plants when conditions are dry. Growers and consultants should aim to reduce the availability of on-farm hosts over winter. Cotton regrowth and volunteer cotton, in particular, pose a high risk as they are both an overwinter aphid host and a reservoir for CBT.

This may be a particular issue if there is germination of cotton seed from fallen seed-cotton or regrowth on cotton stubs.

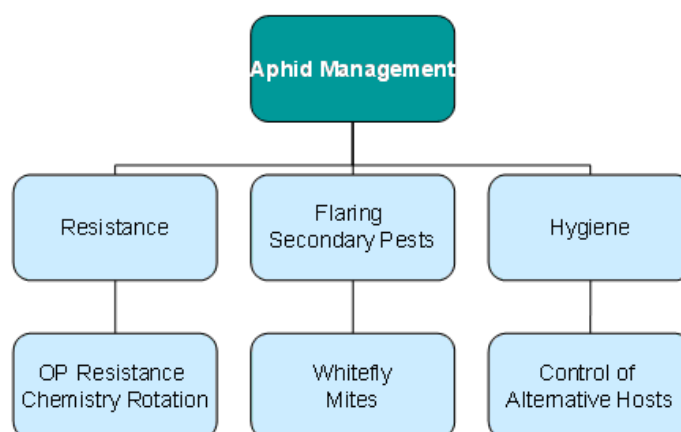
Winter growing crops of woolly pod vetch, canola, and lucerne will not support cotton aphid and lupins and faba beans usually support cotton aphid poorly. Be wary if these crops are infested

with cotton aphid hosts such as weeds or volunteer cotton.

If farm hygiene is adequate through winter it is possible that localised aphid survival will be low and that immigrant colonising aphid clones will be susceptible in the following year. Where resistance problems have occurred in the previous season consider planting a 'non-host' rotation crop, such as a winter cereal. Control of weeds, cotton stubble and cotton volunteers between seasons is also critical.

Seasonal conditions during winter will also effect host numbers. Higher aphid pressures early in the season could be expected following a moist warm winter that allows extensive growth of alternative hosts.

## Key Considerations



It is important to manage aphids within an integrated pest management (IPM) system that takes into account the whole year (see IPM Guidelines & Useful documents and links - at the end of this document).

Decision making in aphid management is critical to maintaining that predator/prey balance in the field. More often than not it may prove more cost effective to take the NO spray approach or use a selective insecticide. This strategy will help to maintain beneficial populations that will help to control other pests.

### Key considerations in aphid management

### Alternative Hosts

Cotton aphid has a broad host range and has been recorded on members of the following families .

**Fabaceae** (legumes, lucerne<sup>+</sup>, medic),

**Solanaceous** weeds (datura, ground cherry, nightshades),

**Cucurbitaceae** (paddy melon),

**Malvaceae** (bladder ketmia, marshmallow - an alternative host for the Cotton Bunchy Top Disease),

**Asteraceae** (sunflower, capeweed, daisies, thistles, bathurst burr).

(<sup>+</sup>survive not thrive )

### Varietal resistance

None of the current commercial varieties show resistance to aphids.

### Seed treatment or 'at planting' insecticide

This strategy may help prevent the early build up of aphid populations, therefore reducing the need for foliar aphicides which may disrupt beneficial populations. It may also reduce the risk of CBT for farmers who have concerns about this disease. However, care must be taken in selecting later insecticide sprays as some seed treatments and 'at planting' insecticides are from the same groups as foliar sprays used for aphid control and there is the potential for prolonged selection with one insecticide group. Check the insecticide label to see that the first foliar insecticide is not the same group as the at-planting insecticide or seed treatment (see Table 1).

Insecticides used to control other pests may also select for resistance in sub-threshold aphid populations. This may then render those products ineffective for aphid control later in the season. This is a particular risk with dimethoate



Picture 1: Marshmallow, *Malva parviflora*, one of a large number of weed species on which cotton aphid can overwinter. this species is also an alternative host for Cotton Bunchy Top Disease Photo WEEDpak

/omethoate being used to control mirids.

### Beneficials.

A range of parasitoids and predators will help to reduce aphid survival. Predators of aphids include; lady beetle larvae, damsel bugs, big-eyed bugs, and the larvae of green lacewings and hoverflies. Wasp parasites *Aphidius colemani* and *Lysiphlebus testaceipes* can mummify and kill aphids (mummified aphids appear as bloated pale brown aphids which do not move).

Beneficials can be very important in keeping aphid populations under control when aphid densities are low. Disruption of these beneficials with a broad spectrum insecticide releases aphid populations from this important source of mortality and populations can increase very quickly.

Once aphid populations begin to increase rapidly it is the more specific beneficials that will eventually control them,



Picture 2: Hoverfly Larvae feeding on cotton aphid

such as ladybeetles, hoverfly larvae and the parasitoids. However, aphids may have already caused economic damage before the beneficials bring them under control, especially if the crop is sprayed with further disruptive insecticides. Those insecticides with the greatest risk are those that are more disruptive of beneficials and have poor efficacy against aphids (Table 3).

The risk of adverse effects of drift of insecticides

applied to nearby cotton on beneficial populations should be taken into account.

Selection of insecticides should



Ladybird Larva. Photos C. Mares (CSIRO)

Picture 3: Ladybird larvae- effective aphid predators of aphid

consider both the target pest and the type of beneficials that are present. For example, an insecticide can have little effect on one beneficial group, such as spiders, yet be disruptive to another, such as predatory beetles (See IPM section, Table 3 of the Cotton Pest Management Guide for a complete list).

### Sampling

Aphid sampling should begin from seedling emergence and be done at least weekly. Aphids generally prefer younger growth so sample the 4th or 5th mainstem leaf below the terminal. This leaf can also be used for mites and whitefly sampling. Aphids have winged and non-winged forms. Score a plant as infested only if non-winged forms are present (winged forms could be non-economic species that are just test feeding before moving on to another host). If a high proportion of plants do have winged forms



then re sample within a few days to check if they have settled and produced young. If reproducing aphids are found it is important to confirm the species (See Aphid Ecology Document), as green peach aphid causes more severe damage than cotton aphid and has a different resistance spectrum.

At the same time as sampling for pests, sample the crop for beneficial insects. See the IPM Guidelines booklet - Sampling beneficial insects and spiders or the Cotton CRC web site, for further details of aphid and beneficial sampling.

### Thresholds.

Australian research has shown that if aphid population are allowed to develop to high levels (>90% plants infested) for an extended period (e.g. 2-3 weeks) then significant loss of yield can occur.

The sampling scoring & conversion system explained on page 5 allows an estimate to be made of yield loss caused by early infestations. This can be compared to cotton price and control option costs to determine if a spray is required.

The system requires that regular samples are taken, averaged and converted to an aphid score and recorded with the sample date.

Table 1a can be used to calculate the Seasonal Aphid Score for each individual check. This score is accumulated as the season progresses.

The seasonal aphid score is added to the accumulation of seasonal aphid scores and compared to the amount of time remaining to 60% open cotton in Table 1b to estimate the yield loss that aphids have caused.

Once cotton has open bolls, the threshold should be changed to 50% of plants infested with aphids or 10% of plants infested if honeydew is present to prevent contamination of lint.

Record keeping and calculation of these Scores can be simplified by using the Aphid Yield Loss Estimator in CottASSIST on the web. The Tool allows users to keep records for multiple crops

on multiple farms throughout the season. After initial set up, the user enters the Average Aphid Score from Step 2 and the date of each check.

The Tool then calculates the Scores and tracks the estimate of yield loss. Find CottASSIST on the 'Industry' home page on the Cotton CRC website.

### Managing aphids and CBT disease

Should managers manage aphids for yield loss or disease transmission? In the past spraying aphids at very low thresholds to prevent disease transmission resulted in rapid selection of aphids for resistance to key control options. Our research shows that the rate of spread of CBT in fields is generally slow, so growers can primarily manage aphids to avoid yield loss from feeding rather than to prevent them spreading disease.



Picture 4: Aphid colony showing brown bloated parasitised mummies (Photo Peter)

The risk from CBT is generally low, for three reasons;

- (1) CBT is poorly transmitted. If just one CBT-infected aphid colonizes a plant, the transmission rate is about 5% (e.g 1 in 20 plants become infected). Three or more infected aphids per plant pushes this to ~40%, but higher levels require even more infected aphids.
- (2) When a CBT-infected aphid feeds on a cotton plant, transmission of the disease from the aphid to the plant will happen within half an hour. A latent period then passes while the number of disease particles in the plant gradually builds. During this

time (at least 10–14 days) young aphids produced by the infected female can feed on the newly infected plant but not pick up the disease. If they move to nearby plants and start new colonies they do not carry the disease. Eventually the number of disease particles is high enough and young aphids may pick up CBT from the original plant, but if they move to, feed on and infect a nearby plant there will again be a latent period in that plant.

- (3) After a female aphid settles on a plant she will produce wingless aphids. Hence movement between plants is only by crawling and fairly slow. This only changes at high aphid densities when crowding stimulates production of winged forms which can disperse further.

The combination of low transmission rates, especially when only 1 aphid colonizes a plant, the latent period and the fact that at low to moderate population densities aphids spread from plant to plant by walking means that the rate of infection and spread of CBT across fields is very slow. Furthermore, if beneficial populations are conserved they will tend to find and control aphid hotspots, so even if some plants are infected the spread is halted. If winters are fairly dry there are few hosts for aphids and populations will be small, as has occurred in recent years. In such situations the main hosts for CBT and aphids are on-farm and management of weeds and cotton ratoons, which are reservoirs for CBT, will have a big impact.

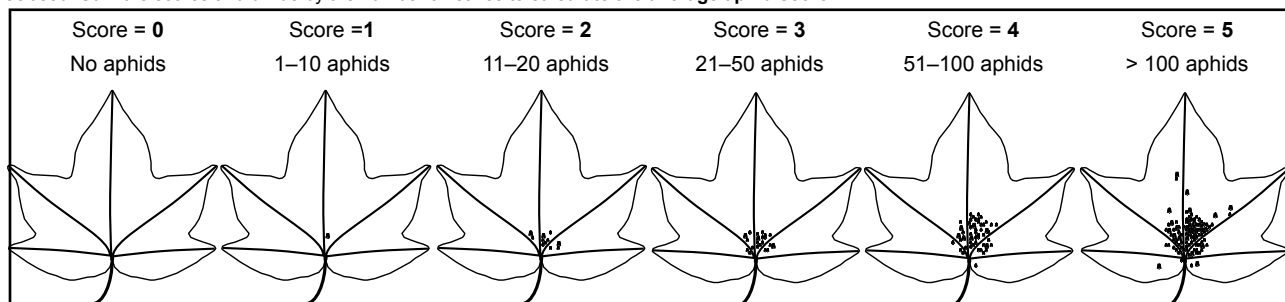
Higher risk situations are when there are many sources of the disease and aphids nearby or within the field (especially ratoon cotton), following wetter winters. Poor management of aphids after they have entered the crop can encourage a rapid increase in populations and development of winged forms which disperse across the field and spread the disease. For instance, attempting to control aphids with an insecticide to which they are resistant and

**STEP 1. COLLECT LEAVES.**

Fields should be sampled in several locations as aphids tend to be patchy in distribution. At each location collect 20 leaves, taking only one leaf per plant. Choose main stem leaves from 3–4 nodes below the terminal. The same leaves can be used for mite scoring.

**STEP 2. SCORE LEAVES.**

Score each leaf as either 0, 1, 2, 3, 4 or 5 based on the number of non-winged aphids on the leaf. As a guide, the diagrams below represent the population range for each score (After counting aphids a few times, you will quickly gain confidence in estimating abundance). Discount pale brown bloated aphids as these are parasitised. Sum the scores and divide by the number of leaves to **calculate the average aphid score**.

**STEP 3. CONVERT TO A SEASON APHID SCORE. Table 1a**

In order to estimate yield loss, the Average Aphid Score must firstly be transformed into a Sample Aphid Score and then into a Cumulative Season Aphid Score. Use the Look Up Table below to firstly convert the Average Aphid Score calculated in Step 2 to a Sample Aphid Score. This step accounts for the length of time the observed aphids have been present in the crop. If aphids are found in the first assessment of the season, assume the 'Score last check' was '0' and that it occurred 5 days ago. Find the value in the table where 'this check' and the 'last check' intersect. **Multiply this value by the number of days that have lapsed between checks.** This value is the Sample Aphid Score. As the season progresses, add this check's Sample Aphid Score to the previous value to give the Cumulative Season Aphid Score. When aphids are sprayed, or, if during the season the Average Aphid Scores return to '0' in 2 consecutive checks, reset the Cumulative Season Aphid Score to '0'. Disappearance of aphids can occur for reasons such as predation by beneficials, changes in the weather and insecticide application.

| Average score last check | Average score this check |     |     |     |     |     |     |     |     |     |     |
|--------------------------|--------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                          | 0                        | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 |
| 0                        | 0.0                      | 0.3 | 0.5 | 0.8 | 1.0 | 1.3 | 1.5 | 1.8 | 2.0 | 2.3 | 2.5 |
| 0.5                      | 0.3                      | 0.5 | 0.8 | 1.0 | 1.3 | 1.5 | 1.8 | 2.0 | 2.3 | 2.5 | 2.8 |
| 1.0                      | 0.5                      | 0.8 | 1.0 | 1.3 | 1.5 | 1.8 | 2.0 | 2.3 | 2.5 | 2.8 | 3.0 |
| 1.5                      | 0.8                      | 1.0 | 1.3 | 1.5 | 1.8 | 2.0 | 2.3 | 2.5 | 2.8 | 3.0 | 3.3 |
| 2.0                      | 1.0                      | 1.3 | 1.5 | 1.8 | 2.0 | 2.3 | 2.5 | 2.8 | 3.0 | 3.3 | 3.5 |
| 2.5                      | 1.3                      | 1.5 | 1.8 | 2.0 | 2.3 | 2.5 | 2.8 | 3.0 | 3.3 | 3.5 | 3.8 |
| 3.0                      | 1.5                      | 1.8 | 2.0 | 2.3 | 2.5 | 2.8 | 3.0 | 3.3 | 3.5 | 3.8 | 4.0 |
| 3.5                      | 1.8                      | 2.0 | 2.3 | 2.5 | 2.8 | 3.0 | 3.3 | 3.5 | 3.8 | 4.0 | 4.3 |
| 4.0                      | 2.0                      | 2.3 | 2.5 | 2.8 | 3.0 | 3.3 | 3.5 | 3.8 | 4.0 | 4.3 | 4.5 |
| 4.5                      | 2.3                      | 2.5 | 2.8 | 3.0 | 3.3 | 3.5 | 3.8 | 4.0 | 4.3 | 4.5 | 4.8 |
| 5.0                      | 2.5                      | 2.8 | 3.0 | 3.3 | 3.5 | 3.8 | 4.0 | 4.3 | 4.5 | 4.8 | 5.0 |

**STEP 4. ESTIMATE POTENTIAL YIELD REDUCTION. Table 1b**

Use the table to estimate the yield loss that aphids have already caused. The 'Time Remaining' in the season needs to be determined the first time aphids are found in the crop. The data set is based on 165 days from planting to 60% open bolls. If for example aphids are first found 9 weeks after planting, the Time remaining would be ~100 days. As the Season Aphid Score accumulates with each consecutive check, continue to read down the '100' days remaining column to estimate yield loss. When aphids are sprayed, or, if aphids disappear from the crop then reappear at a later time, reassess the time remaining based on the number of days left in the season at the time of their reappearance. Crop sensitivity to yield loss declines as the crop gets older. The estimate takes into account factors that affect the rate of aphid population development, such as beneficials, weather and variety. Yield reductions >4% are highlighted, however the value of the crop and cost of control should be used to determine how much yield loss can be tolerated before intervention is required.

| Cumulative Aphid Score | Days until 60% open |    |    |    |    |    |    |    |    |    |
|------------------------|---------------------|----|----|----|----|----|----|----|----|----|
|                        | 100                 | 90 | 80 | 70 | 60 | 50 | 40 | 30 | 20 | 10 |
| 0                      | 0                   | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| 5                      | 0                   | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| 10                     | 2                   | 2  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  |
| 15                     | 5                   | 4  | 3  | 3  | 2  | 1  | 1  | 0  | 0  | 0  |
| 20                     | 7                   | 6  | 5  | 4  | 3  | 2  | 1  | 1  | 0  | 0  |
| 25                     | 9                   | 8  | 7  | 6  | 5  | 3  | 2  | 1  | 0  | 0  |
| 30                     | 11                  | 10 | 8  | 7  | 6  | 5  | 3  | 2  | 1  | 0  |
| 40                     | 15                  | 13 | 12 | 10 | 8  | 7  | 5  | 3  | 1  | 0  |
| 50                     | 19                  | 17 | 15 | 13 | 11 | 9  | 7  | 5  | 2  | 0  |
| 60                     | 23                  | 21 | 18 | 16 | 13 | 11 | 8  | 6  | 3  | 1  |
| 80                     | 31                  | 28 | 25 | 22 | 18 | 15 | 12 | 8  | 5  | 1  |
| 100                    | 38                  | 34 | 31 | 27 | 23 | 19 | 15 | 11 | 7  | 2  |
| 120                    | 45                  | 41 | 37 | 32 | 28 | 23 | 18 | 13 | 9  | 3  |

**TABLE 1** IMPACT OF APHICIDES ON PREDATORS IN COTTON AND REGISTRATIONS ON OTHER PESTS  
Adapted from "Impact of insecticides and miticides on predators in cotton" Cotton Pest Management

[illegible]

**DISCLAIMER:** Information provided is based on the current best information available from research data. Users of these products should check the label for further details of rate, pest spectrum, safe handling and application. Further information on the products can be obtained from the manufacturer.

## TABLE NOTES

- Total predatory beetles – ladybeetles, red and blue beetles, other predatory beetles.
- Total predatory bugs – big-eyed bugs, minute pirate bugs, brown smudge bugs, glossy shield bug, predatory shield bug, damsel bug, assassin bug, apple dimpling bug.
- Pyrethroids; cypermethrin, alpha-cypermethrin, betacyfluthrin, bifenthrin, fenvalerate, esfenvalerate, deltamethrin, lambda-cyhalothrin.
- Persistence of pest control, short, <3 days; medium, 3–7 days, long, >10 days.
- Impact rating (% reduction in beneficials following application, based on scores for the major beneficial groups);

|           |                                                                                   |
|-----------|-----------------------------------------------------------------------------------|
| <b>VL</b> | (very low), less than 10%;                                                        |
| <b>L</b>  | (low), 10–20%;                                                                    |
| <b>M</b>  | (moderate), 20–40%;                                                               |
| <b>H</b>  | (high), 40–60%;                                                                   |
| <b>VH</b> | (very high), > 60%. A '–' indicates no data available for specific local species. |

- Pest resurgence is +ve if repeated applications of a particular product are likely to increase the risk of pest outbreaks or resurgence. Similarly sequential applications of products with a high pest resurgence rating will increase the risk of outbreaks or resurgence of the particular pest spp.
- Very high impact on minute two-spotted ladybeetle and other ladybeetles for wet spray, moderate impact for dried spray.
- Data Source: British Crop Protection Council. 2003. The Pesticide Manual: A World Compendium (Thirteenth Edition). Where LD50 data is not available impacts are based on comments and descriptions. Where LD50 data is available impacts are based on the following scale: very low = LD50 (48h) > 100 ug/bee, low = LD50 (48h) < 100 ug/bee, moderate = LD50 (48h) < 10 ug/bee, high = LD50 (48h) < 1 ug/bee, very high = LD50 (48h) < 0.1 ug/bee. Refer to the Protecting Bees section in this booklet.
- Wet residue of these products is toxic to bees. Applying the products in the early evening when bees are not foraging will allow spray to dry, reducing risk to bees the following day.
- May reduce survival of ladybeetle larvae – rating of **M** for this group.

Table 2: Seed Treatment Component Descriptions

| Trade Name/s                                                                                                                                                                                                             | Active - Ensure rotation with foliar sprays                               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| Amparo™                                                                                                                                                                                                                  | Imidacloprid, (neonicotinoid) Group 4A<br>Thiodicarb (carbamate) Group 1A |
| Gaucha Genero™                                                                                                                                                                                                           | Imidacloprid: (neonicotinoid) Group 4A                                    |
| Cruiser®                                                                                                                                                                                                                 | Thiamethoxam: (neonicotinoid) Group 4A                                    |
| Lorsban® 30 Flowable                                                                                                                                                                                                     | Chlorpyrifos: (OP) Group 1B                                               |
| Gaucha® is a registered trademark of Bayer Crop Science.<br>Cruiser® is a registered trademarks of Syngenta.<br>Genero™ is a trademark of eChem Crop Protection Products<br>Amparo™ is a trademark of Bayer Crop Science |                                                                           |

## \* Important Use of Pesticides

Pesticides must only be used for the purpose for which they are registered and must not be used in any other situation or in any manner contrary to the directions on the label.

Some chemical products have more than one retail name. All retail products containing the same chemical may not be registered for use on the same crops. Registration may also vary between States. Check carefully that the label on the retail product carries information on the crop to be sprayed.

## CHEMISTRY NOTES

**Pirimicarb** : A very selective insecticide that basically only controls aphids and has little negative effect on beneficials. There is resistance to this insecticide that confers cross resistance to dimethoate and omethoate. A test kit is available to test aphids for this type of resistance and this information can be valuable when selecting control options.

**PSO**: Petroleum spray oil. These products require good coverage to provide control. They can be added to insecticides applied against other pests to help suppress populations of aphids and mites. They are only effective as a stand-alone option when aphid populations are relatively low.

**Diafenthiuron** : Provides good control of aphids, including strains resistant to pirimicarb and OPs, and mites, and suppresses silver leaf whitefly populations. Has low negative effect on beneficials. Requires a closed canopy to obtain best results from fumigant action.

**Pymetrozine**: Moderately selective aphicide which will control pirimicarb/OP resistant aphids. Requires actively growing cotton for best results.

**Endosulfan**: Moderately selective insecticide. Is unlikely to flare mites or whitefly.

**Acetamiprid**: Same chemical group as imidacloprid and thiamethoxam. Most selective compound of this group. Provides effective control of aphids and can be used late in the season due to short with-holding period (10d). Will control pirimicarb/OP resistant aphids.

**Thiamethoxam**: Same chemical group as imidacloprid and acetamiprid. Very selective as a seed treatment, moderately disruptive to beneficials as a spray. Can increase the risk of mite outbreaks as it controls thrips, which eat mite eggs as well as damage the plant, but not mites. Controls pirimicarb/OP resistant aphids. No withholding period so can be used very late.

**Imidacloprid**: Same chemical group as acetamiprid and thiamethoxam. Effective and soft on beneficials as a seed treatment. Can increase the risk of mite outbreaks as it controls thrips, which eat mite eggs as well as damage the plant, but not mites. Less effective, and moderately disruptive to beneficials as a foliar spray. Long withholding period

**OPs**: High level resistance to omethoate and dimethoate is common and confers cross resistance to pirimicarb. Moderate resistance to profenofos and chlorpyrifos occurs occasionally, resulting in poor control. OPs are disruptive of beneficial populations and will increase the risk of mite or whitefly outbreaks. Use of OPs against other pests will select for resistant aphids even if populations are below threshold.

Table 3: Pesticides registered for other pests that may encourage aphid resurgence

| Insecticides<br>(in increasing rank order<br>of impact on beneficials) | Rate (gal/ha) | Target pest(s) |       |       |        | Pest<br>resurgence <sup>12</sup> |       |             |
|------------------------------------------------------------------------|---------------|----------------|-------|-------|--------|----------------------------------|-------|-------------|
|                                                                        |               | Helicoverpa    | Mites | Mrids | Thrips | Mite                             | Aphid | Helicoverpa |
| Indoxacarb (low)                                                       | 80            |                |       | ✓     |        |                                  | +ve   |             |
| Indoxacarb (low + Canopy)                                              | 80            |                |       | ✓     |        |                                  | +ve   |             |
| Fipronil (v. low + salt)                                               | 8             |                |       | ✓     |        | +ve                              | +ve   | +ve         |
| Indoxacarb <sup>11</sup>                                               | 127.5         | ✓              |       | ✓     |        |                                  | +ve   |             |
| Propargite                                                             | 1500          |                | ✓     |       |        |                                  | +ve   | +ve         |
| Fipronil (low)                                                         | 12.5          |                |       | ✓     | ✓      |                                  | +ve   | +ve         |
| Thiodicarb                                                             | 750           | ✓              |       |       |        | +ve                              | +ve   |             |
| Chlorfenapyr (high)                                                    | 400           | ✓              | ✓     |       |        |                                  | +ve   |             |
| Pyrethroids <sup>1</sup>                                               |               | ✓              | ✓     | ✓     |        | +ve                              | +ve   | +ve         |

This publication is only a guide to the use of pesticides. The correct choice of chemical, selection of rate, and method of application is the responsibility of the user.

Pesticides may contaminate the environment. When spraying, care must be taken to avoid spray drift on to adjoining land or waterways. Residues may accumulate in animals fed any crop product, including crop residues, which have been sprayed with pesticides. In the absence of any specified grazing withholding period(s), grazing of any treated crop is at the owner's risk.



which decimates beneficials. However, even in this situation the 'infection, colonisation, latent period' cycle will occur so prompt control of the aphids would prevent significant yield loss.

### Aphids and insecticides

Insecticides that can be used for aphid control and their effect on beneficial insects can be found in Table 2.

A list of seed dressings and there active groups can be found in Table 3. It is important to ensure that alternative chemical groups are used even if they are applied in different forms.

### Rotation of insecticides

As aphids have developed resistance to some insecticides it is essential that we try to preserve the efficacy of existing aphicides. This requires a combination of resistance management and improved management of aphid populations. Insecticides used to control aphids (aphicides) act on the aphids in different ways. Each insecticide belongs to a 'mode of action' group, which describes the way the insecticide acts within the insect to kill it. In general, if insects develop resistance to one insecticide from a given mode of action group they will be resistant to other insecticides in that group as well. For this reason it is important to alternate between mode of action groups rather than repeatedly using insecticides from the same group. Mode of action groups for aphicides are listed in Table 1.

Our current resistance management strategy for aphids hinges on four main points;

1. A maximum of 2 sprays of any registered aphicide mode of action group against aphids, unless the product is otherwise restricted.
2. Rotation of chemistry, that is, do not use the same chemical group consecutively.
3. The first aphicide spray should not be from the same chemical group as any seed treatment or at-planting

insecticide used that also controls aphids, see Tables 1 and 2.

4. There is cross-resistance between carbamate (group 1A) and organophosphates (group 1B) and therefore they should be considered as the same group for aphid control. However, note that aphids resistant to pirimicarb, dimethoate and omethoate are not resistant to aldicarb, so this product can be treated as if it were a different mode of action for resistance management.

It is important not to follow a failure with a given product with another product from the same group. The current aphicides registered for use in cotton and their chemical groups are listed in Table 1 and in the Cotton Pest Management Guide. If there is a spray failure the follow-up spray should use an active ingredient from a different chemical group.

### New control technology

#### Biopesticides.

A new fungal control for aphids will be evaluated in large scale trials in the 2008-09 season.

#### Semiochemicals

Semiochemicals are essentially 'signalling' chemicals. They can be produced by plants or animals.

Research is being conducted into their effectiveness in aphid management in the cotton system.

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### Useful documents and links

Aphid Ecology in Cotton: Companion information sheet

Integrated Pest Management Guidelines for Cotton Production systems in Australia (IPM Guidelines ) hardcopy or COTTON-paks CD version available from The Cotton TRC or from the CRC website: <http://www.cottoncrc.org.au>.

Cotton aphid hosts in Australia Web link: [http://www.cottoncrc.org.au/content/Industry/Publications/Pests\\_and\\_Beneficials/Aphids\\_\\_Bunchytop/Overwinter\\_host\\_plants\\_of\\_Cotton\\_Aphid.aspx](http://www.cottoncrc.org.au/content/Industry/Publications/Pests_and_Beneficials/Aphids__Bunchytop/Overwinter_host_plants_of_Cotton_Aphid.aspx)

Cotton pest Management guide: Published yearly by NSW DPI also web: <http://www.dpi.nsw.gov.au/agriculture/field/field-crops/fibres/cotton/cotton-pest-management-guide>