

Cotton insects

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Aphid ecology in cotton

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Aphids, once only 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, yield reductions from large early season infestations and late season effects of honeydew on fibre quality. Aphids ability to reproduce asexually has an impact on resistance management as does their ability to overwinter on non cotton hosts.



Picture1: Leaf affected by Aphid honeydew (left)

Introduction

This is a companion document to 'Strategies to manage aphids in cotton' available from the Cotton CRC web site.

Aphids, once considered only a secondary pest in cotton are now a major problem for growers in some regions. Three species are commonly found on cotton, the cotton aphid (*Aphis gossypii*), green peach aphid (*Myzus persicae*) and cowpea aphid (*Aphis craccivora*). The cotton aphid is the most common. Occasionally there are early or late season infestations of green peach aphid, which die off during hot periods. Cowpea aphid is sometimes found on seedling cotton in late spring after legume crops die off, but rarely establishes effectively in cotton plants.

Damage

Aphids insert their stylets into leaf or terminal tissues of plants and probe until they contact a phloem vessel. The phloem is the tissue that distributes the products of photosynthesis

(assimilates) required for plant growth throughout the plant. The sap in the phloem is under pressure and is basically 'forced' into the aphids, which regulate the flow. Phloem sap is rich in sugars, but poor in amino acids which aphids need for growth. To accumulate enough amino acids for growth the aphids 'pass' a lot of excess sugar, which is excreted onto plants as a shiny sugar-rich deposit known as 'honeydew'. Honeydew encourages the growth of sooty moulds on leaf surfaces. Aphid feeding causes economic damage to cotton in four ways;

1. Competition with young growth and developing fruit (squares and bolls) for assimilate. If this is beyond the capacity of the plant to compensate, reduction in growth is likely.

2. Reduced photosynthesis due to the presence of aphids on leaves. The cause of



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this effect is not well understood but could be due to a number of factors including; the damage caused by insertion of stylets, (especially when there are many aphids), the effects of assimilate depletion or the effects of saliva secreted in to the plants by the aphids.

3. Secretion of honeydew (Picture:1) onto leaves also reduces photosynthesis.

4. Late season aphid infestations result in honeydew contaminating lint, making it sticky and discoloured. Severe downgrading of sticky lint may result because of the difficulties of processing it in high speed spinning machinery.

Cotton aphids generally prefer to feed on the terminals, young leaves and fruit, sites where the supply of assimilate is high. Damage symptoms from cotton aphids initially appear as crinkled and curled leaves, with the margins of the leaves curling downwards (Picture 2).

Prolonged high populations of cotton aphid will lead to a dramatic shortening of internodes, severely reduced leaf size, leaf / fruit loss and



Picture 2. Severe aphid damage results in wrinkling, stunting and cupping of leaves. Younger leaves may show a yellow margin and reddened patches may appear on leaves. Photo: L. Wilson

obvious yellowing or mottling of young leaves. This yellowing or mottling often occurs on areas of leaves heavily damaged by aphids or can occur evenly around the margins of leaves and should not be confused with the angular mottling found with Cotton Bunchy Top (see Picture 4).

Pre-squaring cotton appears to be able to fully compensate for aphid damage as long as the aphid feeding ceases. However, prolonged high population levels up to cut-out (when fruit production slows or stops) can cause substantial damage and reductions in yield. Populations in excess of 90% of plants infested with aphids for 3 or more weeks are likely to result in economic loss. (see companion

article 'Strategies to manage aphids in cotton' for details).

Biology Ecology and Insecticide Resistance

In Australia, the life cycle of aphids is quite different to that of other cotton insects. Cotton aphids (*Aphis gossypii*) are all females, there are no males and therefore no sexual reproduction. Females give birth to live female young which are clones of themselves, inheriting all of their

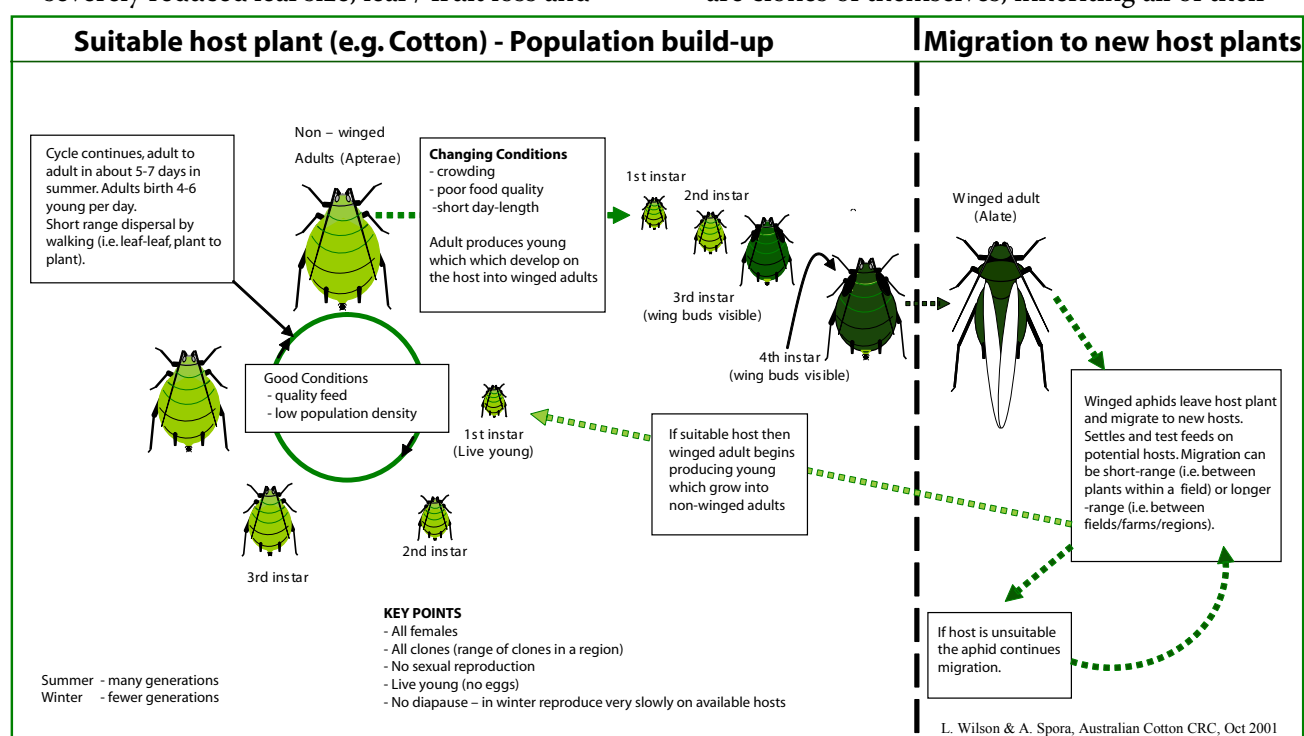


Figure 1: Life cycle of cotton aphid

characteristics including insecticide resistance. A female aphid can produce live young at the rate of 4 - 6 per day, which in summer can mature through four nymphal stages into adults in 4 - 7 days. They can immediately begin producing live young. Female aphids have within them many live young at various stages of development. These cloned offspring already have clones developing within them before they are born. This is how so many generations can be produced in such short periods. Populations can explode if conditions such as food quality and climate are favourable.

Biology, Ecology and Colonisation of Cotton

Colonisation of a new host plant usually occurs by the winged (alate) adult. Aphids will settle on the plant and test feed. If the plant is unsuitable the winged adult will resume the “flight, settle and test feed” pattern, until it finds suitable food or dies. If the plant is suitable, production of live young commences quickly. These mature through four nymphal stages into wingless adults (apterae). The wingless cycle will continue until some aspect of their environment triggers the switch to the production of dispersing (winged) forms. This switch can be caused by declining food quality, for instance if the host plant is senescing, by overcrowding or by reduced day-length.



Picture 3. Cotton aphids on a leaf. Note wide variation in colour and globula shape. Centre left is a predatory larvae of a hoverfly.

Photo: C. Mares

Once triggered to disperse, the adult aphid produces live young which develop wing-buds. These nymphs mature into winged adults, which then fly off to find a new host plant. This could entail only a short flight, to another uncolonised plant in the same cotton field, or depending on wind currents, a longer flight to a new crop or weed host further away.

Resistance in aphid populations

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.

It is likely that there is 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, and some resistant aphid clones appear as well adapted as non-resistant clones. Table 1 summarises current resistance in aphids found in Australian cotton.

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.

Table 1 Resistance notes for major aphid species found in cotton

Aphid species	Resistance
Cotton Aphid	Patchy resistance and cross resistance to a broad range of aphicides. In particular resistance to dimethoate or omethoate and cross resistance to pirimicarb is common. Resistance to profenofos, chlorpyrifos ethyl and methyl, pyrethroids and endosulfan is also found in some populations. Patchiness of resistance indicates that basic measures like farm hygiene can still limit resistance spread. See Information Sheet: Strategies to manage aphids in cotton for latest details.
Green peach aphid	Resistance to OP's and Pirimicarb. Resistance levels are lower compared to cotton aphid See Information Sheet: Strategies to manage aphids in cotton for latest details.
Cowpea Aphid	No known resistance.

Overwintering

In winter, cooler temperatures slow the growth rate of aphids dramatically. In Australian cotton regions, neither cotton aphids, nor green peach aphids nor cowpea aphids have an overwintering form. Instead they persist through winter in small scattered populations on whatever suitable host plants are available. In spring as temperatures increase aphid populations begin to build rapidly again.

Predators parasites, parasitoids and pathogens

Beneficial insects play an important role in aphid control at the stage before aphid numbers begin to increase exponentially. Disruption of beneficial populations by some insecticides can lead to earlier, more severe aphid outbreaks.

Aphids are bread and butter for many predators in cotton. Major predators of aphids include the larvae of the hoverfly (Syrphid) and lacewings, and nymphal and adult stages of ladybirds (white collared, transverse, variable), red and blue beetle and the brown smudge bug.

Parasites of aphids include small wasps (*Aphidius colemani* and *Lysiphlebus testaceipes*) that sting developing aphids, inserting an egg which hatches into a larvae that grows and matures in the aphid, resulting in the pale bloated aphid mummies often seen on cotton leaves.

Natural variability in predator and parasite abundance means that some will be more important in different seasons.

During periods of heavy rainfall fungal pathogens can also take a toll on infestations

Cotton aphid

The cotton aphid varies widely in colour. The winged adults are typically black, but the wingless stages can vary from pale yellow through to dark green, brown and dull black (Picture 3). The wingless forms have a typically bulbous round shape.

The development of cotton aphid is favoured by warm temperatures and this species does well on cotton through the peak growing period.

Cotton aphid has a broad host range and has been recorded on members of the following families; Fabaceae (legumes, lucerne, medic), Solanaceous weeds (datura, ground cherry, nightshades), Cucurbitaceae (paddymelon), Malvaceae (bladder ketmia, marshmallow) and Asteraceae (sunflower, capeweed, daisies, thistles, bathurst burr). A more complete host range can be found in the IPM Guidelines, or Cotton CRC website (see Useful Documents and Links at the end of this document).

Cotton aphid and Cotton BunchyTop (CBT)

The cotton aphid is the only known vector of cotton bunchy top disease.

Symptoms of CBT include reduced plant height, leaf surface area, petiole length and internode



Figure 4: Leaf symptoms of Cotton Bunchytop in the field

length. Pale, angular patterns on the leaf margins are often observed with the remainder of the leaf blade usually dark green in colour. These darker leaves have a leathery and sometimes glossy texture when compared to those on healthy plants. Typically, the pale angular patches in field-grown cotton turn red as leaves age. Boll development is also affected, with bolls often less than half the size of healthy bolls.

Host plants for CBT include volunteer cotton and marshmallow and potentially other malvaceous weeds.

Green peach aphid



Picture 5: Green peach aphid, note pale green/yellow colour and tubercles with indented 'U' shape between them (see Figure 1). Photo: L. Wilson

The green peach aphid is a pale yellow-green and is more tear-drop shaped than the cotton aphid (Picture 4). Colonies tend to be uniform in colour compared with cotton aphid. Seen with a hand lens or microscope, green peach aphid has a small tubercle at the junction of the antenna and head, which is absent in cotton aphid and cowpea aphid. The area between these tubercles is 'U' shaped in green peach aphid whereas it is flat in cotton aphid. Also, the green peach aphid has a pair of long, pale, tube-like siphunculi at the tip of its abdomen, whereas those of cotton aphid are quite short and usually dark (see Figure 2).

The green peach aphid causes far more severe effects on plant growth at much lower densities than cotton aphid. Symptoms include yellowing of young leaves and the terminal and severe reductions in internode length and leaf / fruit size. Plants generally recover quickly if the green peach aphid numbers decline due to hot weather, beneficial insect activity or insecticides.

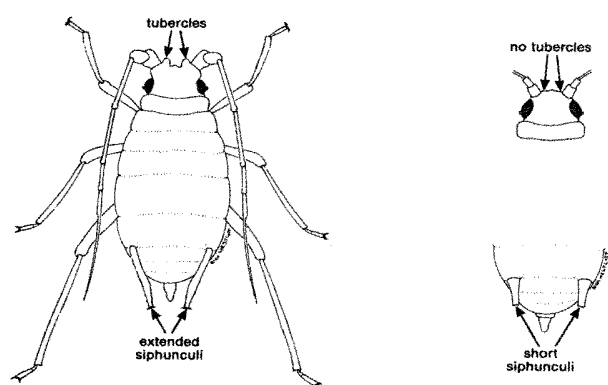


Figure 2. Green peach aphid (left) and cotton aphid (right). - extracted from Forrester and Wilson 1988.

Fortunately this pest rarely establishes well on cotton.

The green peach aphid prefers cooler conditions. It is sometimes found on cotton early in the season but populations do not usually persist once hot conditions commence. Green peach aphid also has a wide host range and is often found on members of the following families. Fabaceae (legumes, lucerne and lupins), Asteraceae or all Brassica sp. They are also often found on peach and plum trees.

Cowpea aphid

The cowpea aphid is very similar to the cotton aphid in appearance. However, the wingless adults of this species are a shiny black, in contrast to cotton aphid, which is always a dull colour.



Picture 6: Cowpea aphid showing shiny black wingless adults Photo J. Wessels

Cowpea aphid will colonise a range of hosts but prefers legumes and is often found on medics. This species is often found on cotton early in the season but seldom establishes, though it may sometimes produce a small number of offspring. More common hosts include the Cucurbitaceae, Asteraceae, and Fabaceae families.

Other species of aphids on cotton

A range of other aphid species are occasionally found on young cotton. These are mostly the winged forms of species that have migrated from other hosts, especially leguminous weeds. These include pea aphid (*Acyrtosiphon pisum*), blue green aphid (*Acyrtosiphon kondoi*) (Picture 7) and the spotted alfalfa aphid (*Therioapihs trifolii*).



Picture 7: Winged adult of blue green aphid, (Photo NSW Agriculture)

These species can settle on cotton to test feed but will not normally establish. Populations of winged adults on seedling cotton may initially be high but will usually decline quickly over two or three weeks. A wide range of beneficial insects also enters cotton crops at this time.

Winged forms of the corn aphid (*Rhopalosiphum maidis*) and the oat or wheat aphid (*Rhopalosiphum padi*) may also migrate from grasses, cereals or sorghum into cotton but do not establish. *Aphis spiraeicola* (apple aphid) is also sometimes found on cotton, and probably originates from certain Asteraceae such as *Conyza* spp. (fleabane) or Chrysanthemum.

Soil aphids

Bean root aphid (*Smynturodes betae*) is a rare aphid pest that feeds on the roots of cotton seedlings (Picture 8).

Death of seedlings can occur and bean root aphid damage may be mistaken for seedling disease. The aphids are small, pale, globular and wingless.

The presence of aphids can be detected by carefully separating the soil away from the roots of seedlings. Aphids can be found on the roots at a depth of about 10 cm and they are tended

by ants which construct small chambers to allow movement of aphids around the roots. The chambers are covered in a white, waxy dust from the aphids. Infestations so far have tended to occur in fields previously heavily infested with burr medic.

If infestations are discovered after seedling emergence there is no effective chemical control for the aphids. If planting cotton into seedbeds which have been infested with burr medic then granular insecticides applied to control other pests may coincidentally control bean root aphid.

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Useful documents and links

Strategies to manage aphids in cotton:
Companion information sheet

“Integrated Pest management Guidelines for Cotton Production systems in Australia” (IPM Guidelines) Hardcopy or COTTONpaks CD versions available from The Cotton TRC or from the Cotton 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

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>