citrus research international

CITRUS BIOSECURITY THREAT:

African Greening and its vector, the African Citrus Triozid (ACT)

The disease

- African Greening is associated with the bacterium '*Candidatus* Liberibacter africanus' (Laf).
- The bacteria are restricted to the phloem vessels in trunks, branches, twigs and/or roots, and block sap flow at the sieve tubes.
- Laf and its vector are heat sensitive, less severe than the exotic Asian forms, and are more active in cooler production regions where tree growth, health and fruit production can be severely impacted.
- Infected trees decline, and symptomatic fruit are unsuitable for fresh fruit or juice markets.
- There is no cure once trees become infected. Infected branches/trees need to be removed and destroyed to prevent spread of the disease.
- Due to the heat sensitivity of African Greening and its vector ACT, the disease can be managed in affected production regions through use of systemic insecticides and infected tree/branch removal. However, Asian Citrus Greening (Huanglongbing; HLB) and its vector the Asian Citrus Psyllid are heat tolerant, spread much faster and are more severe, even in warmer production areas.
- African Greening is present in Limpopo, Mpumalanga, Gauteng, KwaZulu-Natal and certain districts in the Western Cape and Eastern Cape provinces of South Africa.

The insect vector

- The African Citrus Triozid (ACT) *(Trioza erytreae)* is the most efficient vector of the Laf bacteria causing African Greening.
- ACT can also transmit HLB, the most destructive citrus disease in the world. HLB does not occur in southern Africa.
- Heavy infestations of ACT can cause severe damage in citrus trees, but its main economic importance is as the vector of African Greening.

Peter Stephen

Trioza erytreae (African citrus psyllid)

Fact sheet produced by CRI's Biosecurity Division, June 2024

Disease symptoms

Leaves

New growth displays shoots that are yellow or pale green with small leaves growing upright and gradually become leathery. Leaf veins are prominent and yellow.

The most characteristic leaf symptom is asymmetrical blotchy mottling on older leaves. Abundant leaf drop is common.

Fruit

Fruit on affected branches are often small and lopsided (inside the columella is curved). Fruit may develop high shoulders at the peduncle end, and are poorly coloured on the shaded sides of the fruits (greening). Colour inversion can occur when maturing: the peduncular (twig) end of the fruit turns orange while the stylar end remains green. Another diagnostic feature is the 'silver thumb print' after pressing on the fruit rind. Affected fruit are low in soluble solids, low in juice percentage, high in acids, and can have a bitter or salty taste. This impacts juice quality and marketability of the fruit. Greening causes pre-mature fruit drop from affected branches, reducing fruit harvest. Seedy varieties contain aborted or undeveloped seed.

Blotchy mottle symptoms typical of African Greening; note the yellow chlorosis is asymmetrical relative to the leaf midrib

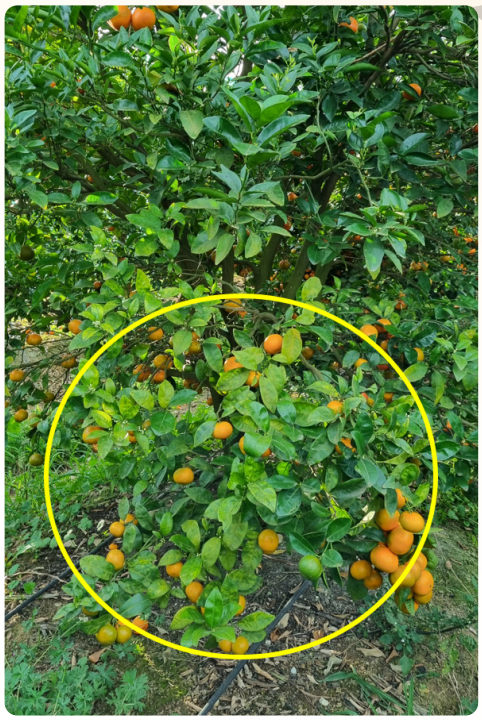
Typical African Greening fruit symptoms; note the oblong shape and white sheen remaining after a thumb-pressure on the yellow rind

Small, lopsided fruit with a bitter taste; also note aborted seed and brown discolouration of the vascular tissue in the stem end and in the columella

Trees

The tree can remain symptomless for months or years after the initial infection. Symptom development is slow and infected trees decline gradually in vigour and yield, and remain stunted or eventually die.

Young trees are stunted when infected at an early stage and show twig dieback and sparse yellow foliage.



African Greening symptoms on a branch/sector of a mature tree

This decline is accompanied by unseasonal growth flushes and blossoming on diseased branches, as well as premature fruit drop. Root systems of severely affected trees are poorly developed with a reduction of fibrous roots.

In older trees, only a section or a branch of a tree can be infected and may display symptoms, whereas the rest of the tree exhibits normal growth and yields normal fruit.

Signs of vector presence

The psyllid itself severely distorts leaves, which become stunted, curled and galled. The leaves may also be dusted with solid white honeydew excreted by the psyllid. Young leaves, especially, may be chlorotic. High psyllid densities and humid environmental conditions may be associated with the development of sooty mould on the honeydew. The presence of small pit-like galls or pockmarks on young leaves can indicate the presence of *T.* erytreae.

Breeding signs of *T. erytreae* are the very characteristic pockmarks and white honeydew seen on leaves

Fact sheet produced by CRI's Biosecurity Division, June 2024

Vector description

Eggs

Eggs are yellow or orange, cylindrical, with an upturned sharp point anteriorly. Each egg has a short stalk, which is inserted into the plant tissue. They are laid on leaf edges and along the midribs of young, tender, actively growing foliage.

Nymphs

There are five nymphal instars. The nymphs are dorso-ventrally flattened with a distinct marginal fringe of white, waxy filaments and vary in colour from yellow, olive-green to dark grey. They are largely sedentary and form distinct colonies, settling on the underside of young leaves where, after a few days of feeding, they produce distinctive cup-shaped or pit-like, open galls (pockmarks).

Adults

Adults are pale and delicate initially, later becoming light brown. They are about 4 mm in length, with large wings and clearly outlined veins. Males are smaller than females and have a blunt tip to the abdomen, the latter ending in a sharp point in females. When feeding, adults take up a distinctive stance, with the abdomen raised at an angle of about 35° to the feeding surface. They fly well, and often jump and fly when disturbed.

Nymphs and pit-like open galls

African Citrus Triozid (ACT) (*Trioza erytreae*)

Possible confusion with

Disease symptoms are almost identical to and can be confused with those of HLB.

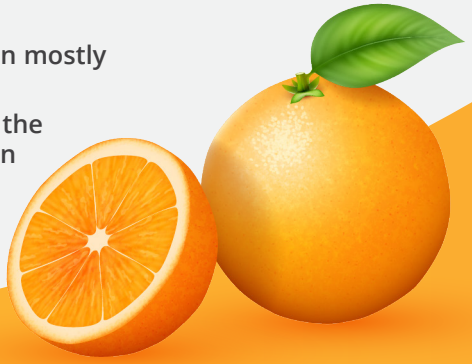
Leaf symptoms can resemble nutrient deficiencies, particularly zinc and iron. Symptoms may include yellowing and interveinal chlorosis. Nutrient deficiencies, however, tend to present uniformly across the canopy on similar aged shoots, whereas African Greening symptoms first appear on single shoots or branches.

Stubborn disease (*Spiroplasma citri)* and Australian citrus dieback ('*Candidatus* Phytoplasma australiense') also induce blotchy mottle. Australian citrus dieback is further associated with other typical African Greening symptoms such as yellowing, reduced fruit size and dieback. Stubborn disease similarly displays symptoms such as small, lopsided fruit, with colour inversion, aborted seeds and out-of-season flowering, which can be confused with African Greening.

Other diseases that may confuse diagnosis include severe infections of Citrus tristeza virus (CTV), which display twig and branch dieback, sparse foliage and small leaves, with various deficiencies and small sized fruit, as well as root rot, caused by *Phytophthora* spp., which can cause leaf yellowing, leaf drop and dieback, often sectorially in the tree.

All these variables complicate field diagnosis of African Greening and identification mostly requires confirmation with laboratory testing.

Adult psyllids could be confused with aphids, but are highly active and jump at the slightest disturbance, compared to aphids, which are less active. Psyllid nymphs can be confused with soft scale insects (such as soft brown scale), but the psyllid nymphs have clear body parts, compared with scales, and can excrete waxy filaments.



Fact sheet produced by CRI's
Biosecurity Division, June 2024

Host range

Mainly plants in the family Rutaceae, including:

- All *Citrus* spp.
- *Fortunella* spp.
- *Poncirus trifoliata* (including hybrids)
- Orange Jasmine (*Murraya paniculata*)

Current distribution

- Africa (both disease and vector)
- Portugal and Spain (only vector)

Method of spread

- **Insect vectors**

  Trioza erytreae feeds from the phloem sap of infected hosts and acquire the African Greening bacteria predominantly from young twigs and flush. Once acquired, the bacteria remain in the haemolymph and the insect retains the ability to transmit the bacteria in a persistent manner throughout its lifespan to healthy trees. Late-instar nymphs, as well as the adults derived from these nymphs, are capable of transmitting African Greening bacteria.

- **Natural flight**

  Trioza erytreae is only likely to spread locally by natural dispersal, up to distances of 1.5 km.

- **Infected plant material**

  Propagation material (trees, cuttings, grafts, budwood) of *Citrus* and related genera

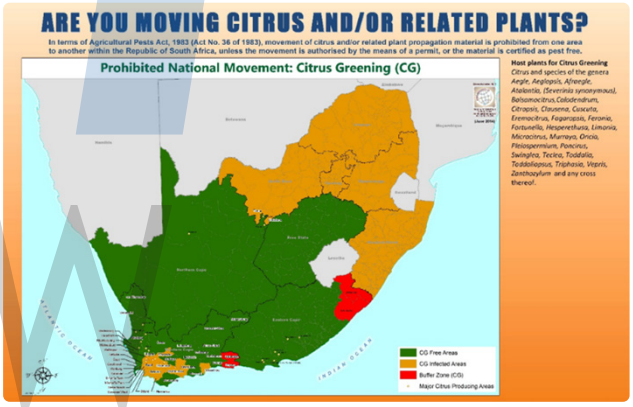
  Propagating material (budwood, cuttings, grafts) and rootstock seedlings of *Citrus* and related genera from infected areas can carry eggs and/or nymphs of ACT over longer distances.

  Propagation material of other hosts, most notably Orange Jasmine, can spread the bacteria or the insect vector.

- **African Greening is NOT fruit or seed transmitted**

Risk management measures

- Plant certified disease-free citrus trees
- Awareness and surveillance
- Confirm identification of African Greening and ACT by PCR
- Removal of all infected branches/trees
- Surveillance and monitoring on farm for signs of the vector and with yellow sticky traps during flushing periods [traps can be sent to CRI's Citrus Research Centre (CRC) in Nelspruit for analysis]
- Effective chemical control of the vector ACT during any vegetative flush period; mostly spring and autumn
- (consult CRI Production Guidelines for restrictions and more information on chemicals)
- Prohibited movement of citrus propagation material from areas where African Greening occurs into African Greening-free areas according to Regulation 110 of the Agricultural Pest Act



Map indicating the prohibited movement of vegetative citrus propagation material due to African Greening: material cannot be moved from areas where African Greening occurs or designated buffer zones (in orange and red) to African Greening-free areas (in green)

Scan to view map

For more information on this disease, or if you find anything unusual, contact Wayne Kirkman from CRI's Biosecurity Division: waynek@cri.co.za, 084 458 0349