



Asian Citrus Greening Disease

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Citrus greening, also known as yellow dragon or Huanglongbing (HLB) is an incurable bacterial disease that affects citrus trees. It is caused by the bacterial pathogen, *Candidatus Liberibacter asiaticus* (CLAs), which is transmitted by an insect vector, the Asian citrus psyllid, *Diaphorina citri* Kuwayama

While the disease poses no threat to humans or animals, it has devastated millions of hectares of citrus orchards throughout the world where it is found. Orange juice industries have been affected by this disease as fruits from the infected tree have a bitter taste. The disease was found in Florida in 2005, which is the largest orange producing state in the United States. Since its arrival in Florida, citrus production has decreased by 74%.

Therefore, although this disease isn't present in South Africa yet, Asian citrus greening could pose a serious threat to the citrus production if it does spread to SA.

There are three known forms of citrus greening bacteria, namely the African form (*Candidatus Liberibacter africanus*), the Asian form (*Candidatus Liberibacter asiaticus*) and the American form (*Candidatus Liberibacter americanus*).

Origin and distribution

Citrus greening is said to have probably originated in China in the 1900s.

The Asian form is the most severe and geographically widespread. This form of the disease currently occurs throughout Asia, the Indian Subcontinent, Saudi

Arabian Peninsula, Brazil, southern Florida, California, Cuba, Mauritius, Reunion, Ethiopia and Kenya. On the African continent the insect vector has also been detected in Kenya and Tanzania since 2010 (Venter, 2012).

The African form (*Candidatus Liberibacter africanus*), is less severe and is more restricted geographically. It is found in Africa, south of the Sahara. On the African continent the insect vector for the African form has been detected in Kenya and Tanzania (Venter, 2012).

The American form (*Candidatus Liberibacter americanus*) is known to occur in Brazil, Cuba, Florida, Belize, Mexico and Dominican Republic.

Symptoms

Citrus trees affected by citrus greening-causing bacteria may not show symptoms for years following infection. The first symptom of this disease is usually the appearance of a yellow shoot on a tree. As the bacteria blocks the phloem, restricting the movement of nutrients from leaves, the entire tree canopy progressively develops a yellow colour (Figure 1) (APHIS, 2007). All three strains of the bacteria produce similar symptoms.

It must be noted that before citrus greening symptoms are seen in the canopy of the tree, root abundance declines by 40-50%.

The incubation period of the symptoms lasts between 6 and 12 months, causing the spread and impact of the disease to occur over multiple years.



FIGURE 1: Citrus tree showing symptoms of yellow shoots (Anonymous, 2021)

The yellowing of the leaves can be confused with nutritional deficiencies, especially a deficiency in zinc (Figure 2). However, there are two important differences. Firstly, early symptoms of citrus greening yellowing often appear on a single shoot or branch, and then spreads randomly in the tree canopy over several years. This is in contrast to nutritional deficiencies which usually occur uniformly throughout the canopy.



FIGURE 2: Citrus leaves showing zinc deficiency (Jackson, 2021)

Secondly, infected leaves show what is called “blotchy mottle” (Figure 3). The patches of yellow are often more on one side of the leaf than the other and are most obvious on newly hardened leaves and fades with age. Leaves with nutritional deficiencies show a general yellowing throughout the leaf.



FIGURE 3: Citrus leaves showing the “blotchy mottle” symptom of citrus greening (Jackson, 2021)

If branches become severely infected, leaves develop symptoms called “rabbit ears”: small upright shoots with short internodes (i.e., the distance between leaves is shorter than usual).

These symptoms are followed by premature leaf drop, twig dieback, decay of feeder and lateral roots, decline in vigour and ultimately the death of the entire tree. Affected trees have stunted growth, bear multiple off-season flowers (most of which fall), and they produce small, irregularly-shaped fruit with a thick, pale peel that remains green at the bottom (Figure 4) (APHIS, 2007).



FIGURE 4: Citrus fruit with a thick, pale peel that remains green at the bottom (Anonymous, 2021)

Greening-affected fruit tastes bitter, medicinal and sour. Seeds usually abort and fruit formation becomes poor. Symptoms vary according to the time of infection, stage of disease, tree species and tree maturity.

Transmission

Citrus greening can be spread by the insect vector as well as by infected plant material. There are two species of psyllid insect that spreads it, the Asian

citrus psyllid (*Diaphorina citri*) and the African citrus psyllid (*Trioza erytreae*). Citrus greening infection can arise in various climates and is often associated with different species of psyllid insects. For example, citrus crops in Africa become infected under cool conditions as the bacteria are transmitted by the African citrus psyllid, *Trioza erytreae*, an invasive insect that favours cool and moist conditions for optimal growth. Citrus crops in Asia, however, are often infected under warm conditions as the bacteria are transmitted by the Asian citrus psyllid, *Diaphorina citri*.

Both species transmit the citrus greening pathogen from infected trees to healthy trees as they feed on the plants. Citrus greening can also be transmitted by grafting infected bud-wood, by dodder and possibly by infected seed. Even though the pathogen is a bacterium, the disease does not spread by contaminated tools, or by wind and rain.

Host range

Citrus greening infects most citrus species relatives. It is largely a disease of sweet orange (*Citrus sinensis*), with Valencias showing more distinct leaf symptoms than Navels. It is also particularly severe on mandarins (*C. reticulata*) and tangelo (*C. sinensis* x *C. reticulata*), but less so on lemon (*C. limon*), grapefruit (*C. paradisi*) and sour orange (*C. aurantium*).

Management

There is no cure or treatment for citrus greening. Once a tree has become infected, it will become unproductive over time. Fertilizer will make the tree appear healthier for a short period of time but will not improve productivity or fruit flavour.

An integrated approach which includes eradicating infected plant material, introducing clean nursery seedlings, adhering to regulatory measures and eliminating insect vectors is recommended.

Treating affected trees with injections of antibiotics alleviates the symptoms but does not eliminate the disease in plants. Removal of trees, which includes cutting the tree at the soil line or removing the whole tree, including roots, is recommended. The tree remains should be burnt.

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