

History of a Plant Pandemic

HUANGLONGBING

(HLB)

Citrus Greening



(HLB)



Citrus Greening

DAMAGE & IMPACT

- Early symptoms include irregular yellow patches on leaves (mottling), followed by defoliation, branch dieback and death of plants.
- Fruit production declines. Those that develop are discoloured, misshapen and bitter in taste.
- Detection and early eradication of HLB is tricky because trees can be infected for up to two years before showing symptoms.
- Up to 30% of trees have been lost in major citrus production regions (e.g. China, Brazil and Florida). Citrus production has dropped by 50% in North America since the disease was first detected in 2005.

Professor Lin Kong-Hsiang

Born in the Pearl River citrus-growing region of southern China, Prof. Lin devoted his working life to identifying the cause of HLB and unlocking the path to disease management. His research career was frustrated by global and national events, beginning with the Japanese invasion in 1937. His university was closed (along with many others) during the Cultural Revolution and he was consigned to a decade of hard labour. Restrictions on international exchanges limited his interactions with other scientists. He carried out extensive surveys of HLB and planted thousands of trees for field experiments. His rigorous scientific approach helped to debunk ideas about the cause of HLB – such as waterlogging, nematodes and nutrient deficiencies. This made him unpopular with contemporaries and peers, particularly with Soviet agronomists who were, at the time, being courted by the Chinese government.



TIMELINE

1890s – CHINA & INDIA
Farmers report mottling of citrus leaves.

1941 – CHINA
Prof Lin begins his survey of citrus groves affected by HLB

1956 – CHINA
Prof Lin publishes seminal research findings: HLB is graft-transmissible and spread by insect vectors

1957 – US (California)
First meeting of International Organisation of Citrus Virologists brings together HLB experts

1970 – FRANCE
Lafliche and Bové use electron microscopy to identify bacteria as the cause of HLB

1971 – 1974 LA RÉUNION
Scientists trial the use of antibiotics to cure HLB and biocontrol of psyllids using parasitic wasps

1980 – LA RÉUNION
Successful biocontrol eradicates psyllid vectors

1995
Huanglongbing (HLB) agreed as official name of the disease

1998 – US (Florida)
Asian citrus psyllid arrives in the heart of orange juice production

2004 – BRAZIL
HLB found in the world's largest citrus producer

2005 – US (Florida)
HLB is confirmed, seven years after the arrival of the psyllid

2008 – US (California)
Asian citrus psyllid first detected. California is the main fresh citrus producer in the US.

2014 – SPAIN
African citrus psyllid found in northern Spain

2020 – US
Prof Hailing Jin's lab develops a peptide treatment for treating HLB

2005

HLB has ravaged the Florida orange juice industry over the last 15 years. The disease appeared in California in 2012 but has been contained. HLB is now widespread in the Caribbean, Mexico and Central America.

2004

First detected in Brazil, the world's biggest orange producer, HLB has led to the destruction of 55 million trees. Larger farms have recovered.

1910s – 1920s

First confirmed in South Africa, where HLB has wreaked havoc on exports. The African psyllid vector is present throughout Africa but so far citrus growers in the Maghreb have escaped the disease. The Asian psyllid is encroaching via the Horn of Africa.

1890s

Asia is the origin of all ancestral citrus varieties and produces over half the world's annual crop. It is where HLB was first found and pioneering research by Prof Lin of China was undertaken.

CAUSE & SPREAD

- First reported in the late 19th and early 20th century in China and India, later spreading across Asia and Africa. Now rampant throughout the Americas.
- HLB is caused by three species of bacteria: *Candidatus Liberibacter*. There are three species: *asiaticus*, *africanus* and *americanus*. The bacteria cannot be cultured outside the host, making research on the disease difficult.
- Short-distance spread is by insects: The Asian Citrus Psyllid (*Diaphorina citri*) and the African Citrus Psyllid (*Trioza erytreae*). They acquire and deposit the bacteria when they feed on leaves and stems. Feeding and egg laying on young leaves also damage citrus plants
- Long-distance spread is usually by movement of infected plants and grafting material. Psyllids can also be carried by strong winds to new regions.

HOSTS: LIME / LEMON / MANDARIN / TANGELO / NAVEL ORANGE

MAIN SYMPTOMS OF HUANGLONGBING

<h5>LEAF</h5> <p>Blotchy mottle Yellow veins Vein corking and green islands</p>	<h5>FRUIT, INTERNAL</h5> <p>Aborted seeds Curved central core</p>	<h5>FRUIT, EXTERNAL</h5> <p>Yellow stain under calyx Abnormal colouring Small & misshapen</p>	<h5>CANOPY</h5> <p>Overall yellowing Off-season bloom Twig die-back</p>
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FUTURE PROSPECTS

- Effective quarantine measures and timely surveillance are critical to preventing new introductions. Important citrus producers in Europe, Australia and much of California are still at risk from HLB.
- Trained sniffer dogs can detect plants 32 days after they've been infected, speeding up identification of new outbreaks and early eradication efforts.
- Pesticides are used in commercial orchards but are controversial. Biological control and antibiotics have had limited success.
- Tolerant citrus plants such as trifoliate orange (*Poncirus trifoliata*) are being used in breeding programs and grafting to limit losses and impact of HLB.
- A new peptide treatment developed by researchers at the University of California Riverside shows promising results. Sprays and injections can clear symptoms and revive healthy growth within a few months.

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