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Huanglongbing disease of citrus trees

Huanglongbing, previously called greening disease, of citrus trees

The worst disease of citrus across much of Africa and Asia is citrus huanglongbing (HLB) which was previously known as greening disease. It is caused by a bacterium that infects only the food conducting tissues of the tree or phloem vessels, and the insects that spread it from tree to tree (the disease vectors). HLB destroys trees, has no cure, and affects all of the main types of citrus. The bacterium, following a naming convention for bacteria that can not be cultured, is called '*Candidatus* Liberibacter asiaticus' and the only known vector is the citrus psyllid, *Diaphorina citri* Kuwayama (Hemiptera: Psyllidae).

The name of the disease was recently changed from greening to the Chinese word, huanglongbing because China was the country in which this disease was first discovered. Huanglongbing is Chinese for 'yellow dragon disease', a description used because infected trees go yellow, usually starting from one branch or one part of the tree, before they die, -as if attacked by a 'yellow dragon'. In other parts of the world (mostly Africa) a different '*Ca.* Liberibacter' species and a different psyllid are responsible for HLB.

HLB is a major new quarantine threat to the Pacific region since '*Ca*. L. asiaticus' and the citrus psyllid appeared in the north west of the Sandaun Province in PNG in 2002. The disease is now the subject of a quarantine containment campaign in PNG. This Pest Advisory Leaflet provides information about surveillance for the disease and its vector and quarantine measures. It also includes some disease management advice which could be useful in places where HLB has become established.

Fig. 1. HLB symptoms on fruits

Fig. 2. A yellowing of only one branch or sector of the canopy or sectoral chlorosis

SYMPTOMS OF HLB

Some of the symptoms of HLB are the same as those of nutrient deficiencies, making early recognition difficult, especially when trees are not well looked after. The leaf symptoms include a blotchy mottle or diffuse yellowing; zinc deficiency symptoms, which are a green on yellow vein banding and islands of green tissue; thin, yellow, upright new growth leaves. On fruits, ripening occurs at the stalk end first, though the colour change may not occur in many citrus fruits in warm climates, and the central column of the fruit is curved, distorting fruit shape, and seeds abort (Fig. 1).

A yellowing of only one branch or sector of the canopy that later spreads, is characteristic of HLB and this would be clearly seen in an otherwise healthy tree (Fig. 2).

Fig 3. Chlorotic blotching plus vein swelling of orange leaves affected by HLB

There are also some combinations of leaf symptoms which are key visual guides. Chlorotic blotching plus swollen or corky leaf veins is one (Fig 3). A blotchy mottle plus green on yellow vein banding together on the same branch is another (Fig. 4).

THE INSECT THAT SPREADS HLB

The citrus psyllid is found on buds and young leaves where they suck the sap, causing some leaf distortion and curling. Leaves may be covered with honeydew and sooty mould. Adult psyllids can live for six months and are 3-4 mm long with a yellowish-brown body and greyish-brown legs. Wings are clear and mottled with brown. Nymphs are smaller and generally yellowish-orange in colour. Psyllids are often confused with aphids, which are of similar size and are common on young tender citrus leaves. The main difference is that aphids move slowly whereas adult psyllids are active insects which jump when disturbed and may fly a short distance. Adult psyllids also hold an unusual posture on the leaf: head down, almost touching the surface, rear end pointing up, at an angle of up to 30 degrees (Fig. 5). Like aphids, psyllids are often tended by ants which are attracted to the honeydew they produce.

Fig. 4. Blotchy mottle plus green on yellow vein banding

Fig. 5. The Asian citrus psyllid, Diaphorina citri

DISTRIBUTION

HLB has been common for decades in Asian countries close to the Pacific Islands, such as Malaysia, Viet Nam, the Philippines and Indonesia and is also a new arrival in South America, confirmed in Brazil in 2004. The disease does not occur in Australia, New Zealand or North America and with the exception of Florida in the USA, the vector is also absent from these countries. Apart from the island of New Guinea, both HLB and the citrus psyllid are also absent from the Pacific region. It does not occur in Australia, New Zealand or north America and apart from the island of New Guinea, it is also absent from the Pacific region. A report that the disease was found in the Fiji Islands, Samoa, Tonga and Palau in the mid 1990s (Kiritani and Su 1999) is now thought to be a mistake. Generally, the arrival of the psyllid in a new region has been followed within a few years, by an outbreak of the disease, as happened on the island of New Guinea.

HOSTS OF THE DISEASE AND VECTOR

Little is known about which plants other than *Citrus* spp. may be hosts for '*Ca*. L. asiaticus' except that there are reliable reports from south east Asia that mock orange (*Murraya paniculata*) is one. The citrus psyllid can feed on many plant species besides citrus. Mock orange (Fig. 6) and Chinese box (*Murraya exotica*) are the best hosts and curry leaf (*Bergera koenigii,* Fig. 7.) and most *Clausena* spp. are good hosts. Mock orange (Fig. 6) and curry leaf (Fig. 7) are particularly common in the Pacific Islands. The former is a favourite ornamental and the latter is often grown in back yards for use in the kitchen. Other known hosts include species within the genera *Atalantia*, *Aegle*, *Limonia* (syn. *Feronia*), *Severinia, Swinglea,* and *Triphasia* (Aurantieae); *Merrillia* (Clauseneae); *Toddalia,* and *Vepris* (Toddalieae). It is likely that there are more unknown hosts including native species.

Fig. 6. Mock orange (Murraya paniculata)

Fig. 7. Curry leaf (Bergera koenigii)

QUARANTINE PRECAUTIONS

'*Ca*. L. asiaticus' will not survive without a vector so quarantine in the Pacific should focus mostly on preventing movement of psyllids. The biggest quarantine threat is transport by people of infested citrus and other host plants, especially mock orange. HLB is not known to be transmitted in seeds.

Surveilance for the vector

Psyllid numbers generally go down after heavy rain and populations will be at their greatest after the first growth flushes of the new wet season following dry weather. Look for psyllid adults and nymphs on under surfaces of new growth flushes of host plants, especially on the lower part of the canopy on the shady side of the tree. Sample with a sweep net and collect psyllids from the net using an aspirator and place them in 70% alcohol.

Surveilance for the disease

As the symptoms of HLB look like those of other problems, the disease can be difficult to survey for when trees are stressed. Chlorotic blotching and swollen or corky leaf veins are two key visual guides, especially when in combination on the same leaf (Fig 3). The pathogen can only be properly diagnosed using biotechnology (DNA testing). If HLB is suspected, leaves showing symptoms, including leaf stalks should be sent under quarantine security to a suitable laboratory (contact SPC for details). Disease symptoms are not seasonal.

WHAT TO DO IF THE DISEASE IS PRESENT

The only cost effective action to take is removal of HLB inoculum which is the infected plant tissues. On a country wide scale, this can be achieved with internal quarantine precautions.

Eradication of small outbreaks

Diseased trees occur in clusters in citrus orchards which reach sizes up to around 25 m across. In the backyards of Vanimo town in PNG where HLB first appeared, diseased trees were also grouped together, but these clusters expanded in size only very slowly. Therefore, the destruction of infected plus all surrounding citrus and psyllid host trees within at least 50m of an infected tree should give a good chance of eradicating the disease. Importantly, a spray program to kill all psyllids infesting these and other host trees prior to felling is essential. This is because short distance spread of HLB mostly occurs when psyllids are disturbed and they react by jumping and making short landing flights. They can travel longer distances if they rise up above the tree canopy and are carried in the wind. Ensuring rapid death of psyllids is also very important and this could be achieved with a foliar spray of higher than normal strength Dimethoate or Diazanon. Systemic insecticides applied to tree trunks would minimise contamination of the environment. Imidacloprid (Confidor) could be painted onto the trunk and this chemical or the cheaper alternative dimethoate could be injected into trunks or simply poured into holes drilled in trunks. Less toxic to the public would be a spray of 2% white oil at very high volume, literally soaking the tree. However, this would need sophisticated spraying equipment with an agitator, capable of spraying 60-100 litres for a 6 m high tree. These are drastic measures, which would incur great expense and environmental impact. Before attempting eradication of a new outbreak, the likelihood of similar incursions following needs to be taken into account.

Disease containment

Natural spread rates in north-west PNG were found to be very low, implying that successful containment within a limited region of a large island is possible. This can be achieved with a campaign of public awareness and legislation to prevent movement of citrus and *Murraya* planting material from the region.

Disease management

Once HLB becomes established in an area, inoculum reduction is again the best control strategy. In South Africa, control measures are based on ongoing removal of infected plant parts, combined with chemical controls to keep psyllid populations at a minimum.

HLB inoculum reduction Individual branches affected by HLB will not bear good fruit and do not recover. As the bacterium spreads only slowly through infected trees, removing only the parts of the tree showing symptoms can be useful, depending on age of tree and infection levels. This practice is summarised in Table 1. Tree destruction or pruning must be done when psyllid populations are at a minimum, otherwise the disturbance will increase tree to tree spread of both psyllids and disease. In many Pacific Islands, it may be possible to carry out inoculum reduction actions when psyllid populations are naturally low, simply by timing the work carefully. This would avoid the environmental impact and costs of killing psyllids prior to working on trees. If a distinct wet season occurs, psyllid numbers will be at their lowest towards the end of it, making this the ideal time to get rid of HLB infected branches and trees. Replacement trees must be known to be HLB free, either obtained from disease indexed nursery stock, or from disease free areas

Table 1. HLB management as practiced in South African orchards, when combined with chemical treatments to minimize psyllid populations.

Age of trees	Amount of canopy with symptoms	Treatment
<5 years	Any symptoms	Destroy tree
6-10 years	<75%	Remove only affected branches
6-10 years	>75%	Destroy tree
> 10 years	<40%	Remove only affected branches
>10 years	>40%	Destroy tree

Minimising psyllid populations Contact and systemic insecticides will not prevent introduction of HLB to individual trees or orchards, but they can help reduce HLB spread by reducing psyllid populations. In Asia, a range of insecticides, mostly organophosphates and pyrethroids, are used in very intensive spray programs to kill nymphs and eggs on flush growth. Horticultural and agricultural mineral oils are now being developed as alternative treatments. These are much less damaging to the environment and less disruptive to biocontrol of other pests. In South Africa, tree trunk applied systemic insecticides aimed specifically at psyllids have been most effective. If HLB becomes a problem in large scale commercial citrus production in the Pacific in the future, seek latest advice on most suitable practices.

Reference

Kiritani K, Su H-J (1999) Papaya ring spot, banana bunchy top, and citrus greening in the Asia and Pacific region: occurrence and control strategy. *Japan Agricultural Research Quarterly* **33,** 22-30.

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