CITRUS BLIGHT

1 PATHOLOGICAL PROFILE

1.1 Distribution and status

Citrus blight, known also as roadside decline, sandhill decline and young tree decline (YTD), is a disease which has confounded researchers worldwide for almost a century. In spite of extensive research efforts the cause of the disease remains obscure. Experiments involving the grafting of infected root pieces or roots of infected trees to roots of healthy trees indicate that blight may be caused by an infectious agent. The identity and nature of this agent is still unknown.

Citrus blight occurs mainly in the hot, humid production areas of southern Africa (Letsitele, Nkwalini, Nelspruit to Komatipoort and Swaziland) but has also been found to occur in cooler, less humid areas, including Marble Hall, Potgietersrus and Muden.

The rate of spread of citrus blight in an area such as Letsitele where the disease is endemic varies from 3 to 5% per annum. Initially the distribution of the disease is random; within a year or two it becomes non-random as trees adjacent to infected trees become infected.

1.2 Description

The cause of citrus blight is unknown. Circumstantial evidence has implicated various soil, nutritional and cultural factors as possible causes of blight, suggesting that blight is a stress-related disease. However, transmission of the disease has been obtained by grafting roots of infected trees to those of healthy trees, which indicates that an infectious agent is implicated.

1.3 Symptoms

Initial symptoms which develop depend on the soil type in which the trees are growing. In sandy loam soils, the first sign of infection is the appearance of zinc deficiency symptoms (inter-veinal chlorosis), first at the canopy skirt and then in mature, hardened spring flush. Wilting of the canopy does not necessarily accompany these symptoms. On heavier soils, initial symptoms are a leaf roll caused by wilting and leaves have a hardened appearance. This is followed by the appearance of zinc deficiency patterns at the canopy skirt and hardened new flush. The symptoms on both soil types may occur in sectors of the tree or affect the entire canopy. When symptoms are limited to a sector the earliest symptoms commonly occur in the north-west sector. Leaf drop accompanies persistent wilting in trees and terminal die-back occurs in affected branches.

Blossom in affected trees is delayed by several weeks and fruit set is lighter than in healthy trees in spite of heavy blossoming. The fruit produced is normal in shape and is of excellent internal quality, but very much smaller. As the disease progresses with time the yield declines to such an extent that only a few fruit are set. At this stage water-sprouts may develop at the base of the trunk and on scaffold branches. The affected trees become moribund but rarely die.

Feeder roots appear healthy and abundant in early stages. In moderately affected trees these roots degenerate and often exhibit signs of necrosis at the distal ends due to invasion by secondary micro-organisms. Sloughing of the bark (phloem) occurs and the wood may be discolored black or brown. No lesions or gummosis appear on the trunk, branches or roots as is the case with several other diseases.

Initially, blight affected trees are usually randomly scattered in an orchard, but solid blocks or rows of trees may also become affected. It may take two to six years for an adjacent tree to become affected.

Many of these symptoms are non-specific and can be caused by other disease agents. Fortunately blight can be distinguished from other declines caused by tristeza, nematodes, *Phytophthora* spp., greening disease and *Fusarium* spp. by measuring the water uptake in the trunk and by analysis of zinc in the trunk xylem (wood) or phloem (bark). Affected trees have restricted water uptake as a result of plugging in the xylem vessels by great numbers of amorphous plugs, and a high zinc content in the xylem, five to tenfold of that in healthy trees. Amorphous plugs are

blockages in the xylem consisting of solid material which has no structure. These plugs are composed of gums, pectins, lignin and proteins.

1.4 Transmission

Field experiments in which roots of healthy trees were grafted to the roots of blighted trees or with diseased root pieces, indicate transmission of an infectious agent. Spread from tree to tree in the row may indicate transmission via natural root grafting or by some other soil-borne vector.

At present there is no direct evidence to support the involvement of an aerial vector. There is also no direct evidence for transmission through seed or infected budwood. These sources cannot be ruled out as there are many cases where solid blocks of trees are affected.

1.5 Seasonal occurrence

The initial symptoms of citrus blight are frequently observed during early summer in newly developed growth. Normally only bearing trees are affected and symptoms become most noticeable by eight to ten years of age. Replants on sensitive rootstocks have been observed to develop blight as early as six years after planting on previously affected sites.

2 MANAGEMENT ASPECTS

2.1 Disease assessment

Non-bearing trees rarely show symptoms. Once a tree in a previously unaffected planting or production area exhibits visual symptoms of the disease, diagnosis can be confirmed using the water injection technique and wood or bark samples should be collected and submitted to Central Agricultural Laboratories (CAL) for zinc analysis. A serological test is also available but has to be conducted in the laboratory at Citrus Research International. This test is not definitive as yet but is considered as a back-up for the other diagnostic tests if necessary.

The diagnostic tests are conducted as follows:

Measurement of water-uptake: Diseased trees have a significantly slower rate of water uptake which can be assessed as follows: A 25 mm deep hole is drilled into the trunk of the diseased tree 20 cm above the bud union using a 3 to 4 mm diameter drill bit. A 30 ml disposable plastic syringe without the needle, is then filled with clean water and fitted snugly in the hole in the trunk. The barrel of the syringe is steadied with one hand while applying maximum pressure to the syringe plunger with the other hand. Endeavour to keep a constant pressure on the plunger when restricted water uptake is encountered. If the pressure is increased the plunger will be bent or broken. The time required to inject 10 ml of water or the amount injected within 30 sec must be recorded using a stopwatch. This procedure must be carried out on at least six healthy and six diseased trees for comparative purposes. This test must be conducted during spring and summer when there is good sap flow.

Wood or bark sampling for zinc analysis:

Diseased trees are also subject to the accumulation of zinc in the bark and outer layers of the wood. In trees exhibiting mild foliar symptoms, zinc accumulation initially occurs in the bark and is absent in the woody tissues. As the tree declines, zinc starts to accumulate in the woody tissues as well. In severely affected trees the zinc content in the bark varies considerably. Wood samples should therefore be collected from trees exhibiting severe symptoms while bark samples should be collected from trees showing mild symptoms.

When collecting bark samples, remove a patch of bark 30 mm x 100 mm over the site where the syringe was inserted during water uptake measurement. Scrape away the cambium on the exposed wood of the trunk and then drill two holes 25 mm deep into the trunk using a 13 mm auger bit. The drillings are caught in a small paper bag fixed to the trunk below the drilling site, by means of drawing pins, or held in place by an assistant. These samples must be air-dried, labeled (requesting zinc analysis) and forwarded to CAL. Never keep the samples in plastic bags as they become mouldy and cannot be processed.

In orchards where the diagnosis of blight has previously been confirmed, visual symptoms are usually sufficiently reliable to base decisions on.

2.2 Control options

There is no successful corrective treatment for this disease. The grower has to decide, depending on the condition of the tree, whether to retain it in the orchard and harvest the ever decreasing crop or whether to remove the tree and replace it. The latter option is recommended as the diseased tree constitutes a source of infection for the adjacent trees and becomes uneconomical due to the progressive decline in fruit size.

2.2.1 Cultural

a) **Plant superplant trees on tolerant rootstocks**

In South Africa, trees on Rough lemon and Volckameriana rootstock are the most susceptible to citrus blight. Those on Troyer citrange and *Poncirus trifoliata* are of intermediate tolerance.

The following has been found to be the order of decreasing tolerance of rootstocks to blight in Florida, USA: sour orange, sweet orange, Cleopatra mandarin, Swingle citrumelo, Carrizo and Troyer citranges and rough lemon. Volckameriana appears to be intermediate between the citranges and rough lemon. Sour orange cannot be used in South Africa due to its sensitivity to *Citrus tristeza virus*.

Results in rootstock trials in Letsitele indicated the following order of tolerance to citrus blight (decreasing order): X639, Benton citrange, Marsh grapefruit, Sunki mandarin, Orlando tangelo, Zuan Luan, Gou Tou, Sun Chu Cha, Sampson tangelo, Cleopatra mandarin, Minneola x trifoliate, Swingle citrumelo, Volckameriana, *Poncirus trifoliata*, Empress mandarin, Carrizo and C35 citranges. At present X639 rootstock is the best option to be used for replanting in blight-affected orchards.

Planting Superplant trees will eliminate a possible source of infection which may have been present in budwood sources used previously.

b) **Prevent secondary spread in the orchard**

Remove affected trees as soon as they are observed and diagnosed as having citrus blight. Trees can be sawn off at 15 cm above ground level and the freshly sawn stumps treated with a herbicide such as Roundup (10% solution) or Sting (100%). The herbicide can be applied with a paint brush or knapsack sprayer immediately following sawing. Any root-sprouts which develop during subsequent months must be treated with Roundup or Sting. It is important that the whole root system be killed as it serves as a source of infection. Replant with trees on a tolerant rootstock six to nine months after treatment.

If the grower is anxious to replant as soon as possible, complete removal of the tree and root system is necessary and then treating the area by a soil drench with 65-100 ml/m^2 of metam-sodium (Busan, Herbifume). It has the benefit that all soil pathogens are eradicated, automatically neutralizing a potential replant problem. If the tree is removed with its root system the grower should avoid dragging the tree through the orchard as this may help to spread the disease. Rather make use of a trailer to remove the uprooted tree.

c) **Soil preparation of new planting sites**

Citrus blight occurs on all soil types planted to citrus, but orchards on certain soil types have a higher incidence of disease. These soils are generally shallow with underlying hard pans. In Florida, USA, blight was found to occur sooner and was more severe where trees were planted on shallow sands over clay pans, compared with deeper sandy soils. A survey of citrus blight affected orchards in Letsitele showed that blight is more severe and occurs earlier on shallow poorly drained soils with underlying hard pans and rocky outcrops.

2.2.2 Plant protection products

No chemical control options have been developed as the causal organism and its vector(s) are unknown.