# PREVENTION AND CURE OF GREENING DISEASE IN CITRUS

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## Introduction

Various new procedures are now available to the farmer in his fight against greening disease. Some of these measures are aimed at controlling the carrier or vector of the disease, namely the citrus psylla, *Trioza erytreae* (Fig. 1). Others are aimed at control of the greening disease organism itself. It is only through a combination of these control measures that really effective reduction of the disease can occur.

## CONTROL OF PSYLLA

### (a) In the nursery

It is essential to protect young nursery trees from psylla attack in order to prevent early infestation by greening which would result in totally retarded and unproductive trees.

It has been found that for container-grown plant, dimethoate (Perfekthion 40% sc) diluted at 400 ml to 100 l of water and applied to the soil at the rate of 250 ml per 15 l container, gives 6 weeks' protection against psylla, aphids and thrips. The solution is simply poured onto the soil around the plant.

Where seedbeds are used, the same mixture (400 ml/100 l) may be watered onto the surface of the seedbeds at a rate of 25 litres per 10 $m^2$. Avoid contacting the foliage, by removing the rose from the watering can (Fig. 2).

*Caution*

Note that seedlings of West Indian Lime and citron are highly sensitive to dimethoate. The *foliage* of rough lemon, sour orange, citron, kumquat and Meyer lemon is also sensitive to dimethoate. No problems have been experienced with the following rootstocks: Empress mandarin, Troyer citrange, Cleopatra mandarin, *Citrus volkameriana* and rough lemon. Empress scions are also sensitive to soil applications.

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**Fig. 1. Leaves pocked by citrus psylla. The nymphs are found on the underside of such leaves.**

### (b) In the field

*(i) Flood irrigation*

It is important to bear in mind that, to be fully effective, dimethoate must reach the entire root system of the tree. Sufficient water must therefore be used to guarantee adequate penetration. Where flood or basin irrigation is used, this is best achieved by first filling the irrigation basin with 30 to 40 mm water and then adding the insecticide in diluted form. It is applied at the rate of 10 ml of formulation per square metre of basin (eg, a basin measuring 4 m × 4 m would require 160 ml of formulation). The dimethoate should preferably be diluted (say 1 part to 10 parts water) before adding it to the irrigation basin. It may be added by way of a watering can, water cart or spray machine (operating at atmospheric pressure only). Remember that

**Fig. 2. Application of dimethoate to nursery seedlings. The foliage should not be wetted.**

the pesticide must *not* be sprayed onto the foliage.

*(ii) Dragline irrigation*

The same principles apply here, as with flood irrigation, namely that the pesticide must reach the roots of the trees and should not be sprayed on the foliage.

The dosage applied is based on the shade area of the tree. (Very young trees (Fig. 3) may be taken as 1 $m^2$). For example a tree with a shade radius of 2 m would receive (2 m × 2 m × 3) × 10 ml = 120 ml. (Radius squared × $\pi$ × 10 ml).

The formulation should first be diluted with water — at least 1 part to 10 parts water — in order to obtain effective distribution around the tree. The solution may be applied by watering can (Fig. 4) or from a water tanker. Herbicide applicators have also been adapted for this purpose. Watering should commence as soon as possible after this primary application and in any case not later than 24 hours after soil application. An irrigation of 25 to 30 mm should be applied in order to wash the pesticide into the root zone.

The pesticide may not be applied through the dragline irrigation system.

*(iii) Microjet irrigation*

The concept of soil application of insecticides to citrus was basically designed for this system of irrigation.

The whole principle of microjet irrigation is based on the application of relatively small quantities of water at very short intervals, thereby maintaining soil moisture more or less permanently at an optimum level. This ensures optimum growth and production and at the same time, because the water is only applied in the root zone, it results in a marked saving in water use. This is particularly important with young trees. The short time interval between applications also allows for a quicker adjustment to prevailing climatic conditions.

Because microjet systems are permanently installed, no movement of equipment is required and this results in a considerable saving in labour. Apart from efficient application of water, the microjet system can also be used for the application of soluble plant nutrients, herbicides and insecticides.

An important advantage in the application of insecticides in this way is the saving of labour. Furthermore the low-profile application does not reach the canopy of the tree (Fig. 5) and therefore the natural enemies of scale insects are not affected.

When treating trees under microjet irrigation, water should preferably first be applied for 30 minutes prior to treatment.

The dosage is calculated on a per tree basis as above (for dragline irrigation) ie, shade area in square metres × 10 ml. A mix-tank is then inserted between the general filter and the main irrigation line. Approximately 100 trees may then be treated at one time, by adding the relevant dosage (eg, area of 1 tree × 100 × 10 ml) to the mix-tank. The irrigation system is then turned on and allowed to run for sufficient time to apply 25 to 30 mm of water per tree.

## TIMING OF DIMETHOATE APPLICATIONS

Various factors should be taken into account in deciding on the time of application of dimethoate. In the nursery, applications should be made every 6 to 7 weeks, depending on the insect pressure. If any psylla is present in the vicinity, regular treatment is essential.

**Fig. 3. Application of dimethoate to the soil around young trees which are under dragline irrigation.**

In the field, the application of dimethoate was originally recommended at 70 to 80% petal drop in order to obtain maximum effectiveness against thrips. Depending on weather conditions it may take 1 to 2 weeks for the treatment to become fully effective.

Where other treatments are applied for thrips control it may be possible to delay application until 100% petal drop. However, as soon as the first signs of psylla adults or eggs are seen on the new flush, treatment should be applied

**Fig. 5. Microjet irrigation for application of dimethoate to established trees.**

**Fig. 4. Watering-in dimethoate around a large tree prior to starting the dragline irrigation system.**

immediately. Follow-up treatments should be applied 6 to 7 weeks later, if psylla pressure is still high.

This treatment has also been found to control the black citrus aphid, *Toxoptera citricidus* and to suppress red scale.

**Another important factor in the timing of these treatments is that any trunk injections of tetracyclines should be carried out during the same period in which the trees are protected against psylla attack. This will reduce the risk of spread of greening disease to a minimum.**

*Caution*

Growers are warned that it has been found that where dimethoate is applied to trees within 3 weeks of application of a mixture of bromacil and diuron herbicides, severe phytotoxicity may follow.

As an alternative to soil application of dimethoate, various pesticides are registered for use as foliar sprays against psylla.

## CONTROL OF THE GREENING ORGANISM

Citrus greening disease can be effectively controlled using an antibiotic commercially known as Citromycin (a.i., tetracycline hydrochloride). The greening organism, which is bacterium-like, occurs in the phloem of diseased trees and therefore the only effective method of applying the Citromycin solution to diseased trees is by trunk injection.

Treatment should be carried out during the first flush period of the season (Aug to Oct). The best results are obtained by a continuous injection for a period of 7 days, irrespective of the quantity of Citromycin solution taken up by the tree. This may vary from 2 to 16 $\ell$, depending largely on the size of the tree. Since this treatment is time-consuming an alternative method, found to be effective, is to inject a fixed volume of Citromycin solution into a tree. This volume, varying from 1 to 8 $\ell$, depends on tree-size and should be sufficient to move into all branches of the tree.

## REQUIREMENTS FOR TREATMENT

1. Citromycin powder and the measuring spoon that is supplied with the powder.
2. Plastic container of about 50 $\ell$. Plastic is preferred to metal because in the latter the antibiotic tends to lose its effectiveness rapidly.
3. Application apparatus, preferably plastic.
4. String or wire to hang the apparatus on the tree.
5. If the plastic container is not graduated, a measuring bucket.
6. Hand-brace with a 10 mm "metal" drill (bit). A "metal" drill is preferred because a cleaner hole is drilled than with a "wood" drill.
7. Plastic squirt bottle (known as a "wash bottle").
8. A piece of 10 mm pipe and a light hammer.
9. Pump (bicycle pump).
10. Clean water.

## PROCEDURE BEFORE CONNECTING THE APPARATUS

Hang the application apparatus from the tree near the trunk from a lower branch at a suitable height (Fig. 6). The supply pipes of the apparatus should be kept in such a way that the openings will be

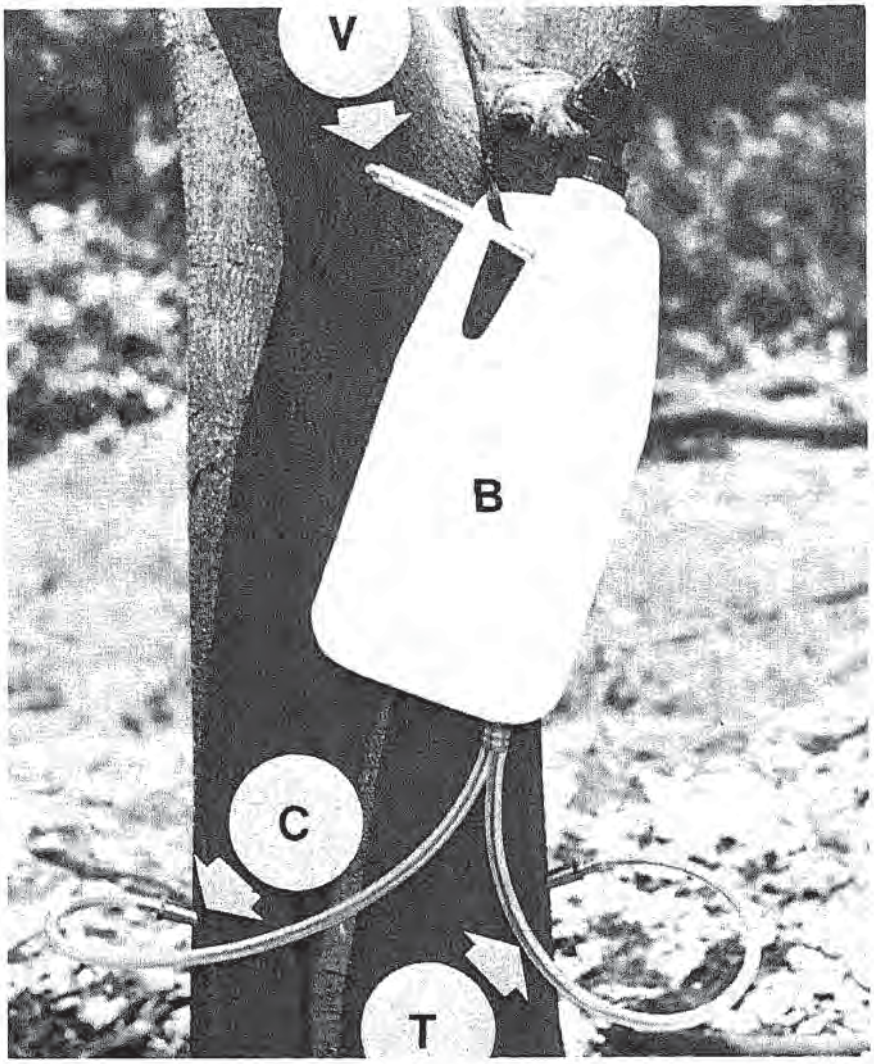



**Fig. 6. Two litre plastic bottle (B) pressurised by bicycle valve (V) and connected to the tree trunk via polythene tubes (T) and connectors (C) for Citromycin application.**

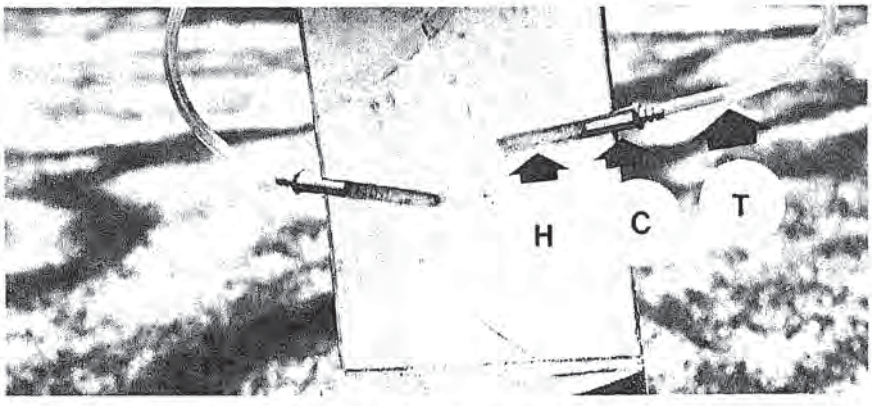



**Fig. 7. Bottle attachment to holes (H) drilled in tree trunk using connectors (C) and tubes (T).**

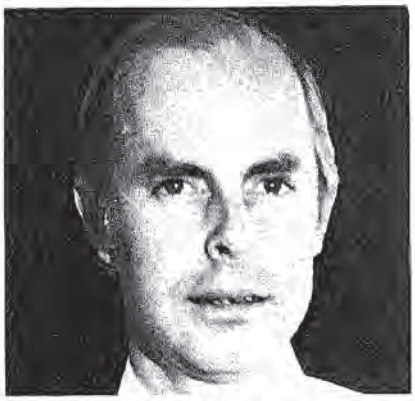
above the Citromycin solution in the container. Measure the desired quantity of water into the plastic container and, using the measuring spoon, add 1 g of Citromycin powder per litre water and stir until all the powder has dissolved. Pour about 2 ℓ of this solution into each container that has been attached to the trees.

## CONNECTING THE APPARATUS

The most important aspect of the connection of the apparatus is the exclusion of all the air in the supply pipes of the apparatus and in the holes drilled into the trunk. Therefore the holes should be drilled slightly downwards opposite each other into the trunk. For good distribution of the solution the depth of the holes should be about half of the trunk-diameter and can be drilled at any site on the trunk (Fig. 7).

Fill the holes in the trunk with water using the plastic squirt bottle. Tap the connection pieces lightly into the holes using the piece of 10 mm pipe and hammer. By using the piece of pipe no damage is done to the connection pieces. See that the connection pieces are also filled with water.

Bring the ends of the supply pipe below the level of the solution in the container until all the air has escaped. Close the pipe at that level by bending it double about 50 mm from the end and



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push the opening over the connection piece. When both pipes are connected the container can be pressurised by the pump (10-15 pumps with a bicycle pump).

As the solution is taken up by the tree the pressure in the container drops, and therefore repressurisation is periodically required. When the level of the solution has dropped, the containers should be refilled if required, and repressurised.

After treatment the apparatus can be depressurised and removed. An easy method to remove the connection pieces from the holes in the trunk is to turn them a few times with a spanner until they loosen. The holes in the trunk can then be treated with a tree-sealing compound.

Care should be taken that reinfestation by psylla does not occur during or after treatment.