

IMPORTANT PATHOGENS OF CITRUS FRUIT

1 GREEN MOULD (*Penicillium digitatum*)

Infection takes place solely through wounds caused by insect attack and injuries caused during picking, hauling and packing. Incidence of green mould can be reduced by careful handling (to minimise injuries), sanitation in orchard and packhouse (to minimise spore load in air and on the fruit), insect control (fruit fly and false codling moth, sometimes fruit piercing moth), chlorination of dump tank, and by fungicide treatments in the packhouse. TBZ (where resistance to the benzimidazoles has not yet appeared), SOPP, imazalil or combinations thereof may be used to control green mould.

2 BLUE MOULD (*Penicillium italicum*)

Mode of infection and control measures are the same as for green mould. May also spread in packed carton from infected fruit to sound, uninjured fruit, causing "nests" of decay.

3 DIPLODIA BROWN STEM-END ROT (*Diplodia natalensis*) (*Botryodiplodia theobromae*)

The fungus sporulates on dead bark and spores may survive from one season to the next. During rainy weather the spores are washed onto the small fruitlets and eventually become trapped under the calyx lobes (button tissue). The fungus does not enter the fruit before natural openings are formed during formation of the abscission layer.

Anything that will lead to formation of the abscission layer, e.g. injuries, over-maturity, ethylene degreening, etc., will contribute to the incidence of *Diplodia* stem-end rot (SER). High temperatures also favour the development of *Diplodia* SER. *Diplodia* SER may be prevented by limiting the amount of dead wood in the tree, picking the fruit before it becomes over-mature, preventing abscission of the button by using 2,4-D in the packhouse and by treating the fruit with the fungicides SOPP, TBZ or imazalil. Getting the fruit under cooling as soon as possible after picking and packing is very important in reducing the potential for development of *Diplodia* SER.

4 SOUR ROT (*Geotrichum citri-aurantii*)

This fungus is widespread and is present in the soil of all citrus producing areas. The spores are spread to the fruit by dust and by water splashing from the soil onto low-hanging fruit. Injuries penetrating to the albedo (white portion of the peel) are necessary for infection to take place. These are often provided by insect attack, mostly false codling moth (FCM), fruit flies and fruit piercing moth and by incorrect snap-picking. All varieties of citrus are susceptible, but especially the mandarin hybrids. The fungus may also be spread by vinegar flies (*Drosophila* spp.) from infected to injured fruit. The fungus develops most rapidly at temperatures above 27°C and overmature fruit are more susceptible than younger fruit.

Guazatine (Deccotine, Deccowax) is the only registered post-harvest fungicide that gives good control of sour rot and the use of SOPP (Dowicide A) results in some protection.

To minimise sour rot, insects must be controlled, serious injuries must be avoided, e.g. those caused by careless snap-picking. The fruit must be packed and cooled as soon as possible after harvest (the fungus develops very slowly at temperatures below 5°C), and fruit must be harvested before they become overmature. Packhouse sanitation must be strict so that there is no opportunity for vinegar flies, which are attracted to rotting fruit, to spread sour rot. Sour rot spreads in packed cartons of fruit from infected fruit to sound, uninjured fruit, causing "nests" of decay. Sour rot development is also stimulated by the presence of green mould spores.

5 ALTERNARIA ROT (*Alternaria citri*)

Alternaria rot of citrus fruit manifests itself in different ways. The fungus causes a navel-end rot of Washington Navels, a stylar-end rot of lemons, mandarin hybrids and sometimes other orange varieties such as Hamlin, Tomango and Valencia, a stem-end rot in all citrus varieties and an internal black or brown rot in most citrus varieties.

The spores of the fungus infect the flower tissue and when the fruit is more mature, the fungus is already established in the button tissue, deep in

the navel cavity of Washington Navels and on the stylar scar - in most cases out of reach of fungicides. *Alternaria* rot may also develop from injuries to the rind, either caused mechanically or by insects such as false codling moth. The incidence of *Alternaria* rot increases with mealybug infestation levels.

Mature fruit and fruit of low vitality, produced because of unfavourable weather conditions such as prolonged low temperatures or frost, dry, hot winds, low humidity or extreme heat, are very prone to attack by *Alternaria*, as well as fruit showing sunburn or, in the case of lemons, affected by endoxerosis.

Control measures consist of cultural procedures that will produce fruit of high vitality, and the culling of fruit showing sunburn, cracks at navel or stylar ends, signs of endoxerosis, e.g. fruit having high colour or no buttons. The use of 2,4-D in the packhouse, to delay abscission of the button, is essential.

6 TRICHODERMA BROWN ROT (*Trichoderma viride*)

This fungus is a common soil inhabitant and attacks the fruit of all citrus varieties. Initial infection depends on injuries to the fruit, but in packed cartons of fruit the fungus spreads from infected fruit to sound uninjured fruit. *Trichoderma* is a cellulose-decomposer and makes good growth on paper, cardboard and wood.

The fungus invades cartons and wooden storage boxes from where it can grow out again and infect sound fruit.

Control consists of avoiding injuries to the fruit, cleaning out (by using steam or formaldehyde) wooden storage boxes or lugboxes in which *Trichoderma* rot of citrus fruit has developed, by using TBZ or benomyl to protect the fruit and by low temperature storage.

7 ANTHRACNOSE ROT (*Colletotrichum gloeosporioides*)

This fungus is widespread in citrus orchards. Spores are produced on dry twigs and dead tissue from where they are spread by wind, rain and insects to the young fruitlets. The fungus penetrates the rind and then remains latent until conditions are favourable for further growth, e.g.

over-maturity or injuries to the fruit. Occasionally young fruit still on the tree may be attacked by the fungus growing from infected, dying twigs into the fruit. All citrus species are susceptible but especially mandarin types.

Control is achieved by cultural practices which result in vigorous trees and fruit of high vitality, by avoiding an accumulation of dry twigs in the tree, harvesting at optimum maturity and avoiding very long storage. Packhouse applications of TBZ, imazalil and prochloraz help to control this disease.

8 FUSARIUM BROWN ROT (several species of *Fusarium*)

Fusarium is a common soil inhabitant and is therefore commonly present in the dust on the fruit surface. *Fusarium* rot does not occur commonly, and is restricted to low vitality or over-mature fruit, or fruit that has been stored for long periods of time.

Fusarium brown rot is avoided by picking fruit at optimum maturity, not packing low vitality fruit (e.g. fruit with navel or stylar end splits), storing fruit at low temperatures (e.g. 4,5°C for oranges) and by not storing fruit for too long. TBZ is quite active against *Fusarium* species.