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Citrus exocortis

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Exocortis, sometimes referred to as scalybutt, was a major disease of Australian citrus trees on trifoliate orange rootstock in the 1940s and 50s, but is now rarely seen because of the use of pathogen-free budwood from the Auscitrus budwood scheme.

Citrus exocortis viroid (CEVd), can infect all varieties of citrus but is symptomless in most. Disease symptoms develop when infected budwood is grown on susceptible rootstocks like *Poncirus trifoliata*, Rangpur lime, and sometimes Swingle citrumelo and citrange. No symptoms of exocortis are seen on trees grown on Rough lemon, sweet orange and mandarin rootstocks.

Symptoms

In Australia, most cases of exocortis have occurred on trees grown on *P. trifoliata* rootstock. Overseas however, symptoms of exocortis have also developed on citrange and Swingle citrumelo rootstocks, but have rarely occurred in Australia.

Figure 1. A 4-year-old orange tree on *P.trifoliata* showing severe stunting as a result of infection by exocortis

Trees grown on *P. trifoliata* are the most severely affected, with symptoms of bark scaling and severe stunting usually developing when trees are around 4 years of age (Figure 1). When bark scaling occurs it appears as cracking and peeling of the bark below the bud union (Figure 2).

Trees grown on citrange rootstock develop symptoms slightly later and the degree of tree stunting is usually not as severe as that on *P. trifoliata*. Trees on citrange rootstocks do not always develop bark scaling.

On other sensitive rootstocks, symptoms include tree stunting, yellowing of the canopy and general tree decline and occasional flaking of the bark of the rootstock. Exocortis has no effect on fruit quality but because it stunts trees it severely reduces tree yield.

The type and severity of symptoms is dependent on the rootstock and the amount of exocortis viroid present in the scion, as well as the presence of other citrus viroids in the tree. High temperatures can also accelerate symptom development.

Disease source and spread

Viroids are the world's smallest infectious agents and differ from viruses in their molecular structure in that they do not have a protein coat.

The exocortis viroid can be present in all varieties of citrus but symptoms are only expressed when infected budwood is grown on susceptible rootstocks. The viroid is carried in the plant sap and can be spread from tree to tree by budding or grafting activities and on pruning and hedging equipment. Natural grafting of tree roots can also transmit the viroid between trees. Exocortis is not transmitted by sap sucking insects, as there is no known insect vector of the disease. Seed transmission is unknown.

Ease of mechanical transmission also varies with the citrus scion, e.g. it is easier to transmit CEVd between lemons, than lemon to orange or orange to orange.

The exocortis viroid is extremely resistant to both high temperatures and dry conditions and can remain infective on propagation and pruning equipment for long periods of time.

Disease verification

Disease verification is undertaken using both biological and laboratory based testing techniques.

Biological testing involves inserting the budwood from potentially infected trees into an indicator plant ('Etrog' citron) grown under high temperatures in a

Figure 2. Bark scaling of the *P. trifoliata* rootstock caused by exocortis.

greenhouse. If the budwood is infected with exocortis viroid, the 'Etrog' citron will develop symptoms of severe downward leaf curling and stunting and vein browning (Figure 3).

Laboratory based testing involves extraction of the viroid from potentially infected plant tissue. This extract is analysed through either gel separation techniques (sPAGE) or amplification of the viroid using molecular methods and then analysis of this product to identify the genetic sequence of the viroid.

Disease control

Citrus trees showing symptoms of exocortis should be tested to verify the presence of the exocortis viroid. Any infected trees need to be removed from the orchard and destroyed so that the viroid is not transmitted to other trees or blocks. As much as possible of the root system should be removed to prevent root sprouting.

Trees infected with exocortis should not be used as a budwood source for the production of citrus trees.

When purchasing citrus trees from a nursery always request the use of budwood that has been tested for graft-transmissible diseases, such as that sold by Auscitrus. Auscitrus is the trading name of the Australian Citrus Propagation Association Incorporated (ACP), a national industry organisation responsible for the supply of citrus budwood and rootstock seed that is true to type and of a high health status. Auscitrus budwood source trees are routinely tested for the presence of graft-transmissible diseases. Auscitrus can also test private budwood sources.

Figure 3. Exocortis symptoms in 'Etrog' citron, which is used as the biological indicator for verification of the disease.

Because CEVd can be mechanically transmitted on cutting, pruning or hedging equipment these implements need to be sterilised in a 1% bleach solution (1% available chlorine).

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