New Zealand Citrus Growers Inc

Guidelines for Growers on the Purchase of Citrus Nursery Trees

By Keith Pyle

Background

In the interests of a sustainable and profitable commercial citrus industry, New Zealand Citrus Growers Inc (NZCGI) wishes to promote the adoption of best practices by nurserymen that will ensure that trees of high quality and health are available to growers. In brief, trees should be propagated from citrus rootstocks and budwood that are true to type genetically and tested to be free from potentially harmful viruses and other pathogens. Nurseries should obtain independent certification that this is the case and that a range of best practice guidelines have been adopted in the propagation of their trees. NZCGI promotes the use of certified trees from certified citrus nursery tree propagators.

This is vitally important as orchards established from sub-standard nursery stock will never be as vigorous, productive, or profitable as those established from high quality disease free material. Citrus have a high rate of natural mutation so care must be taken to ensure budwood is only taken from superior trees. As well as this, citrus trees may be infected with diseases that show no symptoms in young plants but will have serious implications over the life of the tree. This article will explain these issues in great depth and ends with a set of key questions which all growers should ask their nurseryman.

Reasons for using certified propagating material

Introduction

The rationale for using certified propagating material is the well known principle that genetically superior, disease and pest free propagating material is the economic foundation of all successful horticultural industries. It is an essential first step and pays huge dividends over the life of the tree as opposed to failures with inferior material that may not reach yield potential and may even have to be uprooted after only a few years. If mother trees used are not genetically "true to type" or contain a harmful virus, then so will the hundreds of trees propagated each year from its buds.

Five different but closely related programmes are needed in any citrus industry:

1. A *quarantine programme* to ensure the safe introduction of new germplasm introduced into the country (MAF controlled).

2. A *clean stock programme* to produce sources of pathogen-free propagating stock of new and existing commercial varieties.

3. A *parent tree programme* in which parent trees of each cultivar are *virus indexed and certified*. This certifies absence of pathogens included in the prescribed testing programme which is based largely on rootstocks used in the industry, their susceptibility to the various diseases and other risk assessments.

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4. A programme of *horticultural evaluation* to ensure that parent trees reflect the true genetic attributes of a variety, without any disadvantageous mutations.

5. A *quality assurance programme* looks at the above elements and whether a range of best practices have been adopted during the nursery propagation cycle to give growers the assurance that the end product is of high quality and is free of diseases and pests.

Some of the main consequences on production if the above factors are neglected are outlined below:

Genetic selection

Citrus trees have a fairly high rate of natural mutation, and quite commonly tend to throw 'sports'. The most obvious of these mutations are sectoral chimeras which can be seen on trees as fruit with ridges, or variegated leaves. Very occasionally, a sport is an improvement on the original parent, but unfortunately the majority of mutations result in a reduction in quality. If budwood is cut from parent trees which are not regularly inspected for fruit quality and abnormal growth habits, then there is a high risk of propagating new trees which are derived from inferior sports.

Citrus budwood is usually cut when there is no fruit on the tree, so it is very difficult to see whether poor sports are present. Records therefore need to be kept from these parent trees at harvest, and inferior branches marked or trees eliminated from budwood selection. Many New Zealand orchards show high variability, indicating that trees have been grown from inferior budwood selections. Yields and pack-out of fruit could have been dramatically improved in many orchard blocks simply by ensuring that each tree was grown from a superior selected bud. This is best achieved by regular and strictly documented evaluation of budwood source trees to ensure they produce good yields of good quality fruit, true to the cultivar's characteristics.

Low yields, poor tree growth, and a lack of uniformity visible in orchards can also stem from poor rootstock performance. Inferior quality rootstock material in citrus can result from using seed source trees that do not produce true to type seeds, or, more usually, because of insufficient rogueing of zygotic seedlings from seedling rootstock populations in the nursery. Most citrus rootstocks in use are polyembryonic and the percentage of zygotic seedlings produced varies between rootstocks. Zygotic seedlings can be expected to perform poorly or out of character compared to true to type nucellar (or clonal) seedlings.

Viruses, Viroids and other similar organisms

Careful selection of healthy nursery stock is the single most important factor that affects the longevity and financial success of new plantings. Diseases caused by most fungi and bacteria in established orchards can be managed with appropriate chemical preventative measures, but systemic diseases caused by viruses, viroids, bacteria and other related microscopic organisms are a different matter.

Graft transmissible diseases may be caused by viruses, viroids or other pathogens and are vegetatively propagated from an infected budline by budding or grafting. They can seriously affect fruit production and quality as well as tree health and longevity. They may be spread to neighboring orchards of healthy trees by insects in some cases, by use of infected

budwood, or by farming equipment. Infections by them can not always be recognized merely by looking at the plant - it sometimes requires subtle changes in the environment for symptoms to be seen. Symptoms can be masked in certain stock/scion combinations but the trees can act as carriers to other susceptible combinations. These organisms can only be controlled by the use of disease free planting material.

Citrus exocortis viroid (CEV)

If citrus trees on *Poncirus trifoliata* rootstock, or its hybrids, are infected by citrus exocortis viroid (CEV) variable performance can be expected, manifested as variable tree size and shape and appearance of the bud union and stock. These symptoms range in severity from a reticulum of surface cracks on the shoulder below the bud union to hard, persistent bark scaling. It is probable that this diversity of symptoms is due to various combinations of different strains of the viroid.

Citrus exocortis viroid and other citrus viroids (CV) like cachexia are only spread through infected budwood and on infected cutting tools eg. secateurs, clippers, budding knives and hedging machines. There is no evidence that the viroids are transmitted by insects or in citrus seed, but they can be spread from infected to neighbouring trees within an orchard by root grafting. Fortunately, because of the limited ways in which they can be transmitted, the spread of CEV and CV are easily prevented through the use of clean budwood and simple hygiene techniques. Exocortis is the main viroid of concern in New Zealand because of the susceptibility of trifoliate rootstock and its hybrids. Cachexia is a viroid that has not been known to occur in New Zealand from indexing done by MAF and HortResearch and it has a low incidence in Australia. Overseas it is mainly a problem on sweet limes, mandarins and tangelos especially where they are used as rootstocks. Timmer and Duncan (1999) list trifoliate and its hybrids as being tolerant.

Psorosis

The Psorosis virus is thought to be widespread in New Zealand and is transmitted by mechanical transmission, in infected budwood and in seed. Budwood must be clean and it is important to ensure that a psorosis-free source of seed is confirmed before propagating rootstocks. The best way of doing this is to import rootstock seed from a certified overseas seed supplier or index seed source trees established in New Zealand. Most citrus species are symptomless carriers of this disease complex (New Zealand Citrus handbook), but the current status and distribution of the disease is unknown. Tests are now available for this virus and can be incorporated into testing procedures.

Citrus tristeza virus (CTV)

Citrus tristeza virus (CTV) is endemic in New Zealand and is transmitted by several species of aphid, but mainly by the brown citrus aphid which is very common. Many CTV strains in the field are mild ones which do little damage to the plant, but severe ones or new virulent strains can arise at any time and be transmitted. The symptoms of tristeza vary according to the virus strain and the scion-rootstock combination. Sour orange rootstocks are very susceptible and for this reason have not been successful in New Zealand except if lemons are used as a scion and aphids are excluded from the rootstock seedling stage. Sweet orange scions are most under threat; mandarins and lemons are not affected to the same degree but will nevertheless carry the virus. Trifoliate rootstock induces some resistance to tristeza but a resistance breaking strain has been identified, and a severe stem pitting strain has affected some Navelina and Newhall trees on trifoliate at Kerikeri Research Station. Symptoms of CTV infection can include flat topped tree shapes, leaf cupping, vein clearing, stem pitting, small fruit size, chlorosis, stunting, or total tree collapse.

Pre-immunization, whereby plants are inoculated with mild strains of CTV to protect them from severe strains, holds the best long term strategy for tristeza control. This especially applies for new introductions which are tristeza free after shoot tip grafting and which may be very vulnerable to challenge from severe stem pitting strains.

Natural mild strain protection can occur in established orchards and until a mild strain inoculation procedure is developed, a clean budwood programme needs to identify superior trees in existing orchards that could have natural mild strain protection. In our case this applies especially to sweet oranges (Navels and Valencia). Sound horticultural evaluation and disease inspection looking for stem pitting of parent trees, dwarfing, flat tops and small fruit size will help to pick up underperforming trees that may have a severe form of the disease. These should be eliminated from use as budwood sources. Changes in rootstock use could have an impact on the expression of different tristeza strains. A mild strain under one set of circumstances may not be consistently mild in another environment or with different stock/scion combinations.

Citrus vein enation virus (CVEV)
Citrus vein enation virus (CVEV) is another virus transmitted by the brown citrus aphid that is widespread in New Zealand. It will not be a problem unless there is a change from using trifoliate and its hybrids as rootstocks.

New threats
Certification programmes will need to be dynamic to cater for new diseases that may become established in New Zealand in future. Some exotic diseases that are particularly risky if introduced to New Zealand are tatterleaf, Citrus variegated chlorosis, stubborn, infectious variegation, greening, and new stem pitting strains of tristeza. Strict quarantine and bio-security will hopefully keep these diseases out.

With the range of diseases at present, parent tree blocks in New Zealand can be located outdoors under strict sanitary control and re-indexed for nominated pathogens on a regular basis as prescribed in the best practices, together with sound horticultural evaluation.

Further details on some viruses and viroids and their impact on production can be found in the book "Growing Citrus in New Zealand- a practical guide" available through NZCGI.

Disease and pest free nursery trees

While viruses and viroids are covered above there are other pests and diseases that can invade citrus nurseries at any stage. Nursery trees should be free of injurious root pathogens and nematodes, all of which can have an adverse effect on tree survival and early tree growth, and should not be spread through the industry on planting material. Growers and nurserymen may be unaware of the presence of these pests, because frequently there are no obvious acute symptoms. Control is achieved by strict sanitation and using pathogen free water, and disease and nematode free soil or propagating mediums.

Nurseries must adopt practices which minimise the risk of sudden death believed to be associated with infestations of a complex of *Fusarium* species and other root pathogens on trifoliate and its hybrid rootstocks. There is evidence that stresses on the root system at any stage can exacerbate later sudden death in orchards which only manifests itself once the trees come into bearing with heavy crops. Keeping rootstocks for an excessively long time in beds prior to budding will mean that the root systems will have to be severed for transplanting. This can cause damage to the root systems, increase the risk of infection with

species of *Phytophthora* or *Fusarium*, and result in problems with growth and later on sudden death. Getting trees off to a good start in the orchard is best achieved by using actively growing trees that have been propagated without any growth checks throughout their growing cycle from seed to the ready to plant tree.

Foliar diseases such as scab and alternaria, should be absent from nursery tree consignments. Their presence could speed up the establishment of these diseases in an orchard even though they are endemic in the area in which the trees are to be grown. Preventive fungicide programmes in the nursery should not include systemic fungicides as this could select genes for disease resistance in the fungal population which can be spread to commercially important areas.

Insect pests should be absent from nursery consignments. Bud mite is a major pest in young trees that can adversely affect growth. Scale insects can be debilitating to the trees, especially the armoured scales that inject toxins into the tree. Aphids are vectors of tristeza and the Australian citrus whitefly should not be spread from infected to uninfected areas (e.g. from Kerikeri to Gisborne).

Key questions to ask your nurseryman

1. Are trees uniform, disease and pest free, healthy looking with straight stems?
2. Are bud unions at a minimum of 10 cm above soil level to minimise the risk of phytophthora infection of the scion?
3. Have they been derived from pathogen free seedling populations grown in a pathogen free soil or growing media?
4. Have seedlings undergone a rigorous selection process to eliminate "off- types."
5. Are the tree root systems free from any potentially harmful pathogens?
6. Are trees being sold within a maximum of 18 months of budding and 36 months from seed?
7. Has the budwood for each cultivar come from parent trees that have been indexed for nominated viroids and viruses and when was the last indexing carried out?
8. Has a process of horticultural evaluation been carried out on budwood parent trees to ensure they are true to type?
9. Does the nursery have a Quality Management system that includes traceability procedures?
10. Has the nursery, its practices, and its source material been audited and certified to comply with the best practice protocols?

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Levels of Certification

The time required for horticultural evaluation means that the pathway to full certification of nursery trees may take time for nurserymen to achieve, so an initial three level scheme of certification is proposed to enable growers to judge how well trees comply with the best practices recommended. Growers are advised to aim for planting Level 3 trees. Level 2 trees will not carry any assurance of their being true to type, while Level 1 trees could have many disadvantages and tree health concerns. The proposed levels of tree certification are:

Level 3 – Full certification. All best practice protocols have been complied with and certification standards met.

Level 2 – Virus indexed parent trees and all other best practice protocols have been complied with and certified, but horticultural evaluation still incomplete.

Level 1 – Only virus indexed budwood has been used and certified. Other best practices have not been met.

All other trees would be considered uncertified.