VIRUS-TESTED PROPAGATING MATERIAL AND THE FRUIT VARIETY FOUNDATION

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INTRODUCTION

Research in Australia and overseas has confirmed that the quality of planting material used in orchard establishment has far-reaching effects on subsequent plant vigour, fruit production and quality, and other crop characteristics.

Of prime importance in determining the potential productivity of planting material in many fruit crops is freedom from harmful virus diseases. These viruses may result in reduced vigour, yield, fruit quality, and orchard life. A list of some deleterious virus diseases of fruit crops is given in Table 1.

Table 1. Some deleterious Viruses of Fruit Crops

CITRUS	
Exocortis	Xyloporosis
Tristeza	Citrus stubborn
Psorosis	Citrus greening
STONE FRUITS	
Prunus necrotic ringspot	Plum pox
Prune dwarf	Western X
Peach yellow bud mosaic	Peach yellow bud mosaic
APPLES	
Apple mosaic	Apple ringspot
Apple proliferation	Apple russet ring
Apple green crinkle	Spy epinasty and decline
GRAPES	
Leafroll	Fanleaf
Yellow speckle	Asteroid mosaic
Corky bark	
AVOCADO	
Sunblotch	

Most orchard crops are propagated vegetatively, either by budding or grafting, and these techniques allow the transmission of viruses from generation to generation. Most viruses are not seed-borne and therefore a similar virus transfer does not normally occur in crops propagated by seed.

Techniques such as meristem culture and heat treatment are available to remove viruses from vegetative material. Horticulturists, plant pathologists, and virologists are, therefore,

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able to work together to produce fruit crop vegetative propagating material free of known deleterious viruses. The material is then termed virus-tested rather than virus-free because it is only checked to ensure that harmful viruses have been removed and it is possible that other relatively unimportant viruses are still present.

Once virus-tested propagating material has been produced, it is important to maintain a nucleus of clean stock, to test it for horticultural trueness, and to develop multiplication systems which will allow the industry to take advantage of its improved vigour and cropping potential.

THE AUSTRALIAN FRUIT VARIETY FOUNDATION (fvf)

The Fruit Variety Foundation (fvf) was brought into being by a decision of the Australian Agricultural Council in 1971. The responsibilities of fvf chiefly relate to the maintenance of virus-tested mother stock of a range of fruit cultivars in special foundation plantings. However the influence of fvf is far wider; for example, it assists in the coordination of the importation of new fruit cultivars into Australia and, at the other end of the system, provides coordination and assistance to State budwood multiplication schemes.

Finance for the development and maintenance of the foundation plantings is provided on a 50:50 Commonwealth/State Government basis with States contributing in proportion to their number of producing orchard trees of the crops involved. A total of four professional staff are employed by fvf in Victoria, New South Wales, and Tasmania to manage the foundation plantings and conduct related activities.

The foundation plantings are administered on a day to day basis by the local State Department of Agriculture, but a co-ordinating committee meets annually to review the functions and operations of the scheme. The committee contains a representative from each State Department of Agriculture, one from CSIRO Division of Horticulture, and one from the Commonwealth Department of Primary Industries (Plant Quarantine). It is comprised of both horticulturists and virologists and is the chief guiding hand of fvf.

The foundation plantings are principally in fenced blocks on Government research stations, but in crops where viruses can be pollen transmitted from one tree to another, the virus-tested mother plants are maintained in glasshouses. A listing of the crops currently in fvf and the location of the foundation plantings are shown in Table 2.

The mother stock maintained in the foundation plantings is regularly reindexed by professional staff to ensure that the

Table 1. Crops in fvf and Location of Foundation Plantings.

CROP	FOUNDATION PLANTING SITE
Apples	Gove, Tasmania
Pears	Gove, Tasmania
Avocados	Somersby, New South Wales
Cherries	Rydalmere, New South Wales
Almonds	Rydalmere, New South Wales
Prunes	Rydalmere, New South Wales
Citrus	Dareton, New South Wales
Grapevines	Irymple, Victoria
Peaches	Burnley, Victoria
Nectarines	Burnley, Victoria
Apricot	Burnley, Victoria

material remains free from deleterious viruses.

SUBMISSION OF FRUIT CULTIVARS TO FOUNDATION PLANTINGS

It is the responsibility of the State Department of Agriculture and CSIRO Division of Horticulture to clean-up virus-infected material of important fruit cultivars and to propose them for incorporation in the foundation plantings. The fvf committee controls the entry of new cultivars to the foundation plantings and regularly reviews the need to maintain existing cultivars. Candidates for submission must be justified on horticultural importance to the fruit industries as well as having freedom from deleterious viruses.

HORTICULTURAL MERIT OF CULTIVARS IN fvf

It is a firm policy of fvf that the foundation plantings are not genetic resource collections. Cultivars which do not have continued commercial relevance to the horticultural industries of Australia are removed. This is to keep the size of the foundation plantings manageable and to control the costs of running the scheme. However, new overseas fruit cultivars with good prospects for industry use may be incorporated.

To ensure that the virus-tested cultivars maintained in the fvf foundation plantings are horticulturally true-to-type, horticulturists check the cultivars from time to time and provide descriptions of cultivar characteristics.

This is a difficult area with stone fruit because the mother plants are maintained in glasshouses and are not allowed to flower or fruit. As previously explained, this is because in these crops some deleterious viruses are pollen-transmitted from tree to tree. In these cases special virus-tested trees need to be planted and grown to determine horticultural characteristics. Alternatively, observations are made in existing trials or plantings on research stations which have used the virus-tested budwood.

ROOTSTOCK/SCION CONSIDERATIONS

It would obviously be unwise to graft virus-tested budwood onto virus-infected stock. For this reason fvf maintains virus-tested material of both stock and scion cultivars. Where seed is used to produce rootstocks, then virus-tested trees are maintained of these cultivars.

STATE MULTIPLICATION SCHEMES

It is the responsibility of the State Departments of Agriculture to arrange multiplication and distribution schemes to ensure that virus-tested budwood is available for industry use.

The first stage in the development of a virus-tested budwood scheme is the establishment of nuclear plantings. These are established with budwood (or seed as appropriate) obtained directly from the professional officer in charge of the relevant foundation planting. Nuclear plantings are usually located on State Government research stations. They act as a local source of budwood for the establishment of multiplication blocks to supply the quantity of budwood required by industry. In some cases there is no need for a nuclear planting and multiplication blocks are established directly. In other situations where only relatively small quantities of budwood are required, the nuclear planting may also serve as the multiplication block.

It is obviously vital that the State Multiplication Schemes are so organized and managed that re-infection with harmful viruses does not occur. To this end nuclear areas are usually fenced and grown in some isolation, stone fruit trees are deblossomed to prevent infection with pollen-borne viruses, and trees are reindexed from time to time to ensure continued freedom from harmful viruses.

In the production of peach seed for rootstocks the trees must obviously be allowed to flower and fruit, and to ensure against re-contamination with pollen-borne viruses the trees are grown in isolation and re-indexed at regular intervals.

The distribution of budwood to industry is often controlled by grower organized committees with technical support from State Departments.

Queensland currently has fvf multiplication schemes for apples, stone fruit, grapes, citrus, and avocados.

THE FUTURE OF fvf

Governments have continued to support the need for the fvf scheme. However a comprehensive review of the scheme is currently in progress and some changes may occur.

Australia with its fvf scheme, together with the Interregional Research Project (IR-2) scheme of USA, and the EMLA scheme of the United Kingdom, has been at the forefront in establishing germplasm banks of virus-tested, horticulturally important fruit cultivars. Interchange of material between these schemes allows for much faster introduction of new fruit cultivars through quarantine and speeds up their incorporation into virus-tested foundation plantings.

The benefits of the scheme are now becoming increasingly apparent in the Australian fruit industries. Continued close surveillance of all facets of the scheme should ensure that these Australian fruit industries have the benefits of virus-tested fvf propagating material.

AN HISTORICAL REVIEW OF GRAFTING TECHNIQUES

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Grafting is the implanting of a piece of tissue from one plant into another in such a manner that they will maintain a permanent bond. It is one of the oldest arts of plantcraft.

Natural grafting has been around at least as long as plants have had cambium layers to unite, and this natural grafting probably stimulated the early practitioners by way of approach grafting.

References are available to show that grafting techniques were used by the Chinese 3000 years ago (9). At approximately 2000 years ago Aristotle (9) (384 to 322 B.C.), Virgil (4) in his "Georgics" or "The Art of Husbandry" (30 B.C.) and Pliny the Elder (4), in his "Historia Naturalis Volume II" (77 A.D.) all discussed grafting with considerable understanding. Paul the Apostle (9), in his Epistle to the Romans (Chapter XI, Verses 17 to 24) "And if some of the branches be broken off, and thou, being a wild olive tree, wert graffed in among them, and with them partakest of the root . . .", appears to show that at that time the possibility of a reaction between stock and scion (cion, cyon, sion) was recognized.

Columella (2,6), who was regarded as one of the most learned writers on practical agriculture in Rome at the time of the birth of Christ, and who wrote 12 books on gardening (De Re Rustica) and related subjects, together with a supplementary treatise on trees, mentioned the bark and cleft grafts and the patch bud.