STUD BUDS — THE FRUIT VARIETY FOUNDATION AND ITS FURTHER APPLICATION TO ORNAMENTAL HORTICULTURE

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The term "stud buds" has been coined in the context of "fvf" or "Fruit Variety Foundation" to denote propagating material which has been tested for virus content and for horticultural characteristics.

The Problem. Viruses and virus-like diseases can affect members of both plant and animal kingdoms. They are considered to be parasitic entities but they are so small they can be seen only through the electron microscope.

Symptoms in virus infected plants vary widely. They can occur on any part of the plant although most often are seen on leaves and flowers. Sometimes they are symptomless or nearly so and not seen at all. On leaves, viruses can cause changes in colour, shape and size. On stems they may shorten internodes or cause flattening or swelling or defoliation of terminal growth or pitting of the wood under the bark. Flowers may be variegated or transformed into leafy structures. The fruit may be deformed, show colour changes, be russetted, or marked in other ways. Roots may be killed or show growth abnormalities. Incompatibilities can occur between scion and rootstock. Growth can be reduced as can cropping.

Fruit tree viruses are commonly spread by the use of propagating material already infected. However, they are not usually transmitted by seed so that seedling rootstocks are generally virus-free, with stone fruits and avocados being two important exceptions. Insects, pollen and nematodes can spread some viruses. Thus the problem of virus transmission is greatest with vegetatively propagated species.

The Control. Virus diseases are controlled by preventing their spread, so that the use of propagating material that is not carrying harmful viruses is the principal method of control. Those disorders which are readily distinguishable by eye are easily eliminated by nurserymen and growers through careful selection of propagating wood. However, the insidious infections are only detectable by using special virus indicator cultivars and clones, called "indexing," by electron microscopy, or by serology. Hence the aim of fvf foundation plantings is to collect and maintain in a virus-tested condition, clones which have been tested for both virus content and superior horticultural characters.

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Why Virus-Tested and not Virus-Free? The term "virus-tested" is used deliberately as "virus-free" can only be used when the results of checks for *all* the known viruses are negative. "Virus-tested" is used where plants have been indexed as free from *particular* viruses, usually those of most economic significance.

There are two other reasons for using the term "virus-tested". Firstly some clonal material may be accepted into fvf even though known to be carrying some viruses of relative unimportance. Such material is still the best available and to await production of a clone completely free of all known viruses would be impractical and contrary to the aims of fvf. The second reason is that in some situations the absence of a mild strain of virus can allow the entry, usually by insect transmission, of a severe strain of the same virus with devastating results — in other words the presence of a mild strain of a virus can protect against infection by a severe strain. Probably the best known example of this situation is the need for citrus to carry a mild strain of the virus disease tristeza.

Some History. At the Australian Plant Pathology Conference in 1961, Dr. A.F. Posnette of East Malling Research Station, United Kingdom, outlined the new methods being developed to detect symptomless virus infection and also the technique of heat therapy employed to free plants of virus. In reporting on his visit, Dr. Posnette noted the wide distribution of virus diseases of fruit crops within the Australian industry. As a result, it was proposed that Australia should establish an isolated National Foundation Planting (previously called Repository) for the important fruit crops. From this planting propagating material was to be made available to associated multiplication units which would supply nurserymen with commercial quantities.

Various problems including interstate quarantine restrictions on the movement of plant material, staffing problems associated with the isolation of such a large complex and its cost resulted in the project being temporarily shelved. Following an informal meeting between horticulturists and virologists in 1970 the Australian Agricultural Council accepted a revised scheme proposing a number of Foundation Plantings which would utilise the resources then available in the different States rather than one single area. Secondly the individual States would be responsible for the multiplication of material for supply to nurserymen.

Another Committee. The present Fruit Variety Foundation Committee is a sub-committee of Standing Committee on Agriculture's Horticulture Committee. The latter comprises Chief Horticulturists (or their equivalents) from each of the six States, CSIRO, and representatives of the Commonwealth Departments

of Primary Industry and Health. The fvf Committee is drawn mainly from those same bodies, some of which provide virologists and some horticulturists. It meets annually and has responsibility for the general planning of Foundation Plantings, the financial management of facilities and staff, and the establishment of criteria for the nomination of fruit cultivars to the Foundation Planting.

This involves:

- maintenance of the foundation sources of virus tested clones of the major fruit cultivars for supply to multiplication units
- participation in international exchange of virus-tested clones
- continual rechecking of the virus status of admitted clones
- horticultural and virus testing of clones nominated for admission in collaboration with the States
- development, through research, of improved methods of virus indexing and of freeing horticulturally desirable clones from virus
- removal from the plantings of previously admitted clones found to have become virus infected or horticulturally unimportant.

The nomination of a candidate clone by a State Department or CSIRO to the Foundation Planting is accompanied by a record of its virus status with details of personnel doing the indexing tests and the conditions under which the material has been kept since last tested, as well as the classification of its horticultural characteristics.

The Foundation Plantings. After being granted admission to the Foundation Planting the material is retested for virus each five years under the present rules. Depending on experience, the period of five years may be extended. As superior clones are admitted so the superceded clones will be removed.

The various Foundation Plantings are supervised by the virologists and horticulturists of the States in which they are located. The salaries of some of these and of some technical staff are subsidised by fvf funds. In addition, the committee provides for one full time virologist who is located with the Victorian Department of Agriculture which has the responsibility for Foundation Plantings for grapevines and some stone fruits. New South Wales has Foundation Plantings for other stone fruits and citrus whilst an avocado planting is currently being built up. The Tasmanian Department of Agriculture operates the pome fruit planting. The numbers of clones currently held or conditionally approved for admission are:

Huonville (Tas)	Apples	74	*Gosford* (N S W)	Avocados	9
	Pears	12			
	Quinces	3			
Irymple (Vic)	Grapevines	115	*Dareton* (N S W)	Citrus	31
Burnley (Vic)	Peaches	68	*Rydalmere* (N.S W)	Cherries	23
	Nectarines	2		Plums	16
	Apricots	3		Almonds	2

Overseas, the two largest Foundation Plantings in operation are the IR-2 scheme in Prosser, Washington State, U.S.A. and the EMLA (East Malling-Long Ashton) scheme in the United Kingdom.

The Status of Ornamentals. At the 9th annual meeting of the committee in 1979 the decision was taken that ornamental clones within the genera covered by the present fvf scheme were eligible for admission to fvf in view of the potential for infection of *commercial fruiting clones from such related ornamentals*, but such admission was not to be at the expense of commercial fruits. Already 11 cultivars of virus-tested crabapples from East Malling are being nominated for inclusion in the Pome Fruit Foundation Planting. In addition nine ornamental cherry cultivars, also from East Malling, are likely to be nominated.

It is necessary to point out that, apart from the related species, virus disease etiology in most ornamentals differs from the commercial fruits in that insect-borne viruses are relatively common. Also the insect vectors associated with ornamental viruses are generally more efficient than those associated with fruit trees and this necessitates more frequent and thorough testing. Because of this there may be little to be gained from small outdoor virus-tested plantings of the majority of ornamental species. However, benefits would accrue to those grown under protected environment conditions, as has been convincingly demonstrated with carnations, and perhaps also to the well-managed larger outdoor plantings.

Overseas Schemes for Ornamentals. The concept of virus-tested ornamentals is well established overseas. In the United Kingdom the Nuclear Stock Association has presently available 83 virus-tested lines of chrysanthemums, 40 of carnations, 18 geraniums, 32 lilies and further schemes are being developed. In Holland the NAKB Inspection Service appointed by the Dutch Government operates schemes for hyacinths, tulips, freesias and nerines. Israel has government-operated schemes for carnations and *Gypsophila* while in the U.S.A. the University of California, Davis, has a scheme for roses, grapes, fruit trees, and Japanese flowering cherries. Also in the U.S.A. healthy carnations and chrysanthemums are produced by private enterprise, e.g. Yoder Bros. in California. South Africa also has a scheme for roses.

The Australian Situation with Ornamentals. So far, no proposals have been put forward for a national Ornamental Variety Foundation (OFV) as a sister scheme to fvf. At State level, Victoria has been most active with schemes for producing virus-tested cultivars of carnations, chrysanthemums and daphne. Similar schemes for roses, bulbous iris, gladiolus, violets, hyacinths and lilies are also being developed or evaluated.

Hibiscus and orchids are two ornamentals for which virus-tested material would benefit industry as in both, virus diseases are prevalent and increasing in incidence because of vegetative propagation techniques. Hibiscus mosaic virus is present in Australia. Although symptoms vary with cultivar; yellow veins, distorted flowers, and reduced leaf size commonly occur.

It does seem a good case can be made for a national scheme to cover roses because:

- they are susceptible to infection by a number of viruses;
- there do not appear to be any insect-borne or nematode-transmitted viruses of significance;
- being woody perennials, a scheme for roses could be somewhat complementary to the present scheme.

On the other hand:

- roses tend to wax and wane in fashion and there could be a problem of very high turnover affecting costs;
- many of the newer fancied roses are more susceptible to other diseases and this, too, could affect costs.

Costs. On the cost angle, as already suggested wtih ornamentals, there would be a much larger range of cultivars and species to be covered and presumably a more rapid rate of turnover. This would increase costs of an OVF compared with fruit. On the other hand, it should also increase income and so may be rather more than less favourable. Again, in contrast to the woody perennial fruit trees and viruses, carnation and chrysanthemum mother plants could be more costly because of their need to be propagated each year by cuttings while the bulbs are annuals and, therefore, have to be lifted and replanted each year. The rate of multiplication of the bulbous ornamentals is also usually slow although tissue culture techniques are improving the situation. Because of the risk of re-infection of mother plants it is considered essential to have an active tissue culture group to clean up any important clones that may be infected.

In an fvf was established for ornamentals, in the present situation Victoria has the greatest expertise because of its existing schemes. However their revenue from sales of cuttings from carnation and chrysanthemum mother plants is less than 10% of the cost of operating the scheme. For such schemes to be operat-

ed on a national basis considerable financial support would be necessary. The present fvf schemes for fruit commenced in 1971/72 with an annual budget of $30,000 and this has reached $100,000 for 1981/82. It must be acknowledged that the true running costs would be more than double those figures as there are many inputs by State Departments for which no charge is made. The gross annual value of the crops which the existing scheme is intended to support is $400 to 450 million. The f.o.b. value of related exports is 25 to 30% of this figure.

Governments in Australia provide varying degrees of services to the ornamental horticultural industries. Whilst in most cases industry would like to see greater involvement, continued pressure could improve the situation.

Conclusion. There are other vegetatively propagated fruit crops and, indeed, plants which are not covered by fvf schemes and in considering development of a scheme for ornamentals, priorities would have to be considered. For example, funds are required for the maintenance of plant genetic resources which need to be balanced against any expansion of the fvf scheme into ornamentals would be favourable received by Governments considering their generally tight financial situation and growing acceptance of the principle that "the user pays." Perhaps an expanded activity in the production of disease-free propagation material of ornamentals seems justified, but the best means of achieving this needs close appraisal. Maybe low cost systems of maintaining and distributing this material, such as is happening in Victoria, is the best way to proceed.

The real questions which need to be answered I think are these:

- What are the threats to the commercial ornamental industries under the present system?
- What would be the benefits of an fvf scheme?
- Is there a real need?
- What is the demand?
- Will the user pay?

MICROPROPAGATION OF GRAPEVINE

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Abstract. A method is described for the *in vitro* propagation of grapevine (*Vitis vinifera* L.) from fragmented shoot apices, which has the potential of