Review of Rootstock Use in Australia

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Introduction
This review deals with the present situation concerning research into the use of rootstocks in Australia, with the acceptance of these results and with possible future developments. It summarizes the results of a survey undertaken for the Grape and Wine Research and Development Corporation and is based on information gleaned from published and unpublished reports and from discussions with many people in government and commercial organizations, whose ready cooperation is gratefully acknowledged. A more extensive report is in preparation.

Rootstock use commenced in Australia with the invasion of vineyards by phylloxera in Victoria, near Sydney (NSW) and Brisbane (Queensland) late in the nineteenth century. This and subsequent events have been described by Hardie and Cirami (1988) and Buchanan (1980). The earlier expected spread of phylloxera did not happen, and own-rooted vines have been and are still being planted in areas outside the 'declared vine disease districts'. It is hoped that future outbreaks can be prevented by vigilance, appropriate quarantine measures and, possibly, by natural barriers.

Interest in the use of rootstocks was renewed when the damage caused by nematodes in vineyards on sandy soils was recognized in the mid-1960s and rootstocks resistant to this pest became available from California.

Today, the planting of grafted vines is general practice where phylloxera and/or nematodes already occur or are likely to occur. However the choice of the most suitable rootstock for a given site is still under discussion, as is the problem of whether to use rootstocks in areas not threatened at present.

Why use rootstocks
The relative merits of planting own-rooted and grafted vines have been summarized recently in the Green Paper by the South Australian Government 'Review of the Phylloxera Act 1936' (Boehm et al. 1992, p. 8). The advantages of using own-rooted vines, in the absence of root pests, are listed as being:

- lower cost of planting material
- ease of obtaining the rootlings
- lower cost of training
- less danger of introducing systemic diseases
- greater longevity of the vines and
- avoiding the difficulty of selecting the most suitable rootstock for a given site.

The Green Paper also gives a calculation of the costs of reconstructing a vineyard invaded by phylloxera. More detailed, up-to-date cost-benefit analyses for other situations would be desirable, such as those given by Stumm (1979) on the optimal timing for replanting an existing German vineyard. This was said to be seldom justifiable unless yield reductions reach 10%, but replanting should be done after year 20 in cases where the monetary return is reduced by more than 10%.

In case of a new phylloxera outbreak it may be possible to delay the total removal of the infested vineyard by interplanting it with advanced grafted vines or by joining rootstock rootlings and existing vines which are thus given a resistant root system. Interplanting has been done successfully by Tankaard, among others, with vines of Sultana grafted onto Ramsey and raised for two years in a field nursery (pers. comm.). Providing a mature, own-rooted vine with a resistant root system by joining its trunk with that of a rootstock rootling planted nearby has been described by Orffer (1982) and Fregoni (1989).

Consideration of using or not using rootstocks must also take into account that some rootstocks reduce the levels of chloride in the soil, thereby improving vineyard productivity and reducing the chloride content of the resultant wine. This is important in situations where the salt content of wine reaches the upper permissible limits due to the salinity of the soil and the irrigation water.

Rootstock use in Australia
Published information on the commercial plantings of grafted vines in Australia is not available. Presumably all new plantings in the 'declared vine disease districts' use vines grafted to phylloxera-resistant rootstocks. Estimates for NSW were provided by Crecy (pers. comm.) that grafted vines were used for more than 80% of the newly planted vineyards of the Murrumbidgee Irrigation Area, 80–90% for the Murray Valley and 30% for other traditional wine regions. Rootstocks are not used in the newer wine districts of Cowra, Orange and Tumut.

Estimates of the intended rootstock use can be obtained from the number of rootstock cuttings sold annually by the members of the Australian Vine Improvement Association (AVIA) (Hamilton 1990, 1991, 1992, 1993): these come in the main from the three mothervine plantings maintained by AVIA in Eastern Australia, the McCreanor block at Barmera of the South Australian Association (SAAVIC), the Sunraysia Mid-Area block of the Victorian Association (VAMVVIA) and the Griffith block of the Murrumbidgee Irrigation Area Association (MIAVIS), and from plantings established by major nurseries.

Over eight million rootstock cuttings were sold by these organizations in the four season 1989 to 1992. 90% of all cuttings came from four cultivars, namely 55% from Ramsey, 18% from Schwarzmann and 5% each from K51–40 and Teleki 5A. In 1992, the South Australian demand for the rootstocks 99 R, 140 Ru and 101–14 increased because of the dissemination of results from experiments in Victoria and South Australia, and because of concern about the suitability of Ramsey, particularly for red wine production.

The final destination of these cuttings is not known. The number sold during the three seasons 1989 to 1991 would have been sufficient to plant 54%, 36% and 27% (i.e., 2,491, 1,661 and 1,245 ha) of the 4,614 ha of new vineyards established in those years, assuming a planting density of 2,380 vines/ha and a 'take' of 100%, 66.7% or 50% respectively. The sales statistics for the three States do not allow estimates of where the cuttings were used: clearly there were major transfers between States.

The lack of better information on the extent of using graft-
ed vines must be detrimental to the planning of industry development, considering the expected boom in new vineyard plantings and the time elapsing before cuttings can be taken from newly planted rootstock mother vines. Perhaps there should be renewed discussion on the usefulness or otherwise of vineyard registration, including information on rootstock mothervine plantings and of grafted vineyards. It would certainly be of help to the Vine Improvement Associations and the nursery industry in their endeavour to make provisions for the future demand of rootlings, either own-rooted or grafted.

In addition to the large task of supplying commercial quantities of rootstock cuttings, some of the AVIA blocks contain collections of rootstock varieties which are unlikely to ever reach commercial importance. While retaining this gene pool in Australia is important, its consolidation in a single collection should be considered as a cost-saving measure.

The choice of the appropriate rootstock
When selecting a rootstock for a given situation, the following criteria need to be considered in sequence:
1. Select only rootstock material for which propagating material free of graft-transmissible diseases (mainly viroid) and of good general health is available;
2. Exclude rootstocks with insufficient phylloxera resistance;
3. Exclude rootstocks which lack nematode resistance unless the soil of the site will not support infestations;
4. Exclude rootstocks incompatible with the chosen scion;
5. Select a rootstock adapted to the soil of the site; this requires consideration of many selection criteria;
6. Select a rootstock supportive of producing the desired type of product;
7. Select a rootstock which is easy to propagate while meeting all other selection criteria.

Use of rootstocks internationally
Almost all the vineyards of the 17 countries for which information was gathered are planted with grafted vines because of phylloxera infestation. Only some 15 rootstocks are being used widely for this purpose from among the several hundred varieties selected or bred in Europe, South Africa and California. They are Rupéstris du Lot, 41 B, 3309 C, 5 BB, 110 R, 99 R, 161–49, 101–14, 420 A, 504, 1103 P, 3306 C, 140 Ru and, in addition, some which are locally important such as ARG1 in New Zealand, California and South Africa. Several rootstocks such as Ramsey are used in for protection from nematode damage, mainly in California, Australia and South Africa.

Australasian rootstock trials
The early selection of rootstocks for commercial use in Australia was largely on advice obtained from Europe. More recently, a large number of trials by the various State Departments of Agriculture and by CSIRO has helped both to make growers accept the use of grafted vines and to select suitable rootstocks. These experiments have been under way since the early 1970s. The information given below has been assembled both from published and unpublished papers.

In all, 85 rootstock experiments are under way or have been concluded in the last 20 years or so throughout Australia, 45 in South Australia, 9 in New South Wales, 25 in Victoria, 2 in Western Australia and 4 by CSIRO. Each trial contained graft combinations of one scion and a number of rootstocks. These trials comprised some 20 scions and 40 rootstocks. Detailed descriptions with information on soil type, growth characteristics, yield and grape quality were published for only some trials; yield data are available at present for 41 trials. This work represents a large investment in time and effort, not in the least because of the effort involved in preparing the necessary planting material. In many cases this commenced with the importation of only 6 cuttings per rootstock.

Interpretation of the trial results proves difficult because the yields of vines grafted on different rootstocks vary in their ranking from season to season, because small numbers of vines were examined per trial and because a number of rootstocks had similar yields. Indeed, in almost all trials there were several rootstock treatments with mean yields over several seasons which were greater than those of all others and which could not be shown to differ by statistical analysis.

Own-rooted and Ramsey-grafted vines were used in almost all trials. They occurred in the group with highest yields in 20% and 92% respectively of the trials in which they were represented. Other rootstocks which were used in at least 10 trials and which belonged in at least one-third of the trials to the group with highest scion yields were Dog Ridge, 5 BB, A RG1, 101–14, 5 A, Freedom, Harmony, 1613 C, K51–40 and 1616 C.

In addition to measurements of yield, must composition was measured in 18 and wine composition and colour in only 6 experiments. While there is concern that the rootstocks of Vi tis x champinii origin (Ramsey, Harmony, Freedom) have an undesirable effect on wine quality — particularly for red wine — because they lead to high potassium content, the experimental evidence is not yet clear-cut. The small number of vines under examination in these experiments restricts winemaking to small-scale techniques. The validity of results obtained in such tests is still being questioned by industry.

Thus the conflict remains: vines grafted on Ramsey are vigorous in many situations, which makes them difficult to manage unless appropriately handled, and may produce undesirable characteristics in red wines. On the other hand, Ramsey is by far the most widely used rootstock because it leads to high yields, not only due to its resistance to nematodes. The extent of the vineyard area planted with Ramsey-grafted vines which produce red wine is not known.

Descriptions of the soil type on which rootstock trials have been planted have been provided in some, but not in all, cases. Work is now being initiated to provide soil data for all trials in a manner which will allow comparisons not only at the local but also at the international level. This should permit better utilization of the information on the relationship between rootstock and soil type than has been possible up to now. This relationship is a major factor in determining the performance of grafted vines.

In summarizing the present situation it may be said that further experiments of the type done up to now are unlikely to improve the information already available, unless new rootstock cultivars are to be tested. However it may be possible to further explore the existing trials to give a better description of the relationship between soil type, vine growth and wine quality (as long as the results of small-scale winemaking are accepted as guide to wine quality). The only other alternative for further tests of rootstocks would be large-scale plantings under commercial conditions, which by necessity would need to be restricted to a small number of rootstocks.

Rootstock recommendations for Australia
Recommendations for rootstock use vary from region to region and are in many cases tentative. In Victoria, where phylloxera is the major concern except for the North-West of the State, rootstocks are listed as to be preferred, to be considered

continued page 48
be verified and that the blocks have been inspected for
trueness-to-type when still in leaf. Class B material can be
considered accredited.

Class C vineyards are normal growers’ vineyards which,
according to the scheme, should not be used for propagation
by accredited nurseries.

Some protocols have been recommended for vine improve-
ment organizations regarding cutting collection and process-
ning. Without going into detail, these will ensure that trueness-
to-type and health status can be guaranteed to the purchaser.
This is the first step in ensuring trueness-to-type of the finished
product. If nurseries can be sure of the cuttings they are using,
all that remains is for nursery operators to have an audit trail
in place so that the movement of cuttings from the vine
improvement organization through the nursery and out into the
vineyard can be traced.

This is one of the recommendations for nursery practice
under the scheme. Other key elements are that nurseries
should preferentially use cuttings from the vine improvement
schemes because there will be a guarantee of trueness-to-type.
A Iso, heat treatment for crown gall, nematodes and root-
borne pathogens is recommended, and accredited nurseries will
be inspected periodically for hygiene and general practices.

Standards for grapevine plants and a uniform system of
labelling which gives the customer full information on the
vine’s origin will be recommended.

The accreditation scheme is not yet in place and decisions
on how it is to be administered and details on inspections have
not been finalized, although it appears that the Australian Vine
Improvement Association may in fact manage the scheme.

Once in place nurseries can apply for accreditation, which will
no doubt confer some marketing advantages.

To summarize progress so far, a national vine accreditation
scheme is being developed and so far it has been fully supported
by vine improvement organizations, nurseries and wine indu-
try groups alike.

Growers purchasing vines from accredited nurseries will
benefit because they will be able to have confidence that
what they have planted is what they thought they had plant-
ed. They will be assured that the material is of a recognized
standard and that it will not be introducing disease into the
vineyard.

Finally, the scheme will give a huge advantage to the
Australian wine industry by ensuring a reliable supply of
quality planting material for winegrape production into the
twenty-first century.

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