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# *Xiphinema index*-resistant *Vitis* rootstocks screened for comparative field performance in a Chasselas vineyard replant site

by

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## Vergleichende Leistungsprüfung *Xiphinema-index*-resistenter Unterlagsreben in einem wiederbepflanzten Chasselas-Weinberg

Zusammenfassung: Die Leistungseigenschaften von 35 Unterlagen, insbesondere Ertrag und Wüchsigkeit, wurden 10 Jahre lang unter Freilandbedingungen geprüft. Unter den geprüften Sorten befanden sich 25 gegen *Xiphinema index* resistente interspezifische Kreuzungen, die von L. A. Lider und R. M. Kunde, Davis, gezüchtet worden waren („Lider-Sämlinge"). Die mit Augen der Sorte Chasselas gepfropften Unterlagsreben wurden in einem mit *Xiphinema index* verseuchten Weinberg im Nordosten Victorias (Australien) ausgepflanzt. Die Sorte Chasselas erbrachte auf den meisten Lider-Sämlingen signifikant höhere Traubenerträge als auf den traditionellen — reblausfesten — Unterlagssorten dieses Gebietes. 6 Lider-Sämlinge lieferten hohe Erträge und waren wüchsig sowie leicht zu vermehren. Im Hinblick auf ihre bereits nachgewiesene Nematodenresistenz sollten sie deshalb weiter geprüft werden.

Key words: rootstock, nematodes, resistance, selection, yield, must quality, growth, Australia.

## Introduction

The dagger nematode (*Xiphinema index* Thorne and Allen) is a destructive pest of grapevines (*Vitis vinifera* L.) throughout the world, particularly when associated with grapevine fanleaf virus (GFV) (Hewitt *et al.* 1958; Raski and Radewald 1958; Van Gundy *et al.* 1968; Lehoczky and Tasnády 1971). These two pathogens commonly occur with grape phylloxera (*Daktulosphaira vitifoliae* Fitch), e.g., in California, south-eastern Australia and southern Europe.

Better control methods for these three organisms are needed. Most of the rootstocks that are used commercially for resistance to phylloxera are susceptible to *X. index*. The rootstock Ramsey, which is used commonly in the sandy soils of the major irrigated viticulture districts in Australia, is also susceptible to *X. index* (Kunde *et al.* 1968; Boubals and Pistre 1978; Harris 1983). Furthermore, fumigation of vineyard soil before planting only temporarily reduces numbers of *X. index* (Lear *et al.* 1981), and no post-plant nematicides have effectively replaced 1,2-dibromo-3-chloropropane (DBCP) since it was banned. A better control method would be rootstocks tolerant of all three pathogens. Alternatively, rootstocks immune to *X. index* would prevent transmission of GFV to newly planted vines. Neither is available yet.

Some species and hybrids of *Vitis* have exhibited resistance to *X. index* in pot experiments (Radewald 1962; Kunde *et al.* 1968; Boubals and Pistre 1978; Harris 1983). However, there are no reports of the performance of many of these vines as rootstocks in vineyards infested with *X. index* or grape phylloxera. Dr. L. A. Lider and Mr. R. M. Kunde of the University of California, Davis, bred many hybrid rootstocks

('Lider seedlings') in the 1960s primarily for resistance to *X. index*, but these also had not been tested in the field. The most promising 25 of these rootstocks were made available for screening in Australia, and 23 were tested in pots for resistance to *X. index* from 1979 to 1981 (HARRIS 1983). This paper compares the field performance of the Lider seedlings with 10 nematode- or phylloxera-resistant rootstocks used in Australia. The rootstocks were budded with Chasselas scions, then planted in a commercial vineyard replant site at Wahgunyah, Victoria, Australia in 1975, and evaluated over 10 years, particularly for yield and vigour.

## Materials and methods

Dormant cuttings of 36 virus-tested grapevine clones were collected from the Sunraysia Horticultural Research Institute. Table 1 shows the parentage of each rootstock, and each accession number encodes details of importation of the rootstock to Australia (IKIN 1978). The cuttings were surface-sterilized in 0.5 % Chinosol W™ (Hoechst) (67 % 8-hydroxyquinoline sulphate + 30 % potassium sulphate), rooted, then transplanted into aerated steam-treated U.C.-type potting mixture (BAKER 1957) in plastic pots in a glasshouse. Budwood of *V. vinifera* cv. Chasselas (clone FV C11 V1) was stored at about 2 °C until late October 1975, when a yema chip bud was placed in each rootstock. Clonal Chasselas rootings budded with the same clone were included for comparison with the rootstocks.

The grapevines were planted in December 1975 in a vineyard infested with *X. index* (HARRIS 1979) and other nematodes at Wahgunyah, near Rutherglen in north-eastern Victoria. A block of 180 vines was removed in August 1975, and the area was cultivated several times before the trial vines were planted. Each rootstock was replicated 5 times, as single vine plots, in a randomised complete block design. The vines were trained onto a 1.0 m high T-trellis with two wires 28 cm apart and a single foliage wire 22 cm above the T-wires. The vines were spaced 2.13 m apart with 3.05 m between rows.

The surrounding and removed vines were Chasselas, planted in 1919. Most were grafted on the rootstock 1202, but some replants were grafted on ARG 1. The soil had a gradational primary profile form, was not calcareous throughout, and surface textures ranged from loamy sand to sandy loam with a neutral soil reaction trend, overlying a coherent B horizon of sandy fabric (NORTHCOTE 1971). The vineyard received one or two sprinkler irrigations (each approximately 100 mm) per year up to 1981, to supplement the natural rainfall (mean = 545 mm/year). From 1981, the vineyard was irrigated regularly as needed, determined by visual assessment of vines and soil. The Rutherglen region has a hot continental climate (SMART and DRY 1980). The vineyard, soil texture and temperatures, rainfall and management were detailed for an adjacent experiment (HARRIS 1979).

Annual measurements were taken from 1979 to 1985 of fresh weight of grapes, number of bunches and weight of prunings after each vine was cane-pruned according to visual assessment of vigour. 4 canes, each having at least 8 nodes, were retained where possible. Because of a number of missing values, 1979 data were omitted, and least squares means were calculated for each vine for each year from 1980. Yields and bunch numbers were transformed to logarithms for analysis because the variance tended to increase as values increased. Mean yields, bunch weights and pruning weights over 6 years were calculated for each vine. Linear, quadratic and cubic trends in time were also calculated to determine whether the relative performance of the rootstocks changed as the vines matured.

Table 1

Grapevine rootstocks tested, their parentage, and accession numbers (IKIN 1978)

Geprüfte Unterlagen, ihre Abstammung und Listennummer nach IKIN (1978)

| Rootstock name and clone | Cross or species | Accession no. |
|---|---|---|
| Chasselas; FV C11 V1 | *V. vinifera* | I.V. 62.2049 |
| ARG 1 (syn. A × R1); FV A13 V21 | *V. vinifera* × *V. rupestris* | I.V. 62.2046 |
| Dog Ridge; FV A6 V8 (H99) | *V. champini* | I.V. 59.2011 |
| Harmony; FV A10 V7 | Open pollinated Dog Ridge seedling | I.V. 66.2134 |
| Ramsey; NF A11 V2 | *V. champini* | I.V. 63.2065 |
| Schwarzmann; ex Western Austral. | *V. riparia* × *V. rupestris* | A.V. 70.2252 |
| SO4; FV A6 V18 | *V. berlandieri* × *V. riparia* | I.V. 66.2136 |
| 101-14 | *V. riparia* × *V. rupestris* | — |
| 110R (syn. Richter 110); OF 4-11 (H102) | *V. berlandieri* × *V. rupestris* | I.V. 64.2083 |
| 1202; FV A7 V13 (H62) | *V. vinifera* Mouvédre × *V. rupestris* | I.V. 66.2135 |
| 1613; FV A9 V5 | *V. solonis* (syn. *longii*) × Othello [= *V. vinifera* × (*V. labrusca* × *V. riparia*)] | I.S. 74.2066 |
| Lider seedlings | | |
| 86-10 | *V. slavini* × *V. riparia* Gloire | — |
| 88-113 | *V. slavini* × *V. rupestris* Metallique | I.V. 75.2423 |
| 91-39 | *V. riparia* Gloire × *V. candicans* | I.V. 75.2424 |
| 101-9 | *V. arizonica* × *V. candicans* | I.V. 75.2425 |
| 101-56 | *V. arizonica* × *V. candicans* | I.V. 75.2426 |
| 106-38 | *V. longii* × (*V. riparia* Gloire × *V. champini* Ramsey) | I.V. 75.2427 |
| 112-2 | (*V. riparia* Gloire × Dog Ridge) × 1613 | I.V. 75.2428 |
| 112-71 | (*V. riparia* Gloire × Dog Ridge) × 1613 | I.V. 75.2429 |
| 116-11 | *V. candicans* × 1613 | I.V. 75.2430 |
| 116-60 | *V. candicans* × 1613 | I.V. 75.2431 |
| 122-16 | *V. rupestris* Metallique × 1613 | I.V. 75.2432 |
| 142-40 | *V. rufotomentosa* × *V. candicans* | I.V. 75.2433 |
| 142-50 | *V. rufotomentosa* × *V. candicans* | I.V. 75.2434 |
| 150-5 | *V. rufotomentosa* × *V. longii* | I.V. 75.2435 |
| 171-13 | *V. rufotomentosa* × *V. vinifera* | I.V. 75.2436 |
| 171-52 | *V. rufotomentosa* × *V. vinifera* | I.V. 75.2437 |
| 176-9 | *V. rufotomentosa* × *V. rupestris* Metallique | — |
| 176-11 | *V. rufotomentosa* × *V. rupestris* Metallique | I.V. 75.2438 |
| 182-7 | *V. solonis* × *V. longii* | I.V. 75.2439 |
| 187-24 | *V. solonis* × *V. candicans* | I.V. 75.2440 |
| 200-92 | *V. solonis* × *V. riparia* Gloire | I.V. 75.2441 |
| 513-4 | *V. rufotomentosa* × *V. riparia* Gloire | I.V. 75.2442 |
| 514-11 | *V. rufotomentosa* × (*V. riparia* Gloire × Dog Ridge) | I.V. 75.2443 |
| 514-30 | *V. rufotomentosa* × (*V. riparia* Gloire × Dog Ridge) | I.V. 75.2444 |
| 515-1 | *V. rufotomentosa* × (*V. riparia* Gloire × *V. champini*) | I.V. 75.2445 |

During the 1981 harvest, samples consisting of 5 berries from each of 20 bunches from each vine were weighed, crushed and sieved. The soluble solids content of the juice was determined by refractometer.

All data were subjected to analysis of variance, and t-tests were used to compare means between rootstocks.

In October 1981, 24 *Vitis vinifera* cv. Thompson Seedless (clone H5) were planted as bait plants to detect phylloxera. These susceptible vines were planted at the end of each trial row and in spaces where trial vines had died. Roots were dug and examined for phylloxera during 1986—1987.

Soil was sampled in November 1975, April 1977 and February 1980 to confirm the presence of *X. index* throughout the trial site. The samples were collected approximately 60 cm from the trunks of vines at a depth of 20—30 cm, then nematodes were extracted using the method of FLEGG (1967). The 30 soil samples collected in November 1975 were also used to test for the presence of viruliferous *X. index*. Subsamples (80—100 g) of field soil were mixed with aerated steam-treated U. C.-type potting mixture in 12 cm pots, and then rootings of *V. rupestris* SCHEELE cv. St. George (syn. du Lot) were planted. The vines were examined for GFV symptoms over 5 years.

All field vines were indexed for GFV at least once between 1977 and 1983. The main method consisted of grafting 2 dormant yema chip buds to each of 2 dormant cuttings of the indicator, *V. rupestris* cv. St. George in October 1977, then growing these for 3 years and inspecting them frequently for virus symptoms. Immature leaves of rootings propagated from the field vines were used for enzyme-linked immunosorbent assay (ELISA) (CLARK and ADAMS 1977), in October 1979, and for mechanical inoculation to 4—6 replicates of the herbaceous indicator host, *Chenopodium quinoa* WILLD. (CADMAN *et al.* 1960) in October 1979, September 1980 and October 1981.

## Results

Yields, pruning weights, bunch numbers, bunch weights (Table 2), berry weights and soluble solids of scion Chasselas (Table 3) differed significantly ($P < 0.01$) depending on rootstocks. The highest yielding treatments in descending order were the rootstocks 171-13, Dog Ridge, 122-16, 101-14, SO4, 88-113, 142-40, 171-52, 110R, Ramsey, 101-56, 106-38, 116-11, 116-60, 514-11 and 112-2, and none of these was significantly different from 171-13 at $P = 0.05$. These high yielding rootstocks had high mean bunch numbers, mean bunch weights and mean berry weights which were not significantly less than the highest values at $P = 0.01$.

The pruning weight of 171-13 was higher than that of any other rootstock ($P < 0.01$), but the other high yielding rootstocks listed above, except 112-2, were not significantly less vigorous (at $P = 0.01$) than 171-52, which had the second highest pruning weight. However, 142-40, 101-56, 116-60, 514-11 and 112-2 were difficult to propagate and/or bud. 7 rootstocks produced insufficient growth, or too few replicates survived, for assessment of yield or vigour, and were therefore omitted from the analyses of variance. Their mean yields and numbers of replicates bearing fruit in most years were as follows: Chasselas, 0.80 kg (n' = 3); 86-10, 8.62 kg (n' = 1); 101-9, 2.55 kg (n' = 3); 176-9, 2.49 kg (n' = 2); 176-11, 0.23 kg (n' = 4); 514-30, 14.82 kg (n' = 2); and 515-1, 15.19 kg (n' = 2). Attempts to replant the missing replicates failed, and therefore these cultivars are considered too weak and difficult to grow.

The linear, quadratic and cubic trends in time did not show any differences between rootstocks.

Although in 1981 all fruit was harvested in one day, the total soluble solids indicate that the rootstocks were harvested at different stages of maturity. Of the high yielding

Table 2

Mean values and standard errors for grape yield, pruning weight, bunch number and mean bunch weight of Chasselas scions budded on each rootstock · 1980—1985 (n' = number of observations in the mean)

Mittelwerte und Standardabweichungen von Traubenertrag, Schnittholzgewicht, Anzahl der Trauben und Traubengewicht der Sorte Chasselas auf den einzelnen Unterlagen · 1980—1985 (n' = Anzahl der Stichproben)

| Rootstock | n' | Yield, fresh wt (kg/vine) | | Pruning fresh wt (kg / vine) | No. of bunches / vine | | Mean bunch wt (g / bunch) |
|---|---|---|---|---|---|---|---|
| | | $Log_{10}$ | Retrans-formed | | $Log_{10}$ | Retrans-formed | |
| 171-13 | 5 | 1.17 | 14.66 | 2.54 | 2.09 | 124 | 125 |
| Dog Ridge | 4 | 1.12 | 13.15 | 0.76 | 2.02 | 105 | 127 |
| 122-16 | 5 | 1.10 | 12.51 | 0.76 | 2.03 | 107 | 120 |
| 101-14 | 4 | 1.04 | 10.98 | 0.64 | 2.03 | 107 | 106 |
| SO4 | 5 | 1.04 | 10.88 | 0.57 | 2.01 | 102 | 111 |
| 88-113 | 4 | 1.02 | 10.46 | 0.98 | 1.96 | 91 | 122 |
| 142-40 | 4 | 1.01 | 10.20 | 0.76 | 1.99 | 97 | 108 |
| 171-52 | 4 | 1.00 | 10.07 | 1.14 | 1.96 | 91 | 113 |
| 110R | 4 | 0.98 | 9.63 | 0.42 | 1.94 | 88 | 112 |
| Ramsey | 5 | 0.97 | 9.43 | 0.43 | 1.96 | 92 | 105 |
| 101-56 | 4 | 0.97 | 9.24 | 0.50 | 1.97 | 92 | 101 |
| 106-38 | 5 | 0.96 | 9.08 | 0.52 | 1.94 | 88 | 108 |
| 116-11 | 4 | 0.94 | 8.74 | 0.87 | 1.94 | 88 | 102 |
| 116-60 | 3 | 0.93 | 8.60 | 0.39 | 1.97 | 92 | 95 |
| 514-11 | 4 | 0.93 | 8.43 | 0.57 | 1.91 | 81 | 107 |
| 112-2 | 4 | 0.92 | 8.24 | 0.28 | 1.96 | 91 | 93 |
| 187-24 | 5 | 0.90 | 7.97 | 0.37 | 1.95 | 89 | 96 |
| 112-71 | 5 | 0.88 | 7.65 | 0.30 | 1.90 | 79 | 99 |
| 513-4 | 5 | 0.88 | 7.53 | 0.66 | 1.85 | 71 | 106 |
| 150-5 | 4 | 0.87 | 7.48 | 0.94 | 1.81 | 64 | 118 |
| 142-50 | 3 | 0.85 | 7.12 | 0.39 | 1.90 | 80 | 94 |
| Harmony | 5 | 0.84 | 6.96 | 0.46 | 1.83 | 67 | 102 |
| Schwarzmann | 5 | 0.81 | 6.51 | 0.25 | 1.86 | 72 | 92 |
| 1202 | 4 | 0.75 | 5.64 | 0.28 | 1.81 | 64 | 89 |
| 1613 | 5 | 0.73 | 5.32 | 0.23 | 1.82 | 66 | 84 |
| 200-92 | 4 | 0.65 | 4.45 | 0.15 | 1.73 | 54 | 83 |
| 91-39 | 4 | 0.48 | 3.01 | 0.10 | 1.63 | 42 | 75 |
| 182-7 | 4 | 0.34 | 2.19 | 0.10 | 1.51 | 32 | 67 |
| ARG 1 | 4 | 0.30 | 1.97 | 0.08 | 1.47 | 29 | 63 |
| Standard error of the mean | 5 | 0.08 | | 0.13 | 0.07 | | 6.2 |
| | 4 | 0.09 | | 0.15 | 0.07 | | 7.0 |
| | 3 | 0.11 | | 0.17 | 0.09 | | 8.1 |
| Standard error of the difference between 2 means | 5, 4 | 0.12 | | 0.20 | 0.10 | | 9.4 |
| | 5, 3 | 0.14 | | 0.21 | 0.11 | | 10.2 |
| | 4, 3 | 0.14 | | 0.23 | 0.11 | | 10.7 |

rootstocks listed above, only SO4, 171-52, 116-11 and 116-60 had significantly ($P < 0.05$) lower total soluble solids content than 1202, the highest, and these rootstocks may thus have delayed maturity of scion fruit in that year.

No phylloxera or phylloxera symptoms were detected on roots of the bait vines during 1986—1987, despite the season being relatively cool and wet, and thus conducive to increase of phylloxera. In 1982, however, phylloxera crawlers and viable leaf galls (hence alates) were detected on closely surrounding vines.

Nematode counts indicated that the whole trial area was infested with low numbers of *X. index, X. americanum sensu lato* and *Criconemella xenoplax* (RASKI) LUC and RASKI. Small numbers of *Meloidogyne javanica* (TREUB) CHITWOOD were also recovered from a few samples. Although *X. index* was found in 25 of the 30 soil samples collected before planting, GFV was detected in only 3. Another 13 samples, however, produced mild, localised or transient distortion or flecking symptoms on leaves of the indicator vines, and thus the presence of GFV vectors in these samples was uncertain.

Indexing of the field vines detected GFV in only 4 vines — one replicate of 101-9, 106-38, 112-2 and 112-16. 8 other field vines gave mild or transient symptoms on St. George indicators, but these vines were not indexed using the other methods. No conclusive positive reactions were obtained from the field vine leaves in the ELISA or *C. quinoa* tests.

## Discussion

Chasselas on 7 Lider seedling rootstocks yielded at least as much as on Ramsey, the best of the rootstocks now commonly used in Australia. Furthermore, some rootstocks promoted greater vigour in the Chasselas scions, which would enable this variety to be trained onto larger trellises suitable for mechanical harvesting. The increased vigour and yields induced by some of the non-traditional rootstocks in this experiment (e.g., some Lider seedlings, Dog Ridge, SO4) may not necessarily be obtainable in the finer-textured and more fertile soils which predominate in the Rutherglen viticultural district. On the other hand, the traditional rootstocks used primarily for resistance to phylloxera (i.e., ARG 1, 1202) were among the worst rootstocks in this experiment, although they may perform comparatively better in finer-textured soils.

The field performance of the rootstocks was undoubtedly influenced by their horticultural characteristics and their response to abiotic and biotic environmental conditions. In this type of experiment, it is impossible to determine the relative influence of factors such as soil type, climate, vineyard management, inherent vigour, rootstock/scion compatibilty, pests and diseases. Generalizations can not be made from the results of this one experiment, because of variables such as weather, irrigation, weed control, pruning level, and pest and diesease incidence. The best rootstocks, however, can be selected for further screening. The yield and vigour of the Chasselas scions at this site was not related directly to their rootstocks' resistance to *X. index* (HARRIS 1983), at least partly because of the low numbers present up to 1980 (mean count = 5.7/200 ml soil). Of the high yielding rootstocks, Dog Ridge, Salt Creek (sic; probably Ramsey) and 110R are susceptible to *X. index*, SO4 and 101-14 are moderately resistant, and 122-16 is tolerant (RADEWALD 1962; KUNDE *et al.* 1968; BOUBALS and PISTRE 1978; HARRIS 1983). 2 other tolerant Lider seedlings (182-7 and 200-92) and some resistant seedlings (e.g., 176-9 and 142-50) were weak in this field experiment.

The possibility of resistance to GFV, or to nematode transmission of the virus, in some of the Lider seedlings needs further research, especially since resistance to GFV has been reported in *V. rotundifolia* MICHAUX (BOUQUET 1981; WALKER *et al.* 1985).

Table 3

Mean values and standard errors for mean berry weight and berry soluble solids of Chasselas scions budded on each rootstock, 1981 · (n' = number of observations in the mean)

Mittelwerte und Standardabweichungen von Einzelbeerengewicht und Mostgewicht der Sorte Chasselas auf den einzelnen Unterlagen, 1981 · (n' = Anzahl der Stichproben)

| Rootstock | n' | Mean berry wt (g / berry) | Soluble solids (°Brix at 20 °C) |
|---|---|---|---|
| 171-13 | 5 | 2.27 | 15.1 |
| Dog Ridge | 4 | 2.20 | 15.6 |
| 122-16 | 5 | 2.23 | 15.4 |
| 101-14 | 4 | 2.24 | 16.1 |
| SO4 | 5 | 2.17 | 15.0 |
| 88-113 | 4 | 2.08 | 15.3 |
| 142-40 | 5 | 2.08 | 15.1 |
| 171-52 | 5 | 1.95 | 14.8 |
| 110R | 4 | 2.10 | 16.4 |
| Ramsey | 5 | 2.06 | 16.1 |
| 101-56 | 4 | 2.02 | 15.1 |
| 106-38 | 5 | 2.02 | 16.0 |
| 116-11 | 4 | 2.08 | 14.5 |
| 116-60 | 4 | 1.96 | 14.5 |
| 514-11 | 5 | 2.07 | 16.5 |
| 112-2 | 4 | 2.00 | 16.0 |
| 187-24 | 5 | 2.12 | 15.3 |
| 112-71 | 5 | 1.83 | 14.7 |
| 513-4 | 5 | 2.02 | 15.1 |
| 150-5 | 3 | 2.09 | 15.3 |
| 142-50 | 4 | 1.91 | 15.0 |
| Harmony | 5 | 2.05 | 16.4 |
| Schwarzmann | 5 | 1.90 | 15.7 |
| 1202 | 4 | 1.95 | 16.5 |
| 1613 | 5 | 1.94 | 15.2 |
| 200-92 | 3 | 1.70 | 14.6 |
| 91-39 | 5 | 1.76 | 14.4 |
| 182-7 | 5 | 1.71 | 14.9 |
| ARG 1 | 3 | 1.46 | 13.6 |
| 514-30 | 3 | 2.19 | 13.9 |
| Standard error | 5 | 0.09 | 0.41 |
| of the mean | 4 | 0.10 | 0.46 |
| | 3 | 0.12 | 0.53 |
| Standard error | 5, 4 | 0.13 | 0.62 |
| of the difference | 5, 3 | 0.15 | 0.67 |
| between 2 means | 4, 3 | 0.16 | 0.70 |

Unfortunately, no *V. rotundifolia* hybrids were available for this experiment. If 171-52 is immune to *X. index* (HARRIS 1983), prevention of the nematodes' stylet probes would eliminate vectoring of GFV. At least some of the Lider seedlings must be susceptible to *X. index*-vectored GFV, because the virus was detected in the Chasselas scions on 4 different Lider rootstocks. The infected replicates had lower yields and pruning weights than the means for each rootstock, particularly in the later years of the experiment. Some indexing results were inconclusive, and therefore further testing is needed.

Preliminary screening indicated resistance in all of these rootstocks to some root-knot nematodes, including *Meloidogyne incognita* (KOFOID and WHITE) CHITWOOD (N. L. FERRARI, personal communication, 1974, 1983), but they should be further assessed for resistance to different *Meloidogyne* spp. as well as to other nematodes. The phylloxera resistance of the best rootstocks also should be measured. Of the high yielding rootstocks, Dog Ridge and SO4 are immune to type B phylloxera in California, and 110R and Salt Creek (sic; probably Ramsey) are resistant (GRANETT *et al.* 1987).

The best rootstocks from this experiment should be grafted with other scion varieties, and the rootstock effects on grape quality assessed. The rootstocks need further testing in a range of soil types and environmental conditions typical of viticultural areas where *X. index* occurs.

## Conclusions

The results indicate several rootstocks which warrant further testing for similar vineyard conditions, especially 171-13, 122-16, 88-113, 171-52, 106-38 and 116-11. Dog Ridge, 101-14, SO4 and Ramsey also performed well, but are known to be susceptible to *X. index*. The two hybrids of *V. rufotomentosa* SMALL × *V. riparia* MICHAUX (171-13 and 171-52) look the most promising for Chasselas under the conditions of this experiment, if their vegetative growth is managed optimally.

## Summary

35 grapevine (*Vitis* spp.) rootstocks were screened for field performance, especially yield and vigour, over 10 years. The rootstocks included 25 hybrid seedlings bred by L. A. LIDER and R. M. KUNDE ('Lider seedlings') primarily for resistance to the dagger nematode (*Xiphinema index* THORNE and ALLEN). They were budded with Chasselas scions and planted in a vineyard replant site infested with *X. index* in north-eastern Victoria, Australia. The scions on most of the Lider seedling rootstocks produced significantly higher yields than those on the rootstocks traditionally used in this area for resistance to grape phylloxera (*Daktulosphaira vitifoliae* FITCH). 6 Lider seedlings produced high yields, and were vigorous and easy to propagate. They were also shown previously to have resistance to *X. index*, and therefore warrant further testing.

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