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Resistance to grape phylloxera in *Vitis vinifera* × *V. rotundifolia* grape hybrids

by

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Die Reblausresistenz von *Vitis-vinifera* × *V.-rotundifolia*-Kreuzungen

Zusammenfassung. — Eine Population von 278 Nachkommen aus Kreuzungen zwischen 26 Elternreben (Quasi-F_1-Bastarde aus *Vitis vinifera* × *V. rotundifolia)*, etliche dieser Eltern, 3 *V.-vinifera* × *V.-rotundifolia*-Kreuzungen (VR), Muskat von Alexandria als anfällige Kontrolle sowie *V. rupestris* du Lot (St. George) als resistente Kontrolle — sämtliche Reben aus einer Anlage der Universität von Kalifornien, Davis — wurden im Gewächshaus auf die Resistenz ihrer Wurzeln gegen die Reblaus geprüft. Einige der Sämlinge, 1 Elternrebe und die 3 VR-Kreuzungen erwiesen sich, auch bei einer zweiten Prüfung, als reblausresistent. Die Verwendung der resistenten Reben als Unterlagen oder zur Züchtung von Ertragsreben wird diskutiert.

Introduction

The grape phylloxera, *Phylloxera vitifoliae* FITCH, is the most widely known of the aphid insects, because of its destruction of grapevines the world over (STAFFORD and DOUTT 1974). For this reason, the breeding, selection and testing of grape rootstocks for phylloxera resistance comprise one of the most widely explored fields of study in modern viticultural research. For more than a century, vine breeders have tried to combine the inherent resistance of some native wild American species, their adaptability to soil, climate, and other environmental conditions, and their ability to form successful unions with *Vitis vinifera* fruiting varieties. Recently, due to the high cost of establishing grafted vineyards, vine breeders have put greater effort in producing cultivars resistant to phylloxera and root-knot nematodes, as well as having desirable fruit characteristics and adaptation to environmental conditions.

In the present paper, we report some of the *V. vinifera* × *V. rotundifolia* hybrids and their derivatives resistant to phylloxera which may have desirable fruit characters or at least could be used as parents to achieve this end.

Materials and methods

The population used in the screening experiment were planted on their own roots in a University vineyard, as part of the grape breeding program of the University of California, Davis. The population consisted of 278 offspring generated by crosses among 26 parents, some of the parents (e and F series: see OLMO (1971) for details of generation of the parents), 3 F_1 *V. vinifera* × *V. rotundifolia* hybrids (VR), Muscat of Alexandria as a susceptible control, and *V. rupestris* du Lot (St. George) as a resistant control. Selection for resistance had not been practiced in any of the populations.

The method, in general, was the one used by DAVIDIS and OLMO (1964). Green cuttings were taken from individual plants in the vineyard and rooted in the greenhouse (using sponge rock and commercial hormones under mist-conditioning). At least 2 cuttings from each offspring (permitting 2 randomized blocks to be used), 5 cuttings from each parent and VR hybrids, and 20 cuttings of Muscat of Alexandria and St. George were used. The rooted cuttings were transplanted into steam-sterilized vineyard soil in a 3½′ × 8′ tank. The tank was set on a bench 30″ high with a surrounding reflexed rim of about 1″. With a depth of only 6″, the tank gave much quicker buildup and infestation. The tank was equipped with a sloping bottom and the drainage water was collected from a ¾″ spout and emptied into a bottle. The clay-loam soil was heavy and cracked on drying, permitting extensive distribution of the radicicola.

1 month after transplanting, the soil was inoculated heavily with roots infested with phylloxera. The infested grape roots were about 10 cm long and put into contact with the root system of each plant. The vines were irrigated regularly, sprayed for foliage pests (using non-systemic pesticides), and were fertilized as needed. A moat of oil was put around the edge of the tank to prevent the spread of the insect into non-infested areas in the greenhouse.

10 months after inoculation, by which time there was heavy damage to the susceptible controls, the plants were scored for resistance as follows (OLMO, unpublished data, and NEDOV 1980):

0 = No galling, no apparent root injury.
1 = A few small and only occasional galls on fibrous roots.
2 = General galling of main and larger roots, but growth of fibrous roots not badly restricted.
3 = Heavy galling of whole root system, fibrous roots matted, partly decayed, length growth severely restricted.

The plants given an initial rating of "0" were replanted in the infected soil to be retested. After 2 months, they were scored again for resistance.

Degrees of resistance for parents and VR hybrids · Immune seedlings ("0" rated) and their progenitor parents are also shown

Der Resistenzgrad von Eltern und VR-Kreuzungen · Die immunen Sämlinge (Klasse „0") mit ihren Elternpaaren sind ebenfalls aufgeführt

Parents	Rating	VR hybrids	Rating	Parentage	Immune seedlings selected
e1-93	0	041-37	0	e2-82 × e2-40	ℓ1-130
e1-100	3	043-25	0	e4-106 × 37-55F	ℓ4-69
e2-106	2	043-43	0	e5-137 × e1-106	ℓ5-89
e4-71	1			e4-72 × 38-105F	m4-58
e4-93	2			e4-76 × 41-33F	m4-177
e6-32	1				
31-76F	3				
37-55F	3				

Results and discussion

With the numerical scale, based on the degree and character of root rotting as the index of resistance, as used by NEDOV (1980), it was possible to evaluate the different plant genotypes.

Almost all the susceptible and resistant control plants rated "3" and "0", respectively, indicating that the infestation was general. The VR hybrids were all rated as "0" (Table), indicating that they carry dominant genes for resistance from their *V. rotundifolia* parent (OLMO 1971 and DAVIDIS and OLMO 1964). Parental plants had different degrees of resistance, since they were derived from different sources (OLMO 1971). Some of them had *V. rotundifolia* genes in their background, hence they generally showed higher degrees of resistance than those which did not. The degree of resistance for each offspring seedling is not shown here, since 278 of them were tested. They also had different degrees of resistance, since they had been derived from highly heterozygous and diverse sources. 6 of the offspring, rated "0", are shown in the Table along with their progenitor parents. All the retested plants scored as "0" again (Table, seedlings of *"ℓ"* and "m", e1-93 and VR hybrids).

The "0" rated plants could be used as resistant rootstocks or could be used safely in a breeding program. Some of these, such as e1-93, 041-37, 043-25 and 043-43, have immunity to both phylloxera and root-knot nematodes (FIROOZABADY and OLMO, in press). These could be used as resistant rootstocks in the areas where both pests are destructive. They also could be used in other vine improvement projects in order to combine their resistance with desirable fruit characters (for a discussion, see the above-cited paper and DAVIDIS and OLMO 1964).

Summary

A population of 278 offspring generated by crosses among 26 parents (some quasi-F_1 hybrids of *Vitis vinifera* × *V. rotundifolia*), some of the parents, 3 *V. vinifera* × *V. rotundifolia* hybrids (VR), Muscat of Alexandria (susceptible control), and *V. rupestris* du Lot (St. George) (resistant control), all grown in the vineyard of the University of California at Davis, were tested in a greenhouse for resistance to the grape phylloxera, *Phylloxera vitifoliae* FITCH. Some of the seedlings, a parent, and the 3 VR hybrids showed resistance to the pest and verified by retesting. The uses of the resistant plants as rootstocks or in a vine breeding project are discussed.

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