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Green-grafting between Muscadine grape (Vitis rotundifolia Michx.) and bunch grapes (Euvitis spp.) as a tool for physiological and pathological investigations

by

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Le greffage en vert entre la Muscadine (Vitis rotundifolia Michx.) et les vignes vraies (Euvitis spp.) comme moyen d'études physiologiques et pathologiques

Résumé. — L'incompatibilité au greffage reconnue depuis longtemps entre les espèces de la section Muscadinia et les espèces de la section Euvitis du genre *Vitis* semble être facilement surmontable par la technique du greffage en vert.

Des essais de greffages réciproques entre *V. rotundifolia* et *V. rupestris* ont été couronnés de succès en employant cette méthode. Toutefois, le taux de reprise est comparativement moins élevé lorsque *V. rotundifolia* est utilisé comme greffon.

Ces résultats sont discutés en fonction des différences de structure anatomique entre les deux espèces. L'éventualité d'une incompatibilité retardée ne peut pas être écartée, mais l'utilité de cette méthode n'est pas tant de permettre une utilisation directe de *V. rotundifolia* comme porte-greffe, que de faciliter la réalisation de tests visant à mieux préciser les aptitudes de cette espèce comme géniteur dans un programme d'hybridation.

Introduction

The Muscadine grape (*Vitis rotundifolia* Michx.) is generally known to be graft-incompatible with other species of the genus *Vitis* and with *V. vinifera* L. especially. This fact, allied with poor rooting ability, explains why this species, introduced into France at the end of the nineteenth century, has been a failure as a rootstock despite its high resistance to phylloxera.

Moreover, hybridization between Muscadine grapes and bunch grapes is very difficult and the hybrids are usually sterile (Wylie 1871). In recent years, there has been a renewal of interest in Muscadine grape for breeding (Olmo 1971) and a program for transferring the disease and pest resistance of *V. rotundifolia* to *V. vinifera* crossings and to various rootstocks was started in France in 1974.

Hence, it is necessary to investigate thoroughly the potentialities of *V. rotundifolia* in order to choose the most suitable genotypes as parents. Several tests of the value of parents are based on grafting, for example tests for resistance to iron chlorosis, resistance to other mineral deficiencies (magnesium, potassium ...), drought resistance, etc.

Grafting to indicator species is currently used for detection of several grapevine viruses. Little is known about the reaction of *V. rotundifolia* to virus infection Boubals and Pistre (1978) observed that Muscadine grapes, grown in containers infected with *Xiphinema index* carrying grape fan-leaf virus do not develop symptoms of the disease, unlike the other species of *Vitis*.

Fig. 1: Reciprocal green-graftings between *V. rotundifolia* and *V. rupestris:* Growth of the plants five months after grafting (left: *V. rotundifolia* used as scion; right: *V. rupestris* used as scion).

Greffages en vert réciproques entre *V. rotundifolia* et *V. rupestris:* Croissance des plantes cinq mois àprès le greffage (à gauche: *V. rotundifolia* utilisé comme greffon; à droite: *V. rupestris* utilisé comme greffon).

Table

Numbers of successful unions between *V. rotundifolia* and *V. rupestris* using the green-grafting method

Taux de reprise des greffages en vert entre *V. rotundifolia* et *V. rupestris*

Graft partners	Number of plants	Number of grafts	Number of successful grafts	
V. rotundifolia used as stock (scion: *V. rupestris* St. Georges)				
Yuga O.P. seedlings	8	18	17	
Magnolia O.P. seedlings	4	12	9	
NC 11-173 O.P. seedlings	3	9	6	
male nº 1	2	4	3	
Carlos	1	1	1	
Total	18	44	36	81,8%
V. rotundifolia used as scion (stock: *V. rupestris* St. Georges)				
Magnolia O.P. seedlings	6	29	2	
NC 11-173 O.P. seedlings	3	20	6	
Total	9	49	8	16,3%

From a more general point of view, it would be interesting to investigate the reactions of the graft partners in combinations between species genetically as different as Muscadine grapes and bunch grapes.

The results reported here show that graft-incompatibility between Muscadine grapes and bunch grapes can be overcome by the green-grafting method.

Material and methods

The Muscadine grapes used in these experiments were mainly open-pollinated (O.P.) seedlings from three varieties: "Yuga", "Magnolia", and "NC 11-173". In addition, two varieties were directly used in small scale trials, i.e. "Carlos" and "male no. 1".

The bunch grape was *V. rupestris* cv. "St. Georges", which is the best indicator for detection of grape fanleaf virus. All the plants were one-year-old and were grown under greenhouse conditions in containers irrigated with nutrient solution.

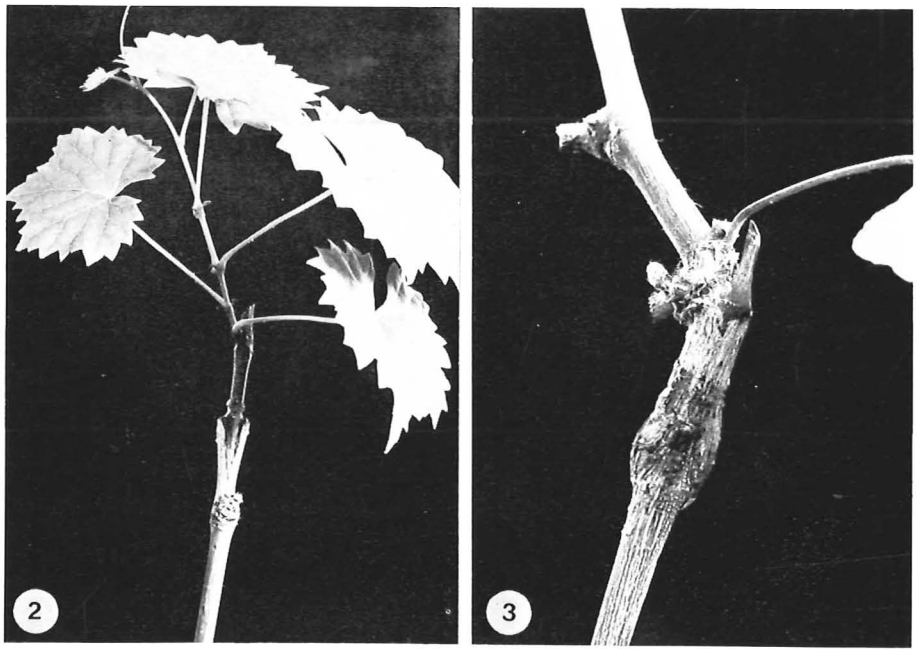

Fig. 2: Two months old green-grafting between *V. rotundifolia* used as scion and *V. rupestris* (latex bandage removed).

Fig. 3: Five months old graft union between *V. rupestris* used as scion and *V. rotundifolia*.

Fig. 2: Greffe en vert âgée de deux mois entre *V. rotundifolia* utilisé comme greffon et *V. rupestris* (bande de latex enlevée).

Fig. 3: Aspect de la soudure entre *V. rupestris* utilisé comme greffon et *V. rotundifolia* cinq mois après le greffage.

Details on the green-grafting method are given by TAYLOR *et. al.* (1966). The stems of both scion and stock were 3—4 mm thick. Scion was bevel-edged (Fig. 2). The union was secured by a self-adhesive latex bandage and a polyethylene bag was fastened over the graft to prevent dessication. The bag was removed after approximately 21 days, i.e. when the bud has burst. All the operations were performed in July 1977.

Results and discussion

Results of the grafting experiment are given in the table. The grafts have been classified successful when the scions were still growing vigorously 5 months after grafting (Fig. 1) and when the graft unions were normally lignified (Fig. 3).

These results, although they may be preliminary, show that grafting operations between Muscadine grapes and bunch grapes are relatively easy to perform and are successful with young unlignified shoots.

Success of the graft requires that the cambium layers of the scion and the stock are in contact. It can be supposed that in young shoots of *V. rotundifolia* and *V. rupestris*, the proximity of the respective cambia may be closer than in one-year-old canes.

However compatibility, referring to the abilities of the stock and scion to exist together, involves structural and chemical similarity. In addition to the different specific gravities of the wood, great structural dissimilarities exist between Muscadine grapes and bunch grapes: the cork cambium (phellogen) is superficial and subepidermal in the Muscadine grape, but it is deep-seated in the outer layers of the phloem in bunch grapes. Moreover, the bundles of phloem fibers are disposed radially in Muscadine grape, but tangentially in bunch grapes. So, the possibility of delayed incompatibility after one year's growth or more, cannot yet be ruled out.

The difference of success between reciprocal graftings is not very clear, but it seems that the degree of lignification of the scion is more critical for successful grafting in *V. rotundifolia* than in *V. rupestris*.

Attempts at using the green-grafting method to associate *V. rotundifolia* and *V. vinifera* are in course. Even with a good level of success in the union, it does not seem that *V. rotundifolia* could have some direct interest as rootstock, owing to its poor rooting ability, its high susceptibility to iron chlorosis and magnesium deficiency and its shallow, spreading root system.

But applications of the method are numerous:

Reciprocal green-graftings including *V. rotundifolia* can be used to analyse the causes of the susceptibility of Muscadine grape to iron chlorosis, i.e. according to POUGET (1973):

— low capacity of the root system for absorbing and supplying iron to the leaf system and (or)

— high iron requirements of the leaf system for chlorophyll synthesis.

Thus, the method can be used to identify the genotypes most suitable to rootstock breeding.

Green-graftings between *V. rotundifolia* and *V. vinifera* are useful for determination of the drought resistance in Muscadine grape, which is also a characteristic of some importance in rootstock breeding.

In pathological investigations, we use green-graftings between *V. rotundifolia* and *V. rupestris*, to test simultaneously:

— the ability (or inability) of the nematode *Xiphinema index* to inoculate grapevine fanleaf virus into *V. rotundifolia*
— the ability (or inability) of grapevine fanleaf virus to multiply in *V. rotundifolia* tissues.

But the method is certainly suitable, with convenient indicator species or varieties (*V. vinifera*, LN 33, Baco 22 A...) to investigate the host-parasite relationships between Muscadine grape and various virus and virus-like diseases for example leaf-roll, corky bark, flavescence dorée.

Summary

Well-known graft incompatibility between Muscadine grapes (*V. rotundifolia* Michx.) and bunch grapes (Euvitis spp.), seems to be easily overcome with the green-grafting method. Attempts at reciprocal graftings between *V. rotundifolia* and *V. rupestris*, using this method, have been successful. However, the number of successful unions is comparatively lesser when *V. rotundifolia* is used as scion.

These results are discussed according to the differences of anatomical structure between the two species. The possibility of a delayed incompatibility cannot be ruled out, however, the interest in the method is not to use directly *V. rotundifolia* as rootstock, but to make easy tests of the value of this species as parent in interspecific breeding programs.

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