SOME FERTILE HYBRIDS OF BUNCH AND MUSCADINE GRAPES

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LMOST 100 years ago the first recorded hybrids between Euvitis and Vitis rotundifolia were obtained by Dr. Peter Wylie¹³. Since his time the work of hybridizing bunch grapes with muscadines has been undertaken by various institutions, including the U.S. Department of Agriculture, and several private workers. All attempts prior to 1955 failed to produce results of practical horticultural value, the primary difficulties being a high degree of sterility in the F1 and weakness in subsequent generations. Although investigation of this problem was begun in 1939 at Greensboro, North Carolina, little was accomplished for some years.

The work reported here is based on an old F₁ hybrid known as N.C. 6-15, presumably produced by Detjen⁴ at the North Carolina Experiment Station, Raleigh, from a cross of a Malaga seedling by a dark-fruited, hermaphrodite, V. rotundifolia selection. It was received from a private breeder, (R. L. Farrer, of Atlanta, Ga.), to whom cuttings had been sent after the V. rotundifolia hybrid work was discontinued at North Carolina in the early 1920's.

The vine is a typical F₁ hybrid with a chromosome number of 2n=39, as established by Patel and Olmo⁹. Morphologically, it is more or less intermediate between the species, and its flowers are pistillate with strongly reflexed stamens.

N.C. 6-15 has been described as "absolument stérile tant par le pollen que par l'ovule," "almost completely pollen and ovule sterile." Patel and Olmo report having obtained several seeds from it, two of which proved viable. It is like all such F₁ hybrids, largely sterile; but it is unlike all such hybrids pre-

cisely in the degree to which it has proved capable of producing, under certain conditions, fruit and viable seed, despite its chromosomal irregularities. Although the few clusters produced are generally very small, one to four berries being the rule, bunches of eight to 12 berries have been obtained, and in 1956 the vine produced, among other smaller clusters, two of 26 and 31 berries, respectively, averaging just under one sound seed (non-floaters) per berry. In 1960 about 100 sound seeds were harvested.

Wylie¹³ noted considerable variation in "compatibility" between individual *Euvitus* and *V. rotundifolia* vines. Dearing¹ and Detjen³ observed similar breeding behavior. In order to explore, in the light of their experience, the possibilities of further breeding, as well as to obtain at once as many seeds as possible, pollen from numerous *Euvitis* varieties, especially *V. vinifera* and Franco-American hybrids, was used on N.C. 6-15 in mixed-open and controlled pollinations, with the results stated above. In the controlled crosses, the variety Blackrose gave the best fruit set.

Germination of the seeds of N.C. 6-15 is normal, i.e., approximately 50 percent. However, behavior of its seedlings is at variance with that previously reported for backcross progeny of such hybrids. Although the majority of seedlings, regardless of the pollen parent, have been weak or very weak, not surviving to fruit, about five percent have ranged from somewhat under average vigor to marked heterosis. Among these backcrosses of N.C. 6-15 have been individuals ranging in fertility from well above that of the seed parent to normal. (The term "backcross" is used to indi-

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N.C. 6-15 AND FIVE SEEDLINGS

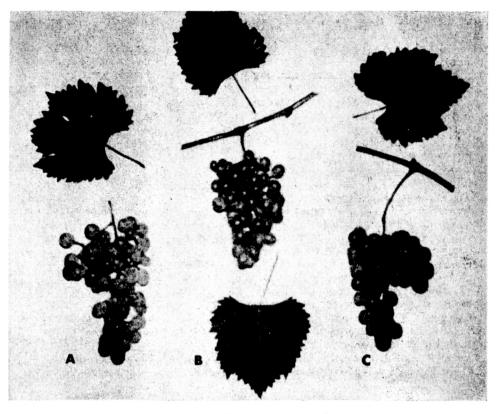
Figure 18

A—DRX 59-3 (\times Blackrose); B—DRX 59-5 (\times Dunstan 17); C—DRX 58-2 (\times Blackrose); D—DRX 58-5 (\times Dunstan); E—N.C. 6-15; F—DRX 57-5 (\times Dunstan 56). The fruit of N.C. 6-15 (E) is just beginning to ripen; the others are mature.

cate the parental species of N.C. 6-15, its exact parental varieties presumably being no longer in existence.) These results are in accord with the well-established principle that fertile lines may be developed from partially sterile F_1 hybrids 10. Eight such fertile selections have been made to date. Seven of them have been backcrossed with Euvitis and three by V rotundifolia (Figure 18). Cytological analysis of four seedlings of N.C. 6-15 \times Euvitis reveals the chromosome number of each to be 2n=38.

The first of these four, designated DRX-55, resulted from an open-pollinated seed of N.C. 6-15, being the one

surviving plant from nine seeds produced in 1954. The vine is intermediate in certain characteristics, although somewhat more *Euvitis* in general appearance. Although its flowers appear phologically perfect, its pollen is entirely sterile. Attempts at selfing, distributed through five seasons of flowering and involving 40 clusters, have failed to produce a berry, while clusters left open with adequate pollen have set normally. Microscopic examination of the pollen shows only abortive grains. This vine, therefore, presents a condition apparently rare in Vitis; normally it has fertile ovules in flowers whose pollen proves consistently sterile. (Stout ob-



DERIVATIVES OF N.C. 6-15

Figure 19

A—DRX 58-12 (DRX-55 \times Blackrose); B—DRX-55 (N.C. 6-15 open pollinated); C—DRX-17 (DRX-55 \times N. Y. Sta. 16829). All fruit mature.

served male-sterile individuals, all Euvitis, some having erect but "crinkled" stamens, others with normal, upright stamens¹¹. He attributed their sterility to intersexualism.) Furthermore, DRX-55 appears unique among Euvitis × V. rotundifolia hybrids in that its fruit clusters are predominantly Euvitis in size and form.

In studying F_1 hybrids of *Euvitis* \times V. rotundifolia, Williams¹² observed that "the degree of expression of the intermediate condition was about uniform in any one vine; that is, a vine with more resemblance to one parent in one character had more resemblance to that parent in other characters." In the

majority of BC₁ progeny of N.C. 6-15, such consistent dominance by either parental species is not apparent.

It will be noted in Table I that four out of the five seedlings illustrated in Figure 18, as well as N.C. 6-15 itself, show the more or less intermediate condition in certain characters.

The BC₂ generation of N.C. 6-15, especially the backcrosses by multispecific *Euvitis* varieties, presents striking patterns of segregation and recombination, with the recurrent species more clearly in evidence. Among the BC₂ occur numerous vines manifesting in altogether novel combinations the anatomical and morphological characters

that distinguish their parental species. Moreover, the forms in some cases are so modified as to be unlike those of either parental species¹⁰. Besides this fact of genetic interest, one finds among the one-hundred-odd vines that have fruited the promise of practical horticultural value, notably, outstanding vigor and resistance to disease as well as fruit of pleasing quality (Figure 19).

Discussion

The pollen sterility of DRX-55, coupled with normal ovule fertility, may be cytoplasmic due to disharmonies caused by hybridism between its widely divergent parental species⁵. Pronounced discordance, possibly cytoplasmic, well known to exist between V. rotundifolia and Euvitis when the former serves as seed parent, appears to make this cross difficult, whereas the reverse cross succeeds readily4,9. The male sterility of DRX-55 could be cytoplasmic, however, only if the pollen parent were V. rotundifolia, in which case the flowers of DRX-55 would be either pistillate or staminate, not perfect, there being staminate but no hermaphrodite V. rotundifolia vines in the 1954 planting⁶. A further complication is that seedlings of DRX-55 appear to segregate in a ratio of approximately 1:1 for male sterility.

If the sterility of DRX-55 is genic in character, its pollen parent could have been *Euvitis*. (The blossoming period of N.C. 6-15 usually bridges by several days that of both *Euvitis* and *V. rotundifolia*.) Search of the literature discloses no case of genic sterility in *Euvitis* \times *V. rotundifolia* hybrids, although such cases may exist. If so, they may

have escaped detection, since genic sterility would exist in conjunction with chromosomal sterility obligate in the F₁, in addition to normal pollen sterility of the pistillate-flowered vines. Therefore, proof of its presence would require special investigation.

These conflicting matters might be clarified in some measure if N.C. 6-15 were assumed to have been selfed. That such was the case seems unlikely, however, since its flowers with tightly recurved stamens would generally produce only nonviable pollen^{2,6,7}. More data are needed to elucidate fully the nature of sterility in these hybrids.

Summary

From one of the old F₁ hybrids of *Euvitis* × *V. rotundifolia*, N.C. 6-15, a series of fertile selections has been obtained, contrary to the implications of previous experience as recorded in the literature.

These results are of great importance, since an imposing array of genetic material represented by *V. rotundifolia* and hitherto not available to the breeder of bunch grapes is now at his disposal. The wall of "species barriers" having been breached or circumvented, it is now possible to pursue the work of breeding at the diploid level, to obtain by conventional techniques of recombination and selection new varieties possessing the most desirable qualities of both the true grapes and the muscadines and especially adapted to conditions in the Southeast.

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TABLE I. Distribution of certain parental characters in N.C. 6-15 and five of its seedlings. I—characters intermediate in approximately even balance; E—closer to Euvitis; R—resembling V. rotundifolia

	Leaf form	Leaf size	Leaf tex- ture	Clus- ter form	Clus- ter size	Skin	Pulp	Seeds	Bark	Canes	Ten- drills	
N.C. 6-15 DRX 58-5 DRX 59-3 DRX 59-5 DRX 58-2 DRX 57-5	E E I I E	E E E R R E	I R E I E I	R E I R R	R E I R R	R R R R R	R I I E I E	R R E R I	I I I R E E	I I I R E	E I E E E	I E E E E

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