Hybridization of *Euvitis* × *Vitis rotundifolia:* Backcrosses to Muscadine[1]

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For almost a century the hope of hybridizing species of *Euvitis* with *V. rotundifolia* remained unfulfilled. A new type of vine, combining the vigor and disease resistance of the muscadines with the fruit quality of the *vinifera,* should make it possible to grow true "table" grapes in the humid Southeast. Attempts initiated by Wylie (9) came to naught in the chaos following the Civil War, and later efforts, both by private and institutional workers, produced prior to 1955 little beyond the highly sterile F_1 generation.

Earlier investigators, notably Dearing (1), Dermen (2), and Patel and Olmo (7), encountered considerable variation in the behavior of individual vines, indicating greater or lesser degree of compatibility in certain combinations and total lack of it in others. Their work, then, points up the existence of a measure of affinity between the bunch grapes and the muscadines, even while disclosing the acute disharmonies existing between them.

The appearance of an ovule-fertile hybrid vine with *Euvitis* type clusters, and the subsequent production of other backcrosses to *Euvitis* capable of normal fruiting have been reported previously (3, 4). This paper describes a new backcross progeny to *V. rotundifolia.*

Materials

DRX-55, one of the fertile backcross hybrids previously reported (4), was pollinated by a perfect-flowered *V. rotundifolia* selection, Georgia Station 14–20, outstanding for its large cluster and berry size. Fruit of both parents is light colored,—the seed parent pale yellow, and the pollen parent bronze to rosy. From this cross some 110 seedlings were obtained in 1960 and transplanted to the test row.

Results and Discussion

The BC_1 hybrid, DRX-55, whose pollen parent was presumably a bunch grape, has regained chromosome stability with the normal *Euvitis* complement of 38.[2] When backcrossed to *V. rotundifolia,* (chromosome number 2n = 40), its progeny, 5/8 muscadine, would be expected to show the same chromosome number as the F_1 hybrids, (2n = 39), and like them be highly, it not totally, sterile. Comparison of the degree of sterility in the F_1 and BC_2 might throw added light upon the nature of the species barrier and the extent of compatibility between *Euvitis* and *V. rotundifolia.* Occurrence of fertile seedlings of this cross would also confirm the hybridity of the seed parent, for if DRX-55 were not a true hybrid,

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[2]For cytological analysis of this and other hybrids herein discussed, warmest thanks are expressed to Dr. Haig Dermen, Cytologist, Crops Research Division, USDA, Beltsville, Md; and for examination of pollen to Mr. William B. Nesbitt, Graduate Assistant in Pomology, New Jersey Agri. Exp. Sta., New Brunswick, N. J.

its progeny would be merely F_1, hence virtually sterile. Chromosome number of the seedlings of DRX-55 × Georgia Station 14–20 is 2n = 39, as determined on several random samples, thus establishing their hybridity.

In their overall aspect these vines resemble strongly *V. rotundifolia,* particularly in color, form and texture of leaves, in density of wood, type of bark, form and size of buds, and in structure of pith. *Euvitis* influence is also clearly expressed in other characters, such as an acutely elongated leaf-blade, slight lobing and pubescent underside of leaves, bark color, strong canes little inclined to branch, bifid tendrils, large flower cluster, berry form, and susceptibility to anthracnose and mildew,—all distributed at random throughout the population.

In 2 areas these vines show extremes of variation:—in growth, from extraordinarily vigorous to very weak; and in size and form of inflorescence, from clusters typical of the smallest female muscadine to those of large-fruited *Euvitis* species (Fig. 1).

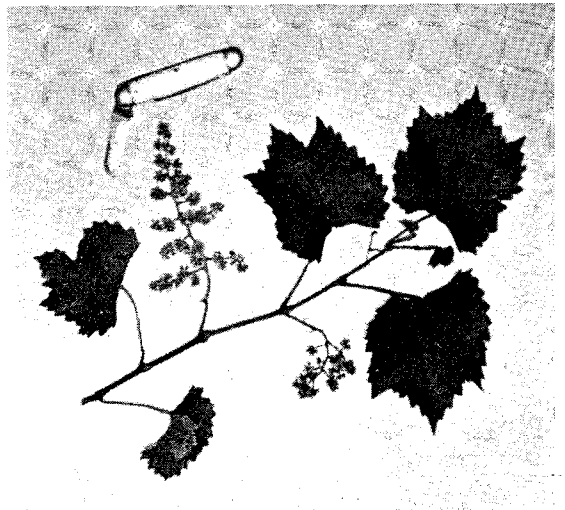

Fig. 1. Secondary blossom of a seedling of DRX-55 × Georgia Station 14–20. Photo 7/6/62. (× 1/3).

Of the 110 seedlings 35 have blossomed to date, the ratio of females to perfect-flowered vines being 1–7. This ratio, slightly below that experienced by Hedrick (5) and Oberle (6), is likely due to the unique floral behavior of the seed parent previously described (4). Blossom period falls roughly between that of the parents, barely overlapping that of the latest bunch grapes, but running well into that of the muscadines. Selfing and germination tests, as well as microscopic examination on random vines, indicate the pollen to be highly defective. Controlled pollination both by bunch grape and

muscadine has given generally erratic results. Nevertheless, 14 vines fruited in 1962, yielding 274 sound seeds (non-floaters), and in 1963 13 vines in open and controlled pollinations gave 470 seeds. Seeds have proved viable, germinating normally, about 50% (7). Like their pollen parent, 5 vines freely produce secondary blossoms. Under open pollination 3 vines approach normal fertility, their fruit-set in 1963 comparing favorably with that of muscadine vines of similar age under like conditions. Seeds have now been obtained in closed pollination by 6 predominantly *vinifera* selections.

The berries are mostly oval to long oval, rarely spherical, sometimes ovoid or obovoid, and occasionally showing a pronounced "neck" (Fig. 2), especially in early stages of growth. Skin is thinner and less tough than in the muscadines, and virtually devoid of muscadine astringency. Pulp also is more tender and more melting than in *rotundifolia,* freeing seeds readily. In other respects—seed, flavor, aroma—fruit veers markedly toward the muscadines. Color of fruit of all vines ranges from dark reddish purple to black.

Although these vines are still too young to reveal their full potential, the first 2 seasons' performance discloses their importance at 3 points:—their relatively high degree of fertility, their extensive gene transfer, and their inheritance of fruit color.

The occurrence of dark-fruited offspring in a cross of 2 light-fruited varieties has not, as far as we know, been hitherto reported for *Vitis,* although similar cases of inheritance of color are known in other plants (8).

Fig. 2. Fruit from five seedlings of DRX-55 × Georgia Station 14–20. Photo 9/10/62. (× ⅓).

The fact that these vines are progeny of the widest cross possible within *Vitis* may provide some clues to their abnormal behavior. Their dark fruit color suggests an atavism similar to that found in inheritance of flower color in sweet peas (8). While neither parent carries the factor for normal dark pigment, the seed parent, itself a "wide" hybrid, may carry some ancestral factor for a chromogen, and the *rotundifolia* pollen parent may carry the "activator" factor, *these two factors being complementary.* The male parent shows some slight factor for "blended" pigment, rosy bronze, very likely dominant to white, but recessive to dark, which may well be sufficient to initiate the reaction producing dark pigment. On the other hand, this anomaly may arise out of discord between *rotundifolia* genes and *Euvitis* cytoplasm.

DRX-55 crossed with light-fruited *Euvitis* varieties, has shown color deviation in only one case. With dark-fruited *Euvitis* it has consistently given the expected dark and light offspring.

These backcrosses to *V. rotundifolia* and others obtained by R. L. Farrer and B. O. Fry,[3] as well as backcrosses to *Euvitis* reported earlier (4), confirm the reality of an impressive degree of affinity between the species. Robust, resistant, fruitful, and showing broad segregation in a rich gene pool, these backcrosses lend further telling weight to the surmise that there is basically a higher degree of homology between the species than has hitherto been believed to exist.

Summary

An ovule-fertile, pollen-sterile BC_1 hybrid of *Euvitis* × *V. rotundifolia,* DRX-55, was pollinated by a perfect-flowered muscadine, Ga. Sta. 14–20.

The progeny, ⅝ muscadine, strongly resembles in vegetative characters the pollen parent, yet shows also abundant evidence of *Euvitis* influence. All vines thus far fruiting deviate radically from the expected pattern of inheritance of color. Although these vines were predicted to be highly if not totally sterile, 40% of those blossoming to date have matured fruit, 3 vines approaching normal in fruit set. Several individuals have been further crossed with *vinifera* types. Seeds from all vines have proved normally viable.

These BC_2 to *V. rotundifolia,* complementing those to *Euvitis* reported earlier (4), indicate a clear breach in the species barrier and thus establish the feasibility of combining *at the diploid level* these long-separated members of the *Vitaceae.*

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