Genotype of Functionally Hermaphroditic Grape Clones

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The way in which the grape flower is able to function in reproduction is closely associated with floral morphology, and is of considerable importance to the grape industry as well as to the grape breeder and geneticist. Oberle†, in an extensive study of grape breeding data at the Geneva Station, has determined the genetic basis for the inheritance of floral morphology and function in grapes. He recognized three distinct flower types, only one of which normally appears on any one individual vine. These, classified as to their reproductive function, are (1) hermaphroditic (a flower possessing both a normally developed pistil and erect stamens with normal anthers), (2) pistillate (a flower possessing a normally developed pistil but with reflexed or down-curved stamens having anthers which produce non-viable pollen—male sterile), and (3) staminate (a flower possessing an incompletely developed pistil—female sterile but with erect stamens and normal anthers). Crosses between these types gives progenies in which the parental types are recovered in simple Mendelian ratios.

Functionally hermaphroditic clones are of two genotypes, (a) heterozygous for hermaphroditism and (b) homozygous for hermaphroditism. When the heterozygous genotype is intercrossed or selfed, a 3:1 ratio of hermaphroditic to pistillate offspring results. Crossing the heterozygous hermaphrodite with pistillate produces a 1:1 ratio of hermaphroditic to pistillate, while staminate by the heterozygous hermaphrodite gives progeny with ratios of 2 staminate : 1 pistillate : 1 hermaphroditic. When a hermaphrodite of the homozygous genotype is intercrossed or selfed, all offspring are functionally hermaphroditic. Staminate pollen used on the homozygous genotype gives progeny with a 1 : 1 ratio of staminate to hermaphroditic.

With few exceptions, functionally pistillate (male sterile) clones have had limited economic value. Perhaps the best known examples of varieties in this category which have attained commercial importance are the Almeria (Ohanez) grown chiefly in Spain and to a lesser extent in Australia, California and South Africa, and the Chaouch grown in Turkey and nearby regions. Fruit production is dependent upon pollination of the flowers by pollen from other suitable pollinator clones. Several factors may influence such a relationship to the extent that consistent economically profitable yields may be adversely affected. Examples of such factors are the number and location of pollinator clones, pollen production and quality, coincidence of bloom periods, and the various environmental forces which influence the distribution of pollen by their effects upon insect population and activity, etc.

The genotype of functionally hermaphroditic clones also assumes a practical as well as a theoretical interest to the grape breeder since, in some measure, this influences genetic techniques and selection procedures. Crosses of pistillate clones with the

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†Oberle, George D. 1938. A Genetic Study of Variations in Floral Morphology and Function in Cultivated Forms of *Vitis*. New York State Agr. Exp. Sta. Tech. Bul. No. 250.

heterozygous hermaphroditic clones or intercrosses of the heterozygous genotype, are relatively inefficient combinations for producing progenies from which potential commercial clones are to be selected, since the use of this genotype as the source of functional hermaphroditism will produce 50% and 25% pistillate individuals respectively in the progenies. When it is considered that one-half to one-fourth of the total progenies available for selection of commercial types must be grown to fruiting age in the vineyard, only to be automatically eliminated prior to selection for the desired characters from the remaining hermaphroditic individuals, does the importance of the genotype assert its relevance.

A particularly vexing problem confronts the grape breeder when selection is carried on for seedless types from progenies in which the source for the hermaphroditic flower character is derived from the heterozygous genotype. Although the character for seedlessness used by grape breeders in developing seedless grapes is not inherited in the same manner as the flower type, pollination is necessary for berry development since, in this type of seedlessness (stenospermocarpic), the ovules are functional during fertilization but abort during later development. Thus, individuals will be produced which are seedless and functionally pistillate with the result that these clones cannot be used as either female or male parent in further breeding, nor can they be utilized as commercial varieties without the need for pollinators. Such "evolutionary dead ends" do not occur when homozygous hermaphroditic clones are used as parents since all progenies will be functionally hermaphroditic. It is unfortunate that perhaps the two best sources for the seedless character in grapes, the varieties Sultanina (Thompson Seedless) and Black Monukka, used by grape breeders at the present time are of the heterozygous genotype.

To determine the genotype of funtionally hermaphroditic grape clones in order that homozygous genotypes may be utilized where possible, an analysis was made of the breeding behavior of functionally hermaphroditic grape clones used in breeding at the Illinois Station and the results presented in Table I. Many other clones were used in breeding but are not included in the Table because of small progenies, incomplete records on flower type, or having been previously reported on by Oberle†. It is

Table 1. Classification of grape varieties being used in the breeding program at the University of Illinois, based on their breeding behavior.

Homozygous Functional Hermaphrodites
Alphonse Lavallee (Ribier)
Lignan blanc
Galibert 256-28*
Joannes-Seyve 23-416
Seibel 14664
Seyve-Villard 20-365
Seyve-Villard 23-18
Heterozygous Functional Hermaphrodites
Blackrose
Buffalo
Captain
Himrod
Kendaia
Muench
Muscat of Alexandria
Muscat Rose
New York 15302
Bertille-Seyve 2667
Couderc 71-20
Joannes-Seyve 26-205
Seibel 1000
Seibel 4986
Seibel 5813
Seibel 6905
Seibel 11342
Seibel 11803
Seyve-Villard 1-72
Seyve-Villard 12-375
Seyve-Villard 18-315

*Received under this designation through Plant Introduction, U.S.D.A., but may not be authentic; possible same as or very similar to S. V. 20-365.

of interest to note that analyses of the following clones used in crosses at this Station have confirmed the results obtained at the Geneva Station: Black Monukka, Campbell Early, Chasselas Golden, Delaware, Goethe, Golden Muscat, Keuka, Mills, Muscat Hamburg, Seneca, Sultanina, and Winchell. Of these clones only Muscat Hamburg and Seneca are homozygous hermaphrodites.

Oriental Persimmons

One of the most exotic, commercially grown fruits of the U. S. is the oriental persimmon. According to a staff writer of The Blue Anchor (Nov. '63 - Jan. '64), there are about 625 acres of this fruit in California, where it is mainly grown.

The oriental persimmon is native to China, and was introduced into this country from Japan in 1828. Of the varieties grown in California there are two main types—one which is sweet while it is still quite firm, and the other which is astringent (puckery) until it is soft and ripe. The latter varieties are artificially ripened by treating the fruit with ethyl alcohol, acetic acid, or carbon dioxide.

Persimmons are propagated by budding or grafting, and three species are used as rootstocks in California, namely: *Diospyros virginiana* (native), and *D. lotus* and *D. kaki* (oriental species), the latter being the most generally used. There are about 1000 varieties in Japan, but only several varieties of commercial importance in California.

Hachuya is the most popular variety, making up 90 percent of the California acreage. The fruit is acorn-shaped, large, attractive, orange-red when ripe, usually seedless, and astringent until soft. It ships well.

Hyakume, second in popularity, is ovate, large, orange with dark brown russeting when ripe, of good quality, and astringent until ripe. It also ships well.

Tamopan has a distinctive blocky shape, with a crown. It is large, seedless, has a pleasant flavor, and is astringent until soft.

Taneshi is usually seedless, large, conic, light orange, pleasant tasting, but mealy when ripe. It is astringent until soft, and its thick skin and firm flesh make it an excellent shipper.

Fuyu is oblate, medium-sized, seeded, a beautiful tomato-red when ripe, and has a spicy, non-astringent flavor even while still firm.

Maru is medium to small, round, very attractive, richly flavored when soft, and has excellent shipping and keeping quality.

Strawberry References from Europe

Dr. George Darrow, noted strawberry breeder, calls our attention to a few valuable references from abroad, on strawberry varieties. One of these is an article in the French Annales de L'Amelioration de Plantes, Vol. 12 (1962), on June bearing varieties, by J. O. Brossier, of the Southern Research Station at Montfavet, France. Dr. Darrow tells us that it is a monumental work of 142 pages, with descriptions of varieties, illustrations of flowers and fruits of each, and a list of species and varieties, with keys for their identification.

The July, 1964 issue of L'Italia Agricola contains a 150 page section on the strawberry, includes 17 articles, and many magnificent color plates of both American and European varieties.

Both of the above references ought to be translated into English, says Dr. Darrow, for the benefit of those in the English speaking countries who are interested in strawberries.