

Sex Determination in a Progeny of a Self Pollinated Staminate Clone of *Vitis*

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Abstract. A staminate *Vitis riparia* vine, in 1 of 13 years produced a few hermaphroditic flowers which when selfed, produced viable seed. In a 15-vine progeny from that seed, 8 were staminate and 7 pistillate flowered, giving a 1:1 ratio as expected in a cross of pistillate × staminate. No hermaphroditic flowered progeny occurred, so the seed set on the staminate vine was not due to a mutation. A possible hypothesis to explain the observations is presented.

INTRODUCTION

FLOWER types in native species of North American *Vitis* consist of 2 well defined functional types, pistillate (male sterile) and staminate (female sterile). Normally only 1 type of flower is found on any individual vine. However, both of these flower types are morphologically hermaphroditic since all possess both pistils and stamens though one or the other organs may be more or less undeveloped. A third type of flower which is both functionally and morphologically hermaphroditic is found in the Eurasian species, *V. vinifera*, and its hybrids.

In apparently rare instances, pistil development in staminate flower types has progressed to the point that berries have set and developed into fruit. Dorsey (1) refers to a case in which a staminate vine of *V. riparia* × *V. labrusca* parentage bore light crops of fruit twice in 30 years. Munson (2) states "As the male flower has no pistil it is clear that its vine cannot bear, unless the vine changes its action from producing purely staminate flowers, to bearing pistillate flowers, which in two or three instances only, in all my observation, have I known to occur." Oberle (3) reported on 2 seedling vines that bore flowers having erect stamens and extremely weakly developed pistils in which a few berries set but fell before reaching maturity. Oberle also mentions 2 staminate rootstock clones of *V. riparia* × *V. rupestris* parentage which set a few berries from flowers showing slight development of the pistils. He states that these berries apparently were of parthenocarpic origin since only a few persisted to maturity and these were seedless. No reports have come to our attention on the inheritance of flower sex types in a progeny derived from selfing a staminate vine exhibiting the pistil development necessary to produce viable seeds. The purpose of this paper is to record such an occurrence, the flower sex types obtained in a progeny of this derivation and to present a possible hypothesis to explain the observations.

MATERIALS AND METHODS

In 1950, dormant hardwood cuttings of a staminate clone of *V. riparia* were obtained from Charles C. Deam, Bluffton, Indiana, Research State Forester of Indiana. This clone, termed Deam, along with other native *Vitis* species material, was sent to the author by Deam for use in disease resistance studies. A single rooted vine of

Deam was transplanted to the experimental vineyard at Urbana, Illinois where it first blossomed in 1953. At that time the vine was recorded as staminate and in all subsequent years except one, it behaved as a typical staminate with abundant production of characteristic *V. riparia* staminate flower clusters.

In the blossoming season of 1958, it was observed that several flowers in a few of these staminate clusters had well developed pistils and stigmas. Other flowers in these clusters showed various degrees of pistil development ranging from fairly well developed pistils to the small button-like pad of the suppressed pistils typical of the staminate flowers on the remainder of the vine. All flowers, regardless of pistil development, had the characteristic normal upright stamens. In most of the flower clusters there were no observable morphological changes in the flower parts to indicate a general increase in pistil development. Pistil development on these few clusters appeared to be a random occurrence among the total cluster complement of the vine.

All opened flowers on the flower clusters displaying increased pistil development were removed, and each cluster with the remaining unopened flowers was bagged to exclude insects and to prevent cross pollination by other varieties in the vineyard. From the berries which developed on the bagged clusters, 32 non-floating seeds were harvested. These seeds were stratified in moist ground sphagnum, after-ripened for 3 months at 35°F, planted in the greenhouse and 23 of them germinated. From these, 15 vines were planted in the seedling vineyard in April, 1962.

RESULTS AND DISCUSSION

These 15 vines blossomed in 1964 and 1965. Eight were staminate and 7 pistillate flowered, apparently a 1:1 ratio. Contrary to expectations, none of the progeny had hermaphroditic flowers, though the parent obviously was a phenotypical and morphological hermaphrodite.

Oberle (3) developed a hypothesis on the inheritance of flower type in *Vitis*, to the effect that functional flower type is controlled by 2 pairs of factor complexes borne on 1 pair of homologous chromosomes and are so closely linked that crossing over rarely, if ever, occurs between them. These gene complexes are symbolized as follows:

So—a dominant factor complex which suppresses ovule development
so—a recessive factor complex for normal ovule development
Sp—a dominant factor complex for normal pollen development
sp—a recessive factor complex which suppresses pollen development

Genetic flower types are symbolized as

A. Pistillate (♀)	so sp/so sp
B. Staminate (♂)	
1. normal wild type	So Sp/so sp

2. derived from hermaphrodite cross So Sp/so Sp.

C. Hermaphrodite ♀

- | | |
|-----------------|-------------|
| 1. heterozygous | so Sp/so sp |
| 2. homozygous | so Sp/so Sp |

According to the hypothesis the development of functional pistils in the staminate flowers would require a change in the genetic constitution from the staminate So Sp/so sp (assuming the normal wild type) to the hermaphrodite so Sp/so sp. This would mean a mutation of So to so or crossing over to give the genotype so Sp/so sp which is indicated by the phenotypical and morphological characters of the hermaphroditic flowers in the staminate flower clusters. Selfing the genotype so Sp/so sp should give the expected ratio of 1 ♀:3 ♂ or if the genotype so Sp/so sp were pollinated by the staminate flowers in the cluster, genotype So Sp/so sp, the expected ratio would be 1 ♀:1 ♂:2 ♂. In either case hermaphrodite flower types should appear in the progeny. Assuming that the clone is not of the normal wild staminate type but homozygous dominant for Sp and heterozygous for So (So Sp/so Sp) and the same conditions prevailed as in the first example then the expected ratio would be 1 ♂:1 ♂. Again hermaphrodite flower types should appear in the progeny.

From the observed 1:1 flower ratio in the selfed Deam progeny it follows that only so sp and So Sp gametes must have been produced in the phenotypically hermaphroditic flowers with the same result as in a mating of normal ♀ and normal ♂ in the dioecious species, giving the expected 1:1 ratio. In view of this and the observations on the variation in floral morphology in the clusters which produced fruit on the staminate clone plus the fact that phenotypic hermaphrodite flowers were noted only once in 13 years, it is clear that we are not dealing with a mutation. Rather it seems probable that the phenomenon of fruit production on staminate flowered vines is due to the modification of sex expression by environmental factors and/or factor complexes located on other chromosomes which affect sex expression through interaction with the chromosome set bearing the So Sp/so sp factor complex.

If this interpretation is correct, as the available evidence indicates, then the phenotypic end product is qualitative, i.e., either ♀ (male sterile), ♂ (female sterile), or ♀ (hermaphrodite) but the expression is controlled by the quantitative action of genes or gene complexes affecting the ♂ or ♀ potential, i.e., maleness or femaleness expressed to varying degrees. This reasoning would explain the observed behavior displayed by the Deam clone.

LITERATURE CITED

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