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Some F_1 Hybrids of Vitis Rotundifolia With Related Species and Genera

L. R. DETJEN
Division of Horticulture

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION
CONDUCTED JOINTLY BY THE
STATE DEPARTMENT OF AGRICULTURE
AND THE
NORTH CAROLINA STATE COLLEGE OF AGRICULTURE AND ENGINEERING
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SOME F_1 HYBRIDS BETWEEN VITIS ROTUNDIFOLIA AND RELATED SPECIES*

L. R. Detjen, *Assistant Horticulturist*

INTRODUCTION

In the search for information regarding the limits of hybridization of Vitis rotundifolia, numerous hybrid plants of different parentage have been produced. Up to the present time only nine different combinations of parents are represented, but from even this small number much valuable information has been obtained as to the nature of the characters found in the F_1 hybrid vines.

Since the hybrid character of the seedling is proof positive that hybridization has been effected between two given individuals, we publish herewith careful descriptions of some of these hybrid vines that the evidence may be conclusive. Furthermore, an analysis of these hybrids has led us to make comparisons of these with certain well-known and so-called "false hybrids" and other vines that are claimed to be hybrids between Muscadinia and Euvitis, and to point out wherein these are not hybrids as represented, but only pure seedlings of the Muscadine group.

The following list of combinations of species and varieties includes representatives of all the hybrid vines that we have so far produced and are herein described, but only seedling vines from the first three parental combinations are old enough to permit of a thorough and minute description.

A. LIST OF PARENTAL COMBINATIONS EFFECTED

I. Winchell (Vinifera-Labrusca-Aestivalis) × Rotundifolia 1912 and 1916.
II. Herbemont (Bourquiniana) × Rotundifola 1913, 1916 and 1917.
III. Malaga Seedling No. 1 (Vinifera) × Rotundifolia 1916.
IV. Malaga Seedling No. 3 (Vinifera) × Rotundifolia 1917.
V. Malaga (Vinifera) × Rotundifolia 1917.
VI. Oberlin Vine (Rotundifolia) × Malaga (Vinifera) 1917.
VII. Vitis cordifolia (native species) × Rotundifolia 1917.
VIII. Concord (Labrusca) × Rotundifolia 1917.
IX. Winchell-Rotundifolia hybrid × Rotundifolia 1917.

* Original manuscript submitted January, 1919.

Fig. 1. Winchell-Rotundifolia hybrid vine of 1913 in foliage. This photograph shows the tardy growth that is characteristic of this class of hybrids. Photographed May 16, 1919. Reduced.

B. DESCRIPTION OF THE CHARACTERS OF HYBRID VINES

I-a. Winchell × Rotundifolia (Light Male), 1912.

General character of plant: During the first few years the hybrid plant seemed weak in growth, in this respect greatly resembling the

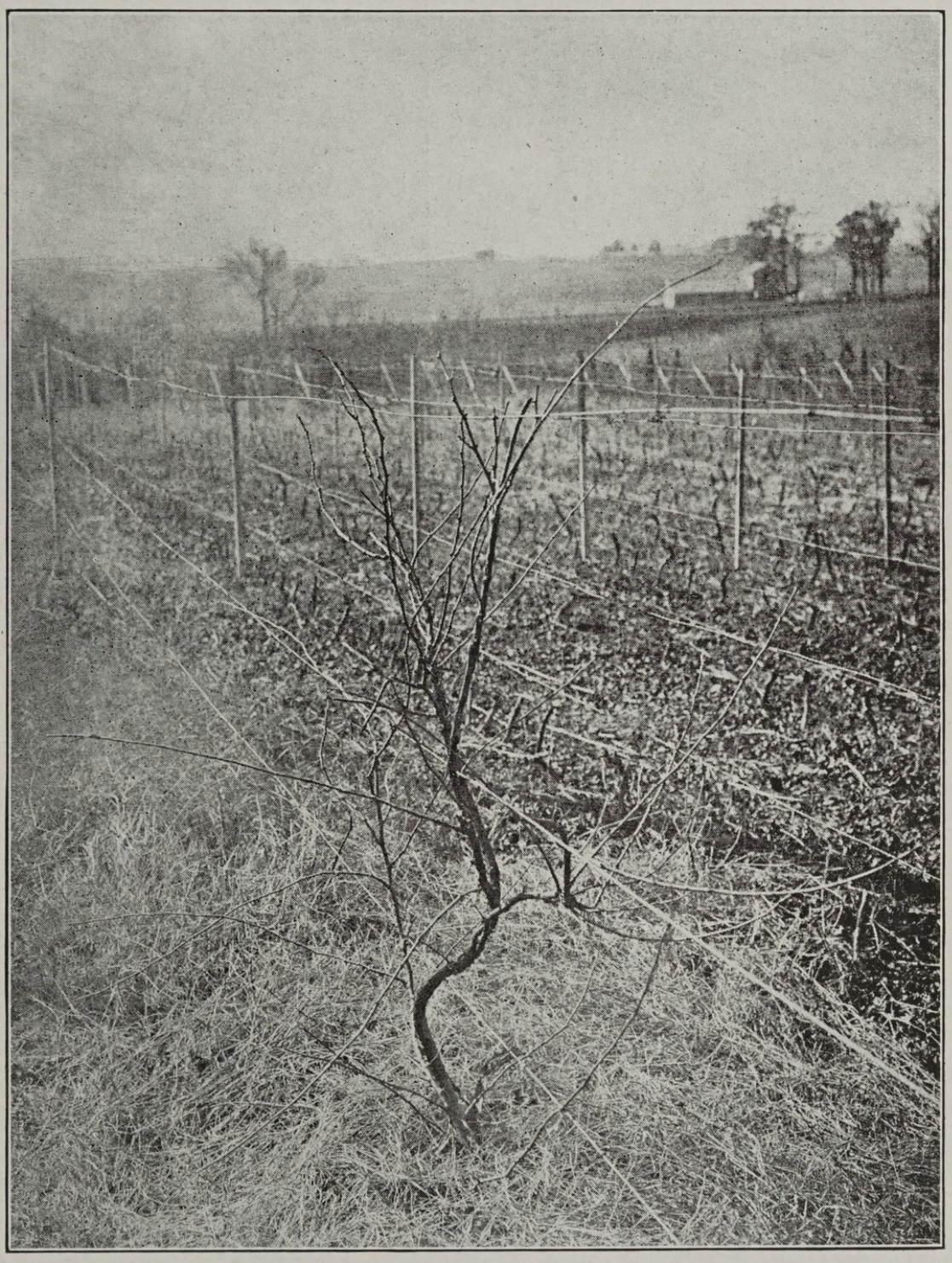

Fig. 2. A Winchell-Rotundifolia hybrid vine. This vine was grown from seed in the spring of 1913 and is the oldest living known hybrid between Euvitis and V. rotundifolia. Unpruned in the dormant stage, winter of 1918-1919. Reduced.

selfed seedlings of Winchell. The plant is not inclined to be rampant in growth, but instead is low and spreading. In general appearance the hybrid vine may be said to resemble the Winchell vine more than the Rotundifolia parent, but a critical examination of individual characters reveals the true hybrid nature of the vine.

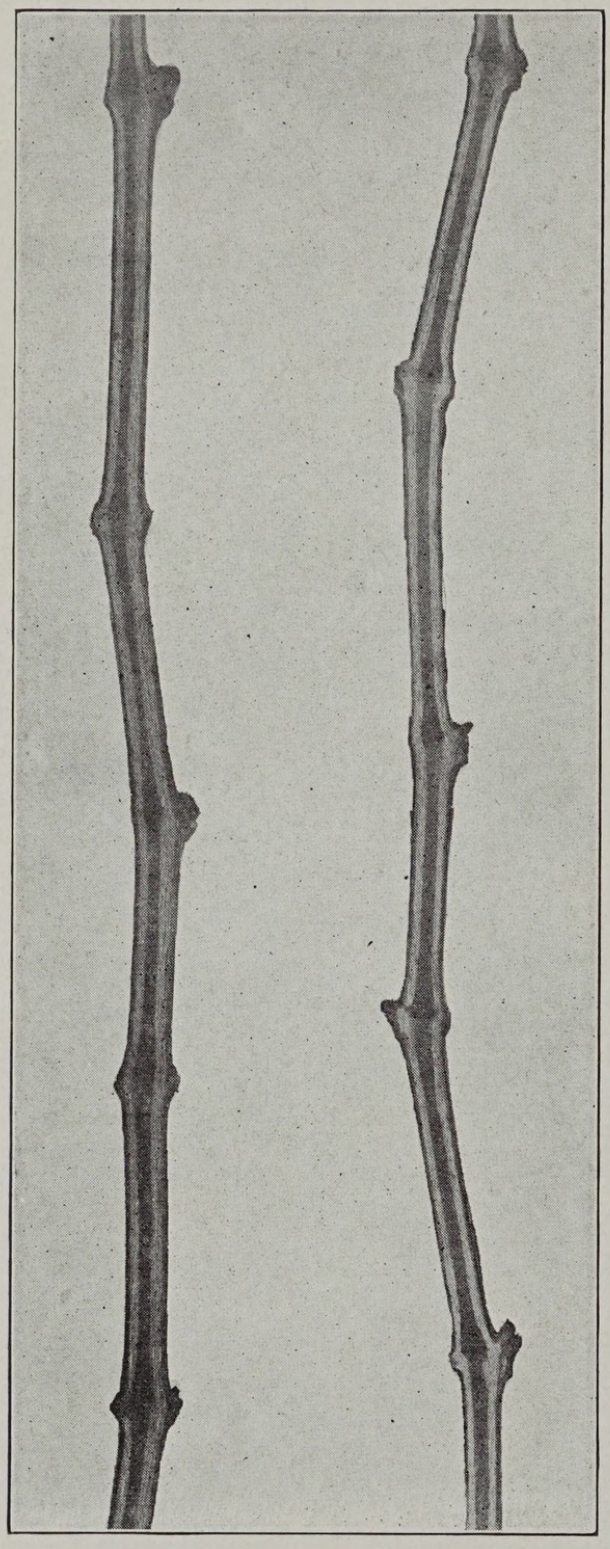

Fig. 3. Sections of two canes from the 1913 Winchell-Rotundifolia hybrid vine showing practically continuous pith which is characteristic of the Rotundifolia parent species. Reduced.

Vigor of vine: Fairly strong but not vigorous, not hardy, very slow to leaf out in the spring, canes die back perceptibly every winter.

Canes: Fairly strong but neither stout nor slender, nearly straight, not bent at the nodes, slightly compressed, angled especially when young. Sometimes at the base the canes become round and smooth. The striation is very obscure.

Wood: Soft, one-year-old wood is greenish-yellow in color; easily grafted onto roots of Euvitis.

Pith: Green and occasionally brown in color, full of sap. The green pith during the dormant season is crowded full of starch grains. The brown pith is composed of dead cells and when dry sometimes splits into discs. Very little, if any, starch grains remain in this pith during the dormant season. Sometimes cells of this brown pith are found scattered among the green.

The pith in general may be said to be continuous through the nodes. It is only very seldom that it is inter-

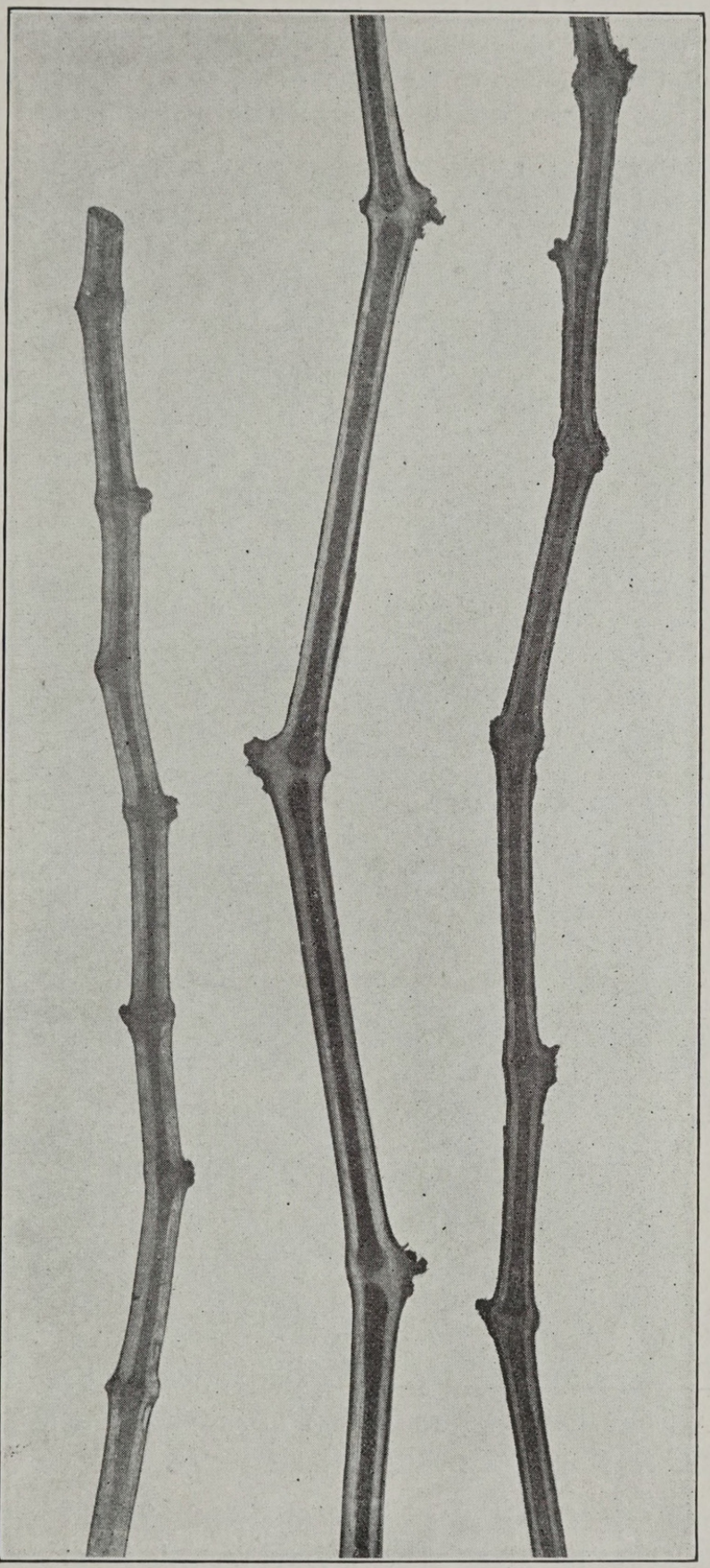

Fig. 4. Sections of canes each of the two parents and of the hybrid vine. The cane at the left is V. rotundifolia (light male), the one in the center is Winchell (female parent), the one on the right is the hybrid.

The Winchell cane shows the well defined diaphragms that interrupt the pith column at every node while the other two canes show no such diaphragms. The hybrid cane, furthermore, exemplifies its hybrid nature in its relatively less zigzag growth, the slightly enlarged nodes, the internodes, which are intermediate in length, and the pith column whose relative diameter is intermediate between that of both its parents. Reduced.

rupted by well defined diaphragms. With some exceptions the tissue at the nodes is composed of true pith cells but these are often so compressed as to give the whole structure the appearance of a partition as seen with the unaided eye. Sometimes, however, we do find true hard and woody

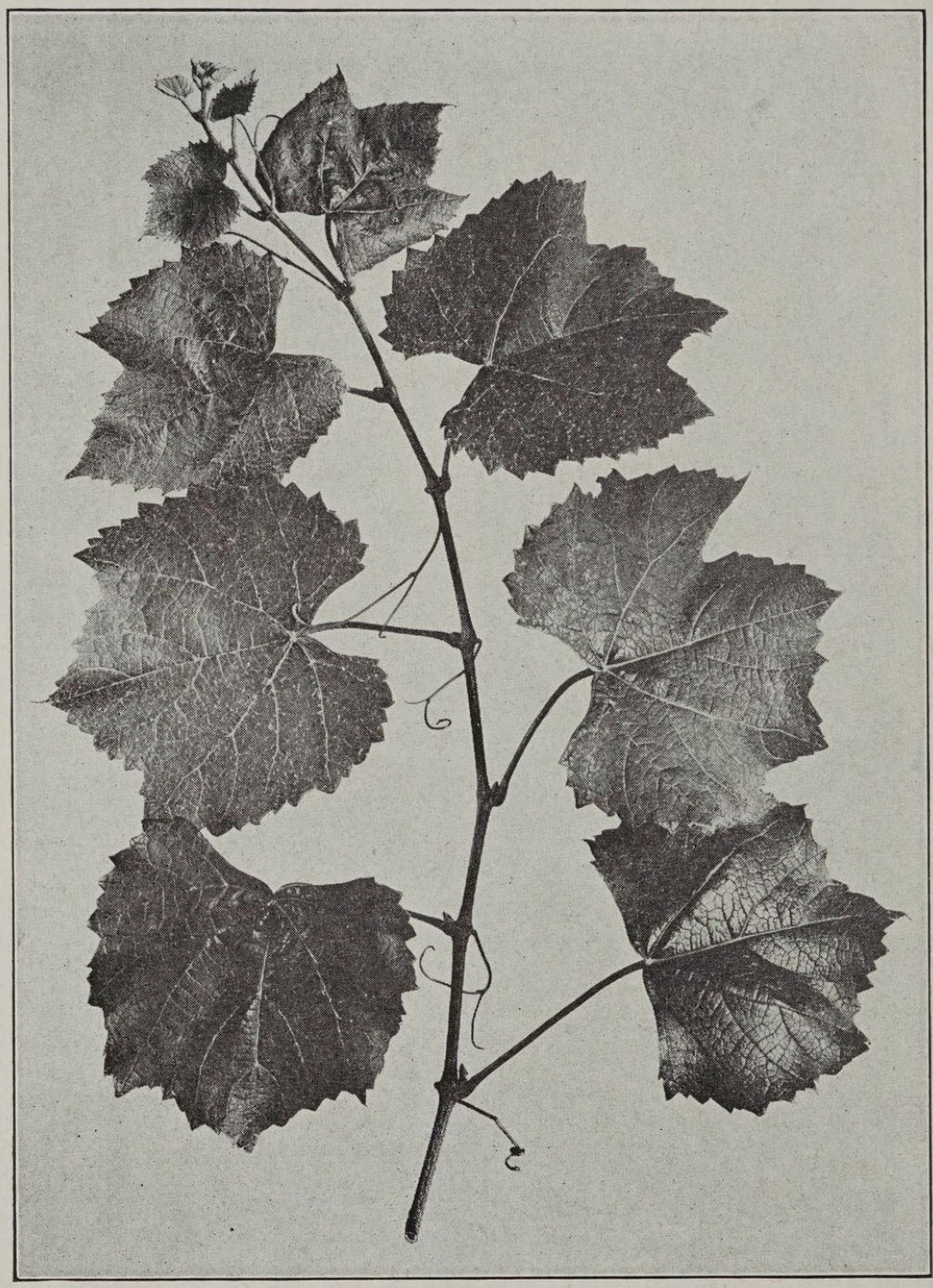

Fig. 5. A leafy shoot from the 1913 Winchell-Rotundifolia hybrid, showing its type of shoot, leaf and tendril. Reduced.

diaphragms. Often we find a complete separation or rent in the pith column just above the place where a diaphragm is supposed to be. The average diameter of the pith column of the hybrid is a little less than that of the two parent vines.

Bark: Reddish brown, covered by a thin layer of gray, rough; lenticels inconspicuous, submerged; bark persistent on young wood and shedding from old wood in broad plates as in Muscadinia.

Nodes: Somewhat enlarged on bud side.

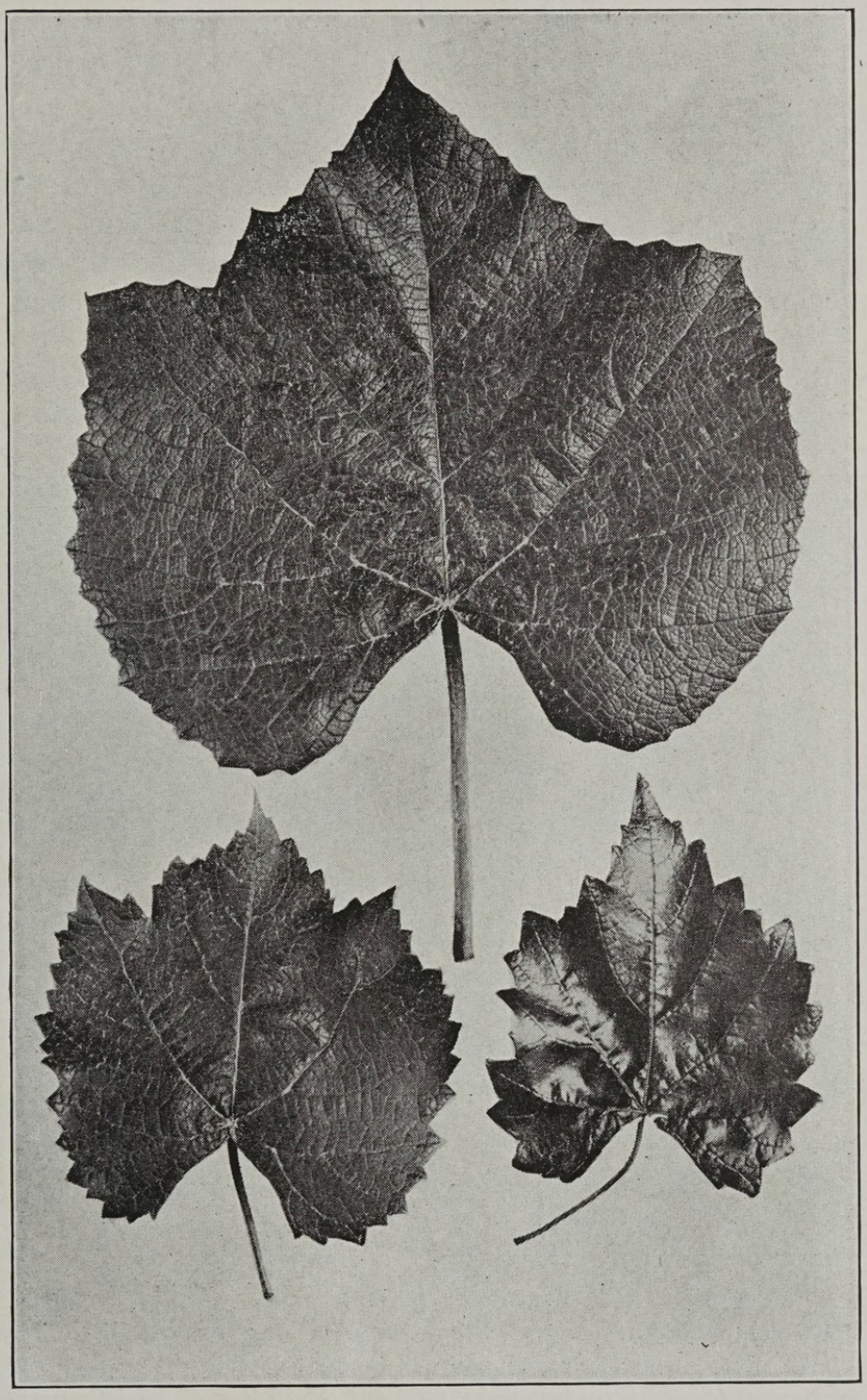

Fig. 6. Three typical leaves representing both parents and hybrid. Upper leaf is from Winchell (female), lower right is from Rotundifolia (male) and lower left is from the hybrid. The size of the hybrid leaf is largely determined by the Rotundifolia parent while the character of the leaf is more intermediate. Reduced.

Internodes: Much shorter than in the variety Winchell, but somewhat longer than in Rotundifolia.

Leaf buds: Small, conical in shape, similar in this respect to those of Winchell, but in size like Rotundifolia, dark brown in color. Young leaf buds often greatly resemble true Rotundifolia buds. Basal leaf buds on new canes usually unfold the same season much like Winchell or V. vinifera.

Shoots: Very much like those of Winchell, leaves unfolding rapidly. The growing tips are not naked as in Rotundifolia.

Color of foliage: Leaves, tendrils and young stems are usually light green in color. Sometimes a faint tinge of brown appears on the tendrils and on the nodes. Young unfolding leaves are pale yellowish-green in color, due mainly to the pubescence which envelops the growing tips.

Leaves: A trifle larger than V. rotundifolia with the shape of Winchell; teeth not as prominent as in Rotundifolia but more so than

Fig. 7. Types of flower-clusters represented by Winchell (perfect hermaphroditic but used as the female parent) on the left; hybrid (imperfect hermaphroditic) second; Scuppernong (imperfect hermaphroditic) third; and staminate Rotundifolia (male parent) on the right. The sizes of the flower-clusters in our native species of Vitis are sex-limited; the cluster of this hybrid vine which is an imperfect hermaphrodite, therefore, is smaller than that of either of its parents, it takes after the size of the flower-cluster that is associated with the imperfect hermaphroditic Rotundifolia vine and, therefore, is determined by the Rotundifolia species. Reduced.

in Winchell; blades thin, silky, hairy above and cobwebby below; petioles and young canes also cobwebby, glossy dark green above, paler beneath; texture and surfaces of leaves are more like Winchell than Rotundifolia; stipules larger than in Rotundifolia. Leaves are comparatively free from insects and fungi. The peculiar yellowing of the leaves in late summer and fall on Rotundifolia vines is also characteristic of this hybrid. The blackened areas on the leaves due to Guignardia Bidwellii (V. & R.), are small and typical of those commonly seen on leaves of Rotundifolia. The leaves drop from the vine late in the fall with those of Rotundifolia.

Tendrils: Small and weak, growing stronger where a support has been gained, mostly bifid, sometimes simple, silky pubescent when young, usually green but occasionally very light brown in color.

Flower-clusters: Very small and often smaller than on Scuppernong; rachis soft and buds crowded as on Winchell; buds larger than on Rotundifolia.

Flowers: Imperfect hermaphroditic; large pistils and reflexed stamens.

Blooming period of vine: Just after Winchell and practically simultaneous with Rotundifolia. A second crop of flowers may be forced out by summer pruning.

Fertility of flowers: Pollen shriveled and impotent; ovules mostly sterile, occasionally fertile. This vine is sterile because of the double phenomenon of intersexualism with attendant impotence and hybridization.

Fruit-clusters: Very small. Thus far no clusters have been produced that consisted of more than two berries; peduncle very short.

Berries: Medium in size, 16 mm. long and 14 mm. wide, do not

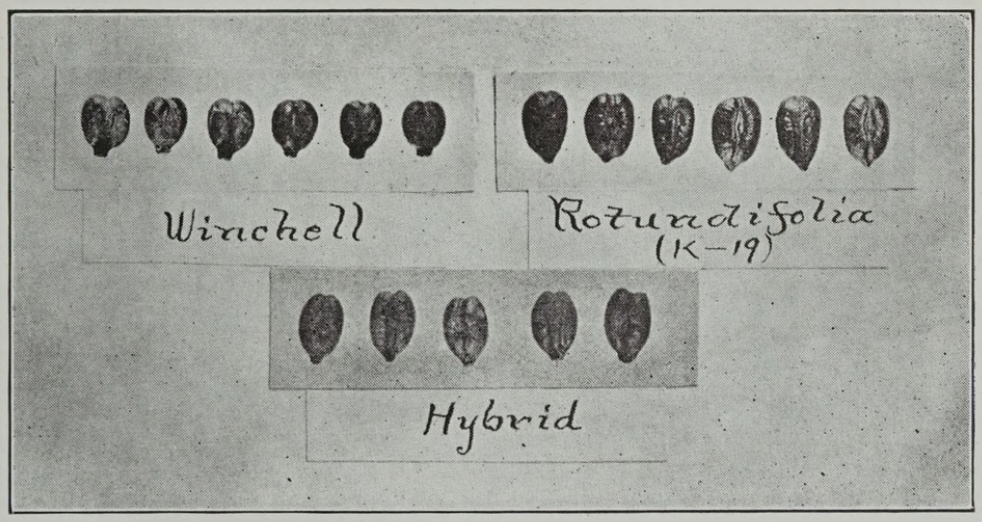

Fig. 8. Seeds from parental and hybrid vines; on the left are seeds from Winchell (female parent), on the right are typical Rotundifolia seeds (representing the male parent), below are seeds from the hybrid vine. The general outline and type of the seeds from the hybrid vine evidently are determined by the Rotundifolia parent. Natural size.

cling well to the stems but do not shatter as readily as the average Rotundifolia; dark red, almost like the variety Emperor in color, decidedly oblong; skin medium thin and tough and covered with a few conspicuous, raised, russet dots; pulp soft, sweet to subacid; very good in quality with an agreeable flavor.

Seeds: Thus far only one seed has been found per berry. The average length of seed (only five seeds having been measured) being 6.3 mm., the average width, 4.0 mm., the average depth, 3.0 mm.; color of the seeds variable ranging from light to dark brown, not glossy; beak the same color as the body of the seed; chalaza located slightly above the middle of the dorsal side of the seed, ovate to oblong in shape, depressed and sometimes sunken; suture broad and deep from the chalaza to the top of the seed and shallow from the chalaza to the beak, slightly wrinkled around the chalaza; raphe hair-like extending from beak to suture on top of the seed where it becomes invisible; ventral depressions deep, broad, curving outward toward the top of the seed,

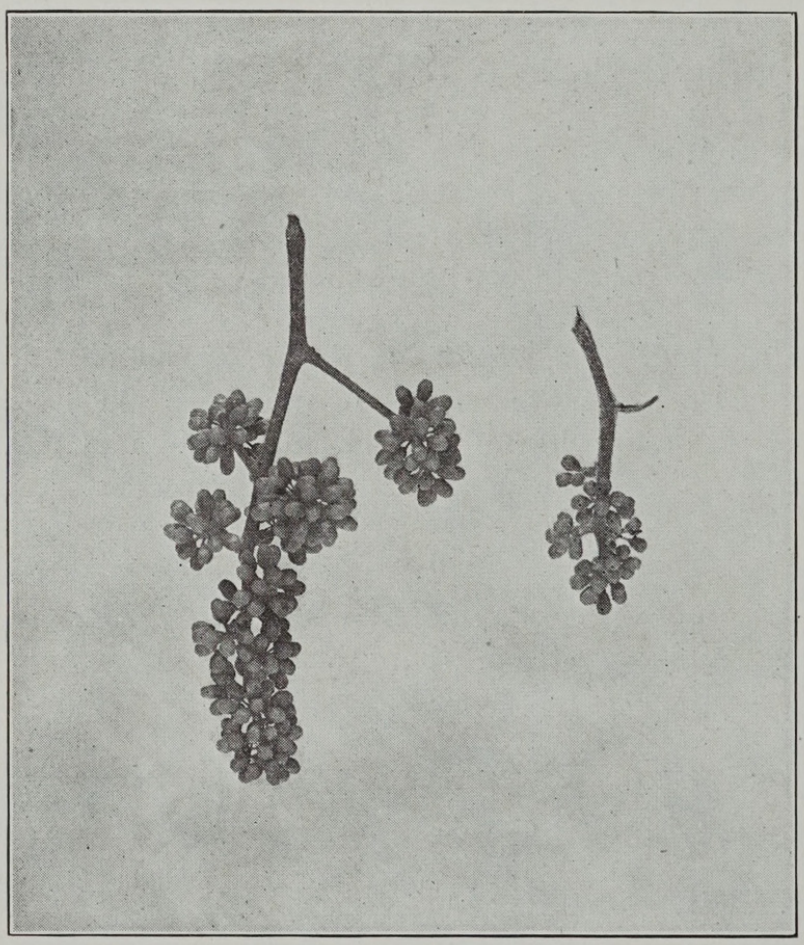

Fig. 9. Two types of flower-clusters found among the F_1 hybrid vines when Winchell is crossed with the perfect hermaphroditic Rotundifolia vine I-1. The cluster on the left (perfect hermaphroditic) assumes the size of the perfect hermaphroditic Rotundifolia vine, while the cluster on the right (imperfect hermaphroditic) assumes the size of similar flower-clusters that are found on Rotundifolia vines. Reduced.

sides of depressions smooth or slightly wrinkled, slightly lighter in color than the body of the seed. The general outline of the seed is oblong with short beak. Its general appearance is that of Rotundifolia, but the broad, deep suture on the top of the seed together with the color and form of the ventral sutures is indicative of the Winchell seed.

I-b. WINCHELL × ROTUNDIFOLIA (I-l and G-52), 1916.

These plants differ from the one preceding in only a few respects. Since the male parent of these vines is a true hermaphroditic Rotundifolia, two types of hermaphroditic vines have appeared, the perfect and the imperfect.

The perfect hermaphroditic vines bear the larger type of flower-cluster that is found associated with the male and hermaphroditic Rotundifolia vine, but the texture of the cluster tissues and the general appearance of the flower buds is more nearly that of the Winchell parent. The imperfect hermaphroditic vines are similar to the one previously described.

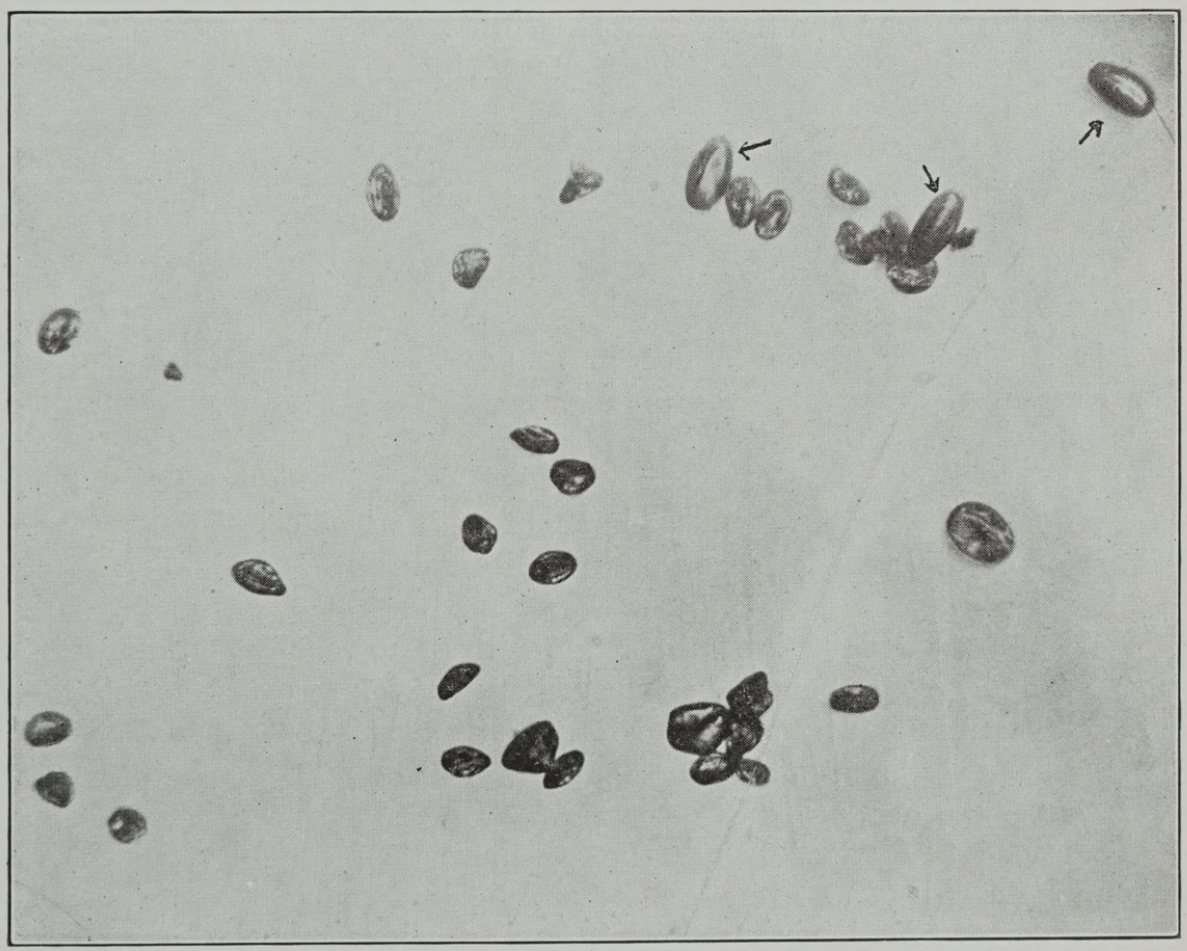

Fig. 10. A sample of the pollen that is produced by the perfect hermaphroditic hybrid vines of Winchell-Rotundifolia parentage. Notice the three apparently normal pollen grains marked with an arrow and found in the upper right-hand corner. Magnified 230 diameters.

The majority of the pollen grains of the perfect-flowered vines are much shriveled, angular and impotent. Some normal and viable pollen grains (about 7.7 per cent) are produced as was discovered by the aid of the microscope and in actual hand pollination experiments. These vines are practically sterile because of hybridization.

While these perfect-flowered hybrid vines did not set fruit in 1918, it is safe to say that some of the pistils in later years will prove fertile. This conclusion is based on work done with the imperfect hermaphroditic Winchell-Rotundifolia hybrid vine of 1912, and the Vinifera-Rotundifolia perfect-flowered hybrid vine of 1916.

The blooming period of these hermaphroditic vines is about midway between that of the two parents.

II-a. HERBEMONT × ROTUNDIFOLIA (Light Male), 1913.

General character of plant: Very weak, not hardy, dies back very badly during the winter if not well protected, very low and bushy. After five years of alternate growing and dying back, the plant measures not more than two feet in height. This plant has neither the appearance of Herbemont nor that of Rotundifolia.

Vigor of vine: Very weak, but more vigorous than some Herbemont seedlings.

Canes: Short and slender, straight, not much bent at the nodes, angled when young, somewhat rounded on older wood, not much compressed, faintly striated.

Wood: Not as hard as that of Rotundifolia, greenish-white in color, easily grafted.

Pith: Greenish-brown to brown, sappy, usually filled with stored starch grains, practically continuous through the nodes, occasionally a woody diaphragm or part of one may be observed. Pith cells at the nodes are compressed and densely packed, thus producing somewhat the appearance of a diaphragm. Column of pith when compared to the diameter of the cane is larger than in Rotundifolia and smaller than in Herbemont.

Bark: Dark reddish-brown overcast with gray, rough; lenticels submerged and inconspicuous; bark persistent in young canes, nonshredding, breaking off in irregular plates and patches when old; no bloom on the bark of the vine.

Nodes: Slightly enlarged on bud side.

Internodes: Average length slightly more than one inch, which is about the length of an average Rotundifolia internode.

Leafbuds: Small, dark reddish-brown in color; mature buds more or less conical in shape; immature buds flattened like those of Rotundifolia.

Shoots: Leaves not expanding as rapidly as in Herbemont, but not as slowly as in Rotundifolia.

Color of Foliage: Almost green but slightly tinged with brown. This is especially noticeable on the tendrils, petioles and leaf veins and in the seedling stage on the hypocotyl and on the lower surfaces of the

Fig. 11. A leafy shoot with a flower-cluster from the 1914 staminate Bourquiniana-Rotundifolia hybrid (Herbemont × Light Male No. 2). This is the oldest known Bourquiniana-Rotundifolia hybrid vine. Notice the five-lobed leaves which are characteristic of these hybrids; the short, simple and bifid tendrils, the small flower-cluster (similar to an average staminate Rotundifolia flower-cluster) and the slender and nearly straight cane. Reduced.

Fig. 12. Three typical leaves representing both parent and hybrid. Upper leaf is from Herbemont (female parent), lower left is from Rotundifolia (male parent), lower right is from the hybrid. The size of the leaf on this hybrid is determined by the Rotundifolia parent but the lobing is much more pronounced than in the mature stage of the Herbemont parent, however, the juvenile leaves of Herbemont are deeply lobed. Reduced.

Fig. 13. A flower-cluster of each of the parents and of the hybrid vine. The large flower-cluster at the right is from Herbemont (perfect hermaphroditic but used as the female parent), upper cluster at the left is from a staminate Rotundifolia vine (male parent), lower cluster is from the 1913 hybrid vine (staminate). The size of the flower-cluster on this hybrid is determined by the Rotundifolia species. Reduced.

cotyledons. The nodes in young wood also carry marks of brown coloration. The young unfolding leaves are usually covered with a yellowish, occasionally slightly pink, pubescence.

Leaves: Small, the same size as that of Rotundifolia, deeply lobed into five, occasionally seven parts; teeth large, more like Rotundifolia than Herbemont; leaves silky hairy above and thinly pubescent beneath, especially along the petioles and veins; blades thin, glossy green and smooth above, paler beneath; stipules larger than in Rotundifolia.

Fig. 14. A Vinifera-Rotundifolia hybrid vine (Malaga Seedling No. 1 × G-52) showing the character of growth, shoots, leaves, tendrils, etc. of this vine. Not all hybrids of this lot resemble the vinifera parent as closely as does this vine. Reduced.

Flower-clusters: Very small, similar to those on small clustered staminate Rotundifolia vines; peduncle and rachis not stout.

Flowers: Staminate on this vine; stamens upright; pistils almost entirely suppressed.

Blooming period: Late, practically simultaneous with that of Rotundifolia.

Fertility of the flowers: Since the vine is staminate, we can test only the pollen grains for fertility. A microscopic examination reveals a mixture of mostly shriveled and angular grains, but also some that are perfectly normal in shape. Pollination tests indicate that some of the pollen grains are fertile. The pollen is mostly sterile because of hybridization. As this vine happens to be staminate, no description of fruits and seeds is possible.

II-b. HERBEMONT × ROTUNDIFOLIA (G-52), 1916 and 1917.

The only difference between these vines and the preceding one lies in the following characters:

1. The color of the growing vines, leaves, tendrils, etc. is a deep reddish-brown.
2. The leaves are variably lobed.
3. These vines undoubtedly will bear two types of hermaphroditic flowers similar to those of the Winchell-Rotundifolia hybrid lots of 1916 because the male parent is one of the identical vines, G-52. The blooming period of these vines might be more intermediate between the two parent species.
4. The perfect and the imperfect hermaphroditic vines of these two lots will probably bear fruit which will be described in a later publication.
5. These vines will also be more or less sterile because of hybridization.

III-a. MALAGA SEEDLING NO. 1 × ROTUNDIFOLIA (G-52), 1916.

General character of plants: Vines are somewhat variable. Some are indicative of tall climbers while others seem to be more of the spreading type. While the lobing of the leaves is somewhat variable, nevertheless, all possess typical hybrid characters. Not much branched.

Vigor of vine: Variable from very strong to very weak.

Canes: Long, slender, fairly strong, somewhat zigzag, few in number, strongly angled on tip of cane, more or less rounded on the base, compressed, obscurely striated.

Wood: Softer than Rotundifolia but harder than Vinifera; new wood greenish in color.

Pith: Green, filled with starch during the dormant season, mostly continuous, occasionally interrupted by a diaphragm. In comparison with the diameter of the cane, the pith column is larger than in Rotundifolia and smaller than in Vinifera. At the nodes the pith cells are more compressed than elsewhere.

Bark: Nearly smooth, light grayish-brown in color; lenticels few, submerged, inconspicuous. Bark inclined to be shreddy even on young canes, no bloom.

Nodes: Enlarged on bud side.

Internodes: Somewhat longer than in Rotundifolia and much shorter than in Vinifera.

Leafbuds: Small to medium, conic on old wood and flattened on the younger wood, light brown in color.

Fig. 15. A leafy shoot with flower-clusters from a Vinifera-Rotundifolia hybrid vine, showing the comparative sizes of the flower-cluster, leaf and tendril; also a different type of lobing of the leaves from that of Fig. 14. Reduced.

Shoots: Rapidly elongating, inclining toward nakedness.

Color of foliage: Light brown to reddish-brown. This is especially noticeable on the rapidly elongating canes and on the tendrils. The

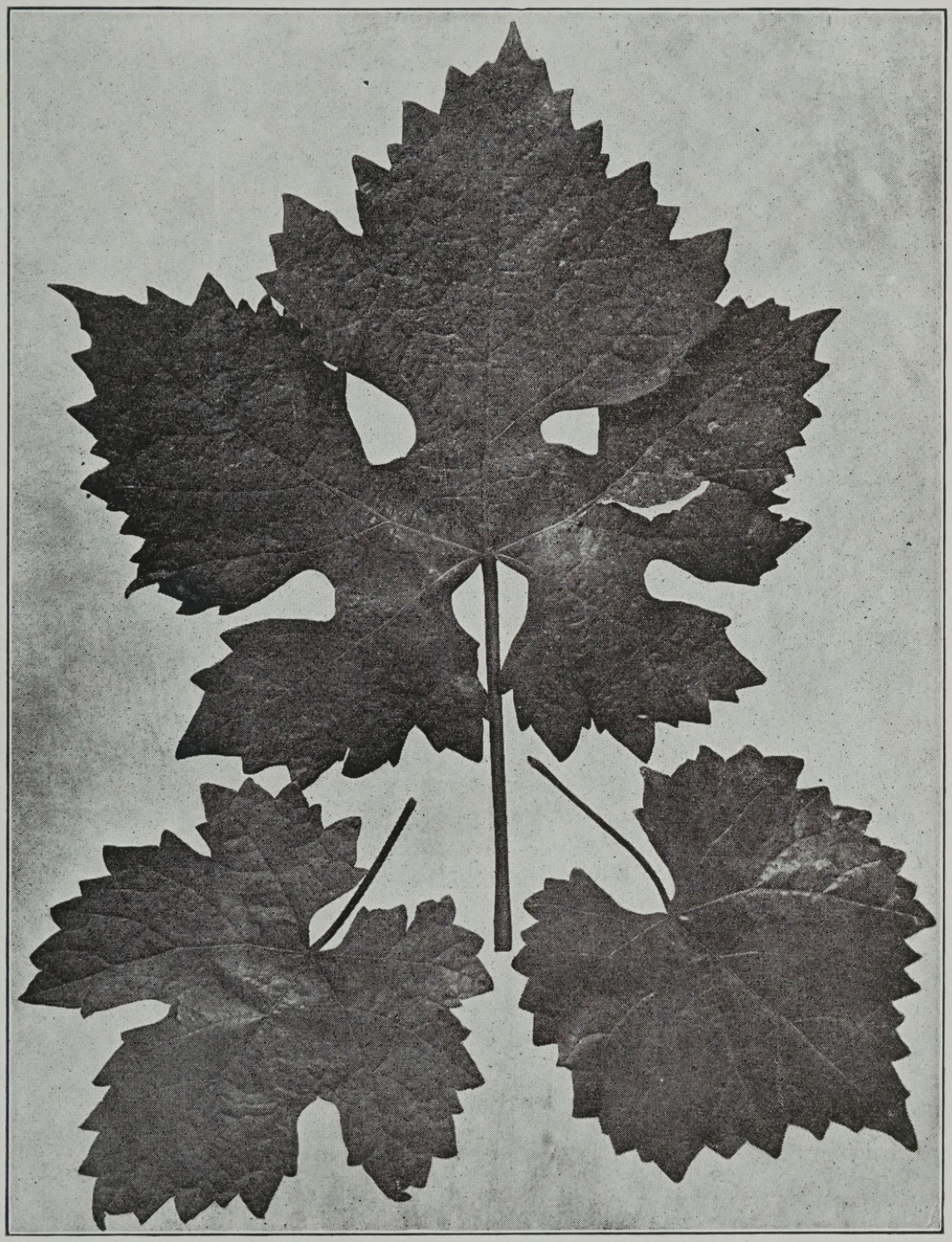

Fig. 16. Leaves from V. vinifera, V. rotundifolia, and from a hybrid vine. Upper leaf is from Malaga Seedling No. 1 (female parent), lower right-hand leaf is from a Rotundifolia vine (male parent), lower left-hand leaf is from a hybrid vine. The size of the hybrid leaf is largely determined by the Rotundifolia species while the character and the lobing seem to be more or less intermediate between that of both the parents. Reduced.

nodes usually are darker than the internodes. Expanding leafbuds and young leaves are covered with a slight whitish or pinkish pubescence.

Leaves: Small to medium in size, averaging pretty closely with Rotundifolia, sometimes a trifle larger, three to five-lobed on some vines and almost entire on others; upper surface of leaves smooth and dull green, silky when young, soon becoming smooth; lower surface paler green and slightly villous epecially along the ribs and veins; teeth large; stipules larger than those of Rotundifolia.

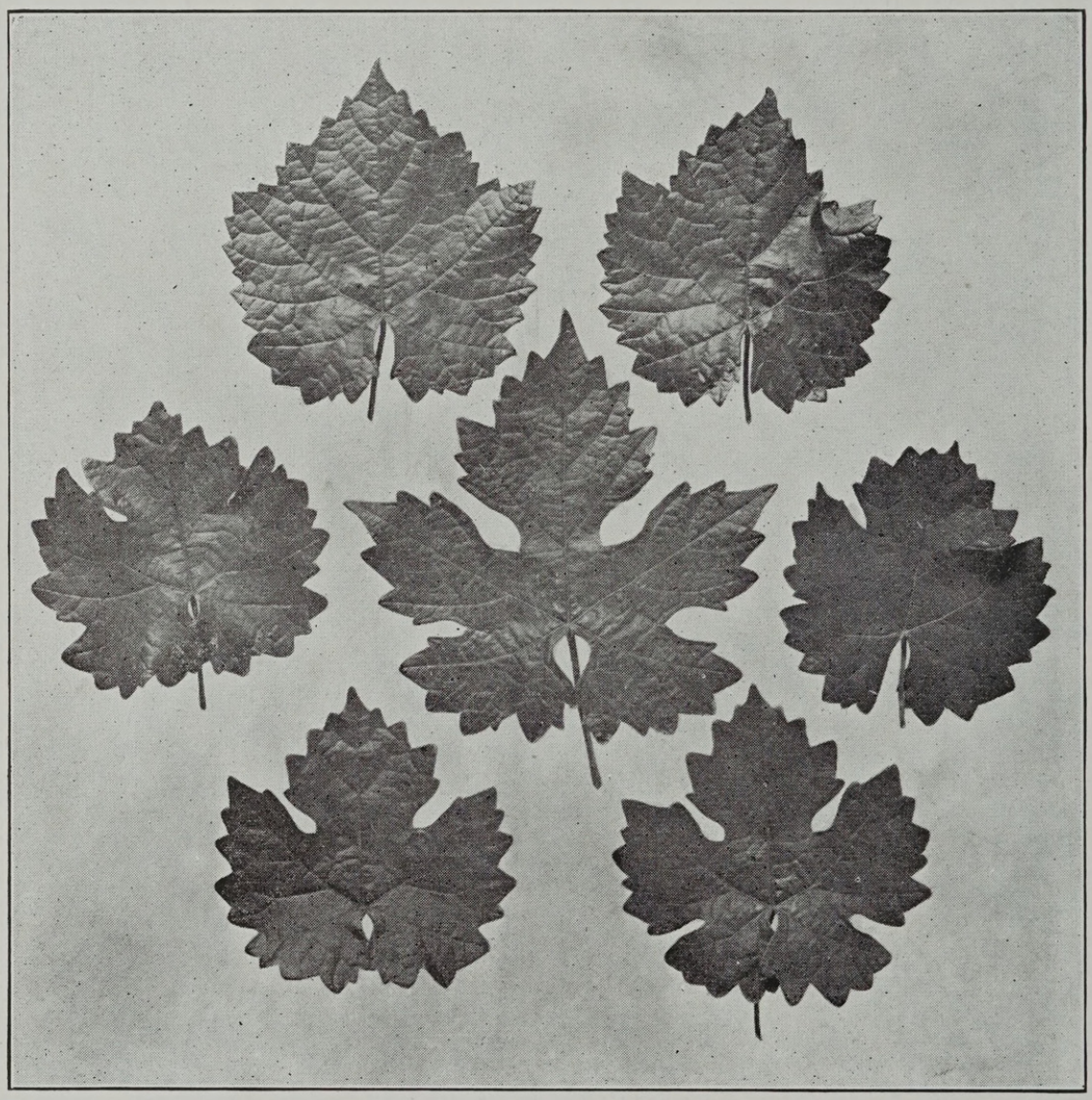

Fig. 17. A sample of leaves from the Vinifera-Rotundifolia hybrid vines, showing the differences that can be observed in the lobing of the leaves. Some are almost like Vinifera while others are almost like Rotundifolia leaves. Reduced.

Tendrils: Variable from simple to bifid, some are weak while others are strong, usually brown or reddish in color.

Fig. 18. Typical flower-clusters of V. vinifera, V. rotundifolia and of a hybrid vine. The cluster at the left is from Malaga Seedling No. 1, imperfect hermaphroditic (female parent); the one at the right is from G-52, perfect hermaphroditic (male parent); the one in the center is from a hybrid vine, perfect hermaphroditic. The small size of the flower-clusters of this and similar hybrid vines is determined largely by the Rotundifolia species. Reduced.

Flower-clusters: Two types as regards size; the clusters on the perfect hermaphroditic vines are small, practically the same size as those found on the Rotundifolia parent vine. The largest cluster produced about 300 flower buds. The clusters usually assume the characters of the Vinifera parent but the size and occasionally the branching of the Rotundifolia. The clusters on the imperfect hermaphroditic vines are much smaller and similar to those on the imperfect hermaphroditic Rotundifolia vines.

Fig. 19. Two types of flower-clusters found among the F_1 hybrid vines when Malaga Seedling No. 1 (imperfect hermaphroditic) is crossed with G-52 (perfect hermaphroditic). The cluster on the left (perfect hermaphroditic) and the cluster on the right (imperfect hermaphroditic) are typical in size of similar flower-clusters found among vines of the Rotundifolia species, otherwise the clusters are hybrid in character. Reduced.

Flowers: Perfect hermaphroditic and imperfect hermaphroditic; stamens upright and pistils medium large in the perfect hermaphroditic, stamens reflexed and pistils well developed in the imperfect hermaphroditic flowers.

Blooming period: Practically half way between that of the two parent vines.

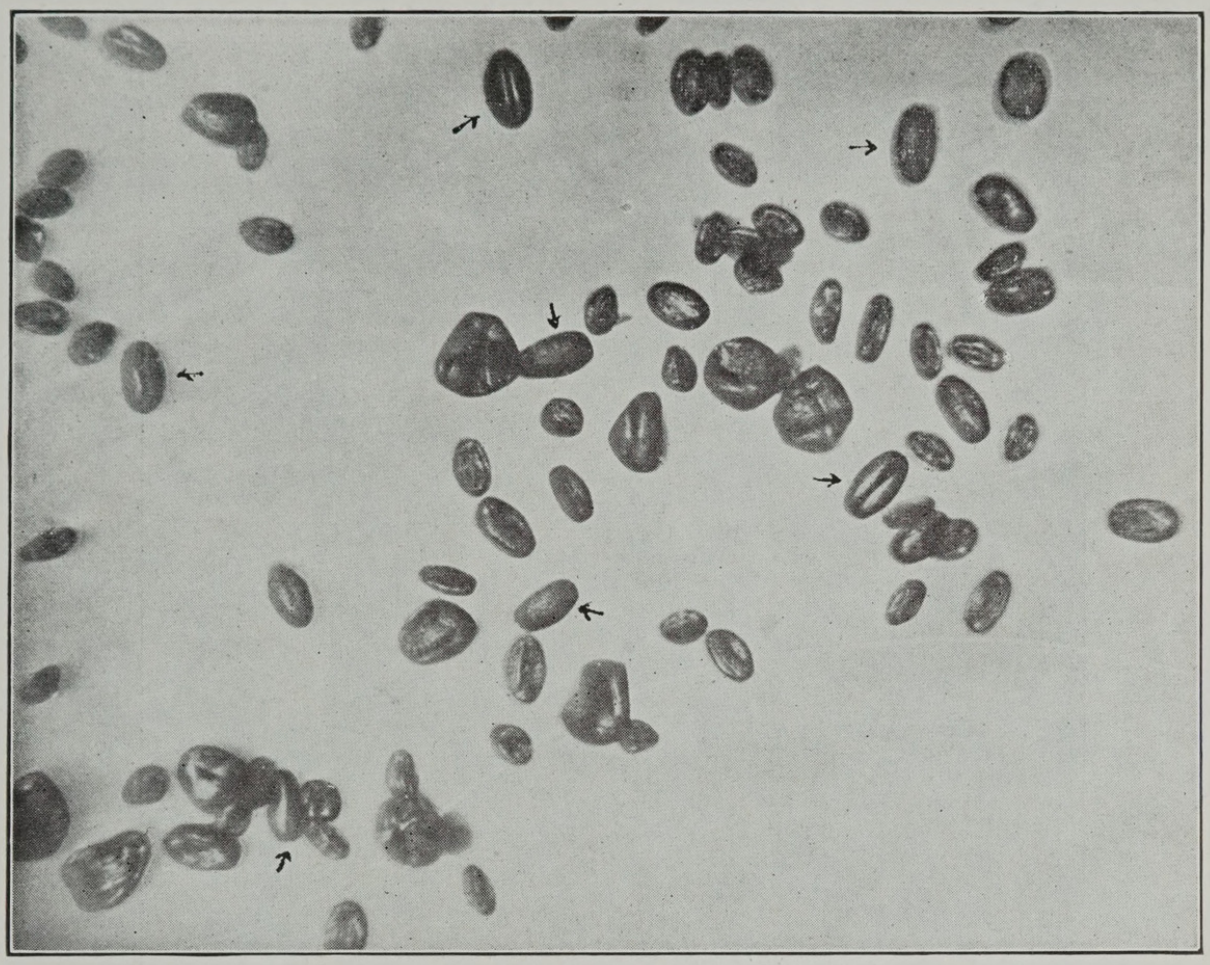

Fig. 20. A sample of the pollen that is produced by the perfect hermaphroditic hybrid vines of Vinifera-Rotundifolia parentage. Notice the comparatively few, about 14.4 per cent, normal pollen grains marked with an arrow. Magnified 230 diameters.

Fertility of flowers: The pollen in the perfect hermaphroditic flowers is a mixture of shriveled and plump, sterile and fertile grains. The fertility of these plump grains has been demonstrated in actual hand-made cross-pollinations, also by selfing some of the flowers. The pollen in the imperfect hermaphroditic flowers is all shriveled and impotent.

The pistils in both types of flowers are mostly sterile, only 2 from 17 perfect hermaphroditic flower-clusters having developed into berries in 1918. The perfect hermaphroditic flowers are sterile because of hybridization, while the imperfect hermaphroditic flowers are sterile due to the double phenomenon of hybridization and intersexualism with attendant impotence.

Fruit-clusters: Very small, only two berries have been grown to maturity and these were on one cluster. The results of 1918 indicate that the fruit-cluster will greatly resemble that of the Rotundifolia parent.

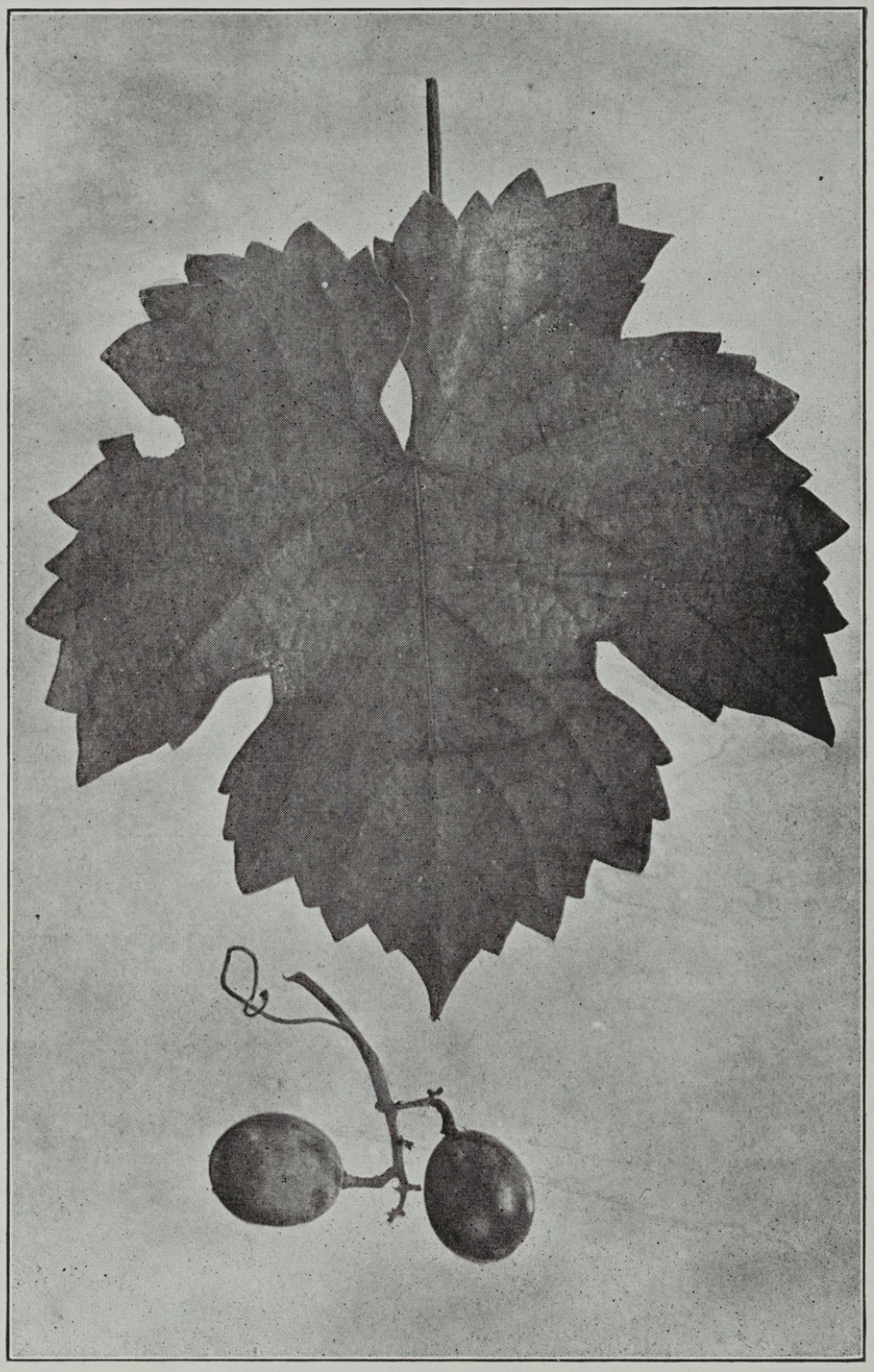

Fig. 21. A leaf and a fruit-cluster from a Vinifera-Rotundifolia hybrid vine (Malaga Seedling No. 1 × G-52). Notice the small fruit-cluster which is characteric of the Rotundifolia species. Natural size.

Berries: Medium in size, 15 mm. long and 13 mm. wide. These measurements have been taken of fruits from only one vine. Berries do not cling as firmly to the pedicles as do those of V. vinifera, but neither

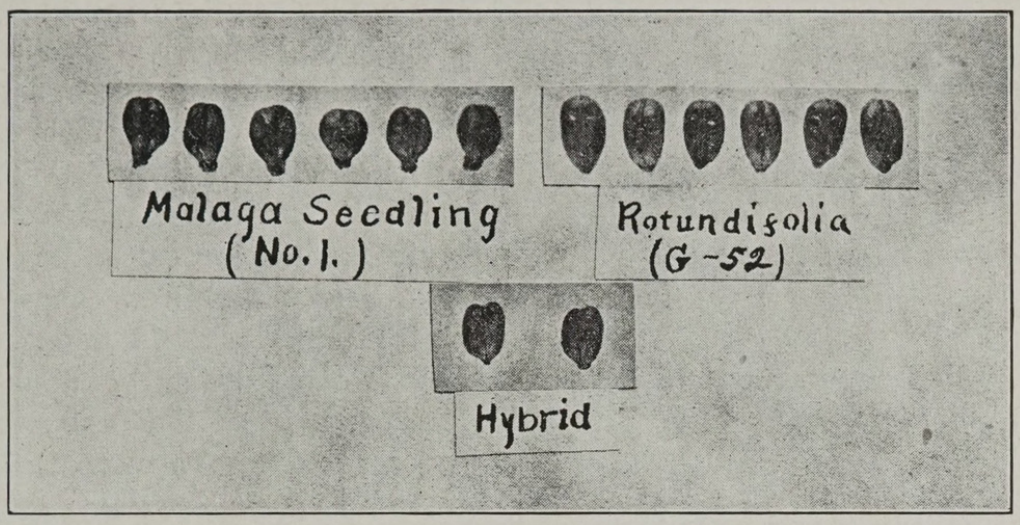

Fig. 22. Seeds from the parent vines and from one of the hybrid vines. Malaga Seedling No. 1 (female), G-52 (male). The general outline and appearance of these hybrid seeds are largely determined by the Rotundifolia species. Natural size.

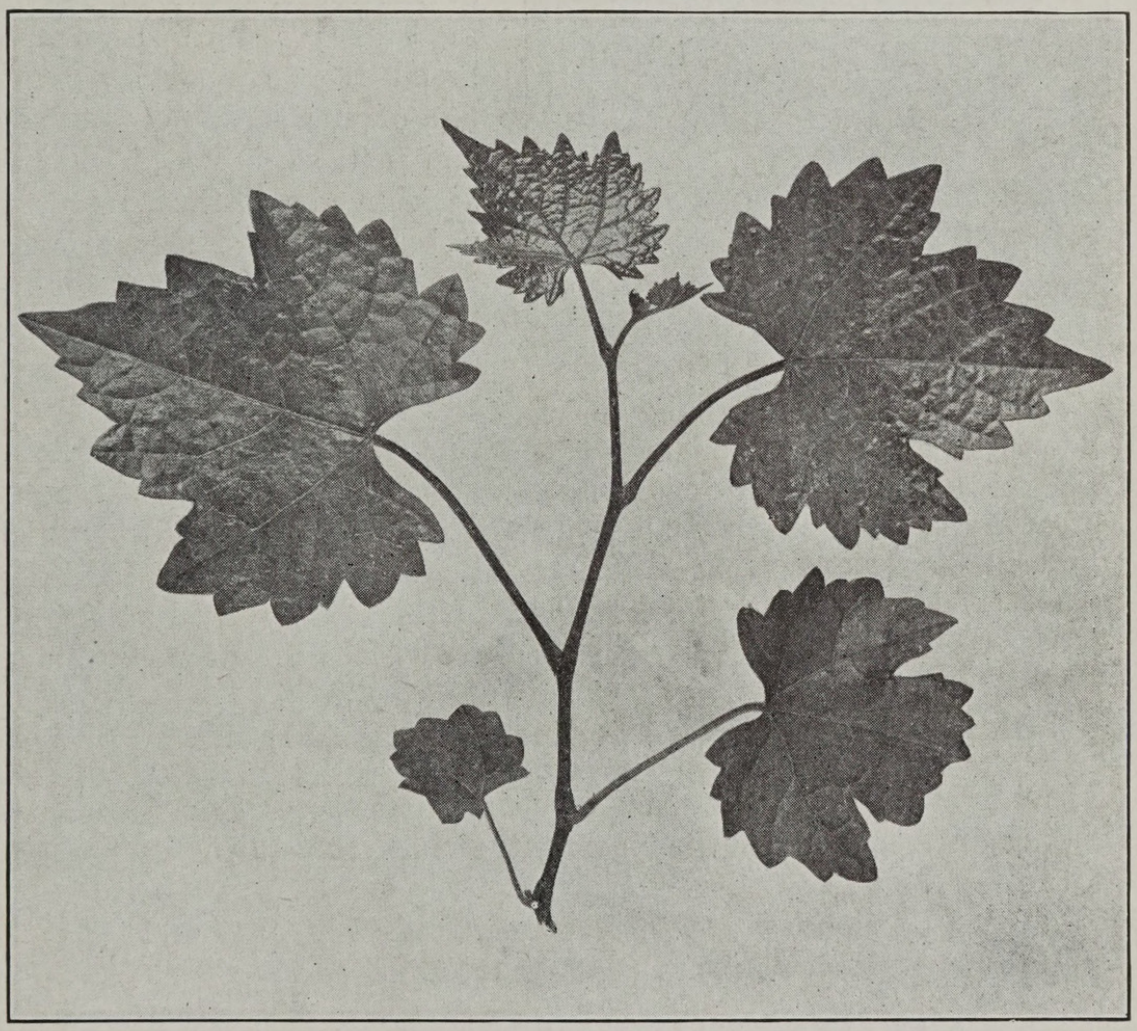

Fig. 23. A leafy shoot from a Rotundifolia-Vinifera hybrid vine (Oberlin vine as female and Malaga as male). Neither of the parent vines has a decidedly lobed leaf. Reduced.

Fig. 24. A hybrid seedling (in a three-inch flower pot) of Oberlin vine when crossed with pollen from Malaga. The leaves of this vine are more like Rotundifolia than are those of the preceding. This vine is beginning the second year of its existence. Reduced.

do they shatter readily. The berries from this vine when fully ripe are black with a good coat of blue bloom, oblong in shape, skin thin but tough; flesh firm like in Vinifera; flavor sweet and vinous.

Seeds: One to each berry. 6.3 mm. long, 4.1 mm. wide, 2.9 mm. deep; beak obtuse. The color of the seed is dark chestnut brown with a light red beak and ventral depressions, glossy surface with minute, raised, light-colored specks; chalaza rather above the middle, sunken in both of the seeds, ovate to oblong in shape; suture deep and broad from chalaza over the top of the seed, not so deep and not so broad from the beak to the chalaza, slightly wrinkled around the chalaza; raphe very fine and hair-like, inconspicious, extending from beak to the top of the seed and then lost in the suture; ventral depression shallow, broad, wrinkled on outer margins like Rotundifolia and lighter in color than the body of the seed; general outline of seed is that of Rotundifolia.

III-b. MALAGA SEEDLING NO. 1 × ROTUNDIFOLIA (I-1), 1916.

These hybrid seedling vines are very similar to those of the preceding. The only difference lies in the vigor of the vines, these being very weak.

IV. MALAGA SEEDLING NO. 3 × ROTUNDIFOLIA (I-1), 1917 and
V. MALAGA × ROTUNDIFOLIA (G-52), 1917.

These hybrid seedling vines are only one year old and in all of their visible characters they are similar to the preceding.

FIG. 25. An F_1 hybrid between V. cordifolia (female) and V. rotundifolia (male), 1918. Two existing vines of this type are the first hybrids to be recorded between these two species of grapes. The character of the growth is very much that of the female parent species. Reduced.

VI. OBERLIN VINE × MALAGA, 1917.

Vines one year old from seed.

Stems and bark are hybrid in character. The leaves are thin, light green, smooth and glossy above, paler beneath and villous especially along the veins and petiole, variably lobed; teeth large.

This description of the Rotundifolia-Vinifera hybrids is not extensive but it is sufficient to point out some of the hybrid characters of the vines.

VII. VITIS CORDIFOLIA × VITIS ROTUNDIFOLIA (I-l), 1917.

This description is taken from one-year-old vines. It will be only general in character.

Stems (first year): Very slender, dark red in color; leaves small, dark green above, paler beneath with pubescence along the veins, slightly silky when young, acuminate; pith mostly continuous. The growing habit of these vines is similar to that of Cordifolia seedlings. The vines are too small for minute description at this time.

VIII. CONCORD × ROTUNDIFOLIA (G-52), 1917.

Stem: Distinctly hybrid in character; bark persist-

ent; leaves dark green, slightly wrinkled above, paler and cobwebby beneath. The shape of the leaves is very much like that of Concord.

Fig. 26. An F_1 hybrid vine between V. labrusca, var. Concord (female) and V. rotundifolia, G-52 (male). The vine is in a three-inch flower pot and going on to its second year of growth. Notice the two simple tendrils, a bifid tendril is on the other side of the vine but not visible. Reduced.

Fig. 27. An F_1 hybrid vine between V. aestivalis (female) and V. rotundifolia, G-52 (male). This vine has been grown from seed that germinated in March of 1919. The Rotundifolia leaf characters are plainly visible in this vine. Reduced.

IX. WINCHELL-ROTUNDIFOLIA HYBRID × ROTUNDIFOLIA, 1917.

The leaf and stem characters of this plant during the first season of its growth appear very much like those of the F_1 hybrid vine between Winchell and Rotundifolia.

C. A GENERAL SURVEY OF THE HYBRID CHARACTERS IN THE F_1 GENERATION

After having minutely described the characters of hybrid vines which are of Euvitis-Rotundifolia parentage, let us briefly compare these with similar characters that are to be found in the parental vines.

The canes may be said to be intermediate in character between the two types of parental vines in that they are nearly straight, somewhat angled like in Rotundifolia and more or less rounded, somewhat bent at the nodes and partially striated as in the Euvitis parents.

The wood is intermediate in color and hardness and bench-grafts grow readily.

The pith is more like that of Rotundifolia than that of Euvitis, but the occasional diaphragms and the indications of such structures at the nodes, also the occasional brown, dead pith cells without starch grains are characteristic of Euvitis.

The bark on both the young and on the old wood is of an intermediate character although the persistence of this bark to the wood is more of a Rotundifolia character. In some hybrids (Vinifera-Rotundifolia 1916) the bark is inclined to be somewhat shreddy but not entirely like that of Euvitis.

The nodes may be said to be intermediate in character.

The leafbuds are probably slightly larger than in Rotundifolia but their shape, especially at maturity, more nearly approaches that of the Euvitis bud.

The young growing shoots of the hybrid vines generally are soon clothed with foliage, but at times a shoot grows more rapidly and appears more or less naked.

The leaves are hybrid in character. The size of the leaf is practically that of Rotundifolia, while the lobing and general appearance and the size of the stipules when compared with the sizes of the leaves are characteristic of that of Euvitis.

The tendrils are variable in size and forking. Some are small and weak while others are found to be large and strong. Some are simple, some bifid and all gradations between these two extremes, but none of the trifid type have been found.

The flower-clusters are typically Rotundifolia in size but more like Euvitis in character. The type of flower in the F_1 hybrid seems to be governed largely by the Rotundifolia species when it is used as the male parent, for example:

Herbemont (perfect hermaphrodite) × Rotundifolia (staminate) produced 1 hybrid vine (staminate).

Winchell (perfect hermaphrodite) × Rotundifolia (staminate) produced 1 hybrid vine (imperfect hermaphrodite).

Winchell (perfect hermaphrodite) × Rotundifolia (perfect hermaphrodite) produced hybrid vines 4 of which are perfect hermaphroditic and 1 imperfect hermaphroditic.

Malaga Seedling No. 1 (imperfect hermaphrodite) × Rotundifolia (perfect hermaphrodite) produced hybrid vines 4 of which are perfect hermaphroditic and 2 imperfect hermaphroditic.

The blooming period of the staminate and the imperfect hermaphroditic hybrid vines coincides more nearly with that of Rotundifolia than that of the Euvitis species, while that of the perfect hermaphroditic vines seems to be more intermediate, however, some overlapping occurs.

The average fruit-cluster, judging from the few that were produced, is smaller than that of either parent but in character more nearly approaching that of Rotundifolia.

The berries are hybrid in character, but the character of the pulp and the sweetness seems to tend toward the Euvitis parent.

The seeds from general appearances are typically Rotundifolia although the colors of the beak, sutures and body of the seed as well as the character of the sutures disclose the true hybrid nature of the seed.

After having made these comparisons, we learn that in the F_1 generation Vitis rotundifolia is not as dominant in character as it is generally supposed to be; that the hybrid vines are not characteristically Rotundifolia in type but more or less intermediate.

Munson (2), speaking about grapes in general, says, "In some combinations, all the characters of one parent are dominant and, of course, all others recessive. This is true of Vitis rotundifolia (as female) when united with varieties of true bunch grapes, the Rotundifolia character being dominant." In the same article he endeavors to establish a law governing the characters in the F_1 generation when a species of Vitis with variable characters is mated with another species the characters of which are very uniform.

The law laid down by Munson reads thus, "Species of grapes very uniform in character when hybridized with species of very variable character give progeny with the characteristics of the uniform species dominant." These conclusions drawn by Munson and based on his so-called "false hybrids" when compared with the results of similar work done at the North Carolina Experiment Station must be considered as incorrect.

D. SO-CALLED "FALSE HYBRIDS"

"False hybrids" defined: "False hybrid" is a term that has been repeatedly used by some early Rotundifolia grape breeders and may be defined thus: a hybrid whose chief visible characteristics have been imparted to it by one of the parents only and all or practically all of whose recessive characteristics have been imparted to it by the other parent.

Theoretically such a hybrid may be possible, several have been reported, but on critical examination these usually turn out to be nothing more than straight seedlings from one of the parent species.

"False hybrids" have been reported by Professor A. Millardet of France (1), by T. V. Munson of Denison, Texas (1) and Dearing (3) reports "One supposed hybrid was secured, a cross of Eden (female) and Flame Tokay (male)." This supposed hybrid from its description, meager as it is, can very easily be placed alongside the "false hybrids" of Millardet and Munson.

Fig. 28. Leafy shoots from six of Munson's so-called "false hybrids." Reading from left to right they are: (1) Sanalba, (2) Labama, (3) LaSalle, (4) San Jacinto, (5) San Melaska, (6) Sanmonta. Notice that all the characters of the tendrils, shoots and leaves are those of true Rotundifolia vines. Reduced.

"FALSE HYBRIDS" AND "TRUE HYBRIDS" OF VITIS ROTUNDIFOLIA COMPARED

If the Rotundifolia-Euvitis hybrids were "false hybrids" then we should not be able to distinguish them from vines of the Rotundifolia species, they being identical in appearance; if, however, such hybrids be not "false hybrids" then we should readily perceive their intermediate characters. From the descriptions of the hybrid vines that were produced and grown by this station, we note that these differ from the vines of the Rotundifolia species in the following:

Wood: The wood of Rotundifolia vines is greenish in color, hard and difficult to graft while that of the hybrids is less green, less hard and less difficult to graft.

Pith: The pith of Rotundifolia vines is green, continuous and packed full of starch in the dormant stage while that of the hybrids is mostly green, sometimes sappy brown, mostly continuous but indications of diaphragms are seen at almost every node; starch is packed in the green and greenish-brown pith cells but is lacking, except for a few stray grains, in the brown pith cells. (See Figs. 3 and 4.)

Bark: The bark on Rotundifolia vines is of a light brown color, overlaid with a thin coat of gray and thickly dotted with gray surface lenticels. The bark is persistent on the young wood and on old wood it separates in broad plates or patches. In the hybrid the color may vary from light to a dark brown overlaid with a very thin coat of gray and the lenticels are mostly submerged and almost invisible. The persistence of the bark to the wood and the shedding of the bark in large plates or patches is in some cases practically that of the Rotundifolia parent, while in one case at least, viz.: Vinifera-Rotundifolia hybrid, these characters are practically intermediate.

Internodes and nodes: The internodes in Rotundifolia vines are short and the nodes are not enlarged, while in the hybrid vines the internodes are longer on the average and the nodes are somewhat enlarged on the bud side. (See Fig. 4.)

Leafbuds: The leafbuds on Rotundifolia vines are small, subconic and pubescent on top while on the hybrid canes they are more or less conical, almost smooth and much larger in size.

Shoots: The shoots of Rotundifolia vines are considered naked, while those of the hybrid when the other parent does not have similar shoots generally are clothed immediately with leaves. (See Figs. 5, 11, 14, 15, 23, 25, 26 and 29.)

Leaves: The leaves of Rotundifolia vines are small, generally not lobed but occasionally indications of lobing are noticed in the leaves of some vines, smooth and glossy above and below, large acute marginal teeth, pubescence only in the angles of veins on the lower side of the leaf. The leaves of the hybrid are small, very nearly like those of Rotundifolia, intermediate in lobing but sometimes lobed even more

than those on the Euvitis parent, more or less intermediate in wrinkling of the surface and in gloss; marginal teeth are more intermediate in character and the pubescence is intermediate in amount and density. (See Figs. 6, 12, 16, 17, 23, 24, 25 and 26.)

Tendrils: Simple in Rotundifolia but occasionally bifid, varying in the hybrid from simple to strongly bifid, not generally simple. (See Figs. 5, 11, 14, 15, 25 and 26.)

Flower-clusters: Small in the staminate and perfect hermaphroditic vines and very small in the imperfect hermaphroditic vines of the Rotundifolia species; small in the staminate and perfect hermaphroditic vines and very small in the imperfect hermaphroditic vines of the F_1 hybrids. The Rotundifolia species in this case seems to practically dominate the size of the flower-clusters. Except for size, the flower-clusters seem more intermediate in character between the two parent species. (See Figs. 7, 9, 11, 13, 15, 18 and 19.)

Blooming period of vines: In the F_1 hybrids the blooming period seems to practically fall midway between that of the two parent species. The only exception to this we find in our 1912 Winchell-Rotundifolia hybrid and in our 1913 Herbemont-Rotundifolia hybrid whose blooming periods practically coincide with that of the Rotundifolia species.

Sterility of flowers: In the Rotundifolia species we find two types of flowers as regards sterility; the perfect hermaphroditic flowers may be said to be self-fertile, the staminate and imperfect hermaphroditic flowers are self-sterile, due to sex and intersexualism with attendant impotence. Among the flowers of the hybrid vines we find another type as regards sterility, namely, the one that is sterile because of hybridization. In the anthers of perfect hermaphroditic grape flowers we generally find normal pollen grains, but in the anthers of such flowers of the F_1 hybrids we find mostly irregular pollen grains; occasionally a normal grain is produced. (See Figs. 10 and 20.) Again the ovules in perfect hermaphroditic grape flowers generally may be said to be fertile, but in the F_1 hybrid the fertile ovule seems to be the exception, for out of all of the ovules from about twenty flower-clusters of this type of flower only two developed into fruit. The sterility of these ovules can easily be attributed to the hybrid origin of the vines. In the anthers of imperfect hermaphroditic grape flowers we generally find aborted pollen grains resulting from the phenomenon of intersexualism, but the ovules in such flowers are usually fertile. In the imperfect hermaphroditic flowers of the F_1 hybrids we find as usual aborted pollen grains in the anthers, but most of the ovules also are sterile: hence sterility in this case is due to the double phenomenon of intersexualism with attendant impotence, and hybridization.

In the anthers of our staminate hybrid vine, Bourquiniana $\times$ Rotundifolia, we again find mostly all aborted pollen grains, hence this vine also is practically sterile because of the double phenomenon of sex and hybridization. Sterility due to hybridization therefore seems charac-

teristic of all Rotundifolia-Euvitis hybrids, and any vine that is claimed to be a hybrid but which is normally fruitful must in the light of our experiments be regarded as of nonhybrid origin.

Fruit-clusters: Small to very small in Rotundifolia and still smaller in the hybrid because of sterility due to hybridization. (See Fig. 21.)

Berries: Roughly speaking, the berries might be said to be of an intermediate character in the hybrid.

Seeds: The seeds of Rotundifolia are oval in general outline, the ventral sutures, extreme ends excepted, are generally parallel to each other. The seeds of the hybrid inherit the same general shape as is found in the Rotundifolia parent but the ventral sutures and some minor markings appear more like similar markings found in Euvitis. The size of the seed seems to be intermediate. (See Figs. 8 and 22.)

From the general comparisons drawn between our true F_1 hybrids and their supposed dominant parent species, Vitis rotundifolia, whose description should correspond with that of the so-called "false hybrids" we can safely conclude that the so-called "false hybrids" are no hybrids at all but simply straight seedlings of Vitis rotundifolia.

CONCLUSIONS

Turning now to the previously reported "false hybrids" we shall endeavor to show why these should not be considered as hybrids with Euvitis but as seedlings of the Muscadine group.

Professor Millardet reported all of his vines as "false hybrids." This information is gathered from a statement made by Dr. T. V. Munson, who had considerable correspondence with Professor Millardet. This statement taken from Munson's Foundation of American Grape Culture and found on page 208, reads as follows:

"The writer (Dr. Munson) had noted what Professor Millardet had written him about "false hybrids" including all his Scuppernong hybrids as such; that while they were actual hand-made hybrids, yet the Rotundifolia was so firmly fixed that its characteristics were the chief to show forth in the hybrid, those of the other parent being 'recessive' according to Mendel's characterization."

The vines of Professor Millardet were lost but this short, general but definite description of them seems, in the light of our investigations with hybrid material, sufficient to stamp them indelibly as being pure seedlings of the Muscadine group and not as hybrids, as their originator supposed them to be.

The varieties LaSalle and San Jacinto originated and disseminated by the late Dr. T. V. Munson at Denison, Texas, which are claimed to be hybrids between Scuppernong (female) and some Post-Oak × Herbemont hybrids (male); and his other similar varieties, Sanalba, Sanmelaska, Labama, Sanmonta and San Rubra, which are similarly claimed to be hybrids between the variety San Jacinto (female) and Brilliant

(male), have been grown under constant observation on the college grounds for nine years and critically examined, and not one trace of hybridity between Vitis rotundifolia and Euvitis has ever been discovered. They are in all respects true Muscadine vines.

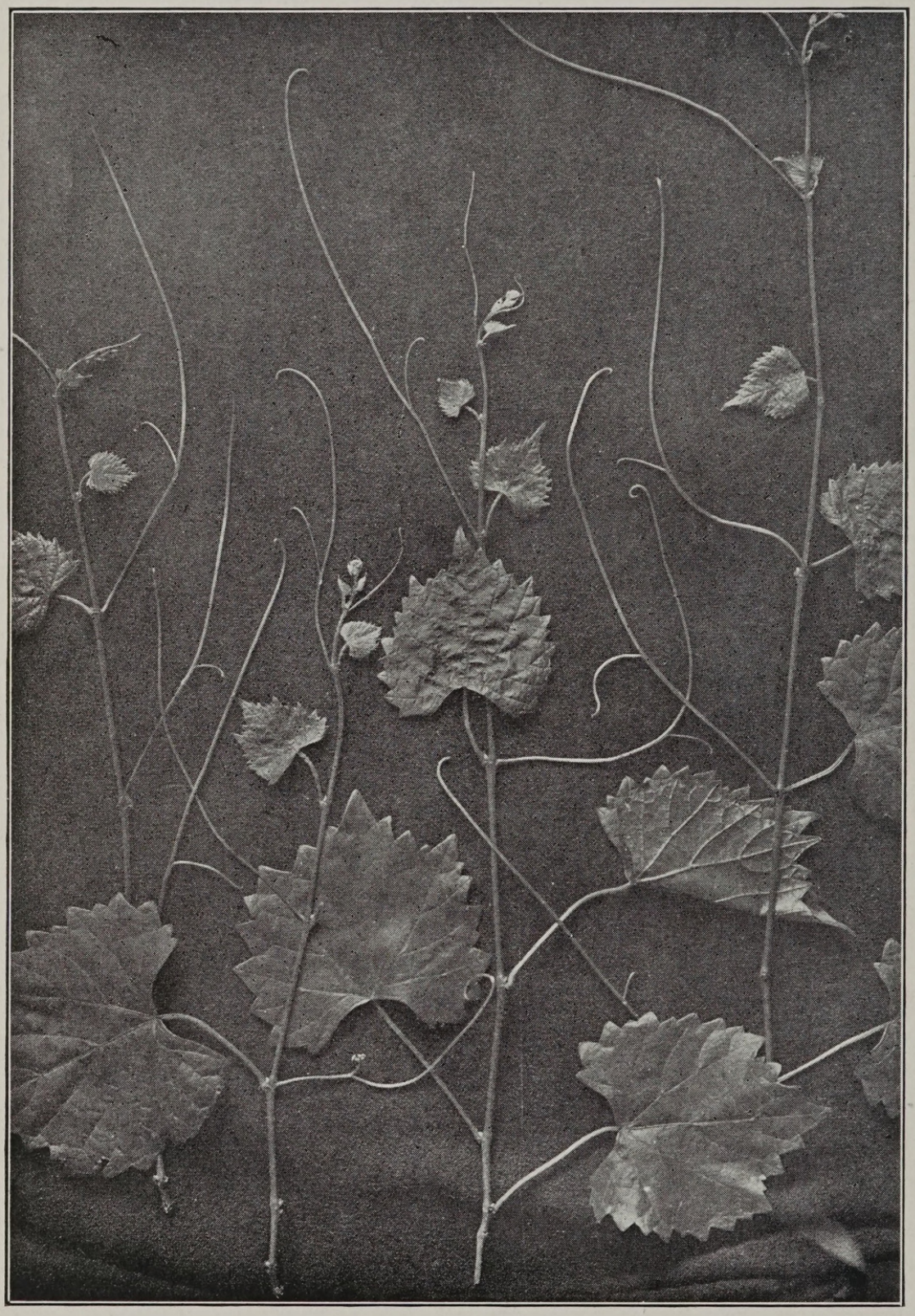

Fig. 29. Selected shoots from a Rotundifolia vine, variety Scuppernong. Notice that many of the tendrils are bifid. Reduced.

The characters on which Dr. Munson based the hybridity of these vines are such as may be found every once in a while among seedlings of pure Muscadines. The tendency toward lobing of the leaf has been repeatedly observed among seedlings of the variety Scuppernong, as

Fig. 30. Selected shoots from Rotundifolia seedling vines, showing variations. Leaves of upper shoots show a decided tendency toward lobing while the tendrils of the lower shoots show that all tendrils on Rotundifolia vines are not simple. Reduced.

well as other varieties. (See Fig. 30.) The occasional forking of the tendril has been noticed on two wild Rotundifolia vines as well as on numerous seedlings even more often than on any of his so-called hybrids. (See Figs. 29, 30 and 31.) The fruit-clusters on six of Munson's

hybrids are no larger than on many of our seedling vines of Scuppernong × Dark Male Vine No. 1 origin, while the fruit-cluster together with the size of the individual berries on his Sanmonta vine are only typical of those of Vitis munsoniana which species Dr. Munson had growing on his estate at that time. (See Figs. 32 and 33.) The thin skin, the character of the pulp, the seeds, the general quality of the fruit, the bark and other characters of Munson's vines are all to be found now and then in the Muscadine group. The sugar content of Sanalba has been far exceeded in our own Rotundifolia seedlings and the pink color of San Rubra has often appeared even more intense than this on light-colored seedling vines in our Muscadine nursery. Again Munson's vines are normally fruitful while from our work we learn that the F_1 hybrids between V. rotundifolia and Euvitis are sterile to a marked degree, fruit on hybrid vines being the exception.

After a complete survey of the characters that are found in Munson's vines and a very careful comparison of these with similar characters found associated with our hybrid vines, we come to the conclusion that Munson's vines are neither "false hybrids," nor true hybrids; that they are nothing but pure Muscadine vines.

The Viticultural Division of the U. S. Department of Agriculture in 1917 reports the production of a "supposed hybrid" vine in 1912 which vine undoubtedly should be classed with this group of so-called "false hybrids." This conclusion has been reached after a careful study of the description of this vine as given by Dearing (3) and a comparison of this with the hybrid vines that were produced at this station. The description reads as follows: "The next year (1912) one supposed hybrid was secured, a cross of Eden (female) and Flame Tokay (male) which has now fruited two years. While it is distinct from other Muscadine seedlings of Eden parentage, it is predominantly Muscadine in character and shows no resemblance to Flame Tokay except in the leaves."

We note from this description that this "supposed hybrid" differs from true hybrids in three prominent points, namely: (1) It shows no resemblance to the Vinifera parent except in the leaf, and just what this resemblance might be is not made clear. (2) The vine is predominantly Muscadine in character. (3) The vine has fruited for two years and no difference in its fruiting habit has been noticed from that of true Muscadine vines; in other words, this vine is normally fruitful and not practically sterile as are true hybrids.

Hybridization of Vitis rotundifolia with species of Euvitis produces true hybrids with varying intermediate and dominant characters, and not as has generally been supposed, "false hybrids" whose characters are chiefly those of Vitis rotundifolia.

SUMMARY

1. Hybrid vines, derived from Vitis rotudifolia and species of Euvitis, generally are more or less intermediate in character. This conclusion is based on a careful study of the characters of hybrid vines which have been derived from Vitis rotundifolia and the following Euvitis

Fig. 31. Selected shoots of a Rotundifolia vine showing that even trifid tendrils may be found within this species. This trifid tendril was first found on a wild (Oberlin) vine and later has been transmitted to a number of its progeny. Reduced.

Fig. 32. A photograph of a branch of a Luola vine (V. rotundifolia), showing that fairly large clusters of fruit may be produced on Rotundifolia vines. Reduced.

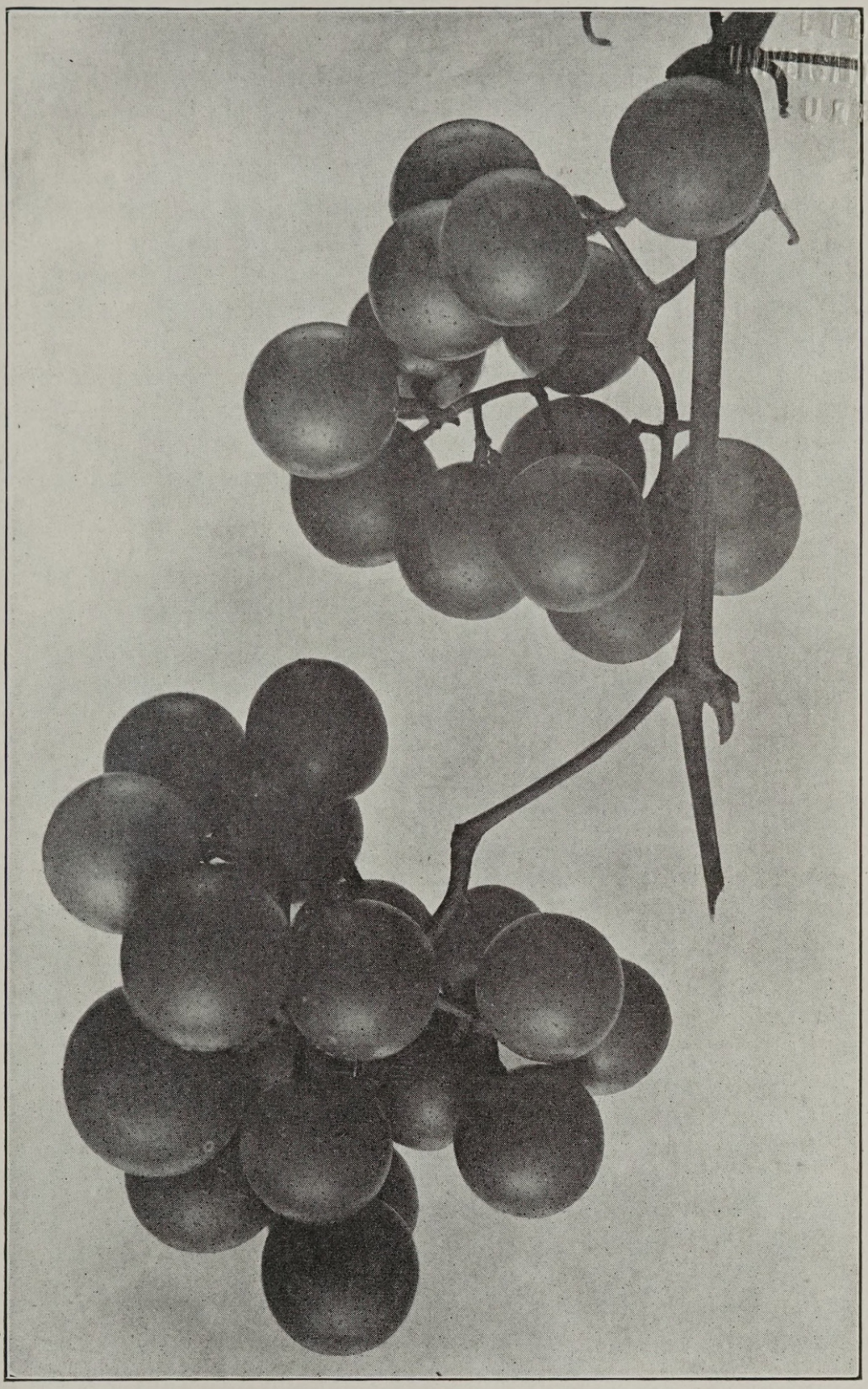

Fig. 33. Two clusters of fruit from a Rotundifolia (Oberlin) vine which shows that all Rotundifolia fruit-clusters are not small. Natural size.

species: V. vinifera, V. labrusca, V. bourquiniana, V. cordifolia and the hybrid variety Winchell.

2. The Muscadine group when hybridized with species of Euvitis is not as prepotent in regard to its external or visible characteristics as has generally been supposed.

3. The hybrids which are derived from Vitis rotundifolia and species of Euvitis are almost sterile and this sterility is due mainly to hybridization. The perfect hermaphroditic forms are sterile from this cause alone, while the imperfect hermaphroditic and the staminate vines are sterile because of the double phenomenon of sex or intersexualism and hybridization.

4. The so-called "false hybrids" which have been reported at various times in horticultural literature and which are said to be hybrids between Muscadine vines and species of Euvitis are not hybrids but straight seedlings of the supposedly dominant parent species, Vitis rotundifolia and Vitis munsoniana.

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