

Observations on the Resistance of Grape Varieties to Black Rot and Downy Mildew

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THE establishment of experimental vineyards of eastern grapes of the United States Department of Agriculture at the United States Horticultural Station, Beltsville, Maryland, in recent years has made possible observations on the degree of resistance to grape diseases of the approximately 270 varieties in the Arlington Farm vineyard, near Washington, D. C., which soon will be discontinued. These observations have added to the inadequate information available on the reaction of standard grape varieties to fungus diseases, under Middle Atlantic States conditions, and have furnished what would appear to be valuable information needed in the development of improved disease-resistant varieties by breeding.

The vineyard used in these studies was established in 1916, when 30 rows of duplicate vines, spaced at 10-foot intervals in rows 10 feet apart, were planted. Replacement of unsuccessful plantings and additions of new varieties were continued up to 1932, at which time the vineyard consisted of 60 rows of American Euvitis varieties and 10 rows of selected Vinifera varieties. The vineyard rows extend in an east-west direction and occupy a slope having a southern-southwestern exposure. A modified Munson trellis was used. Standard cultural practices were followed.

With the exception of the summer of 1928, when some trouble was encountered, satisfactory control of fungus diseases prior to the present season was accomplished by the regular use of a 3-3-50 bordeaux spray applied at approximately 2-week intervals during the spring and early summer. In 1928, in spite of the spraying schedule, black rot caused a loss of as much as 25 per cent of the fruit in some of the Vinifera varieties and appreciable loss in a number of Euvitis kinds.

In order to study the response of different varieties of grapes to diseases, it was decided this season (1937) to discontinue spraying and to allow the vines to become exposed to natural infection. Standard pruning, cultural, and fertilizer treatments were given.

Since the vineyard had been kept relatively free of diseases in previous years, it was expected that at least 2 years would be required for it to become sufficiently invaded by fungus diseases to permit a reasonably fair reading on the relative resistance of the different varieties, but so severe and so uniformly distributed was disease infection throughout the vineyard in 1937 that it was felt that a preliminary report should be made at this time.

SEASONAL CONDITIONS

Since fungus diseases of grapes are largely influenced by climatic factors, the temperature and humidity conditions at Arlington Farm this season may be of some interest. During the first half of June the daily mean temperatures ranged from 66 to 81 degrees F, considerably

TABLE I—SHOWING AMOUNT OF INFECTION FROM BLACK ROT AND DOWNY MILDEW IN DIFFERENT VARIETIES OF GRAPES AT THE ARLINGTON EXPERIMENT FARM, VIRGINIA, DURING THE SEASON OF 1937

Variety	Probable* Species Percentage	Black Rot (Per Cent)	Downy Mildew (Per Cent)	Variety	Probable* Species Percentage	Black Rot (Per Cent)	Downy Mildew (Per Cent)
<i>Dual Resistance Group</i>							
Ambrosia	L.a. Vin.	2	1	Lutie	L.a.	2	5
America	Lin. Rup.	Trace	Trace	Montefiore	Rip. La.	Trace	0
Caywood No. 50	L.a. Vin.	3	10	Moore	L.a.	1	3
Challenge	L.a. Vin.	3	3	Nectar	L.a. Vin. Bour.	5	0
Clinton	Rip. La.	5	5	Neosho	Lin.	Trace	Trace
Cottage	L.a.	Trace	3	Norton	Aest. La.	5	3
Cynthiana	Aest. La.	Trace	10	Pearl	Rip. La.	2	10
Dakota	Rip. La.	Trace	Trace	Perfection	L.a. Vin. Bour.	Trace	5
Dry Hill	L.a.	5	5	Suelter	Rip. La.	Trace	Trace
Franklin	Rip. La.	0	0	Steuk	L.a.	Trace	10
Hermann	Aest. La.	5	5	Wine King	Aest. Vin. Rup.	4	5
Kentucky	Aest. La.	5	3	Wyandotte	Lin.	Trace	5
Kline	(?)	5	0	Virginia Dare	(?)	Trace	5
Loretto	Lin.	2	0				
<i>Downy Mildew-Resistant—Black Rot-Susceptible</i>							
Amerbonte	Bour. Lin. Rip.	15	5	Diamond	L.a.	15	5
America x Malaga 2-1		25	10	Elvibach	Rip. La.	10	Trace
America x Malaga 2-2		—	10	Hernito	L.a. Vin.	15	10
Arkansas	L.a.	25	1	Limn	L.a.	40	0
Bacchus	Rip. La.	20	2	Louisiana	Bour.	10	2
Black Pearl	Rip. La.	90	2	Manitto	Lin. Rup. Vin. Bour. La.	10	10
Catawba x Jaeger 70	Lin. La. Vin.	30	Trace	Norfolk	L.a.	50	5
Champanel	Cham. La.	10	1	Palmyra	L.a. Vin.	30	10
Concord	L.a.	30	5				
<i>Black Rot-Resistant—Downy-Mildew-Susceptible</i>							
Bell	Rip. La. Bour.	5	25	Jefferson	L.a. Vin.	3	40
Benjamin	L.a.	0	60	Kingsessing	L.a. Vin.	1	25
Berkmans	Rip. La. Bour.	2	40	Ladano	Cham. La. Vin. Bour.	1	40
Beta No. 1	Rip. La.	Trace	25	Lightfoot	L.a. Vin.	5	20
Beta No. 2	Rip. La.	Trace	25	Livingston	L.a. Vin.	3	50
Beta No. 3	Rip. La.	Trace	20	Lucile	L.a.	Trace	20
Brilliant Seedling	L.a. Vin. Bour.	5	40	Luse	L.a.	5	30
Brown	L.a. Vin.	5	30	Marguerite	Lin. Bour.	Trace	20
Campbells Early	L.a. Vin.	5	50	Marsala	L.a. Vin.	Trace	60
Carman	Lin. La. Bour.	0	20	Martha	L.a.	3	40
Chambri	Cham. La. Vin. Bour.	5	40	Mary Favorite	L.a. Vin.	5	50
Champion	L.a.	3	15	Mills	L.a. Vin.	5	40
Chicago	L.a.	Trace	40	Minnie	Lin. La. Vin.	5	60
Clevene	L.a. Aest. Rup.	Trace	50	Missouri Riesling	Rip. La.	0	25
Cloeta	Lin. Rup. Vin.	5	60	New Red	(?)	Trace	60
Columbian Imperial	Rip. La. Bour.	5	40	Noah	Rip. La.	5	30
Dela ware	L.a. Vin. Bour.	5	80	Paradox	L.a. Vin.	3	50
Diogenes	Rip. La.	5	25	Peabody	Rip. La. Vin.	5	40
Dr. Wiley	(?)	5	40	Presley	Rip. La.	Trace	50
Dracut Amber	L.a. Vin. Bour.	1	15	Requa	L.a. Vin.	5	50
Early Visitor	L.a. Vin. Bour.	5	30	Rockwood	L.a.	5	25
Eaton	L.a.	5	40	Rogers No. 13	L.a. Vin. Vin.	3	75
Elvira	Rip. La.	3	30	Rommel	Rip. La. Vin.	Trace	80
Emerald	L.a. Vin. Bour.	Trace	40	Rupert	Lin. Rup. Vin. La. Bour.	1	40
Etta	Rip. La.	Trace	50	Salamander	Cham. La. Vin. Bour.	1	40
Golden Grain	L.a. Vin. Bour.	5	75	Shala	Lin. Rup. La.	Trace	15
Green Early	L.a. Vin.	1	40	Sunrise	L.a. Vin. Bour.	1	50
Hanover	L.a. Vin.	5	75	Triumph	L.a. Rip. Can. Vin. Bour.	4	60
Hartford	L.a.	5	15	Valhallah	Lin. Rup. Bour. Vin.	3	30
Hicks	L.a.	3	40	Wapanuka	Lin. Rup. La. Vin.	5	40
Ives	L.a. Aest.	2	15	Xlinta	Lin. Rup. La. Vin.	Trace	20
				Worden	L.a.	5	50

*The probable-species background of the different varieties indicated here is based on the statements found in "Grapes of New York," by U. P. Hedrick, et al.; "Foundations of American Grape Culture," by T. V. Munson; and "American Grape Varieties," by I. W. Dix and J. R. Magness (U. S. D. Agr. Cir. 437, 1937).

TABLE I—Concluded

Variety	Probable* Species Percentage	Black Rot (Per Cent)	Downy Mildew (Per Cent)	Variety	Probable* Species Percentage	Black Rot (Per Cent)	Downy Mildew (Per Cent)
Agawam	La. Vin.	15	75	Eclipse	La.	60	85
Albania	Lin. La. Aest. Bour.	20	50	Edna	Lin. La. Vin.	90	70
Alexander Winter	La. Vin.	50	25	Eldorado	La. Vin.	60	50
Alice	La. Vin. Aest.	50	25	Ellen Scott	Lin. La. Vin.	75	60
Alvey	Aest. Vin.	10	40	Empire State	Rip. La.	10	20
Amber Queen	La. Vin. Rip.	50	75	Eumedel	La. Vin. Bour.	85	50
America x Malaga No. 16	Lin. Rup. Vin.	50	50	Eumelan	La. Vin. Aest.	30	60
Armalaga	Lin. La. Vin.	50	60	Faith	Rip. La.	15	50
Atoka	Lin. Rup. Vin. Bour. La.	25	15	Fredonia	Rip. La.	50	30
August Giant	La. Vin.	40	15	Gaertner	La. Vin.	10	25
Barley	Lin. La. Vin.	25	25	Geneva	La. Vin.	10	60
Black Eagle	La. Vin.	90	30	Glenfield	La. Vin.	15	35
Blondin	Lin. Aest. Bour.	20	40	Goethe	La. Vin.	70	30
Bride	La. Vin. Bour.	50	90	Goff	La. Vin. Aest.	30	60
Brighton	La. Vin.	40	60	Gold Dust	La. Vin. Bour.	15	80
Brilliant	La. Vin. Bour.	20	100	Golden Drop	La. Vin. Bour.	50	30
Caco	La. Vin.	25	25	Golden Muscat	La. Vin.	50	50
C. A. Green	La. Vin.	25	50	Gov. Ross	La. Vin.	25	60
Captain	Lin. Rup. La.	80	15	Greins Golden	Rip. La.	10	30
Captivator	La. Vin. Bour.	25	40	Helen Keller	La. Vin.	40	30
Catawba	La. Vin.	25	75	Hidalgo	Bour. La. Vin.	10	60
Cayuga	La. Vin.	75	75	Hightand	La. Vin.	10	60
Cochee	La. Bour.	30	40	Herbament	Bour.	80	80
Cream	Lin. La. Vin.	90	60	Herbert	La. Vin.	75	60
Creveling	La. Vin.	25	50	Iona	La. Vin.	85	50
Croton	La. Vin. Bour.	75	60	Isabella	La. Vin.	10	20
Delawba	La. Vin. Bour.	10	60	Isabella Seedling	La. Vin.	50	55
Diana	La. Vin.	60	60	Jessica	La. Vin.	75	40
Dunkirk	La. Vin.	60	20	King Philip	La. Vin. Rip.	25	50
Dutchess	La. Vin. Aest. (?)	90	50	Krause	La. Vin. Bour.	80	40
Early Concord	La. Vin. Aest.	15	30	Lady	La. Vin.	25	60
Early Dawn	La. Vin. Aest.	75	40				

Variable Low-Resistance Group

Variable Low-Resistance Group—Continued

Lady Washington	La. Vin.	10	60	President	La. Vin.	10	20
Lampasos	(?)	10	80	Red Eagle	La. Vin.	100	80
Lenoir	Bour	90	70	Red Riesling	(?)	25	85
Lindley	La. Vin.	10	70	Riehl's Eclipse	La. Vin.	—	30
Lindmar	La. Vin.	10	20	Ripley	La. Vin. Aest.	70	80
Little Blue	La. Vin. Aest	25	75	Rogers No. 5	La. Vin.	75	75
Lomanto	Cham. La. Vin. Bour.	25	40	Rogers No. 17	La. Vin.	60	40
Longfellow	Lin. La. Vin.	90	80	Rogers No. 32	La. Vin.	60	40
Mabel	La. Vin. Bour.	40	15	Rogers No. 33	La. Vin.	70	40
Manson	(?)	90	40	Ronaldo	Rip. La. Vin.	98	80
Marie Louise	La. Vin.	40	80	Ruby	La. Vin. Rip.	90	50
Marion	La. Vin.	15	30	Rustler	La. Vin.	20	20
Massasoit	La. Vin.	50	50	Salem	La. Vin.	25	60
Merrimac	La. Vin.	50	40	Shelby	Rip. La.	60	40
Millers Seedling	La. Vin. Bour.	10	75	Sheridan	La. Vin.	15	60
Moyer	La. Bour. Vin.	50	40	Studley No. 2	La. Vin.	60	50
Neva Munson	Lin. Bour.	25	20	Stouts Seedless	La. Vin.	75	60
New York No. 6165	(?)	10	60	Thompsons No. 5	La. Vin.	60	60
Niagara	La. Vin.	85	75	Tonkawa	La. Vin. Bour.	20	30
Nitodal	La. Lin. Vin. Bour.	25	25	Uhland	Rip. La.	10	30
Norwood	La. Vin.	30	50	Ulster	La. Vin. Aest.	10	50
Old Gold	Rip. La. Vin.	80	50	Urbana	La. Vin.	30	80
Old Gold	La. Vin. Bour.	30	60	Vergennes	La. Vin.	15	75
Oltta	Lin. La. Vin.	70	30	Veronica	(?)	15	20
Olttafoo	La. Vin.	15	50	Vesta	La. Vin.	15	20
Oneida	La. Vin.	25	60	Volney	Lin. La. Vin.	80	20
Ontario	La. Vin.	50	40	Wachita	La. Vin. Bour.	25	90
Oriental	La. Vin.	10	40	Waddel	La.	30	60
Osage	La. Vin.	15	60	Wayne	La. Vin.	20	80
Paragon	La. Vin.	10	20	Wetumka	La. Vin. Bour. Aest.	10	40
Perkins	La. Vin. Bour.	50	80	Wilder	La. Vin.	60	75
Poughkeepsie	La.	15	75	Wyoming	La.	25	40
Portland	La.						

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above normal, and for the remainder of the month from 70 to 77 degrees F. The total precipitation for June of 6.49 inches, more than one and one-half times the normal amount, fell during 11 of the 30 days. During July rain fell during 12 of the 31 days with a total of nearly 4 inches. Wide fluctuations in the mean daily temperatures occurred, ranging from 66 to 84.5 degrees F. The first half of August was abnormally warm and except for the 6 days from the 12th to the 17th, inclusive, the daily mean up to August 22 ranged between 80 and 85 degrees F. During the month 7.95 inches of rain fell in 13 out of the 31 days, the precipitation on these days ranging from a few hundredths to more than 2½ inches.

It is believed that with the normal temperature range that exists at Arlington Farm, humidity rather than abnormally high temperatures is of more significance in the spread of fungus diseases. In this connection, it is interesting to note that during the period June 1 to August 31 in 1928, when fungus diseases were prevalent in spite of control measures, rain fell on 14 days in June, 8 days in July, and 12 days in August, with a total precipitation for the period of more than 7 inches above the normal, while the mean daily temperatures fluctuated widely below as well as above the normal mean. Weather records for other years, when examined for comparison with those of 1937 and 1928, show less favorable distribution of rainfall for spread of fungus diseases.

VINEYARD OBSERVATIONS

The fruit and foliage diseases most destructive to the grape in the vicinity of Washington, D. C., are black-rot (*Guignardia bidwellii*), downy mildew (*Plasmopara viticola*), anthracnose (*Sphaceloma ampelinum*), ripe-rot (*Glomerella cingulata*), and bitter-rot (*Melanconium fuligineum*). The two former were by far the most destructive in the variety vineyard during the season of 1937. The relative importance of each was recorded as found in the vineyard. A part of these data is recorded in Table I.

Black-rot caused the greatest damage to the fruit, but some ripe-rot and bitter-rot appeared during the ripening period. Lesions of the black-rot organism occurred on the foliage of many of the varieties, but resulted in very little foliage damage to any except the Vinifera.

Downy mildew began to show in the 10 rows of Vinifera situated on the windward side of the vineyard during the latter half of May and spread rapidly to the American species and varieties. By midsummer the disease was killing the foliage of many. This disease as a whole caused a negligible amount of damage to the fruit. Two varieties, Brocton and New Red, both Vinifera crosses, showed as much as 50 per cent of fruit damage. It was not observed on the fruit of other American varieties in sufficient amount to warrant recording.

Observations on the relative resistance of the approximately 270 grape varieties were made four times during the season: May 18, July 1, August 2 and 3, and August 16. On May 18 there were scattered infections of downy mildew on the foliage of a few of the Vinifera, but none was observed on the American forms. Six weeks later the fruit

of the Vinifera varieties was in bad condition due to black-rot. Two varieties, Dodrelabi and Damascus, showed a loss of 25 per cent, Alicante Bouschet about 50 per cent, and the balance showed practically total loss. On August 2, when final readings were made on these varieties, the foliage of Black Monukka was free from mildew and that of Jura Muscat, Muscateller and Sylvaner showed only 25 per cent infection. The fruit of all four had been destroyed by black-rot. Damascus, on the other hand, showed 25 per cent healthy fruit, although its foliage had been destroyed. With these exceptions, the foliage of all the vines in the Vinifera group was in very bad condition and the fruit completely destroyed. At this time the American varieties showed a wide range of variability of resistance to both black-rot and mildew. On the fruit the resistance varied from no rot to 98 per cent. A similar variability of resistance was noted for downy mildew on the foliage. The older foliage of a few varieties was falling at this time and exposing the fruit to the direct rays of the sun, while foliage of other varieties was luxuriant and entirely disease-free.

One month later both diseases had become more accentuated as to intensity, but some varieties continued to demonstrate outstanding resistance to diseases. A few showed resistance to both black-rot on the fruit and mildew on the foliage, while others exhibited marked resistance to one disease and little or none to the other.

The data taken August 2 and 3 were considered the most important of any and were used in the final analyses and discussions. At this time it was thought that black-rot had attained about its greatest degree of destructiveness to the fruit. The damage to the foliage by downy mildew was sufficiently obvious to make fairly accurate estimates of final injury. Then, too, at this period other factors were entering into the picture, such as cracking of the berries, bird and insect injury, and sun scalding of exposed fruit, all tending to make subsequent observations less valuable.

Vineyard observations as of this date are presented in Table I. The data express the combined judgment of the authors as to the percentage of damaged berries and the amount of defoliation and badly injured leaves. In this table black-rot and downy mildew are considered. The varieties have been segregated into four groups: (a) 27 showing marked resistance to both diseases; (b) 17 displaying notable resistance to downy mildew but a high degree of susceptibility to black-rot; (c) 63 exhibiting a high degree of resistance to black-rot but high susceptibility to mildew; and (d) 127 named grapes showing medium to low resistance to both diseases. The 37 following varieties belonging to the Vinifera species were included in the study, but because of their almost universal susceptibility to both diseases they are not tabulated here: Agadia, Alicante Bouschet, Barbarossa, Black Hamburg, Black Monukka, Black Shahanee, Blue Portuguese, Chasselas Doré, Chasselas de Fontainebleau, Chasselas Rose Royal, Cinsaut, Corinth Rose, Damascus, Dismar, Dobrelabi, Emperor, Foster Goolabie, Gros Colman, Gros Guillaume, Jura Muscat, Maraville de Malaga, Mourastel, Muscat Alexandria, Muscat Hamburg, Muscat Noir Precoce, Muscateller, Palomino, Panariti, Pedro Ximines,

Prune de Cazouls, Red Hanepoot, Sultanina, Sylvaner, Valdepenas, and Zinfandel.

Of the entire 270 varieties under observation only one, Franklin, showed complete resistance to both diseases, although America, Dakota, Montifiore, Neosho, and Suelter stood nearly as high, and several others were outstanding in this regard. More varieties showed high resistance to black-rot than to downy mildew, but in the case of 17 varieties the reverse was true.

It is regrettable that of the highly resistant varieties so few are included that have outstanding table quality and that, in some of the resistant kinds, at least, undesirable characters are found, such as lack of vigor, low yield, tendency to shatter, and small size of cluster and berry. However, there are among them some that do have very desirable characters, and these may well serve as the starting point in the development of improved disease-resistant varieties through breeding. A detailed horticultural description of these varieties is contained in United States Department of Agriculture Circular 437 (1937).

Relatively little seems to have been published on the genetics of the grape with reference to the inheritance of disease susceptibility. It is known that the *Vinifera* species, taken as a whole, is extremely susceptible to black-rot and downy mildew, and from the work of Negrul (1) it appears that the gene transmitting susceptibility to mildew, at least, is dominant. In the case of the American *Euvitis* species, the evidence seems to indicate that the difference in the inheritance of disease susceptibility among the different species varies in degree only.

In the consideration of our American grapes from the standpoint of their species background, we are confronted by the fact that, especially among the early introductions, many are of obscure or unknown parentage. Some varieties have arisen as chance seedlings, and in certain instances where conscious effort was made at crossing known varieties, it is by no means sure that the result was a true cross. Another fact that must be taken into consideration in this connection is that our present varieties are selections from an unknown number of undesirables and the degree of disease resistance of the rejects is unknown. Some species representatives as well as hybrids are included in the varieties under study, and some consideration of these as bearers of disease susceptibility, on the basis of the present observations, seems warranted. We do not have sufficient varietal populations within some of the species to make our readings significant, but certain relationships are worthy of mention.

The very high susceptibility of the *Vinifera* varieties included in these studies has already been mentioned. If we now assume that the species background of all our varieties is as indicated, we may consider various groups on this basis. In the case of the 31 straight *Labrusca* varieties, the amount of infection averaged 14.3 per cent for black-rot, with a co-efficient of variation of 112.5 per cent; and for downy mildew an average of 31 per cent with a coefficient of variation of 75.5 per cent. Comparing these figures with those for the 77 varieties having *Labrusca-Vinifera* parentage, we find that the average infection from black-rot for these latter was 33.2 per cent, with a coefficient of variation of 84

per cent, an amount more than twice that of the *Labrusca* group; while for mildew infection the average was 45.1 per cent, with a coefficient of variation of 51.8 per cent. Here the susceptibility of the *Labrusca-Vinifera* for downy mildew was about one and one half times that of the *Labrusca* group. The marked carrying over of the tendency to susceptibility to these diseases from the *Vinifera* parents would appear to be the explanation.

If we consider now the *Riparia-Labrusca* group of 23 varieties, we find a much higher degree of resistance to both black-rot and downy mildew, greater than that even of the *Labrusca* group. Here the average amount of infection from black-rot was 11.1 per cent with a coefficient of variation of 184.6 per cent, and an average invasion of 22.2 per cent by downy mildew, with a coefficient of variation of 68.9 per cent. These figures for the *Riparia-Labrusca* group are probably somewhat higher than they really should be, due to the fact that two varieties, Shelby and Black Pearl, which exhibited much greater susceptibility than the other varieties in the group, are of uncertain parentage and possibly should not be included here.

Attention is called to the small group of five varieties with *Aestivalis-Labrusca* parentage. Here the damage from black-rot averaged but 3.6 per cent, and from downy mildew but 7.2 per cent. This group is too small, of course, to warrant sweeping conclusions, but tendencies toward high resistance to these diseases seem clear. Included here are *Cynthiana*, *Hermann*, *Kentucky*, *Norton*, and *Ives* varieties.

The same may be said for the *Lincecomii* species group, represented by *Loretto*, *Neosho*, and *Wyandott*. These exhibit outstanding resistance. When the *Lincecomii* blood is mingled with that of *Labrusca* and *Vinifera*, however, a striking difference is noted, for whereas the *Lincecomii* were invaded to the extent of about $1\frac{1}{3}$ per cent by black-rot and 2 per cent by downy mildew, the ten varieties having *Lincecomii-Labrusca-Vinifera* parentage showed the average amount of infection of black-rot of 60.5 per cent with a coefficient of variation of 15.3 per cent, and by mildew of 53.6 per cent with a coefficient of variation of 50.3 per cent.

Of the other groups showing complex parentage, only the *Labrusca-Vinifera-Bourquiniana* combination will be considered here. This group, which includes 24 varieties, showed an average loss by black-rot of 27.6 per cent, with a coefficient of variation of 52.9 per cent; while an average of 51.2 per cent defoliation was noted for the mildew, with a coefficient of variation of 45.9 per cent. This group showed considerably more resistance to black-rot than the *Lincecomii-Labrusca-Vinifera* group, but the reaction to downy mildew was about the same.

DISCUSSION

This report deals with the results of but one season's observations, and the final reading has not been made on the relative resistance of these grape varieties to black-rot and downy mildew. However, the only probable effect of further exposure of the vineyard to attack by fungus diseases, if any, would be a further reduction in the amount of observed resistance. While some further reduction may be expected

it is believed, from the severity of the attack this season, that later findings will not alter materially the conclusions drawn here.

It must be emphasized further that drawing conclusions as to the importance of various species in transmitting susceptibility to fungus diseases is unsatisfactory when based on heterogeneous material such as our present varieties. In spite of the fact, however, that we are dealing with selections from populations rather than with entire populations, it is with these selections that one must deal in the making out of a breeding program involving disease resistance as one factor. It is to certain species and species crosses that we must look for parent varieties. It would appear from the present findings that varieties having *Riparia*, *Aestivalis*, *Lincecomii*, or *Labrusca* blood would most likely prove best sources of disease-resistant material.

While high susceptibility to black-rot and downy mildew seems to characterize the *Vinifera* species group, it is to be noted that some resistance was observed, and it seems likely that a factor for resistance is possessed by some representatives of this group. European workers (2) are apparently finding this to be true and are able to secure vines possessing marked resistance from *Vinifera* sources.

CONCLUSION

The present report deals with the relative resistance of 270 American *Euvitis* and European *Vinifera* grape varieties to infection from black rot and downy mildew, as observed at Arlington Experiment Farm, in Virginia, during the season of 1937.

According to their degree of resistance to these diseases, the varieties have been segregated into five groups, as follows: (a) 27 varieties showing marked resistance to both diseases; (b) 17 displaying notable resistance to downy mildew but a high degree of susceptibility to black rot; (c) 63 exhibiting a high degree of resistance to black rot, but high susceptibility to infection by downy mildew; (d) 127 showing medium to low resistance to both diseases; and (e) 36 varieties of the *Vinifera* species exhibiting high susceptibility to these diseases.

Riparia, *Aestivalis*, *Lincecomii*, and *Labrusca* species appear most likely sources of desirable material for use in the development of disease-resistant grapes.

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