

Susceptibility of American, European, and Interspecific Hybrid Grape Cultivars to the Fungus *Septoria ampelina*

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Abstract. European *Vitis vinifera* L. (four cultivars); interspecific hybrid (seven cultivars); and American *V. aestivalis* Michx. (one cultivar), *V. labrusca* L. (three cultivars), and *V. rotundifolia* Michx. (two cultivars) grapevines were tested for susceptibility to septoria leaf spot disease. *V. rotundifolia* cultivars Cowart and Fry exhibited hypersensitive-type resistance. All other American, European, and hybrid cultivars tested were susceptible with varying levels of disease severity. Cultivars with little (e.g., interspecific hybrid) or no (e.g., European) *V. labrusca* L. heritage were more susceptible to septoria leaf spot than American *V. labrusca* cultivars.

Septoria leaf spot (also called mélanose), which is caused by the fungus *Septoria ampelina* Berk. & Curt., is found infrequently in the eastern United States from New York to Florida and in the midwestern United States from Wisconsin to Texas (McGrew and Pollack, 1988). Very little information exists on the pathogenicity of this fungus. Terevnikova-Babayan (1977) proposed a key to differentiate seven *Septoria* spp. found on American grapevines, including *Septoria ampelina* and *S. melanosa* Rostr. *S. ampelina* is the presently accepted species found infecting grapes (McGrew and Pollack, 1988). Boubals and Mur (1983) isolated *S. ampelina* from leaves of American grape rootstock 110R (*Vitis rupestris* Scheele × *V. berlandieri* Planch.) and SO4 (*V. riparia* Michx. × *V. berlandieri* Planch.). The fungus infected American *Vitis* spp., whereas European *V. vinifera* L. cultivars were immune. No information on susceptibility of interspecific hybrid cultivars was given.

During 1991 and 1992, septoria leaf spot was diagnosed as causing substantial defoliation of American *V. labrusca* L. cv. Concord grapevines in several vineyards in northwestern Arkansas. Registered protestant and sys-

temic fungicides were applied, but the disease still approached epidemic proportions, with 60% disease incidence. Commercial production of interspecific hybrid grapes is expanding rapidly in this region of the United States. Cultivars developed by the Univ. of Arkansas Agricultural Experiment Station, including 'Venus' (Moore and Brown, 1977), 'Reliance' (Moore, 1983), 'Mars' (Moore, 1985), and 'Saturn' (Moore et al., 1989), all interspecific hybrids of *V. labrusca* × *V. vinifera*, are being planted rapidly to contribute to further expansion of this industry. The large amount of *S. ampelina* inoculum in this area is of concern because no information is available on susceptibility of interspecific hybrid cultivars, especially those with *V. labrusca* heritage.

Objectives of this study were to determine if 1) interspecific hybrid cultivars of *V. labrusca* × *V. vinifera* are susceptible to septoria leaf spot and 2) there is a correlation between percent *V. labrusca* ancestry of a particular cultivar and susceptibility to septoria leaf spot.

Materials and Methods

Pathogen isolation and culture. Two isolates of *Septoria ampelina* (89-602 and 91-537) were collected from diseased 'Concord' grape leaves in Washington Co., Ark. Conidia of *S. ampelina* were isolated from sporulating lesions by using a heat-sterilized dissecting needle under a stereomicroscope and then transferring the conidia to potato-lextrorse agar (PDA). Isolates were maintained in glycerol-skim milk at -80C.

Conidial inoculum of isolates was produced on pea extract agar plates (400 ml of canning liquid from commercial, salt-free,

canned peas, 18 g agar, and 600 ml distilled water) seeded with conidia from 8- to 9-day-old cultures. Plates were incubated on a laboratory bench for 8 to 10 days at 26C under cool-white fluorescent lights (1: 1, GroLux) adjusted to a 14-h photoperiod.

Grape culture. Rooted grape cuttings were planted into 4-liter plastic pots (one plant/pot) containing 2 peat: 1 perlite: 1 vermiculite (by volume) mix amended with 6.3 kg CaCO₃ and 1 kg Osmocote 17N-9P-13K fertilizer per cubic meter. Plants were grown outside in a slatted-shadehouse until six fully expanded true leaves were present.

Grape cultivars tested included: *Vitis aestivalis* ('Cynthiana'), *V. labrusca* ('Concord', 'Fredonia', and 'Niagara'), *V. rotundifolia* ('Cowart' and 'Fry'), *V. vinifera* ('Cabernet Sauvignon', 'Chardonnay', 'Flame Seedless', and 'Thompson Seedless'); and interspecific hybrids ('Einset Seedless', 'Mars', 'Reliance', 'Rivat', 'Saturn', 'Vanessa', and 'Venus'). 'Rivat' is believed to be a hybrid of *V. rupestris* × *V. vinifera*, while the remainder of interspecific hybrid cultivars tested are progeny from crosses of *V. labrusca* × *V. vinifera*.

Pathogenicity tests. Each treatment consisted of two grape plants, and the experiment was replicated twice. An aqueous conidial suspension of each fungal isolate (89-602 and 91-537), amended with Tween20 (0.02%, v/v), was prepared and standardized at 1 × 10⁷ spores/ml with a hemacytometer. The two isolates were then mixed 1:1. The third and fourth true leaves of the plants were inoculated to runoff with the conidial suspension using an artist's airbrush atomizer (1.37 × 10⁵ Pa). Leaves of controls (two plants of each cultivar) were sprayed with water plus surfactant only. Sprayed plants were air-dried, placed into a dew-deposition chamber at 24C for 20 h, returned to the shadehouse, and arranged in a randomized complete-block design. The shadehouse area was equipped with overhead sprinkler irrigation adjusted to run for 4 min at 0800, 1000, and 2000 m daily. This regime was followed for 7 days after inoculation, then the sprinkler was adjusted to run once a day at 1000 hr for 4 min until the end of the experiment. All plants were examined twice a week for 4 weeks for disease symptoms and rated as immune if no symptoms were found and susceptible if lesions were found. After 28 days, plants were rated for disease severity as follows: 0 = no disease; 1 = 1% to 10% of leaf tissue with lesions; 2 = 11% to 25% of leaf tissue with lesions; 3 = 26% to 50% leaf tissue with lesions, 1% to 10% necrotic tissue; 4 = 51% to 75% leaf tissue with lesions, 25% to 50% necrotic tissue; 5 = 76% to 90% leaf tissue covered with lesions, 51% to 80% necrotic tissue; and 6 = dead or abscised leaves.

After final ratings were obtained, inoculated leaves were removed from plants, placed into moist chambers for 4 days, and observed for sporulation. Conidial masses, if present, were observed under the microscope to verify the presence of *Septoria* spores.

Percentage of *V. labrusca* ancestry in selected interspecific hybrid cultivars, in conjunction with disease severity data from se-

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lected cultivars, was plotted to determine if a correlation exists between percent *V. labrusca* of a clone and susceptibility to septoria leaf spot. *Vitis vinifera* grape cultivars analyzed in this manner included 'Chardonnay', 'Thompson Seedless', 'Flame Seedless', and 'Cabernet Sauvignon', which are assumed to be 100% *V. vinifera*. American grape cultivars analyzed included 'Fredonia', 'Concord', and 'Niagara', which are assumed to be 100% *V. labrusca*.

A nested analysis of variance (ANOVA) was run on disease severity data using the MANOVA procedure of SPSS (SPSS Inc., 1988). The LSD post-hoc tests were run using the one-way procedure of SPSS. The denominator for the overall test was modified according to the hierarchical design analyzed under MANOVA.

Results and Discussion

Septoria ampelina caused leaf spot lesions in all grape cultivars tested. 'Chardonnay', 'Cynthiana', 'Einset Seedless', 'Flame Seedless', 'Rivat', 'Thompson Seedless', and 'Vanessa' developed leaf spot symptoms 8 days after inoculation. Symptoms of leaf spot appeared in 'Cabernet Sauvignon', 'Cowart', 'Fry', 'Mars', 'Reliance', and 'Saturn' 13 days after inoculation. Lesions on 'Cowart' and 'Fry' were water-soaked and appeared to be a hypersensitive-type response to infection. Leaf spot symptoms did not appear in the remaining two cultivars tested, 'Concord' and 'Fredonia', until 18 days after inoculation. Sporulation of the fungus was observed in all inoculated leaf samples placed into humidity chambers, except in 'Cowart' and 'Fry'. From the 17 cultivars tested representing five distinct grape species and interspecific hybrids, 'Cowart' and 'Fry' (both *V. rotundifolia*) were the only cultivars that appeared resistant to this fungus.

According to disease severity ratings of the grape cultivars, the *V. vinifera* cultivar Cabernet Sauvignon was highly susceptible to this fungus (Table 1). About 37% defoliation occurred by experiment termination. In general, the widely planted *V. vinifera* cultivars were significantly more susceptible to *S. ampelina* than American cultivars. These data contradict earlier reports that *V. vinifera* cultivars are immune to this disease and only American *Vitis* spp. are susceptible (Boubals and Mur, 1983; McGrew and Pollack, 1988). In fact, the American cultivars Fredonia, Concord, and Niagara exhibited the highest resistance to this fungus (Table 1). The only highly susceptible American cultivar was 'Cynthiana' (*V. aestivalis*). Susceptibility in hybrid cultivars ranged from high ('Saturn' and 'Vanessa'), to moderate ('Einset Seedless', 'Reliance', and 'Rivat'), to low ('Venus' and 'Mars') in disease severity. This was expected in hybrids of American x European grapes, where varying levels of American (e.g., *V. labrusca*) heritage

Table 1. Susceptibility of selected grape cultivars to the fungus *Septoria ampelina*.

Cultivar	Mean disease rating ^y	Species ^z ancestry
Fredonia	1.13 a ^x	A
Concord	1.38 ab	A
Niagara	1.75 a-c	A
Fry	1.25 a	A
Cowart	2.38 cd	A
Cynthiana	3.88 f	A
Venus	1.63 a-c	IH
Mars	2.13 b-d	IH
Einset Seedless	3.25 ef	IH
Reliance	3.25 ef	IH
Saturn	3.50 f	IH
Vanessa	3.88 f	IH
Rivat	2.75 de	IH
Chardonnay	3.38 ef	E
Thompson Seedless	3.38 ef	E
Flame Seedless	4.00 f	E
Cabernet Sauvignon	5.38 g	E

^zA = American or native, IH = interspecific hybrid, E = European grapes.

^yDisease severity ratings: 0 = no disease; 1 = 1% to 10% of leaf tissue with lesions; 2 = 11% to 25% of leaf tissue with lesions; 3 = 26% to 50% leaf tissue with lesions, 1% to 10% necrotic tissue; 4 = 51% to 75% leaf tissue with lesions, 25% to 50% necrosis; 5 = 76% to 90% leaf tissue covered with lesions, 51% to 80% necrosis; and 6 = dead or abscised leaves.

^xMean separation in the column by LSD ($P \leq 0.05$).

Table 2. Ancestry of selected interspecific hybrid grape cultivars.

Cultivar	<i>V. vinifera</i> ^a (%)	<i>V. labrusca</i> (%)
Reliance	25	75
Mars	40	60
Venus	60	40
Saturn	78	22

^aJ.N. Moore (personal communication).

could result in offspring from a particular cross.

The percentage of *V. labrusca* ancestry in several selected interspecific hybrid cultivars (Table 2), in conjunction with disease severity data from selected cultivars (Table 1), was plotted to determine if a correlation exists between percentage of *V. labrusca* in a clone and susceptibility to septoria leaf spot. The correlation coefficient (r) was high (-0.80), suggesting that there is a correlation between percentage of *V. labrusca* in ancestry and susceptibility to *S. ampelina* in the cultivars tested (Fig. 1). Validation resulted in a linear equation, with intercept 3.90 and a slope of -0.024.

The r value could be higher than current data demonstrate. Susceptibility to septoria leaf spot disease in *V. labrusca* may not always be transferred to the same degree, or even at all, in specific crosses made of *V. labrusca* x *V. vinifera*. Indeed, if this occurred in the selection of 'Reliance' and 'Venus' (Fig. 1), removal of these two data points from

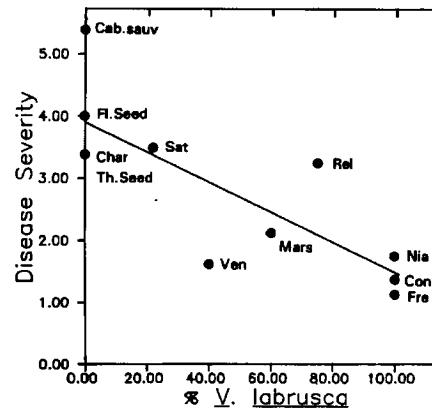


Fig. 1. Comparison of percent *V. labrusca* heritage in selected grape cultivars with susceptibility to septoria leaf spot. $Y = -0.024X + 3.9$, $r = -0.80$.

the correlation analysis would increase the r value to -0.90 (intercept 4.02, slope of -0.027). In addition, the inclusion of disease severity data from more hybrids could potentially change the value of r . We were able to collect information on only the percentage of *V. labrusca* ancestry for the four hybrids included in this experiment.

Cultivars are being evaluated, selected, and released in several *Vitis* breeding programs to improve quality at present. Results of this study suggest that septoria leaf spot is a potentially devastating disease of European and interspecific hybrid grape cultivars. New plantings in grape-producing areas that have a high potential for septoria leaf spot should consist of American *Vitis* spp. or hybrid cultivars containing a high percentage of *V. labrusca* heritage. Information is needed on environmental parameters necessary for infection of grapes by *S. ampelina* and sensitivity of this fungus to currently registered fungicides.

Literature Cited

Boubals, D. and G. Mur. 1983. Another grapevine disease is raging in Penedes(Spain)(in Russian with English abstr.). Prog. Agr. Viticult. 100:453.
 McGrew, J.R. and F.G. Pollack. 1988. Septoria leaf spot, p. 31. In: R.C. Pearson and A.C. Goheen (eds.). Compendium of grape diseases. Amer. Phytopathol. Soc. Press, St. Paul, Minn.
 Moore, J.N. 1983. 'Reliance' seedless grape. HortScience 18:963-964.
 Moore, J.N. 1985. 'Mars' seedless grape. HortScience 20:313.
 Moore, J.N. and E. Brown. 1977. 'Venus' grape. HortScience 12:585.
 Moore, J.N., J.R. Clark, and J.R. Morns. 1989. 'Saturn' seedless grape. HortScience 24: 861-862.
 SPSS, Inc. 1988. SPSS reference guide. 4th ed. Stat. Package for the Social Sciences Inc., Chicago.
 Teterevnikova-Babayan, D.N. 1977. On the pathogenesis of septoria disease of grapevine (in Russian with English abstr.). Biol. Zhur. Armenii 30:13-17.