chase muscadine grapes. There is adequate information to suggest that muscadine grapes as fresh fruit is marketable in supermarkets. although more than half of those surveyed had never purchased muscadines. The current market for muscadine grapes, as data suggest, is in the African American community, particularly, among female African Americans who are familiar with the grapes and showed the greatest willingness to purchase them. African Americans, in general, also have more favorable perceptions of muscadine grapes than Caucasians. However, Caucasians with favorable perceptions have a high likelihood and willingness to purchase muscadine grapes. A good percentage (74%) of Caucasians like the taste of muscadines after they tasted it, and a great percentage of those who like the taste, texture or color exhibited a willingness to purchase the grapes. The Caucasian market for muscadine grape represents an immense market potential that could be developed and exploited with consistent market promotion.

The study also shows that the taste of muscadine grapes is an acquired one. Those who are familiar with the muscadine taste are also more likely to purchase the grapes. Therefore, market promotions will greatly help to familiarize consumers and educate them to the taste and flavor of the muscadine grapes. This will have a positive impact on market demand and make muscadine grapes more marketable.

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ORIENTAL *VITIS* SPECIES - A NEW GERMPLASM SOURCE FOR FLORIDA GRAPE BREEDING?

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Abstract. **Eight Asiatic *Vitis* species were cultured at the Center for Viticultural Sciences, Florida A&M University. Evaluation of these germplasm was conducted last three seasons. Resistance to grape fungal disease anthracnose and Pierce's disease (PD) caused by Gram-negative bacterium was found among the Oriental *Vitis* species. Some of these species also demonstrated high adaptability to the north Florida environment, namely humid and hot summer with excessive rainfall. Results from this study indicate that the oriental grape species are a potential source for breeding disease-resistance grapes for Florida and the southeastern United States.**

Grapes belong to the genus *Vitis* which consists of 60 plus species. The most popular cultivated grape species, *V. vinifera*, also known as the European grape, is believed to have originated from the Black and Caspian Sea areas (Einset and Pratt, 1975). It was domesticated 5,000 years ago westward from Asia Minor throughout Europe and eastward throughout Asia (Alleweldt and Possingham, 1988). The other *Vitis* species originated from East Asia (Zhang et al., 1989) and North America, which account for about 30 species in each group. Several Florida native species have been described, namely, *V. aestivalis, V. shuttleworthii, V. rufotomentosa, V. smalliana* etc. They are all characterized by high resistance to Pierce's disease, anthracnose and downy mildew.

Early settlers attempted to grow the European grapes in Florida and the other southeastern States over 300 years ago. Through centuries of experimentation, however, scientists and grape growers found that non-native grape vines could not endure the region's climate, being hot and humid, with too much rainfall and with high night temperature during most of the growing season. These unfavorable climactic conditions caused serious disease problems for the grape, such as Pierce's disease (caused by the Gram-negative bacterium *Xylella fastidiosa* (Hopkins, 1989; Wells et al., 1987), fungal diseases (downy mildew [*Plasmopara viticola* (Berk. & Curt.) Berl. & de Toni]), and anthracnose [*Elsinoe ampelina* (de Barry) Shear]. Most of the grapes died a few years after planting. Through years of research and cultural practice, it is clear now that *V. vinifera* is extremely susceptible to all the American pests, and diseases, including downy mildew, anthracnose, black rot, powdery mildew, phylloxera and Pierce's disease (Pearson and Goheen, 1988).

Species native to the southeastern United States, such as 'bunch' grapes *V. aestivalis, V. shuttleworthii* and the 'muscadine' grapes *V. rotundifolia,* are resistant to various fungal and

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bacterial diseases which affect non-natives. However, most of the native species do not have commercial value due to their poor fruit quality. In order to develop commercial grape cultivars that can grow in the area formerly considered unsuitable for grape production, a grape breeding program was established at the University of Florida in the 1940's. The goal of the breeding program is to combine the disease resistance genes from the native species and good fruit characteristics from the European grapes. Through 50 years' breeding effort, breeders in this region have released many cultivars (Mortensen, 1992). Unfortunately, none of the bunch grape cultivars have prevailed due to either disease susceptibility or poor fruit quality. Pierce's disease and anthracnose disease are considered to be a limited factor to grow Florida hybrids in the state.

Like many other crops, utilization of host resistance through breeding is the most effective and economical strategy to control grape diseases. A sound grape germplasm is needed as the foundation for a successful breeding program (Sprague, 1980). Evaluation for disease resistance from native American species was conducted by breeders and viticulturists in this region. Mortensen et al. (1977) investigated American species for Pierce's disease resistance and concluded that species native the southeast are rich sources for PD resistance. Mortensen (1981) also found that many native *Vitis* species, including *V. aestivalis* Michx., *V. champini, V. labrusca* L., *V. rupestris* Scheele, *V. shuttleworthii* House, *V. tiliafolia* Humb. & Bonp, *V. vulpina* L. *V. munsoniana* Simps., *V. rotundifolia* Michx, were resistant to the anthracnose disease. He also concluded that evaluation for anthracnose disease based on vineyard observations was more reliable than an artificial inoculation technique.

The southeastern United States possesses one of the most disease-resistance sources of grape germplasm in the world. Although utilization of these germplasm to improve resistance of European grapes has been going on for over half a century, new cultivars derived from crosses of American species × *V. vinifera* are still short of expectation. Looking for other potential source of disease-resistance germplasm will undoubtedly enhance the future breeding program. We therefore evaluated the germplasm originated from the East Asia for disease resistance and their adaptability for the Florida environment. The objective of this study is to evaluate Asiatic *Vitis* species for PD and anthracnose resistance and incorporate them into the Florida grape breeding program.

Materials and Methods

Eight Asiatic grape species, including 32 accessions, were used for evaluation of resistance to Pierce's disease (PD) and anthracnose disease. Five of these accessions were grown from seeds collected from China. Other collections were from the grape Repositories at the University of California (Davis) and at the New York Agricultural Experimental Station in Geneva. This study was conducted at the Center for Viticultural Sciences, Florida A&M University, Tallahassee. Five Dormant cuttings of each accession were rooted by placing them in a pit filled with builder sand. The rooted cuttings were potted in 1 gallon pot and transferred to 3 gallon pot in the second year. The plants from dormant cuttings were kept in propagation area next to the experimental vineyard while the accessions grown from seeds were planted in the experimental vineyard in the second year.

Previous experiments indicated that the pathogen pressure is very high in our experimental vineyard. We decided not to inoculate the vines but just left them for natural infection. *V. vinifera* cultivar 'Thompson Seedless' and Florida hybrid 'DN3-43' were used as susceptible control. Individual plants were recorded for symptoms of PD from June to September. Disease was rated on a scale of 0-5 based on the technique used by Hopkins, where 0 = no symptoms; 1 = any symptom of PD, such as marginal necrosis (MN) in basal leaf; 2 = MN in less than ⅓ of leaves; 3 = MN in ⅓ to ½ of leaves; 4 = ½ - ¾ of leaves with MN and a dead growing point; 5 = 100% of leaves with symptoms or a dead plant. Observations for anthracnose symptoms were conducted from late May to August. The anthracnose disease was graded from 0-5, based on the estimated percentage of lesion over the whole leaf: 0 = no symptoms; grade 1 = extremely resistant, less than 5%; grade 2 = highly resistant, 5.1 - 20%; grade 3 = resistant, 20.1 - 35%; grade 4 = susceptible, 35.1 - 50%; grade 5 = highly susceptible, more than 50%.

Result and Discussion

Evaluation for Pierce's disease resistance. Preliminary investigation indicated that some of the Asiatic species expressed resistance to Pierce's disease while the others were susceptible. Among the eight species (32 accessions) evaluated, three species, *V. davidii, V. pseudoreticulata, V. quinquangularis*, showed no symptoms in all the accessions evaluated, while the other 5 species had PD symptoms from light to severe (Table 1). For example, of the 15 accessions of *V. amurensis*, eight had no symptoms and the other 7 accessions had PD severity rating from 1 to 3. Interestingly, of the 2 *V. yeshanensis* accessions evaluated, one showed highly resistant (0 rating) and the other was highly susceptible (5 rating). Both controls (Fla. hybrid DN3-43 and 'Thompson Seedless') were highly susceptible to PD.

The evaluation data indicates that sources of PD resistance exist in Asiatic *Vitis* species. Inter and intraspecific variation of PD resistance appeared in the Asiatic species. Since the vines used for this study were relatively young (1-3 years), symptoms may have yet developed in some potentially susceptible vines. Further investigation of these materials and more other Asiatic *Vitis* species are therefore necessary before a better conclusion can be drew.

Grape growing has captured the imagination of people living in the deep south for many centuries (Mortensen, 1992). Early effort to import European grapes and grow them in Florida failed because serious disease occurred in the vineyard, causing degeneration of vine and death of plant. Later research by the University of Florida discovered that Pierce's disease was the cause of the vine degeneration (Stoner, 1951). The grape breeding program in the University of Florida then emphasized on the developing PD resistance cultivars. By late 1980's, at least 10 bunch grape cultivars were released at the Leesburg Research Station in the University of Florida. Most of these cultivars were derived from hybridization of native American species and *V. vinifera.* They were resistant/tolerant to the PD and possess good fruit quality. Growers had high expectation to these cultivars and acreage was once up to 1,500 by early 90s. Unfortunately, vine degeneration occurred in cultivars that have European grape parentage. This may due in part to their susceptibility of Pierce's disease. Some of these cultivars were later found to be highly

Table 1. Rating of resistance to Pierce's disease and anthracnose disease in eight Asiatic species.

Species	No. of accessions	PD rating[z]						Anthracnose rating[y]					
		0	1	2	3	4	5	0	1	2	3	4	5
V. amurensis	15	8	5	1	1	0	0	0	4	8	3	0	0
V. coignetiae	6	2	0	2	2	0	0	0	2	4	0	0	0
V. thunbergii	3	0	2	1	0	0	0	0	1	2	0	0	0
V. Piasezkii	1	1	0	0	0	0	0	0	1	0	0	0	0
V. Yeshanensis	2	1	0	0	0	0	1	0	2	0	0	0	0
V. davidii	1	1	0	0	0	0	0	0	1	0	0	0	0
V. pseudoreticulata	2	2	0	0	0	0	0	0	0	2	0	0	0
V. quinquangularis	2	2	0	0	0	0	0	0	2	0	0	0	0
CK 1 (*V. vinifera*, cv. 'Thompson Seedless')	1	0	0	0	0	0	1	0	0	0	0	0	1
CK 2 (Fla hybrid DN3-43)	1	0	0	0	0	0	1	0	0	0	0	1	0

[z]The Pierce's Disease was rated on a scale of 0-5, where 0 = no symptoms; 1 = any symptom of PD, such as marginal necrosis (MN) in basal leaf; 2 = MN in less than ⅓ of leaves; 3 = MN in ⅓ to ½ of leaves; 4 = ½-¾ of leaves with MN and a dead growing point; 5 = 100% of leaves with symptoms or a dead plant.
[y]The anthracnose disease was graded from 0-5 based on percentage of lesion over the whole leaves and petioles, 0 = no symptoms, grade 1 = <5%, grade 2 = 5.1-20%, grade 3 = 20.1-35%, grade 4 = 35.1-50%, grade 5 = >50%.

susceptible to fungal diseases, particularly the anthracnose. The acreage declined quickly. Today, very few bunch - grape vineyards are still in commercial operation. Identification of PD resistance from the Asiatic species may provide another parental source to improve disease resistance of the Florida cultivars.

Evaluation for anthracnose disease resistance. Results for anthracnose resistance evaluation indicated that all the 32 accessions of Asiatic species showed certain degree of resistance to the disease, and varied from high to moderate resistance (Table 1). However, none of the Asiatic species were immune to the disease. The controls were rated from susceptible (Fla. hybrid DN3-43) to highly susceptible ('Thompson Seedless') under the same environment.

Anthracnose disease is one of the major fungal diseases affecting the cultivation of bunch grapes in Florida that has a warm and humid climate throughout the growing season. Resistance to anthracnose disease was found in native American species such as bunch grape *V. labrusca*, *V. aestivalis*, *V. shuttleworthii* and muscadine grape *V. rotundifolia* (Mortensen, 1981). These native grapes have greatly facilitated disease-resistance breeding programs for the southeast. This work indicates that the Asiatic species are another useful source for anthracnose resistance. The potential of using Asiatic *Vitis*, which accounts for 40%-50% of the known species, for improving disease resistance of Florida grape cultivars is very promising. In addition, the Asiatic *Vitis* species have some advantage characteristics over the American species since they do not possess undesirable foxy flavors, as does *V. labrusca* (Wang et al. 1995). The Asiatic species are cross compatible with *V. vinifera*, and the anthracnose resistant genes seem dominantly inherited to the F1 progenies of *V. vinifera* × Asiatic species (Wang, personal communication). For instance, Cultivar 'Beichun', an interspecific hybrid of *V. vinifera* 'Muscat Hamburg' × *V. amurensis* selected by Beijing Botanical Garden, has been successfully grown in the Changjiang Valley and southern part of China due to its good resistance to anthracnose.

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