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MUSCADINE ROOTSTOCK INCREASED THE RESISTANCE OF FLORIDA HYBRID BUNCH GRAPE CV. 'BLANC DU BOIS' TO PIERCE'S AND ANTHCRANOSE DISEASES

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Abstract. **'Blanc du Bois' has been recognized as a premium wine grape cultivar in Florida. However, it is highly susceptible to the fungal disease anthracnose. Although it is tolerant to Pierce's disease (PD), symptoms ranging from mild to severe were found under certain circumstances, particularly under stress conditions. Extensive care and a carefully managed fungicide spray program are necessary to ensure a good crop. To test the feasibility of using musacdine as a rootstock for cv. Blanc du Bois, we successfully grafted 'Blanc du Bois' on to muscadine by using a chip budding technique. Grafted and non-grafted 'Blanc du Bois' wines were evaluated for 3 years. Muscadine rootstock had no significant effects on berry size and total acid, while soluble solid content was slightly higher in the grafted vines. Muscadine rootstock limited the development of PD and anthracnose. The preliminary results demonstrated that muscadine rootstock could be beneficial to the production of 'Blanc du Bois' although technical difficulty of using muscadine as rootstocks has to be overcome.**

'Blanc du Bois', a Florida hybrid bunch grape, was released by the University of Florida as a vigorous and long-lived variety (Mortensen, 1987). It has been the most important cultivar used by Florida wineries. However, it is highly susceptible to anthracnose disease and although it is tolerant to Pierce's disease (PD), severe PD symptoms may occur under stress conditions. Extensive vine care, therefore, is needed to ensure a good crop. For example, in the vineyard at Florida A&M University, 19 of the 26 vines (73%) were lost from diseases within 8 years. The vine fatality may be caused by a combination of various diseases. Preventing diseases would therefore be one of the top priorities for growing 'Blanc du Bois'. Besides application of fungicides, few other options are available for preventing or curing these diseases.

Stress resistant rootstocks are used world wide to improve performance of fruit trees. Muscadine (*Vitis rotundifolia* Michx.), a grape native to the southeast U.S., is resistant to grape pests and diseases commonly found in North America, including Pierce's disease and anthracnose. These characteristics make muscadines extremely valuable as rootstocks (Olien, 1990) although it has been generally believed that grafting between bunch and muscadine grapes is very difficult, if not impossible. This may be due to genetic (Olien, 1990) and histological (Goffinet et al., 1999) differences. Our previous work has shown that bunch grapes may be grafted onto muscadines when a proper technique and conditions are chosen (Ren and Lu, 1999). The purpose of this work was to study the possibilities of improving disease resistance of 'Blanc du Bois' by using muscadine rootstock.

Materials and Methods

The research work was conducted at the experimental vineyard, Florida A&M University, from 1998 to 2002. Own-rooted 'Blanc du Bois' vines were planted in 1990, with normal vineyard management except during 2001 and 2002, in which no fungicide was sprayed. Grafting experiments using the chip budding method were conducted in 1998 and 2002. In 1998, grafting was done in mid-July, with newly grown 'Blanc du Bois' buds. While in 2002, grafting work was done in late April, with dormant buds. Since there is a significant difference in sizes between shoots of muscadine and 'Blanc du Bois', the buds of 'Blanc du Bois' were grafted on the trunks or branches of 2+ year old muscadines. Fruit characteristics and diseases were recorded with three 'Blanc du Bois'/muscadine and three own-rooted 'Blanc du Bois' vines. Pierce's Disease and anthracnose were surveyed through September in 2000 and from April through October in 2001, at three to ten days intervals. PD was scored using a 0 to 5 scale with the criteria modified from Hopkins (1985): where 0 = no symptoms, 1

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= less than 10% of leaves with marginal necrosis (MN), 2 = 11-30% of leaves with MN; 3 = 31-50% of leaves with MN; 4 = 51-75% of leaves with MN and a dead growing point; 5 = over 75% of leaves with symptoms with a dead arm or dead plant.

Similarly, anthracnose was scored with a 0 to 5 scale using five random shoots from each vine: 0 = no symptoms; 1 = less than 10% of young leaves and shoots with symptoms; 2 = 11-30% of young leaves and shorts with symptoms; 3 = 31-50% of leaves/shoots with symptoms; 4 = 50-75 leaves/shoots developing symptoms, and 5 = over 75% of leaves/shoots with symptoms.

Anthracnose was also scored on flower clusters in 2001 since it was very wet during anthesis. Inflorescences were randomly surveyed among the grafted and own-rooted 'Blanc du Bois' vines. An inflorescence was considered as infected if anthracnose developed in more than one flower branch, while a branch was considered infected when more than three flowers showed symptoms. There were two independent anthracnose surveys on flowers for determining the infection of inflorescence and florets.

Results and Discussion

Because of substantial differences in genetics and morphology between muscadine and bunch grapes, grafting bunch grapes onto muscadines was found to be extremely difficult. After testing whip-and-tongue, bench-tool-graft and chip-budding, we found that chip-budding was the best technique. Using this method, up to 85% of 'Blanc du Bois' buds survived and grew on muscadine rootstock in the 2000 experiment (Table 1). These results were considered to be very satisfactory since it has been suggested by others that a successful graft union would not be possible (Winkle, 1974). In the spring of 2002, a survey was conducted of the 1998 grafted vines. Only one of the own-rooted 'Blanc du Bois' plant remained alive (33%), while four out of five Blanc du Bois/Muscadine plants (80%) survived and grew healthy and vigorously.

Muscadine rootstocks seemed to have an impact in limiting the development of Pierce's disease. During the survey conducted in September, 2000, PD averaged 0.7 among grafted vines, while the ungrafted ones were 3.0. In 2001, the monthly average PD score was always lower in the grafted vines than among the own-rooted vines (Table 2). For example, at the end of 2001 season, PD severity was 2 in a 0-5 scale on the grafted 'Blanc du Bois', while average PD on the own-rooted vines was as high as 4.5.

Table 1. Survival of grafting 'Blanc du Bois' to muscadine rootstock with bud grafting techniques.

Year	Bud no.	Survival	%
1998	16	5	31.3
2002	14	12	85.7
Total	30	17	56.7

Table 2. PD and anthracnose scores on grafted ('Blanc du Bois'/muscadine) and own-rooted 'Blanc du Bois' grape vines.

	Pierce disease		Anthracnose	
	Grafted	Own-rooted	Grafted	Own-rooted
		2000		
September	0.7	3.0	1.7	2.3
		2001		
April	0.0	0.0	0.1	0.8
May	0.0	0.0	0.5	1.3
June	0.1	1.1	1.1	3.9
July	1.1	2.8	2.0	4.4
August	2.0	4.0	2.0	4.6
September	2.0	4.3	3.0	5.0
October	2.0	4.5	3.0	5.0

The average anthracnose scores were 1.7 among 'Blanc du Bois'/muscadine vines and 2.3 among the ungrafted vines in September, 2000. During bloom (late April to early May) in 2001, little anthracnose was found on the young leaves / shoots of grafted vines, while the own-rooted vines averaged 0.8. In the mid-summer (July), when almost all the shoots and leaves of own-rooted vines developed severe anthracnose symptoms (4.4 average), the grafted vines averaged only 2.0, a very moderate symptom development (Table 2). The first appearance of anthracnose on grafted vines was 19 Apr., about 2 weeks later than the controls which first showed signs of anthracnose on 7 Apr. By the end of the growing season, the severity of own-rooted vines reached 5.0 while the grafted ones were 3.0 only.

During anthesis of 2001, anthracnose symptoms were found among flower clusters. All the inflorescences among own-rooted vines were infected with anthracnose, but only a quarter of the grafted vines had anthracnose symptoms. Similarly, the infected flower branches of own-rooted vines reached 79%, while the grafted ones were only 15% (Table 3).

The effect of muscadine rootstock on limiting anthracnose development was more obvious in 2001 in comparison to 2000. This is because the vineyard received normal management practice in year 2000, but no fungicide sprays were applied in 2001. When there was no fungicide protection, the susceptible own-rooted vines were more vulnerable to anthracnose, while the resistance of grafted vines was increased with the contribution of muscadine rootstocks. Rootstock had no significant effects on fruit size, sugar and acid levels over the three sampling periods (Table 4). In 2000, the sugar levels of fruit from grafted vines seemed slightly higher than from own-rooted vines. This may be the result of increased vegetative vigor and increased foliage and canopy development.

Table 3. Effects of muscadine rootstock on anthracnose development in flower clusters.

	Inflorescences			Flower branches		
	No.	Infected	%	No.	Infected	%
Blanc du Bois/own root	38	38	100	80	63	78.8
Blanc du Bois/muscadine	55	14	25.5	62	9	14.5

Table 4. Effects of muscadine rootstock on fruit quality of 'Blanc du Bois'.

	Fruit size (g)	SSC (%)	pH	TA (%)
		1999		
Blanc du Bois/own root	2.4 ± 0.1	17.1 ± 1.2	3.1 ± 0.1	0.6 ± 0.1
Blanc du Bois/muscadine	2.4 ± 0.2	17.4 ± 0.9	3.1 ± 0	0.6 ± 0
		2000		
Blanc du Bois/own root	2.3 ± 0.2	18.1 ± 0.6	3.2 ± 0.1	0.6 ± 0.1
Blanc du Bois/muscadine	2.2 ± 0.1	19.6 ± 0.9	3.1 ± 0.1	0.7 ± 0.1
		2001		
Blanc du Bois/own root	—	—	—	—
Blanc du Bois/muscadine	2.4 ± 0.1	18.5 ± 0.5	3.0 ± 0.1	0.6 ± 0.1

Rootstocks not only perform a critical function in water uptake and nutrient assimilation (Rom, 1996), but also provide increased tolerance of insect pests and diseases of grapes (Kunde et al., 1968; Winkle, 1974). Using the resistance of muscadine to limit diseases of bunch grapes should be possible when the bunch grapes can be successfully grafted onto the muscadines. Four years after grafting, Blanc du Bois/muscadine vines showed healthy growth, normal fruiting, and decreased PD and anthracnose symptom development. Our data demonstrated that the muscadine may be used as a rootstock for 'Blanc du Bois' to improve its performance. Due to the technical difficulty of grafting between bunch and muscadine grapes, and the influence of genotypes on the grafting incompatibility (Bouquet, 1980), additional work is needed to improve grafting techniques for higher survival rate before muscadine can be used as a rootstock for the bunch grapes in commercial nursery practices.

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