Muscadine Fungicide Evaluations In North Carolina

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Introduction

The muscadine grape, *Vitis rotundifolia* (synonym *Muscadinia rotundifolia*) was declared North Carolina's "Official State Fruit" by the NC General Assembly in 2001. The state has around 300 acres of muscadine grapes, and acreage is increasing steadily as demand for healthful muscadine wine goes up. The backbone of the NC muscadine crop is the 150 or so remaining acres of older, bronze-fruited 'Carlos' vines planted in the 1970s. Most 'Carlos' grapes are machine harvested and sold by the ton to local wineries, although some hand harvesting is done early in the season. Second in importance for wine use is 'Noble', a small black grape used for red muscadine wines. Most NC growers do some pick-your-own (PYO) and ready-picked business, and often they will plant a few rows of larger-fruited cultivars like 'Triumph' and 'Nesbitt' with this clientele in mind. Older vineyards use the Geneva Double Curtain (GDC) trellis and are mostly non-irrigated, while newer vines tend to be on a single wire trellis and may have drip irrigation. Wine grape returns (2002) are $500 to $750 per ton. PYO prices are around $1 per pound and up, pre-picked $1.15 to $1.50 and up. Discount PYO and ready-picked prices of $25 to $35 per bushel (50-55 lbs) are usually given to home canning enthusiasts and hobby winemakers who buy a bushel or more at a time. A limited number of grapes are packed and sold in retail stores, but there is interest in expanding this market potential through establishment of USDA grade standards.

The importance of fungicides for the control of diseases on fruit and foliage of muscadine grape is well documented, and a list of references for further study is provided at the end of this article. Of particular interest to growers will be the chapter on diseases in the book *Muscadine Grapes* (Basiouny and Himelrick, 2001) and the web sites dealing with disease identification and control.

This paper will cover recent experiments and surveys conducted in NC:

- Comparison of sprayed vs unsprayed vineyards
- Timing of sprays for maximum effect – early vs late
- New fungicides – when and how to use them

NC Muscadine Disease Survey -- Sprayed vs Unsprayed

Muscadine grapes, especially ‘Carlos’, are often grown by NC blueberry growers who use their over-the-row blueberry harvester to pick the grapes. Machine-harvestable muscadines are a good companion crop for blueberries since the harvest seasons do not overlap, and much of the equipment used for blueberries (harvesters, orchard tractors, sprayers, packing lines, fruit lugs, pruners, etc) can also be used for muscadine grapes. However, spraying is often entirely neglected on the grapes, since the grape spray season <u>does</u> overlap the blueberry harvest! Also, when winery prices were low in the 1980s and 1990s, some growers felt that they could not justify the cost of fungicide sprays, especially since ‘Carlos’ was perceived as being disease resistant. In 2001, we set out to document the effects of grower sprays on disease levels at harvest.

Sprayed and unsprayed muscadine vineyards were surveyed for diseases. All were evaluated immediately prior to harvest by visual inspection in the same 8-day period (Sept 5-12). We estimated “percent berries infected” based on the amount of symptomatic fruit on the vine as well as on the ground underneath. We rated Powdery mildew *(Uncinula necator*), Macrophoma rot (*Botryosphaeria* sp.), Bitter rot (*Greeneria uvicola*) Black rot (*Guignardia bidwellii*) and Angular leaf spot (*Mycosphaerella angulata*). One disease that we expected but did not encounter in commercial vineyards in 2001was Ripe rot caused by *Colletotrichum* sp. Mature vines were selected randomly, and numbers in tables are the average of four single-vine ratings. At some sites, as many as eleven different cultivars were evaluated; however, ‘Carlos’ was the only cultivar common to all sites. Results are shown in Tables 1 & 2.

Table 1. Comparison of diseases observed on ‘Carlos’ muscadine grape vines from sprayed and unsprayed sites in NC during harvest 2001.

‘CARLOS’ 2001 (% infected)	Macro-phoma rot	Bitter rot	Powdery mildew (fruit)	Black rot (fruit)	Black rot (leaf)*	Other leaf spots*
Unsprayed (Site # 1)	1.0	12.0	6.0	2.0	12.5	10.0
Unsprayed (Site # 2)	<1.0	7.5	45.0	21.0	32.0	60.0
(Avg. Unsprayed)	(1.0)	(9.75)	(25.5)	(11.5)	(22.25)	(35.0)
Sprayed (Site # 3)	<1.0	<1.0	0	0	0	<1.0
Sprayed (Site # 4)	0	0	<1.0	<1.0	0	22.5
(Avg. Sprayed)	(<1.0)	(<1.0)	(<1.0)	(<1.0)	(0.0)	(11.25)

* % of leaves with one or more spots. “Other leaf spots” includes Angular Leaf spot and Bitter rot.

Table 2. Comparison of disease levels observed on unsprayed vines of bronze 'Carlos' and black 'Noble' muscadine grapes at a single location in Bladen County, NC in 2001.

'CARLOS' vs 'NOBLE' Site # 2 (% infected)	Macro-phoma rot	Bitter rot	Powdery mildew (fruit)	Black rot (fruit)	Black rot (leaf)*	Other leaf spots**
'Noble'	0.0	2.8	22.5	0.0	0.0	5
'Carlos'	<1.0	7.5	45.0	21.0	32.0	50

* % of leaves with one or more spots
** % leaf area affected, includes both Angular leaf spot and Bitter rot leaf infections.

Survey Conclusions: 'Carlos' yields are significantly reduced by disease, and fungicidal sprays reduce this disease. Dark-fruited cultivars (like 'Noble') are generally more disease resistant. Disease type, incidence and severity also varies by site and certainly by year. Bitter rot caused 7.5-12% visible losses in unsprayed 'Carlos' vineyards at harvest. Additional bitter rot yield losses may have occurred at bloom but could not be measured at harvest because total yields were not determined. Ripe rot caused by *Colletotrichum acutatum* was not observed.

Spray Timing

Experiments in 1992 - 94 were concerned with spray timing questions:

- When should fungicides be applied to maximize disease control?
- Could the number of sprays be reduced without losing benefits?
- Are certain fungicides effective only at certain times?

To answer these questions, we looked at three spray regimes – early-season only (three sprays every two weeks from June to mid-July), late-season only (three sprays every two weeks from mid-July to August) and full-season (six sprays applied every two weeks from June through August). Experiments were conducted at the NCSU Horticultural Crops Research Station in Castle Hayne, on the cultivar 'Carlos'. These were replicated trials with two vines per plot in a randomized complete block design with four replications. All ripe grapes on the test vines were harvested on two dates, 14 days apart, and fruit rot diseases were evaluated by examining a one gallon subsample from each plot. The results of these experiments appear in Table 3.

Table 3. Results of fungicide timing trials on the incidence of Macrophoma rot caused by *Botryosphaeria* spp.

Treatment and rate/A	Spray timing	Macrophoma rot (%)		
		1992	1993	1994*
Captan 50 WP 4.0 lb + Benlate 50 WP 1.0 lb	Early (6/1, 6/15, 7/1)	2.0***	4.7***	6.4***
CGA 455 50 WP 6.0 oz	"	4.7***	3.0***	--
Nova 40 WP 4.0 oz	"	--	31.1	14.4
Unsprayed check	"	9.4	32.6	17.8
Captan 50 WP 4.0 lb + Benlate 50 WP 1.0 lb	Late (7/15, 8/1, 8/15)	4.7***	24.1	14.9
CGA 455 50 WP 6.0 oz	"	0.1***	2.6***	--
Nova 40 WP 4.0 oz	"	--	10.4***	6.0***
Unsprayed check	"	11.8	32.7	17.8
Captan 50 WP 4.0 lb + Benlate 50 WP 1.0 lb	Full Season	0.8***	8.8***	--
CGA 455 50 WP 6.0 oz	"	0.1***	1.2***	--
Nova 40 WP 4.0 oz	"	--	16.5***	--
Unsprayed check	"	7.3	30.0	--
Least significant difference (P=0.05)		4.3	13.5	6.1

*In 1994, Captan was used alone, and full season sprays were not tested.
*** Significantly different from unsprayed control.

Spray Timing Results: Early-season sprays of Captan + Benlate or CGA 455 were consistently as effective as full-season sprays. Nova was not effective in early sprays but did work consistently in late season sprays.

Efficacy of Fungicides

In 2002 as in previous years, we evaluated new (unlabeled) and existing labeled fungicides at the NCSU Horticultural Crops Research Station in Castle Hayne, for efficacy against diseases of muscadine grape. We were especially interested in thiophanate-methyl (Topsin-M) as a possible replacement for benomyl (Benlate).

This experiment was conducted on 'Triumph' and 'Fry' in alternating rows. Plots consisted of four vines, two of each cultivar in adjacent rows. A randomized complete block design was used with four replications. Spray treatments were applied using a CO_2-powered backpack sprayer, biweekly from bloom to near harvest for a total of six spray dates. All ripe fruit was hand harvested and grapes were weighed and sorted based on visible symptoms.

Table 4. Efficacy of selected fungicides against diseases of muscadine grape, 2002.

Treatment and rate/A	Market-able (%)	Sooty blotch (%)*	Macro-phoma (%)	Bitter rot (%)	Black rot (%)*	Defol-iation (%)
TRIUMPH						
Unsprayed check	91.2 ab**	--	3.5 ab	2.3 ab	2.9 abc	55 a
Messenger 6.5 oz . . .	86.5 a	--	5.3 a	2.8 a	4.6 a	62 a
Topsin-M 1.0 lb	91.5 ab	--	3.4 ab	1.4 bc	3.7 ab	22 bc
Indar 2.0 oz	95.2 bc	--	2.3 ab	1.1 bc	1.1 cd	10 c
Captan 4.0 lb + Benlate 1.0 lb	93.6 bc	--	2.3 ab	1.7 abc	2.2 bcd	22 bc
Abound 11.0 fl oz . . .	98.5 c	--	1.0 b	0.5 c	0.7 d	25 b
BAS 516 8.4 oz	95.8 bc	--	1.9 b	1.6 abc	0.5 d	10 c
FRY						
Unsprayed check	86.7 ab	5.4 a	6.6 ab	2.7 a	--	72 a
Messenger 6.5 oz . . .	85.4 a	5.2 ab	9.4 a	1.4 b	--	82 a
Topsin-M 1.0 lb	90.9 abc	1.5 c	5.8 ab	1.0 b	--	38 b
Indar 2.0 oz	88.6 ab	0.4 c	8.0 a	1.2 b	--	20 cd
Captan 4.0 lb + Benlate 1.0 lb	92.4 bc	0.4 c	3.9 ab	0.8 b	--	35 bc
Abound 11.0 fl oz . . .	96.5 c	0.7 c	1.6 b	0.6 b	--	32 bc
BAS 516 8.4 oz	96.5 c	2.5 bc	1.1 b	0.8 b	--	12 d

* Blank column entries (–) signify lack of symptoms.
**By cultivar, means within a column followed by the same letter are not significantly different, LSD, (P=0.05).

Fungicide Test Results: Disease pressure was adequate for testing, and we found Triumph resistant to sooty blotch, Fry resistant to black rot. Fry showed rain-splitting near the stem end. Marketable yield was significantly increased by Abound on both cultivars and by BAS 516 on Fry. All fungicides except Messenger significantly reduced sooty blotch and angular leaf spot. Phytotoxicity (spray injury) was monitored throughout the season; none was observed. Fruit affected by sooty blotch were blemished but were considered marketable. Percent defoliation was estimated on 7 Oct as an indicator of angular leafspot severity, and all fungicides except Messenger reduced defoliation.

In 2000, sooty blotch (*Peltaster fructiola*) was identified on 'Fry'. This disease is common on apples in unsprayed orchards. It is a surface blemishing fungus that has not been previously reported to occur on muscadines in NC.

Conclusions

- Fungicides can provide measurable increases in yield of muscadine grapes. Black-skinned cultivars are generally more disease-resistant.
- Early sprays are more important than later ones for disease control.
- Strobilurin fungicides labeled for grape (Abound, Flint and others) should be included in your spray schedule, alternated with other fungicides.

References

Fruit Disease Note # 12: Muscadine Grape Diseases and their Control
http://www.ces.ncsu.edu/depts/pp/notes/Fruit/fdin012/fdin012.htm

North Carolina Agricultural Chemicals Manual – Muscadine Grape Spray Program
http://ipm.ncsu.edu/agchem/chptr7/707.pdf

Muscadine Grapes. 378 p. Fouad M. Basiouny and David G. Himelrick, Eds. 2001, ASHS Press, Alexandria, VA ($ 59.95) http://www.ashs.org/ashspress/mgrapes.html