Fresh Muscadine Varieties and How to Train Them

Connie Fisk, Extension Associate – Muscadine Grapes
North Carolina State University

January 16, 2009
28th Annual Horticulture Industries Show
Fort Smith, Arkansas

Overview
- History
- Cultivars
- Yields and Vineyard Life
- Site Selection
- Site Preparation
- Trellising
- Planting
- Training

Muscadine Grapes
- Originated in the humid SE US
- Tolerant of intensive rainfall and high humidity
- Resistant to most diseases and nematodes that plague V. vinifera
- Cultivated for over 400 years

The Mother Vine, Manteo, NC 2008

Muscadine Grapes
- Mostly dark-fruited in the wild
  - Bronze-fruited types rarely occur in the wild and are often referred to as “Scuppernongs”
  - Scuppernong is actually a specific cultivar
- ‘Scuppernong’ was first muscadine brought into cultivation from the wild
  - Discovered around 1760 in Tyrrell County, NC
  - Unusual bronze-fruited cultivar

Processing Cultivars
- Of the numerous muscadine grape varieties, only a few account for most of the commercial production acreage
- The leading variety, Carlos, represents most of the acreage in NC (>90%)
  - Carlos has excellent yield but breaks bud earliest, and therefore is at risk of damage from late spring cold events

Processing Cultivars
- The second most important winegrape is Noble
  - Noble is outstanding for its high yields, but is strictly a processing berry due to its small berry size
Fresh market opportunities

- Health benefits – muscadines have lots of natural, beneficial phytochemicals
- Pick-your-own, ready-picked, tailgate markets and farm markets
- Organic muscadines
- Buy local -- Big chain stores are seeking “local flavor”

The best fresh cultivars have:

- Large size
- Uniform color
- Unblemished skin
- Dry stem scar
- Acceptable yield
- Good flavor
- At least 15ºBrix
- Edible skin

Female vs. Perfect-Flowered

- Muscadine cultivars may be either female or perfect-flowered
- If a female cultivar is used, a perfect-flowered variety must also be planted in order to assure proper pollination (within 25 ft.)
  - Most of the fresh market varieties are female

Cultivars vary widely in color, size and suitability for fresh market or wine production

Buy local -- Big chain stores are seeking “local flavor”
Proven Leading Cultivars in SE: Fry
• A favorite in fresh fruit taste panels, U-pick, and commercial fresh market
• Very large berries and excellent flavor
• Female, so requires a pollinator
• Subject to winter cold damage in NC
• Wet stem scar
• Requires vigorous spraying with fungicides to control ripe rot

Proven Leading Cultivars in SE: Jumbo
• Large, black, female cultivar
• Vines are vigorous and productive, but fruit are astringent when under-ripe and have a strong undesirable flavor when overripe
• 32% dry stem scar
• Will decline in popularity with release of self-fertile black cultivars

Proven Leading Cultivars in SE: Nesbitt
• Large, black, self-fertile
• Good vigor, productive
• Dry stem scar
• Excellent for fresh fruit use
• Ripens over a 3-week period
• Good for U-pick and home growers, but not suitable for mechanized harvest

Proven Leading Cultivars in SE: Summit
• Large, pink-bronze, female
• Vines are vigorous and productive and produce fruit a year earlier than most other cultivars
• 84% dry stem scar and more uniform ripening than ‘Fry’
• Less susceptible to winter cold damage and ripe rot than ‘Fry’

Proven Leading Cultivars in SE: Triumph
• Sister of ‘Summit’ but is self-fertile
• Early ripening, edible skin, few rots
• 78% dry stem scar, may fall from plant during U-pick
• Good production and vigor
• Contains genes for crunchy pulp that are useful in developing cultivars like ‘Florida Fry’

Newer Unpatented Cultivars: Alachua
• Self-fertile
• Oval, black berries
• Ripens uniformly, 74% dry stem scar, easy mechanical harvest
• Main use is fresh fruit
• Good fruit quality, above medium vine vigor and competitive production
Newer Unpatented Cultivars: Tara
- Large, bronze, self-fertile
- Similar in size and quality to ‘Fry’
- Recommended for fresh fruit production
- May replace ‘Fry’ and ‘Summit’ since it is an excellent pollinizer

Newer Patented Cultivars: Scarlett
- Very large, self-fertile, bronze
- Fresh market
- Good flavor and high percentage of dry stem scars
- Fresh buyers may perceive it as “over-ripe”

Newer Patented Cultivars: Supreme
- Very large, female, black
- Fresh market
- Wins in consumer preference tests
- Some vines died in years 2-4, probably due to overcropping. Thinning or removal of fruit is recommended in early years of production.

Newer Patented Cultivars: Granny Val
- Very large, self-fertile, bronze
- Fresh market
- Good flavor and high percentage of dry stem scars
- May have a problem with a wet stem scar if picked slightly under-ripe
- Really late variety, so there may be weather issues around harvest

Best fresh market performers at Castle Hayne, NC (unfortunately the experiment did not include Tara, Early Fry)
- Triumph (Bronze, early, perfect-flowered)
- Summit (Bronze, mid, female-flowered)
- Nesbitt (Black, late, perfect-flowered)
- Supreme (Black, mid-late, female)
- Scarlett, Pam, Ison recommended for further trial
- Cluster harvest might be used for Fry, Granny Val, Pam (lg brz) and Ison (med blk)

Recommendations from other sources:
- U. of Ark. – Sugargate, Black Beauty, Jumbo, Nesbitt, Fry, Summit, Darlene, Tara
- Kildeer Farms – Supreme, Granny Val, Tara, Ison, Triumph, Summit
- UGA – Early Fry, Fry, Granny Val, Pollyanna, Summit, Supreme, Tara, Triumph
- UFL – Fry, Summit, Nesbitt, Southern Home
Fresh Market Considerations

Wet stem scar is a challenge for fresh marketing

• Uneven ripening is a major problem with muscadines when considering once-over harvest
• Generally, the fruit is picked over several harvests for fresh market and in one harvest for processing

Some cultivars like Black Beauty and Sugargate will split during rainy weather, attracting bees and creating a hazard for U-pick

Hand Harvesting

• Fresh muscadines have to be hand harvested, which will greatly increase labor costs.
  – A small amount of fresh production is harvested mechanically.

Fresh Market Considerations

• Pick-your-own – requires supervision (one example is that customers will shake the vines to get the fruit to drop on the ground, but then they don’t actually buy everything they shake off)
• Retailers (Harris Teeter, Food Lion, etc.). Food Lion in NC was carrying Carlos last year, which doesn’t sell very well. Need to supply varieties that consumers want.
  – Many retailers only want bronze – again, talk to them before planting

• When selling to the fresh market, growers need a back-up plan
  – What will you do with the grapes when your fresh buyer backs out or refuses product?
  – Examples include wineries, any value-added processor (juice, jelly, barbeque sauce, etc.)
Home-made catcher frames (left) or those designed for blueberries (right) can be used to speed harvest and reduce ground loss.

Sorting & Packaging Fresh Muscadines
- Can be picked directly into clamshells or harvested in bulk and sorted before packaging.

USDA Grading Standards
- USDA Grading Standards should be followed to achieve consistency state- and industry-wide
  - no minimum size specified because growers wanted Carlos to be acceptable
- Cannot have variation in size in one container and can only have one cultivar in each container (keep cultivars separate)

Organic and non-organic muscadine grapes sold for $7.99 per 20 oz clamshell in 2008

Additional Comments on Fresh Muscadine Production
- Georgia varieties may not be winter hardy enough for all areas.
  (The NC muscadine industry is really pushing for breeding effort for cold hardiness, phenolic content, flavor, size, and season extension.)
- Irrigation is highly recommended for optimum yield and fruit quality.

Sources of vines
- Old Courthouse Nursery (NC) 910-293-0374
  http://www.old-courthousenursery.com
- Ison's Nursery (GA) 1-800-733-0324
  http://www.isons.com
- Bottoms Nursery (GA) 770-884-5661
  http://www.bottomsnursery.com
- Tinga Nursery (NC) 910-762-1975
  http://www.tinganursery.com
- Others, including home garden centers
Yields

- Muscadines are generally very productive
- Potential for 2 bushels per vine
- Or, 1 bushel per 10 foot arm!
- 5-8 tons per acre average commercially
  some fruit in 2nd year

MARKETABLE yields at Castle Hayne, NC 2005 (wet year, vineyard not irrigated, no fungicides used).

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Berry (g)</th>
<th>Tons/Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carlos</td>
<td>5.2</td>
<td>5.8</td>
</tr>
<tr>
<td>Darlene</td>
<td>14.0</td>
<td>1.8</td>
</tr>
<tr>
<td>Doneen</td>
<td>4.6</td>
<td>-a</td>
</tr>
<tr>
<td>Fry</td>
<td>11.0</td>
<td>5.4</td>
</tr>
<tr>
<td>Gr. Val</td>
<td>14.0</td>
<td>5.5</td>
</tr>
<tr>
<td>Higgins</td>
<td>9.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Isom</td>
<td>8.0</td>
<td>2.8</td>
</tr>
<tr>
<td>Jumbo</td>
<td>9.3</td>
<td>-a</td>
</tr>
<tr>
<td>Nesbitt</td>
<td>-</td>
<td>-a</td>
</tr>
<tr>
<td>Triumph</td>
<td>8.2</td>
<td>3.7</td>
</tr>
</tbody>
</table>

Tons/Acre for specific cultivars:
- Triumph: 8.2
- BBQ: 8.5
- Supreme: 16.4

*Yield not shown for immature vines
*Sweet Jenny had only 47% marketable due to rots
*Sugargate had 24% splits, Supreme 7%
*Summit with 10% loss due to macrophoma rot

Site Selection

- The most critical consideration in choosing a planting site for muscadines is internal soil drainage
- Although wild muscadines survive on a wide variety of soils, you must select a well-drained soil for optimal growth and yield
- Water should not stand on the site after a normal rain, and the subsoil should not restrict drainage

Site Preparation

- Submit a soil sample for analysis
- Follow recommendations you receive on the soil test report to add fertilizer as needed and dolomitic lime to bring the pH to 6.5
  - Incorporate well before installing trellis or planting vines
- Subsoil if necessary to break up hardpan
Trellising

- Decide on the trellis system and complete the construction before planting
- A practical system allows for establishing permanent cordons (arms) that can be easily reached for the required annual pruning
- This requires training of the cordons to single strands of wire
  - No. 9 wire is recommended

Trellising

- A single wire 5 to 6 feet above the ground and well anchored on each end is the easiest trellis to construct and maintain
- Four-foot cross arms of 2 x 6 inch treated lumber can be attached to treated posts to support the Geneva Double Curtain trellis
  - The GDC system will yield about 30% more than the single-wire system

Geneva Double Curtain

- Vines should be placed ~18 inches from the post
- If placed between the two posts the trunk will bow with the weight of a mature crop and additional posts may need to be added

The crossarm at each post is needed for the double wires in a horizontal plane

The GDC system will yield about 30% more than the single-wire system
Overhead arbors

North Carolina System

Planting

• Wait until there is little chance of sub-freezing temperatures before spring planting
• Potted plants are easier to hold until the proper planting time, but bare-root plants are satisfactory if the roots are kept moist (not wet), and the plants are refrigerated until planting time

Planting

• Prune back to 2 buds
• Plant at the same depth or slightly deeper than the previous planting depth
• Vines should be a minimum of 10 feet apart in the row, but more desirably, 20 feet apart
• Distance between rows can depend on the equipment used for mowing, but 8 feet should be a minimum
Training

- When new growth begins, select the most vigorous shoot and cut away the others
- A bamboo training stake beside the plant is convenient for attaching the growing vine
- Loosely tie the shoot to the stake with materials that will stretch or degrade so as not to girdle the growing vine
  - Max Tapener used in picture

Training in First Year

- Do not attach string to the developing trunk as it will eventually girdle it.

Training

- Continue tying the vine each week and removing side shoots
- When the vine is ~8 inches above the wire, cut the growing tip 6-8 inches below the wire to force lateral buds
- Shoots from the lateral buds should be trained down the wire to form the cordons, just as the trunk was trained up the stake

Questions???
Muscadine Production for the Home Garden

Connie Fisk, Extension Associate – Muscadine Grapes
North Carolina State University
January 16, 2009
28th Annual Horticulture Industries Show
Fort Smith, Arkansas

Overview

- Reasons for Poor Yield
- Pruning
- Vine Nutrition
- Irrigation
- Pest Management

The many reasons for poor yield

1. Poor fruit set is a common complaint on backyard vines, but almost unheard of in well-managed commercial vineyards with known cultivars. This suggests that the problem is cultural. A common cause of low yields in backyards is thin, weak growth caused by lack of proper pruning, or by competition from nearby trees.

Home vines are often grown on an overhead trellis, and may not be pruned correctly (or at all). Such vines are very productive when young (around years 4-7), but eventually become a mass of thin, unproductive wood due to lack of pruning.

From musc-mg 4.3 (May 15, 2008) available online at: http://www.ces.ncsu.edu/muscadines/muscadine/Musc-mg/musc-mgVol4No3.html

The many reasons for poor yield

2. Some heirloom vines are low producers. We have been collecting cuttings from old vines at abandoned homestead sites in southeastern NC. Some of these old clones produce very little fruit, even with the best of care. If the vine has been passed down for generations, there is a chance it is inherently low-yielding.

The many reasons for poor yield

3. Some fungal pathogens (powdery mildew, bitter rot) can attack flowers and fruit at an early stage, causing poor set or fruit drop. Look for a white "haze" on the surface of young berries (powdery mildew), or black spots, streaks, or shriveling of flower clusters and small fruit. Near harvest, bitter rot can also cause drop of large green berries.

From musc-mg 4.3 (May 15, 2008) available online at: http://www.ces.ncsu.edu/muscadines/muscadine/Musc-mg/musc-mgVol4No3.html

The many reasons for poor yield

4. Insects may feed directly on flowers and small berries. Look for Japanese beetles and June beetles feeding on flower clusters.

5. Stink bugs can cause severe fruit drop on muscadines. Developing berries punctured by stink bugs drop off without any obvious injury visible on the surface, but will have one or more dead, brown seeds when cut open in cross-section. Stink bug damage occurs when grapes are sizing but before the seeds harden.

From musc-mg 4.3 (May 15, 2008) available online at: http://www.ces.ncsu.edu/muscadines/muscadine/Musc-mg/musc-mgVol4No3.html
The many reasons for poor yield

6. Poor pollination can surely occur due to adverse weather, but is rarely reported from commercial vineyards in NC. Dry weather (drought stress) has been implicated in fruit drop on muscadines.

7. Something called 'dry calyptra' has been reported from Georgia on female-flowered vines. The calyptra is the cap that covers the individual flowers, and if it does not fall off, that flower cannot be pollinated (resulting in poor fruit set). This isn't a problem in self-fertile cultivars because they are often pollinated before, or as, the cap is falling off.

From musc-mg 4.3 (May 15, 2008) available online at: http://www.ces.ncsu.edu/muscadines/muscadine/Musc-mg/musc-mgVol4No3.html

The many reasons for poor yield

8. Some cultivars are female-flowered and must have a pollinator in order to set fruit. Unless there just happens to be a wild male vine in the woods nearby, pollination will not occur on a female vine (i.e., no fruit) unless a perfect-flowered cultivar (like 'Carlos' or 'Noble') is planted close by. This is often the culprit when a productive vine stops producing after development removes surrounding woods.

Solution: plant a self-fertile cultivar within 25 feet.

From musc-mg 4.3 (May 15, 2008) available online at: http://www.ces.ncsu.edu/muscadines/muscadine/Musc-mg/musc-mgVol4No3.html

Pruning

Pruning Neglected Vines?

See AG-94, Muscadine Grape Production Guide for NC

Before and After

Before pruning Trunk Condon
Fruiting spur
5 1/2'
10'
After pruning

Boron deficiency may also result in poor fruit set. Visible symptoms generally do not appear until the vine is critically deficient in this micronutrient, so foliar analysis can be used to check boron status.

For mature vineyards, a common recommendation has been to apply 5 pounds per acre of Borax (10 percent) every 2 years or spray annually with 1 pound per 100 gallons of water of Solubor (20 percent) just before bloom.

For mature backyard vines 2 Tablespoons of Borax can be mixed in with the fertilizer and spread over a 20 ft x 20 ft square around each vine every 2 to 3 years, before bloom.

Boron deficiency is more likely on sandy soils with high pH.

Excessive boron causes injury; do not exceed boron recommendations.

From musc-mg 4.3 (May 15, 2008) available online at: http://www.ces.ncsu.edu/muscadines/muscadine/Musc-mg/musc-mgVol4No3.html
**Best time to prune?**

You will see less “bleeding” from pruning cuts in Dec-Jan-early Feb

Bleeding from pruning cuts will not harm the vine

**Basic Tools Needed**

- Loppers
- Hand Pruners
- Gloves
- Eye Protection

**Use loppers for heavier cuts on the permanent arm**

**Bud forms in leaf axil**

Growing season

Dormant season

**New shoot (early May)**

Count bud on spur (1 yr wood)

**Weak (top) vs. healthy (bottom)**

1 year wood
Definition:
Cane – growth of the current season or shoots that have become woody

1st winter – prune back to just 1 bud
Still trying to establish cordon. If cordon is full-length, can leave longer spurs.

From year 2 on, leave a 4-inch spur (2-3 buds) every 4-6 inches

Spur pruning, 3rd winter before pruning (black-colored canes will be retained for next season’s fruiting wood)

Spur pruning, 3rd winter after pruning
Spur pruning, 4th winter before pruning (black-colored canes will be retained for next season's fruiting wood)

Spur pruning, 4th winter after pruning

Using hedgers to pruning away unwanted 1 year wood, and to "shape the vine" so that the zone of fruitful 1 year wood is inside the imaginary circles on each arm.

Benefits of hand pruning

- Encourages base and latent buds to break
- Useful for keeping fruiting wood close to cordon

Cordon of a healthy 5 year old vine - each year the 1 year 'fruiting spurs' move further from the cordon

When hand pruning...

- Remove spurs with poor orientation:
  - Anything pointed downward
  - Anything crossing the cordon
- Also be sure to remove any tendrils, which may girdle the vine

Older vine with less fruitful "bearers"
Prune to a 1 bud renewal spur

February 2007

After mechanical pruning
Pruning to rejuvenate vines

February 2007

Additional Pruning Tips

- Prune later to delay budbreak. Based on observations following the 2007 Easter Freeze, NC growers should wait until February/March, if possible, to prune their vines.
  - "Bleeding" does not harm the vines. Pruning later may cause the vines to "bleed" more, but studies have shown that the "bleeding" is just a sugar water solution and does not harm the vine.
- Be careful not to damage the tender buds while pruning late.

October 2007

Vine Nutrition

- Generally, apply ¼ lb of 10-10-10 in an 18-inch circle around each vine beginning 2 weeks after planting (late April-early May*) and repeat every 6 weeks until early July
- During the second year, apply in early March, May and July at double the first year’s rate (½ lb per vine)
  - Do not put the fertilizer closer than 21 inches from the trunk
- In the third year use a rate of ½ pound per vine at the same intervals
- To minimize the potential for winter cold injury, growers should not apply fertilizer after the first week in July since this may lead to winter damage and possibly crown gall

*These recommended dates are for NC growing conditions. Contact your local Cooperative Extension Agent for questions about your individual location.

October 2007

Alternative Fertilizer Regime

- In eastern NC (sandy soils), an alternative fertilizer to 10-10-10 that shows promise involves the application of 6-6-18 tobacco fertilizer because it contains several micronutrients in addition to N, P, and K
- It should be applied in March and then again in late June, at ¼ lb per vine after planting and ½ lb per vine in the second year
- Mature vines should receive 2 to 3 lb at each application
- An application of calcium nitrate should also be applied in mid-May at 6 to 7 oz per vine
- Leaf samples can be taken to determine the actual nutritional status of mature vines
Irrigation

• Muscadine grapes are quite drought tolerant
• Water is essential during dry periods the first two years, then the vines can usually obtain adequate water from the soil even during dry periods
• Most commercial growers continue to use irrigation to maximize yields
• You can tell when a vine needs water because the leaves and tendrils will droop

Weed Management

• Weeds can compete with vines for water and nutrients and should therefore be managed, especially during establishment

Mulching Around Grapevines

• Mulching has several advantages in the vineyard:
  – It helps to suppress weed growth, which reduces competition for soil moisture and nutrients,
  – It helps to conserve soil moisture, increases rainfall penetration, and reduces erosion, and
  – It often helps to maintain or increase vine vigor with fewer fertilizer inputs, as nutrients are supplied by the mulch as it decays.
• If you decide to try mulching use a durable mulch such as chipped hardwood.
• Many other organic materials such as straw and sawdust can also be used as mulch, but be sure to replenish the mulch layer each year.
• Black plastic, landscape fabric, or other shredded materials can be used, so long as they do not leach chemicals into the soil around the vines.

Mulching Around Grapevines

• Avoid mulching on poorly drained soils - muscadines do not like wet feet and mulching may actually increase moisture in the root zone.
• In addition, keep in mind that mulching can increase fire and rodent hazards.
• If you choose to mulch a new vineyard, be sure to pull the mulch a few inches away from the tender young plant so that it receives adequate air and sunlight (see photo at right).

Muscadine Grapes are Sensitive to Herbicide Drift Damage

• Grapes are very sensitive to 2,4-D and dicamba drift

Pests During Establishment

• During the 2-3 years required for establishment, few insects or diseases are usually encountered
• However, Japanese beetles can be a fairly severe problem
  – They normally feed over a 4- to 6-week period – spray as needed
• Japanese beetles feed on grass roots and may emerge in large numbers on land that was previously a well-established pasture
Pests During Establishment

• Symptoms of black rot may appear on the leaves of muscadines during the establishment period, but since no fruit is usually present and infections are not usually severe, sprays are not usually necessary.

Diseases of Mature Vines

• Major diseases of muscadine grapes include angular leaf spot, bitter rot, powdery mildew, ripe rot, macrophoma rot, and black rot.

• Angular leaf spot

Diseases of Mature Vines

• Bitter rot

• Powdery mildew

Diseases of Mature Vines

• Macrophoma rot

• Ripe rot

• Black rot

Pierce’s Disease

• A bacterial pathogen transmitted by leafhoppers such as the glassy-winged sharpshooter.
• The cultivar Pride is highly susceptible and may be killed by the bacterium.
• Growers should avoid propagating from symptomatic vines.
• Chemical control is not available.

Pierce’s disease causes a marginal leaf burn on susceptible cultivars such as Carlos.

Crown Gall

• Crown gall is caused by a bacterium frequently associated with gall formation on grape vines.
• Galls are fleshy, irregularly shaped growths.
• The disease usually occurs in association with freeze injury, and galls may form all along the length of the trunk and cordon.
• Fall planting exposes new vines to freeze injury and should be avoided.
Reduce Disease Through Cultural Practices

- Cultural Practices
  - Mowing or otherwise reducing undergrowth near vines will improve air movement through the vineyard
  - Timely harvesting and removal of leftover fruit at the end of the season helps reduce fruit rot
  - Avoid excessive late-season fertilizing to reduce disease and the likelihood of winter injury to cordon's and trunks of vines

Fungicide Control of Major Diseases

- Fungicides
  - A regular spray program is often not necessary in the backyard garden
  - Won’t need to begin the disease control spray program until the second or third season after planting (because you won’t have any fruit)
  - If necessary, repeated early season applications of fungicides (May-June-July) are more effective than treating after you see disease on leaves or fruit

Potential for Organic Production

- Muscadine grapes can often be grown successfully without insecticides or fungicides
  - Immune to Downy Mildew
  - Immune to Bunch Grape Anthracnose
  - Resistant to Phomopsis
  - Physically tough, thick-skinned
  - Sulfur can be used to control the biggest disease threat, Powdery Mildew

<table>
<thead>
<tr>
<th>Fungicide</th>
<th>Angular</th>
<th>Leaf Spot</th>
<th>Bitter</th>
<th>Powdery</th>
<th>Ripe</th>
<th>Brown</th>
<th>Black</th>
<th>Plant</th>
<th>Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Captain 50WP</td>
<td>XXXX</td>
<td>XXXX</td>
<td>0</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
</tr>
<tr>
<td>(4.0 lb/acre)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wettable Sulfur</td>
<td>0</td>
<td>0</td>
<td>XXXX</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
</tr>
<tr>
<td>(4.0 lb/acre)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Novo 40WP</td>
<td>0</td>
<td>XXXX</td>
<td>XXXX</td>
<td>0</td>
<td>X</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
</tr>
<tr>
<td>(5.0 oz/acre)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*O = ineffective or impersistent; XXXX = very effective or very safe

Potential for Organic Production

- Japanese beetles are often the most damaging insects
  - Pheromone traps are one control option
- Selecting cultivars with some disease resistance such as 'Carlos', 'Nesbitt', 'Noble', 'Triumph' or 'Regale' will reduce the losses without pesticide applications

To order book:
Call ASHS Press at 703.836.4606
Visit: http://www.ashs.org/ashspress/mgrapes.html
For Further Information

- Contact your local Horticulture Extension Agent

Online Resources

- Southern Region Small Fruit Consortium  
  www.smallfruits.org
- NC Muscadine Grape Association  
  www.ncmuscadine.org
- Connie Fisk, connie_fisk@ncsu.edu  
  http://www.ces.ncsu.edu/muscadines

Questions???