American Native Southern Grape Varieties and Clean Plants

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NCPN General Meeting May11-13, Davis, CA
To make a great wine, one needs:

- a madman to grow vine
- a wise man to watch over it
- a lucid poet to make the wine
- a lover to drink it!!!!
Why Florida and SE are special ???

We still don't know if it is our curse or our blessing may be......

Pierce's Disease of Grape in United States

- rare
- occasional
- severe
Florida and Southeastern US non-\textit{vinifera} grape industry

\textit{Vitis riparia}

\textit{Vitis vinifera}

Gallet, 1982: \textit{Muscadinia} 2sp.

\textit{Muscadinia rotundifolia-♀}\textit{Muscadinia munsoniana-♀♂}

Florida and Southeastern US grape industry

\textit{Vitis labrusca}

\textit{Vitis riparia}

\textit{Pierce’s Disease !!!}

\textit{Muscadinia (Vitis) rotundifolia}

“Southern \textit{aestivalis}, “Aestivales” group

Munson \textit{Pixiola-FL}, cultivars: Norton, Black Spanish, Herbermont, Blanc du Bois, Stover, Suwannee, Conquistador???
With its French and Spanish early settlers, Florida and the SE have probably the longest winemaking history in North America.

Florida alone between 1880 and 1920 had >12,000 acres vineyards "labrusca" based.
Appellation “Muscadine”

- Common name “Muscadine”, “Bullace”, “Scuppernong” is well known throughout the southern states as the original American wine or “the first American grape and etc.

Noble var.

Fry var.

www.plants.usda.gov/
Muscadine is a high-yielding, sub-tropical grape grown in Florida, Texas, North Carolina, and other southern states. The grape belongs to the sub-genus *Muscadinia*, not the sub-genus *Euvites*, to which *labrusca*, *vinifera*, *riparia* and *rupestris* belong.
Appellation “Muscadine”

- It has **very unusual exotic appearance.** It grows in clusters, rather than in bunches, and its fruit resemble small plums, more so than grapes.
Appellation “Muscadine”

- **Vigorous and productive:** A single vine can envelop more than an acre, and supply over a ton of fruit.
Appellation "Muscadine"

It produces very distinctive, perfume-laden wines. Generally made sweet, they were once blended with Concord and Catawba, to make Virginia Dare, the most popular U.S. wine before Prohibition. Bunch varietals are very susceptible to disease and mildew in the humid southern states.
Appellation “Muscadine”

Appellations producing the most Muscadine wines:

- North Carolina (State Appellation) - 254 wines labeled
- Tennessee (State Appellation)
- Alabama (State Appellation) - 39 wine labels
- Texas (State Appellation) - 321 wine labels
- Florida (State Appellation) - 30 wine labels
- America (Country Appellation)
- Georgia (State Appellation) - 149 wine labels
- South Carolina (State Appellation)
- Louisiana (State Appellation) - 22 wines labels
- Arkansas (State Appellation)
What we have in common???

- PD’s limitation and high disease occurrence due to hot and humid climate
- Numerous legislative obstacles in the aftermath of the Prohibition time
- Long and rich history with failures in to the recent past
- Bright future and industry on a rise

To Ensure Consumer Choice in Fine Wine
FREE THE GRAPES!
Fedup? Signup!
What is helping us?

*Muscadinia rotundifolia,* Small is native to the southeastern United States and has been cultivated for more than 400 years. **The discovery of high levels of anti-oxidant compounds in muscadine juices and wines has brought more attention to the muscadine grape,** not only as an alternative cash value crop for the Southeast, but also as a new healthy food. (*Colova et al., 2007*)

1. Growing markets

2. Recent legislative changes

3. Vacated land and transfer of resources from the tobacco industry’s settlement.
Muscadinia rotundifolia, Small is native to the southeastern United States:

“Miraculous Muscadine…America's First Grape™”

“Muscadines are Called "Smart Grapes" For A Good Reason “ and etc….

Muscadine Bulk Nutraceuticals:

[Images of grapes and capsules]
Categories of “Good Medicine” in Muscadines

- Anthocyanins
- Flavonols
- Flavan-3-ols
- Phenolic acids
- Stilbenes
- Ellagitannins
  - Free ellagic acid
  - 3 ellagic acid glycosides
  - Several ellagitannins

Diane K. Hartle, Ph.D.
Phillip Greenspan, Ph.D.
James L. Hargrove, Ph.D.
Muscadine Nutraceutical Products

• Powder ingredient products
  – E.g. “PURPLE POWER” by Paulk Vineyards is on the market since 2003
  – Capsules, tablets, multiple ingredient products, functional food ingredients etc.

• Extracts
  – Liquid gel caps, syrups, tinctures
  – Dried extract concentrates for capsules
  – Multiple ingredient products
  – Dermatological products
  – Functional foods or functional beverages
1. Evidence: In tertiary sediments of northern Europe – fossilized seeds of Vitis teutonica (similar to modern Vitis grapes) and Vitis ludwigii (similar to Muscadinia and Ampelocissus grapes).

2. Muscadinia and Vitis have only 13 pairs of the chromosomes in common (Olmo, 1955)

Hypothesis: 2 unknown ancestors with respectively 6 and 7 basic chromosome numbers.

Vitis – temperate climate: ancient polyploid \((6+7)+6 = 19\), after undergone diploidization resulting with 38 chromosomes (Galet, 1967)

Muscadinia – transitional form between Vitis and Ampelocissus grapes: \((6+7)+7=20\), after undergone diploidization resulting with 40 chromosomes.

Ampelocissus – tropical climate – 40 chromosomes.
The ‘survivor’ scenario
Microarray scan and image analysis: 'Noble' véraison non-pigmented vs 'Noble' véraison pigmented

Spots scanned at wavelength 635 nm (red) and 532 nm (green)
Annotations were based on the VvGI (V. vinifera Gene Index).

**Noble:** 1,051 (651 up-regulated and 400 down-regulated; pValue ≤ 0.05)

**Cynthiana:** 858 (536 up-regulated and 322 down-regulated; pValue ≤ 0.05)

- **NP vs NN** (360) (98)
- **NM vs NN** (411) (274)
- **CM vs CP** (364) (225)
- **CP vs CN** (265) (112)
- **CM vs CN** (265) (112)
- **NM vs NP** (172) (178)
- **Up-regulated**
- **Down-regulated**
- >2 fold

NN - Noble véraison non-pigmented, NP – Noble véraison pigmented, NM – Noble mature, CN – Cynthiana véraison non-pigmented, CP – Cynthiana véraison pigmented, CM – Cynthiana mature
Two patents pending:
In vitro synchronized strain of muscadine pericarp cells

<table>
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<tr>
<th>sample</th>
<th>GAE, mg/l avg</th>
<th>GAE, mg/g FW estimated</th>
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<tbody>
<tr>
<td>Noble juice cold press</td>
<td>1360</td>
<td>0.576</td>
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<tr>
<td>Noble juice hot press</td>
<td>1646</td>
<td>0.697</td>
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<tr>
<td>Blend juice M:Iv 3:1</td>
<td>1117</td>
<td>0.473</td>
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<tr>
<td>Blend juice M:Iv 4:1</td>
<td>1187</td>
<td>0.503</td>
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<tr>
<td>Blend juice M:Iv 8:1</td>
<td>1295</td>
<td>0.549</td>
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<tr>
<td>Noble wine</td>
<td>1895</td>
<td>0.803</td>
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<tr>
<td>Noble mature berries 2007 pulp</td>
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<td>0.655</td>
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<td>42.325</td>
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<tr>
<td>Noble mature berries 2007 skin</td>
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<td>7.851</td>
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<tr>
<td>Pericarp cells</td>
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Total Phenolics as Gallic acid equivalents (GAE)
The top tourist destination FL peninsula is home for a vibrant wine industry and unique warm climate grape germplasm: 8 wild grape species
Vineyard-BMP-Stover
custom grafting “Double A Vineyard”-NY
Vineyard-BMP-Cynthiana/Norton

custom grafting “Double A Vineyard”-NY
What is the new danger for us?

1. Lack of improved disease free planting material for muscadines or completely absence of such for highly promising bunch grape variety like Stover and Suwannee or rootstock vines.

2. Growing industry, growing monoculture of the vineyards is coming at the price of even higher pest and disease occurrence.
Problem Identification

- The is one major restrain that can very well compromise all the efforts in the direction of further development and expansion of the grape industry.

- This serious constraint is faced from both the existing growers, looking to expand their vineyards and from enthusiastic new growers.
Solutions:

- Improved disease free planting stock for the region
Reality Check:

(Male) Carlos Scuppernong Grape
Vine price (s):
- 2 year $5.95
- 3 year $9.95
- (Male) Carlos Scuppernong Grape

THE NURSERY AT TyTy
<table>
<thead>
<tr>
<th>Quantity</th>
<th>1-15</th>
<th>50 and above</th>
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<tbody>
<tr>
<td>Price</td>
<td>$7.95</td>
<td>$6.75</td>
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Since 1934
What we propose?

- Florida A& M University’s Center for Viticulture and Small Fruit Research to establish and maintain for industry use the disease free G1 nuclear planting stock in protected environment (screen house) of single copy grapevines.

- Establish and maintain a 4 acres Foundation Vineyard (G2) that will initially be planted with 25 economically important muscadine and Florida native hybrid varieties originating from single source *in vitro* meristem culture.

- To work in cooperation with FDACS Plant Industry Department and other stakeholders for development of the grape certification program for Florida and neighboring states restricted to the Pierce’s disease (PD’s) zone of the American viticulture.
Florida Vine Improvement and Distribution Program

15 varieties:
9 muscadines + 2 rootstocks
+ 3 AE hybrid var.

Disease Elimination:
In vitro 0.3-0.5 mm meristem culture

Source Block
BMP vineyard CV&SFR
('mother vines' after 4 years quality observations

Pathogen Testing:
11 viruses + Eutypa, Agro, PD

Foundation vineyard

Disease Free G1 Nuclear Planting Stock
-1 copy in screen house

Southeast Grape Certification Program

Certified Block in Registered Nurseries

Certified Planting Stock for the Industry

Pathogen Testing: after 6-12 months growth
11 viruses + Eutypa, Agro, PD
Diagnostic and therapy of initially 25 economically important muscadine and Florida native hybrid varieties (in cooperation with Cornell University)

- Targeted pathogen transmittable with the planting stock in the region

  - Eutypa dieback by PCR
  - Agrobacterium vitis (crown gall) by PCR and selective media.
  - Xylella fastidiosa bacteria (Pierce’s Disease)
  - Phytoplasmas by PCR. Five-year intervals

- Viruses - ELIZA
  - Grapevine fanleaf virus
  - Tomato ringspot virus
  - Tobacco ringspot virus
  - Grapevine leafroll-associated virus 1
  - Grapevine leafroll-associated virus 2
  - Grapevine leafroll-associated virus 3
  - Grapevine leafroll-associated virus 4
  - Grapevine leafroll-associated virus 5
  - Grapevine leafroll-associated virus 6
  - Grapevine leafroll-associated virus 7
  - Grapevine leafroll-associated virus 9
  - Grapevine virus A

- Viruses PSR
  - Arabis mosaic virus,
  - Grapevine fleck virus
  - Peach rosette mosaic
  - Strawberry latent ringspot virus
  - Tomato blackring virus
  - Raspberry ringspot virus.
Are we capable to do it?

- **Operational Facilities**
  - the breeding program for muscadine and FL hybrid bunch grapes
  - collection of 55 commercial muscadine and warm climate *Vitis* varieties and numerous wild grape species.
  - 40 acres research vineyards
  - 4 acres site in pre-planting development for Foundation Vineyard
  - state of art laboratories
  - greenhouse complex
Since 2006 we are cooperating with the Florida Department of Agriculture and Consumer Services for implementing The Florida Vine Improvement and Distribution Project I and II with main goal establishing the Foundation Vineyard and Florida Registration and Certification Program for grape clean planting stock.
In November 2009 we formally joined the Tier 2 – Grape of the NCPN
Wood Diseases Cost by Fungi

*Eutypa Dieback*
Diseases Cost by Bacteria

Crown Gall

Pierce’s Disease
Angular leaf spot (*Mycosphaerella angulata*) is an important leaf disease.

Bitter rot (*Greeneria uvicola*, syn. *Melanconium fuligineum*) can be a very destructive fruit disease shortly after bloom.

Powdery mildew (*Uncinula necator*) attacks berry clusters and young berries just after flowering.

Ripe rot (*Glomerella cingulata*; imperfect stage *Colletotrichum* sp.) Berry rot near harvest and in recent years has become the most damaging fruit rot disease.
Macrophoma rot (*Botryosphaeria dothidea*) small, sunken, black fruit spots that are round with distinct edges in the early part of the season.

Black rot (*Guignardia bidwellii f. muscadinii*) circular brown leaf spots and a black scabs on berries.

Pierce's disease (*Xylella fastidiosa*)

Crown Gall (*Agrobacterium* sp.)
Anthracnose
Graduate Students Ms. Tresia Walters and Ms. Lelan Parker during grape harvest in the FAMU vineyard with Dr. Enrico Peterlunger, visiting scholar from University of Udine, Italy
Our Clientele: Growers Field Day-May, 2006
Muscadine and southern grape varieties are unique national treasure for U.S.

- We would like to clean preserve and make them available for the industry first at home.
- There are already data available for introduction trials and interest towards of muscadine grape in China and Brazil.
Thank You!!!