Vineyard Nutrient and Weed Management

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Grape Grower Field Day

NC STATE UNIVERSITY

NC COOPERATIVE EXTENSION

Overview

- Nutrient requirements of muscadines and bunch grapes
- How to collect a tissue sample and where to send it for analysis
- Vineyard weed control
- Herbicide injury
- Fertilizer burn

Soil Sampling During Site Prep

- Soil samples should be submitted to lab for analysis the year before planting
  - Indicate that you intend to plant grapes
- Amend with fertilizer as per recommendations listed on the soil test report

Adjusting pH to Maximize Nutrient Availability

- Apply and work in dolomitic lime at the rate recommended by the soil test to bring the pH to 6.5 before planting
  - Lime materials are not very mobile in the soil and must be incorporated before planting for best results
  - Liming materials take several months to react with the soil and raise soil pH
- pH ranging between 6 and 6.5 will maximize the nutrients available to the vines
  - Deficiencies are often seen when pH is too high or too low, even if there is an adequate supply of the element in the soil

Essential Nutrients

Obtained from Air and Water	Obtained from Soil	
	Macronutrients	Micronutrients
Carbon (C)	Nitrogen (N)	Iron (Fe)
Hydrogen (H)	Phosphorus (P)	Manganese (Mn)
Oxygen (O)	Potassium (K)	Copper (Cu)
	Calcium (Ca)	Zinc (Zn)
	Magnesium (Mg)	Boron (B)
	Sulfur (S)	Molybdenum (Mo)
		Chlorine (Cl)

Muscadine Post-Plant Fertility

- Generally, apply ¼-½ lb of 10-10-10 in an 18-inch circle around each vine beginning 2 weeks after planting (late April*) and repeat every 6 weeks until early July (13-23 lb N/ac total)
- During the second year, apply in April, May and late June at ½-1 lb per vine (34 lb N/ac total)
  - Do not put fertilizer closer than 21 inches from the trunk
- In the third year use a rate of 1 pound per vine at the same intervals (40-50 lb N/ac total)
- When vines are mature broadcast fertilizer at 400 lb/ac in early spring and a second application of 200 lb/ac in June (40-75 lb N/ac total)

*these dates apply to muscadines grown in NC and should be adjusted for other locations

Alternative Muscadine Fertilizer Regime

- In eastern NC, an alternative fertilizer to 10-10-10 that shows promise involves the application of 6-6-18 tobacco fertilizer because:
  - It contains N, P, and K plus several micronutrients
  - It contains a sulfate form of potash (need more S on the sandier soil of eastern NC)
  - It has a lower salt content
- It should be applied in April* and then again in late June, at ¼ lb per vine after planting and ½ lb per vine in the second year
- Mature vines receive 2 to 3 lb at each application
- Calcium nitrate should also be applied in mid-May at 6 to 7 oz per vine

*these dates apply to muscadines grown in NC and should be adjusted for other locations

Additional Muscadine Fertility Considerations

- Adjust fertilizer rates to compensate for the effects of rain or drought
  - Overfertilizing during extreme drought will damage vines
- 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
- Apply compost only during the dormant season or early spring to avoid nitrogen release into the soil late in the growing season

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Bunch Grape Fertilizer Schedule

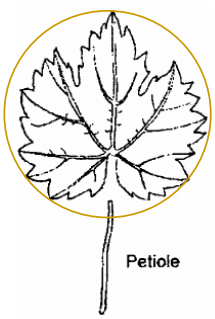
- Young vines are more often injured than benefited by fertilizer applied during the first season
- Under most conditions, if the vineyard soil was well-prepared and the soil pH was adjusted before planting, vines will require very little, if any, fertilizer in the first few years of growth
- After that, nutrient status should be monitored with tissue testing, and fertilizer only applied if needed
- Rates should not exceed 4 lb per vine of 6-6-6 or 8-8-8 per year
- Apply $^{2}/_{3}$ of recommended fertilizer at bud break and the other $^{1}/_{3}$ immediately after bloom
- Apply through drip irrigation or in bands under the trellis rather than broadcasting

Tissue Sampling

- It is important to take tissue samples every year or every other year to monitor the fertility of the vines and establish trends.
- Some growers take a tissue sample in mid-May (before bloom) to assess the need to apply boron.
- A sample collected in mid-June will help you determine if another fertilizer application is required.
  - Do not apply fertilizer after 4th of July* to reduce the risk of cold injury in the fall

*these dates apply to muscadines grown in NC and should be adjusted for other locations

Muscadine Tissue Sampling

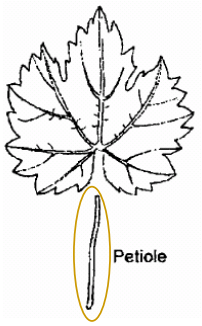


- Collect ~20 leaves of each cultivar, and make sure to take a sample that is representative of the vineyard
- The leaves should be opposite flower/berry clusters
- Choose the third to fifth leaves back from the growing point, immediately twist off and discard the petiole (leaf stalk), and place the leaf blades in a paper bag or envelope

Recommended Nutrient Levels for Muscadines

Element (unit)	Optimal Range
Nitrogen (%)	1.65-2.15 (you do not want levels above 3.0)
Phosphorus (%)	0.12-0.18
Potassium (%)	0.80-1.20
Calcium (%)	0.70-1.10
Magnesium (%)	0.15-0.25
Boron (ppm)	15-25
Copper (ppm)	5-10
Iron (ppm)	60-120
Manganese (ppm)	60-150
Molybdenum (ppm)	0.14-0.35
Zinc (ppm)	18-35

Bunch Grape Tissue Sampling



- Collect petioles at full bloom, when ~$^2/_3$ of the flower caps have dropped
- Sample each variety separately
- Collect 100 petioles from leaves opposite the 1st or 2nd flower cluster from the bottom of the shoot
- Discard leaf blades and place petioles in a small paper bag

Nutrient requirements of bunch grapes

Element (unit)	Optimal Range
Nitrogen (%)	1.20-2.20
Phosphorus (%)	0.15-?
Potassium (%)	1.50-2.50
Magnesium (%)	0.30-0.50
Iron (ppm)	40-?
Manganese (ppm)	25-1000
Copper (ppm)	7-15
Zinc (ppm)	35-50
Boron (ppm)	30-100

Soil Testing to Monitor Nutrient Status

- Routine soil testing is another way to monitor nutrient status, though not as accurate as tissue testing
- Collect soil samples in late summer or fall since soil pH is lowest at this time
- Usually only major soil deficiencies or toxicities can be determined by soil analysis, but can be valuable in trying to diagnose a nutrient problem

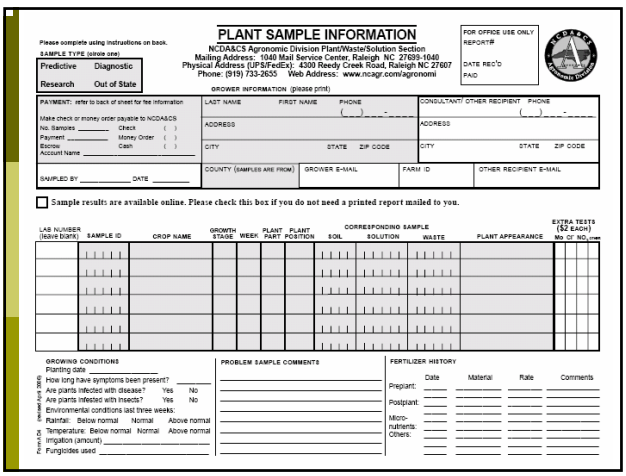
Soil and Plant Testing Laboratories

North Carolina

- NCDA&CS Agronomic Division, Raleigh, NC, 919-733-2655, http://www.ncagr.com/agronomi
  - Sample containers and forms can be obtained at your local Cooperative Extension Office

Other States

- A&L Analytical Laboratories, Inc., Memphis, TN, 800-264-4522, http://www.allabs.com
- Western Agricultural Laboratories, Inc., Lubbock, TX, 806-794-4888



PLANT SAMPLE INFORMATION

Please complete using instructions on back.

SAMPLE TYPE (circle one): Predictive Diagnostic Research Out of State

NCDA&CS Agronomic Division Plant/Waste/Solution Section
Mailing Address: 1040 Mail Service Center, Raleigh NC 27699-1040
Physical Address (UPS/FedEx): 4300 Reedy Creek Road, Raleigh NC 27607
Phone: (919) 733-2655 Web Address: www.ncagr.com/agronomi

FOR OFFICE USE ONLY
REPORT#
DATE REC'D
PAID

GROWER INFORMATION (please print)

PAYMENT: refer to back of sheet for fee information
Make check or money order payable to NCDA&CS
No. Samples _____ Check ( )
Payment _____ Money Order ( )
Escrow Account Name _____ Cash ( )

LAST NAME FIRST NAME PHONE ( ) -
ADDRESS
CITY STATE ZIP CODE
COUNTY (SAMPLES ARE FROM) GROWER E-MAIL FARM ID

CONSULTANT/ OTHER RECIPIENT PHONE ( ) -
ADDRESS
CITY STATE ZIP CODE
OTHER RECIPIENT E-MAIL

SAMPLED BY _____ DATE _____

☐ Sample results are available online. Please check this box if you do not need a printed report mailed to you.

LAB NUMBER (leave blank)	SAMPLE ID	CROP NAME	GROWTH STAGE	WEEK	PLANT PART	PLANT POSITION	CORRESPONDING SAMPLE: SOIL	SOLUTION	WASTE	PLANT APPEARANCE	EXTRA TESTS ($2 EACH): No. OF NO_3 TEST

GROWING CONDITIONS
Planting date _____
How long have symptoms been present? _____
Are plants infected with disease? Yes No
Are plants infested with insects? Yes No
Environmental conditions last three weeks:
Rainfall: Below normal Normal Above normal
Temperature: Below normal Normal Above normal
Irrigation (amount) _____
Fungicides used _____

PROBLEM SAMPLE COMMENTS

FERTILIZER HISTORY

	Date	Material	Rate	Comments
Preplant:				
Postplant:				
Micro-nutrients:				
Others:				

Revised April 2005

HOW TO FILL OUT THE INFORMATION SHEET

SAMPLES WILL NOT BE ANALYZED UNLESS ALL INFORMATION REQUESTED IN THE SHADED AREAS ON THE FRONT OF THIS FORM IS PROVIDED.

SAMPLE TYPE
Predictive analysis checks nutrient content and provides interpretation and general recommendations.
Diagnostic analysis identifies nutritional problems and provides interpretation and specific recommendations.
Research is for samples submitted in connection with an approved research contract agreement.
Out of state is for samples submitted by non-North Carolina residents.

GROWER INFORMATION — Provide as much contact information as possible (phone with area code, address, e-mail) and area where sample was collected.

PAYMENT — Cost **per sample = Base fee** [$5 for N.C. residents; $25 for out-of state samples; $12 for research samples] + **$2 for each additional mandatory** test [petiole nitrates is required for cotton, strawberry and vinifera grape, a molybdenum test is required for alfalfa, broccoli, all kinds of cabbage, cauliflower, collards, kale, poinsettia, spinach and turnip greens] + **$2 for each optional test requested** [petiole nitrates, molybdenum and/or chloride].

SAMPLE ID — Provide sample identification (no more than six digits or letters). Put the same ID on the sample envelope.

CROP NAME — Enter the name of the crop sampled. You can use the common and/or botanical name.

GROWTH STAGE — Identify plant growth stage by one of these letter codes: **S = Seedling, E = Early growth, B = Bloom, F = Fruiting, M = Mature.**

WEEK — Indicate the estimated number of weeks that the crop has been in the current growth stage.

PLANT PART — Identify the part of the plant that was sampled by one of these letter codes: **W = Whole plant, T = Top three inches, E = Ear leaf, M = Most recent mature leaf (including petioles for appropriate crops), H = Harvested leaf.** For most plants, the most recent mature leaf (**M**) is the proper plant part to sample.

PLANT POSITION — Identify the position on the plant where the sample was taken by one of these letter codes: **U = Upper, M = Middle, L = Lower.** For most plants, the upper (**U**) position is the proper place to sample.

CORRESPONDING SAMPLE ID — List the IDs of any matching soil, solution or waste samples submitted.

PLANT APPEARANCE — Describe the symptoms of the plant at sampling. **If this space is left blank, we assume growth is normal.**

EXTRA TESTS — Indicate nonstandard tests desired: molybdenum, cloride, nitrate nitrogen or other (heavy metals, aluminum, lithium).

GROWING CONDITIONS — Answer the questions as completely as possible.

PROBLEM SAMPLE COMMENTS — Provide additional information needed to help diagnose specific problems.

FERTILIZER HISTORY — Answer the questions as completely as possible.

Please do not place samples in plastic bags.

Leave ample air space in paper containers to promote drying and avoid sample deterioration.

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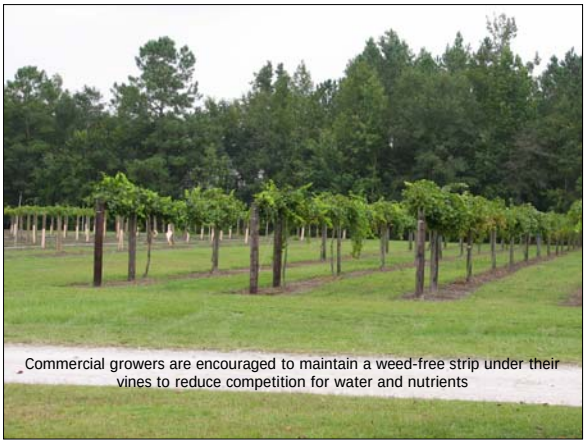
Visual Observations

- Vine nutrient needs can often be determined by visual examination of the leaves and vigor of the vine
- A common rule of thumb used to evaluate vigor in muscadine vineyards is that individual shoot growth of 30-36 inches should be achieved each growing season
- Excess N fertilization will result in vigorous vegetative growth at the expense of fruit yield and quality

Weed Control

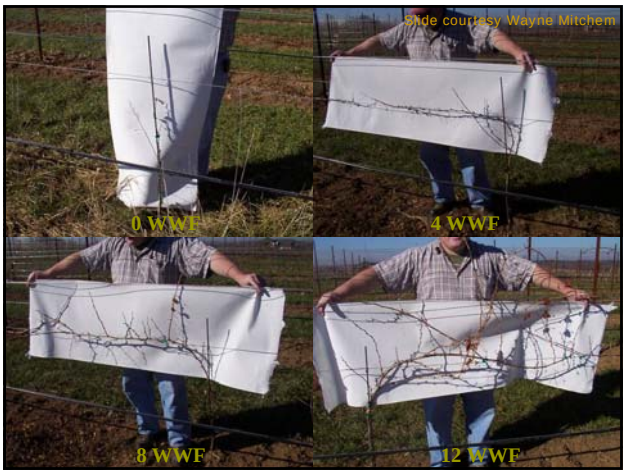
- During the first 3 years of a new vineyard, weed management is extremely important
- Elimination of weeds should be part of site preparation
- Prevention is especially critical with perennial weeds, such as bermudagrass and johnsongrass
- Proper tilling techniques and systemic herbicides can minimize or eradicate many problem weeds before planting
- A 3-4 ft wide weed-free strip should be maintained under the vines to minimize competition for water and nutrients



Commercial growers are encouraged to maintain a weed-free strip under their vines to reduce competition for water and nutrients

Competition in young vineyards reduces growth and survivability.

Slide courtesy Wayne Mitchem



The competitive advantage improves with time!

Slide courtesy Wayne Mitchem

Weed Control

- When the vines begin growing, control of weeds is much more problematic
- Before weed seeds germinate, treat the soil with a PRE-emergence herbicide
- To maintain control throughout the growing season, at least two applications of these herbicides are required
- The second spray should also be made before weeds emerge
- Any emerged weeds should be hoed or sprayed with a systemic or contact herbicide before the soil is treated with a PRE herbicide

Weed Response to PRE- Herbicides

Weeds	Prowl	Surflan	Chateau
Crabgrass	E	E	E
Fall Panicum	E	G	G
Goosegrass	G	G	E
Pigweed	G	G	E
Lambsquarter	G	G	E
Tropic Croton	P	P	E
Florida Pusley	G	G	E
Morningglory	P	P	G-E

Alternate PRE-herbicides used to reduce development of resistance

Slide courtesy Wayne Mitchem

Weed Control

- Once the grapes begin to grow, take great care to prevent any contact with systemic or contact herbicides
- Any contact of these herbicides with green leaves or stems may injure the plant
- If used properly, grow tubes and shields for sprayers or vines can sufficiently protect vines from herbicide contact
- Consult your local Cooperative Extension agent for a complete list of herbicides labeled for grapes
  - See *NC Agricultural Chemicals Manual* at http://ipm.ncsu.edu/agchem/8-12A.pdf for a table of chemicals labeled for weed control in North Carolina vineyards

Weed Control with Mulch

- Mulching has several advantages:
  - Suppresses weed growth, which reduces competition for soil moisture and nutrients
  - Conserves soil moisture, increases rainfall penetration, and reduces erosion
  - Often maintains or increases vine vigor with less fertilizer inputs, as nutrients are supplied by decaying mulch
- Use a durable much such as chipped hardwood, or one of many other organic materials such as straw or sawdust if able to replenish each year
- Avoid mulching on poorly drained soils as it may actually increase moisture in the root zone
- Mulching may increase fire and rodent hazards

Causes of Chemical Injury To Grapes and Grapevines

- Causes of herbicide injury
  - The wrong product was used
    - Or the equipment used was contaminated with a chemical dangerous to grapes
  - The application rate of the product was too high
  - Timing of the application was incorrect
    - Wrong growth stage
    - Plants are under drought or temperature stress
  - A nonselective herbicide was applied with no shield or with a shield that did not work
  - Drift from adjacent fields
- Causes of fertilizer burn
  - Fertilizer was placed too close to the plant, especially when plants are under moisture stress

Herbicide Drift Injury

- Spring applications of herbicides often accumulate in the growing points of grapes, where injury symptoms appear first.
- Fall applications may accumulate in roots. So, as a general rule, avoid applying herbicides like glyphosate after the 4th of July*.
- Damage caused by herbicide accumulation in roots may affect vine growth in coming years and ultimately, survival.

*these dates apply to muscadines grown in NC and should be adjusted for other locations

Herbicide Injury

- Herbicide injury can cause malformation of young plants and yellowing, burning, and dying of leaves.
- Leaf burning results from getting a directed spray of a contact herbicide such as paraquat (Gramoxone) on the leaves.
- You can distinguish herbicide injury from foliar disease by looking for burning that occurs in patterns from the sprayer nozzle and which only affects leaves of a certain age which were exposed when the chemical was applied.

Herbicide Drift Damage

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

Glyphosate

- Glyphosate is the active ingredient in Roundup and similar products and is labeled for use in vineyards.
- Injury may result when glyphosate is allowed to contact the green tissues of the vine.
- Glyphosate can drift in windy conditions and, because it is systemic, can translocate within grapevines and kill the growing points.

Photo courtesy Wayne Mitchem

Chateau + Glyphosate Issue

- Movement of Chateau with glyphosate
  - Volatilization – NO!
  - Inversion – Yes!
- What causes an inversion?
  - Layer of cool surface air with warmer air in the immediate atmosphere
  - Most common occurrence
    - During calm periods
    - During the morning.

Prevention: *Tank mix Chateau with paraquat or Rely after vines leaf out. Neither of theses herbicides have been found to cause the same problem*

Chateau injury on apples

Slide courtesy Wayne Mitchem

Paraquat (Gramoxone)

- Herbicide (contact, non-selective)
- Drift from ground application
- Distorts young expanding leaves
- Yellow spots become tan to brown

Slide courtesy Bill Cline

Paraquat (Gramoxone) Injury

Photo Credit Annemiek Schilder, MSU Horticulture

At times this injury may look similar to black rot infections on leaves, but paraquat injury lacks the dark pycnidia (fruiting bodies) and the cream-colored center that occurs with black rot.

This injury typically results from spray drift, so the damage is most severe on leaves near the ground.

Gramoxone used for sucker control can girdle young vines

Slide courtesy Bill Cline

Gramoxone-injured trunk of 2-yr-old 'Carlos' vine (with bark removed to show damage)

Slide courtesy Bill Cline

In this instance, gramoxone applied to suckers was translocated up the vine, burning the leaf veins throughout the vine

Slide courtesy Bill Cline

Application Precautions to Minimize Grapevine Injury

- Both grape growers and nearby growers of other crops can take steps to reduce the risk of herbicide injury to grapevines:
  - Follow directions on product labels. Only use chemicals labeled for the intended use and only apply at recommended rates.
  - Avoid making herbicide applications during sensitive periods of grape growth and development or when plants are under drought or temperature stress.

Application Precautions to Minimize Grapevine Injury, cont.

- Don't use surfactants. They are not usually needed for increasing efficacy and they may increase injury to grapes.
- Don't spray if air temperature is predicted to be >80ºF during the day of application.
- Shielded sprayers may help reduce physical spray drift, though they won't affect volatility.
  - Use a shield mounted to a wand for backpack sprayer application or a commercial shielded sprayer such as a dome sprayer.
  - Use vine grow tubes to protect young vines from herbicide contact with green shoots.

Shield on this sprayer prevents herbicide from contacting young grapevines.

From Purdue University Coop Ext Service - http://www.ipmcenters.org/cropprofiles/docs/INgrapes.html

Application Precautions to Minimize Grapevine Injury, cont.

- You may also want to establish buffer zones or plant a wind break to reduce the drift reaching the vines.
- After vines leaf out, tank mix Chateau with paraquat or Rely instead of glyphosate to prevent movement into the vine and fruit.
- Glyphosate is registered for use in grapes; however, if not applied properly, severe damage can occur. To avoid injury, grape growers should observe the following guidelines:
  - Avoid glyphosate contact with any green parts of the vine or by drift.
  - If possible, avoid summer and fall applications when grapes are most susceptible to injury.
  - And, avoid glyphosate applications when shoots begin to trail.

Application Precautions to Minimize Grapevine Injury, cont.

- Make sure that spray tanks are cleaned after each use or purchase separate equipment for grape pesticide application so that residue from harmful chemicals doesn't mix with the sprays you're applying to your grapes.
- For home growers, do not use a combination fertilizer and weed killer on lawn areas near grapevines; the weed killer may be absorbed by the grape roots and injure the vine.

Final Herbicide Recommendations

- If chemical weed control is practiced in the vineyard, begin the weed management program with PRE-emergence herbicides and follow up with POST-emergence herbicides before bud break.
- In midseason, use a contact herbicide (not systemic) to treat weeds.
- If using 2,4-D in your vineyard, apply it before active shoot growth occurs, use low spray pressures, and be extremely careful to avoid treatment when weather conditions favor drift, such as during high temperatures, breezy conditions, and temperature inversions.

Fertilizer Burn

- Fertilizer burn may be from direct contact of the fertilizer with young tissue, improperly calculated application rates or over-fertilization, applying fertilizer during periods of drought stress, or excessive nitrogen levels (such as those found in raw poultry litter) or salt concentration.

Preventing Fertilizer Burn

- Placing the fertilizer in a circle of about 18 to 24 inches in radius should work well, or in bands along each side of the row at a similar distance from the plant.
  - Fertilizer may be broadcast applied in established muscadine vineyards.
- Care should be taken to avoid direct contact with the plant because nitrogen fertilizer has a great potential to "burn" the living tissue contacted.
- Be sure to follow recommended fertilizer rates as over-fertilization, especially during drought, may damage vines.

References

- *Muscadine Grapes.* FM Basiouny and DG Himelrick, eds. 2001.
  For ordering information visit http://www.ashs.org and click on Publications, then ASHS Press and search for "muscadines"
- *The North Carolina Winegrape Grower's Guide.* EB Poling, ed. 2007.
  http://www.cals.ncsu.edu/hort_sci/fruit/winegrapes.html
- *Nutrient Deficiencies and Toxicities of Plants* [CD]. APS Press. 2000.
- *Preventing Herbicide Drift and Injury to Grapes*. DA Ball, et al. 2004.
  http://extension.oregonstate.edu/catalog/pdf/em/em8860.pdf

Additional Resources

- Southern Region Small Fruit Consortium
  http://www.smallfruits.org/
  - IPM/Production Guides
  - Crops: Muscadine and Bunch Grape Production Guides, Marketing, Pest Management, Regional Experts
- NC Muscadine Grape Association
  http://www.ncmuscadine.org

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