The Basics of Vineyard Nutrition

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University of Maryland Extension
The Wine is Made in the Vineyard!
Vineyard Nutrition

GRAPEVINE NUTRITION

• Optimizing vine nutrient status
  – Soil testing
    • Pre-plant
      – Site history
    • Maintenance
  – Plant tissue analysis
    • Established vineyards
  – Visual, yield and quality assessments
    • Knowledge of common deficiency situations
  – Avoidance and correction of deficiencies
PLANT TISSUE ANALYSIS

**Tissue:** leaf petioles from leaves opposite cluster (VA)

**Timing:** Bloom (VA), mid-summer (PA); 70-100 days post-bloom (NY)

**Number:** 75-100

**Labs:** Multiple

**Interpretation:** Diagnostic samples related to nutrient sufficiency ranges that have been generated from similar tissues. There is some lab-to-lab variation in sufficiency ranges used.
**Vineyard Nutrition**

**Soil testing**

- **Proper sampling**
  - Area, depth, volume, handling
  - Send to lab for analysis
    - detail and cost will depend on lab and specific request

- **Results**
  - pH, buffer pH
  - Macro- and micro-nutrient availability (lbs/acre and ppm)
  - Cation Exchange Capacity (C.E.C.)
  - Base saturation percentage (Ca, Mg, and K, relative to CEC)
  - Organic matter (extra $?)
Soil Analysis

**Cornell Nutrient Analysis Laboratories**

New York State College of Agriculture and Life Sciences * A Statutory College of the State University
BNR Brattield Hall, Cornell University, Ithaca, NY 14850 * Telephone 607/255-4540 FAX 607/255-2644

<table>
<thead>
<tr>
<th>ID</th>
<th>SAMPLED</th>
<th>RECEIVED</th>
<th>REPORTED</th>
<th>CNTNT</th>
<th>ENG #:</th>
<th>SAMPLE ID</th>
<th>ACRE</th>
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<th>AGENTS PHONE</th>
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**ADDRESSES**

DRIVE PETTON
COUNTY OFF BLD
135 COURT ST
PIER UN NY 14527

**BACKGROUND INFORMATION**

<table>
<thead>
<tr>
<th>SOIL</th>
<th>SOIL ESTIMATION</th>
<th>CHIPS</th>
<th>SPECIAL NEEDS</th>
<th>MAPS</th>
<th>ANALYSIS</th>
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**PHOSPHORUS** (P % A): 23
**KALIUM** (K % A): 170
**MAGNESIUM** (Mg % A): 190
**CALCIUM** (Ca % A): 2570

**EXCITABILITY (W/10%)**

<table>
<thead>
<tr>
<th>Element</th>
<th>% A</th>
<th>Medium</th>
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<tr>
<td>Mn</td>
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<td>Zn</td>
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<td>Cu</td>
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</tr>
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<td>Mg</td>
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<tr>
<td>Ca</td>
<td>20</td>
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**LIME AND FERTILIZER RECOMMENDATIONS**

<table>
<thead>
<tr>
<th>1ST YEAR</th>
<th>VINEYARD GRAPE (SPV)</th>
<th>2ND YEAR</th>
<th>VINEYARD GRAPE (SPV)</th>
<th>3RD YEAR</th>
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<tbody>
<tr>
<td>Lime</td>
<td>(T/A)</td>
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<td>(T/A)</td>
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<tr>
<td>Phosphate</td>
<td>(P2O5 % A): 0</td>
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<td>(P2O5 % A): 0</td>
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<td>(P2O5 % A): 0</td>
</tr>
<tr>
<td>Potash</td>
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<td>Potash</td>
<td>(K2O % A): 150</td>
<td>Potash</td>
<td>(K2O % A): 150</td>
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</table>

1ST YEAR:
1. If old grass, sod, straw, or cover crop is to be plowed down, apply area of N before planting a month prior to planting.
2. Apply starter solution at transplanting and 0.25 x rate of calcium nitrate (0.04 oz) after foliage begins to develop.
3. Recommended amounts should be used and the soil test results should be adjusted accordingly.
4. Do not apply the recommended amount of N to the soil test results.
5. The rate of N should be adjusted to the soil test results.
6. The rate of P should be adjusted to the soil test results.
7. The rate of K should be adjusted to the soil test results.
8. Slit line application is recommended half to full in half.
How Soil pH Affects Availability of Plant Nutrients

<table>
<thead>
<tr>
<th>pH</th>
<th>Strongly Acid</th>
<th>Medium Acid</th>
<th>Slightly Acid</th>
<th>Very Slightly Acid</th>
<th>Very Slightly Alkaline</th>
<th>Slightly Alkaline</th>
<th>Medium Alkaline</th>
<th>Strongly Alkaline</th>
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<tr>
<td>4.0</td>
<td>Nitrogen</td>
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<tr>
<td>5.0</td>
<td>Phosphorus</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>6.0</td>
<td>Potassium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.0</td>
<td>Sulfur</td>
<td></td>
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<td></td>
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<tr>
<td>8.0</td>
<td>Calcium</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>9.0</td>
<td>Magnesium</td>
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<td>10.0</td>
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<td>Manganese</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Copper &amp; Zinc</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Boron</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Molybdenium</td>
<td></td>
<td></td>
<td></td>
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</tbody>
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## Vineyard Nutrition

### Soil pH and Lime addition*

<table>
<thead>
<tr>
<th>Soil pH</th>
<th>pH of 6.8 desired</th>
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<tbody>
<tr>
<td></td>
<td>Sand</td>
</tr>
<tr>
<td>4.8</td>
<td>4.25</td>
</tr>
<tr>
<td>5.0</td>
<td>4.0</td>
</tr>
<tr>
<td>5.5</td>
<td>3.0</td>
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<tr>
<td>6.0</td>
<td>2.0</td>
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<tr>
<td>6.5</td>
<td>1.25</td>
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*Addition of Lime in Tons/Acre
### Vineyard Nutrition

**Essential Nutrients for Grapevines**

<table>
<thead>
<tr>
<th>Obtained from air and water</th>
<th>Obtained from Soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon (C)</td>
<td>Nitrogen (N)</td>
</tr>
<tr>
<td>Hydrogen (H)</td>
<td>Phosphorus (P)</td>
</tr>
<tr>
<td>Oxygen (O)</td>
<td>Potassium (K)</td>
</tr>
<tr>
<td></td>
<td>Calcium (Ca)</td>
</tr>
<tr>
<td></td>
<td>Magnesium (Mg)</td>
</tr>
<tr>
<td></td>
<td>Sulfur (S)</td>
</tr>
<tr>
<td></td>
<td>Others (?)</td>
</tr>
<tr>
<td></td>
<td>Iron (Fe)</td>
</tr>
<tr>
<td></td>
<td>Manganese (Mn)</td>
</tr>
<tr>
<td></td>
<td>Copper (Cu)</td>
</tr>
<tr>
<td></td>
<td>Zinc (Zn)</td>
</tr>
<tr>
<td></td>
<td>Boron (B)</td>
</tr>
<tr>
<td></td>
<td>Molybdenum (Mo)</td>
</tr>
</tbody>
</table>
NITROGEN

• Required by vines
• Nitrogen can limit growth
  – Low organic matter soils
• Consequences of excess N
  – Excess vine vigor (mineral soils 1-4 % OM)
• Deficiency consequences
  – Reductions in vine vigor/yield
  – Fermentation problems, including ATA
NITROGEN ISSUES

• Assessing need
  – Visual means (vine size, leaf color, trellis fill)
  – Tissue analysis (timing, tissue, relationship to standards (total N assessed at bloom-time - sufficiency at 1.2 to 2.1% N with this timing)
  – Cane pruning weights (e.g., < 0.2 lbs/ft canopy)
SYMPTOMS OF NITROGEN DEFICIENCY
## Common nitrogen fertilizers

<table>
<thead>
<tr>
<th>Material</th>
<th>% N</th>
<th>Pounds of lime (CaCO₃) required to neutralize each lb of N</th>
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</thead>
<tbody>
<tr>
<td>Ammonium sulfate</td>
<td>21.0</td>
<td>5.35</td>
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<tr>
<td>Ammonium nitrate</td>
<td>34.0</td>
<td>1.80</td>
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<tr>
<td>Diammonium phosphate</td>
<td>21.0</td>
<td>3.60</td>
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<tr>
<td>Calcium nitrate</td>
<td>15.0</td>
<td>1.35</td>
</tr>
<tr>
<td>Potassium nitrate</td>
<td>13.0</td>
<td>2.00</td>
</tr>
<tr>
<td>Urea</td>
<td>46.0</td>
<td>1.80</td>
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</tbody>
</table>
Potassium

- Deficiency most apt to occur with high soil pH, under conditions of drought, and with young vines (small root system).
- Sufficiency range for bloom-sampled vines is 1.5 - 2.5%
- Concentration decreases with season - led to use of late-season (70-100 days post-bloom) sampling in NYS (Shaulis).
- High K may lead to high pH high TA wines
Potassium deficiency symptoms

TEMPRANILLO

CABERNET FRANC

VINCENT
Correction of K deficiency

- Pre-plant soil test: 150 to 200 lbs K/Acre (75 - 100 ppm) desired range (VT Rx)
- **Example** (conversion of ppm to lbs/acre of K$_2$O):
  - sample tests at 50 ppm K
  - Want 100 ppm
  - difference is 50 ppm $\times$ 2.4 = 121 lbs K$_2$O/acre
  - or 202 lbs KCl (60% K$_2$O)
  - or 242 lbs/acre of K$_2$SO$_4$ (50% K$_2$O)

Multiply ppm by 2 to obtain lbs/acre
EXAMPLES OF MAGNESIUM DEFICIENCY SYMPTOMS

Chardonnay: 0.19% Mg in petioles, Piedmont Vineyards, 1986

- Symptoms typically on basal to mid-shoot leaves
- More common with low soil pH (< 5.5)
- Impact on fruit yield and quality not well quantified.
Correction of Mg deficiency

- Pre-plant soil test: 96 to 168 lbs Mg/acre (48 - 84 ppm) desired range (VT Rx)
- **Example:**
  - Soil test shows 50 lbs/acre Mg and pH of 6.1
  - Rx: adjust pH with dolomitic lime to raise pH to 6.8. This is likely to bring Mg within recommended range
  - If pH acceptable, adjust Mg with MgSO$_4$ (300 lbs/acre [50 lbs MgO/acre])
Boron toxicity symptoms in Virginia (left) and Long Island (right)

Rx petiole boron range of 30 to 60 ppm; however, unlikely to see B deficiency symptoms above 20 ppm. Soils that test at < 0.3 ppm are typically associated with petiole B of < 30 ppm.
Example of commercial micronutrient (boron) fertilization recommendations, based on soil test results.

<table>
<thead>
<tr>
<th>Soil Test ppm</th>
<th>Application rate (lbs/ac)</th>
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<tbody>
<tr>
<td>0 – 0.3</td>
<td>VL</td>
</tr>
<tr>
<td>0.4 – 0.5</td>
<td>L</td>
</tr>
<tr>
<td>0.6 – 1.2</td>
<td>M</td>
</tr>
<tr>
<td>1.3 +</td>
<td>H</td>
</tr>
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</table>
Foliar Application of Nutrients

• Supplement to soil supply
• Where timing is critical
  – spring boron (annual on sandy soils)
  – post-harvest nitrogen
• Examples
  – nitrogen
  – magnesium
  – boron
“Wine Makes daily living easier, less hurried, with fewer tensions, and more tolerance.”

Benjamin Franklin
Joseph A. Fiola, Ph.D.
Specialist in Viticulture and Small Fruit
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