Nitrogen fertilization materials, rates and timing

Larry Stein, Texas A & M AgriLife Extension Service
Nitrogen deficiency
Fertilizers

• Not miracle products
• Nutrition is just one of the components of a sound production program
Fruit Nutrition

• 20 essential chemical elements
• C, H, O, and N – 95% of plant solids
• Other 16
Other 16 Nutrients

- P
- K
- S
- Ca
- Mg
- Fe
- Mn
- Cu
- Zn
- B
- Cl
- Mo
- Co
- Na
- Si
- V
Nitrogen- The Key Element in Striking the Fruiting/Vegetative Balance

Needed for amino acids and proteins

Essential for Chlorophyll
Critical Characteristics of Nitrogen

• Very Mobile in Soils (neg. charge)
• Very Mobile in Plants
• Soils Typically Very Low in Nitrogen
• Native Nitrogen in Soils Consists of:
  – Complex, Insoluble Unavailable Organic Compounds
  – Simple, More Soluble, Available Compounds in Soil Solution
Nitrogen is Universally Low in Our Soils

SOIL ANALYSIS

<table>
<thead>
<tr>
<th>ACIDITY</th>
<th>PH</th>
<th>ACIDICITY</th>
<th>NITRATE-</th>
<th>PHOSPHORUS</th>
<th>POTASSIUM</th>
<th>CALCIUM</th>
<th>MAGNESIUM</th>
<th>SALINITY</th>
<th>ZINC</th>
<th>IRON</th>
<th>MANGANESE</th>
<th>COPPER</th>
<th>SODIUM</th>
<th>SULPHUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>MILKY</td>
<td>7.9</td>
<td>LOW</td>
<td>4.8</td>
<td>411.8</td>
<td>49072.5</td>
<td>847.2</td>
<td>289.2</td>
<td>HIGH</td>
<td>NONE</td>
<td>LOW</td>
<td>HIGH</td>
<td>HIGH</td>
<td>LOW</td>
<td>HIGH</td>
</tr>
<tr>
<td>ALKALINE</td>
<td>5.6</td>
<td>LOW</td>
<td>4.8</td>
<td>211.8</td>
<td>49072.5</td>
<td>847.2</td>
<td>289.2</td>
<td>HIGH</td>
<td>NONE</td>
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<td>LOW</td>
<td>HIGH</td>
</tr>
</tbody>
</table>

(PPM X 2 = LBS/ACRE 6 INCHES DEEP)

CROP AND YIELD RANGE: MINIMUM REQUIREMENT: WARM SEASON PERENNIAL GRASS

SUGGESTED FERTILIZER RATE LBS/A: 30 - 0 - 0

APPLY PREPLANT.

MINIMUM REQUIREMENTS FOR ESTABLISHING VEGETATIVE CONSERVATION COVER.

FURTHER INFORMATION AND ASSISTANCE CAN BE OBTAINED FROM YOUR COUNTY EXTENSION AGENT:

BILL BODNAR
95 FREDERICK RD
FREDERICKSBURG TX. 78624
General rule of thumb - usually just need N

- Poorer soils - K, Mg, Mn, Fe, Zn and B may develop
- P, Ca, S and Cu deficiencies are rare
N Deficiency

- Pale green to yellow leaves
- Red to brown spots
- Restricted shoot growth
## Practical Nitrogen Sources

<table>
<thead>
<tr>
<th>Material</th>
<th>%N</th>
<th>Salt Index*</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anhydrous Ammonia (NH₃)</td>
<td>82</td>
<td>47</td>
<td>Very volatile Liquid/Gas</td>
</tr>
<tr>
<td>Urea (NH₂-CO-NH₂)</td>
<td>46</td>
<td>75</td>
<td>Volatile Dry Material</td>
</tr>
<tr>
<td>Ammonium Nitrate (NH₄NO₃)</td>
<td>34</td>
<td>105</td>
<td>Dry Material Less Volatile</td>
</tr>
<tr>
<td>Nitrogen Solutions (UAN) Urea +NH₄NO₃ + water</td>
<td>28-32</td>
<td>74</td>
<td>Volatile, Usually Injected in Drip</td>
</tr>
<tr>
<td>Ammonium Sulfate (NH₄)₂SO₄</td>
<td>21</td>
<td>69</td>
<td>Volatile on High pH soils</td>
</tr>
</tbody>
</table>

* Compared to Sodium Nitrate (=100)
Manures - Be Cautious

• Little Control on Nitrogen Availability to the trees

• Weed Seed Contamination?

• Potential High Salt Content
Keys to Nitrogen Management

• Promote Growth Early in the Season
• Maintain Healthy Canopy Until First Frost
• Small, Frequent Applications Most Economical
• Use Caution on Young Vines
• Foliar Applications May Have Value Post-Harvest
Nitrogen Fertilizer Timing & Placement

- **Broadcast** First Application in Spring? (Rainfall Dependent)

- Make Nutrients Available to As Many Roots As Possible
Determining Nitrogen Needs

- Petiole Sampling at Bloom
- Sample Correctly
  - 50-100% Bloom
  - Subtending Leaf of Medial Cluster; opposite the cluster
Tissue & Timing?

- Yields Are Usually Suppressed Even Before Nitrogen Deficiency Symptoms are Evident
- Nitrogen Levels Between Bloom and Veraison Fluctuate Greatly Between Sites, Varieties and Between Vines
- N Levels in Leaf Blade Varies More Greatly than That in Leaf Petioles
Best Guide For Analyzing Nitrogen Program in Bearing Vines?

1.) Trellis Fill

2.) Leaf Color

3.) Leaf Retention Post-Harvest
Nitrogen Deficiency
Nitrogen Fertilizer Timing & Placement

• Summer Applications May Be Best Applied Through Drip System

• Small, Frequent Doses are Most Cost Effective
Foliar Nitrogen Fertilization

• Remember, Nitrogen is a MACRO Nutrient
• May Make Sense in the Fall to Simply Maintain a Healthy Canopy
• Feed Grade Urea
  – 5 lbs. per 100 gallons
What Tools Do We Have to Manage Grapevine Vigor?

- Water
- Weed Control
- Pruning/Crop Control
- Rootstocks
- Nitrogen
Situations to Avoid

• **High Nitrogen Applications in Vineyards Still At Risk From Frost**
  
• **Excessive N Status at Bloom**
  – Shatter
  – Poor Flower Bud Initiation
Situations to Avoid

• Over Fertilize Naturally Vigorous Varieties or RS/Variety Combinations

• Being Unprepared to Manage Weed Growth
Effect of N Source on Ammonia Volatilization

<table>
<thead>
<tr>
<th>Fertilizer Source Reaction Product</th>
<th>% of NH$_4^+$ volatilized</th>
</tr>
</thead>
<tbody>
<tr>
<td>(NH$_4$)$_2$SO$_4$ CaSO$_4$</td>
<td>58%</td>
</tr>
<tr>
<td>(NH$_4$)$_2$HPO$_4$ CaHPO$_4$</td>
<td>40%</td>
</tr>
<tr>
<td>NH$_4$NO$_3$ CaNO$_3$</td>
<td>15%</td>
</tr>
<tr>
<td>NH$_4$Cl CaCl$_2$</td>
<td>10%</td>
</tr>
</tbody>
</table>
Ammonia Volatilization

Occurs when:

2) Ammonium fertilizer is surface applied to calcareous soils. (e.g., ammonium sulfate)

\[(\text{NH}_4)_2\text{SO}_4 + \text{CaCO}_3 \rightleftharpoons \text{CaSO}_4 + \text{NH}_3 + \text{CO}_2\]

- Controlled by the solubility of the Ca reaction product.
- Influenced by soil moisture content which promotes reaction.
- Managed by incorporation (≥1 inch sufficient to significantly reduce potential for loss).

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Ammonia Volatilization

Occurs when:

3) Urea is surface applied to any soil.

\[
\text{(NH}_2\text{)}_2\text{CO} + \text{H}_2\text{O} \xrightarrow{\text{Urease}} \text{(NH}_4\text{)}_2\text{CO}_3
\]

\[
\text{(NH}_4\text{)}_2\text{CO}_3 \xleftrightarrow{} \text{CO}_2 + \text{H}_2\text{O} + \text{NH}_3 \uparrow
\]

- Soil moisture conditions important in promoting reaction, losses minimal in dry soils.
- Temperature important in increasing evaporation and microbial activity, loss minimal below 50 F.
- Loss potential greater from high pH soils, due to formation of NH\(_4\) in acid soils.
Effect of pH On Volatilization Loss of NH$_3$
From Surface Applied Urea

% NH$_3$ Loss

Soil pH

5.0 5.5 6.0 6.5 7.0 7.5

9 13 19 27 38 52

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Precautions for Efficient Use

Volatilization of Ammoniated Fertilizers

\[ \text{NH}_4^+ \rightarrow \text{NH}_3 \uparrow \]

Potential Loss

Urea 35%
- surface applied to any soil

Ammonium sulfate 25%

Ammonium nitrate 7%
- surface applied to calcareous soil
Effect of Urea Fertilizer Placement on NH₃ Volatilization

<table>
<thead>
<tr>
<th>Depth</th>
<th>Nitrogen Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>“On Surface”</td>
<td>20%</td>
</tr>
<tr>
<td>1/4 inch</td>
<td>15%</td>
</tr>
<tr>
<td>1/2 inch</td>
<td>12%</td>
</tr>
<tr>
<td>1-1/2 inch</td>
<td>6%</td>
</tr>
</tbody>
</table>

*Rainfall/irrigation (≥ 0.25”) also can accomplish incorporation.

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