Developing a Nutrition Management Plan for Your Field or Vineyard

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Budgeting is a Fundamental Component in Crop Management:

• Applied resources such as nutrients can and should be managed through budgeting
  – To optimize resource use efficiency
  – To minimize resource loss to the environment
  – To conserve resources

• Management plans and good record keeping provide organization and the ability to learn from past experience
Nutrition budgeting fundamentals - nutrient supply:

- Plants get most of their nutrients from the soil solution.
- The availability of mineral nutrients in the soil solution over time is affected by physical, chemical, and biological soil factors.
- Efficient long-term budgeting optimizes use of mineral nutrient resources present in the soil.
- Our ability to monitor mineral nutrient supply is limited to snap shot lab analysis results.
Nutrition budgeting fundamentals - nutrient acquisition:

- Plants take in most of their nutrients through roots.
- Anything limits root growth and function will limit nutrient uptake.
- Mineral uptake capabilities vary over the course of a growing season.
- Mineral nutrient uptake involves both passive and active processes to varying degrees.
- For perennial crops: rootstock influences...
Nutrition budgeting fundamentals - nutrient demand:

- Plant growth and development drives mineral demand
- Plant growth and development depends on growing conditions - heat, sunlight, water, etc
- It also depends on crop phenology
- Usually, the harvested crop represents the greatest nutrient loss from a field
- Therefore, it is often proportionate to the requirement for applied mineral nutrients
What are the basic elements of a nutrition management plan?

- Management goals for the field or block
- Estimate plant nutrient demand
- Appraisal of mineral nutrient supply
- Nutrient applications required to achieve goals
- Nutrient economy monitoring guidelines
- Constructing a nutrient management budget and plan for the field or block
Developing a Nutrition Management plan: Start with Goals

What are your management goals?

• What is your target yield?
• What are your crop growth and quality requirements?
• Do you have a financial budget for nutrients?
• Do you need to root zone issues regarding supply?
• Are there root growth and activity concerns?
Estimating Nutrient Demand for Management Unit - Field or Block

- Biomass per acre is proportionate to the plant population density
- Crop phenology: seasonal growth drives seasonal demand
- Replacement of nutrients removed with the harvested crop
Appraising The Mineral Nutrient Supply

• Soil Analysis
  • Potentially available nutrients: those commonly reported = extracted nutrients
  • Readily available nutrients: soluble nutrients
• Contributions from soil amendments/cover crops
• Contributions from irrigation water
• For perennial crops, contributions of stored nutrient reserves in woody tissues
Nutrient Applications Required to Achieve Goals

• Assuming sound management with minimum nutrient loss the environment:

• Total nutrient requirement = nutrients in harvested crop - available nutrients

• Schedule applications to meet demand for growth and development (e.g. size & quality)
Nutrient Economy Monitoring Guidelines

• Supply monitoring
  • Soil analysis
  • Irrigation water analysis
  • Soil amendment analysis
  • Fertilizer analysis

• Demand monitoring
  • Visual observations of plant condition
  • Plant tissue analysis
Creating a nutrition management plan/budget – putting it altogether

• The plan might have the following components
  • Stated goals and keys to success
  • Historical records of yields and inputs
  • Nutrient sources considered
  • Estimated application schedule and method for nutrient inputs = the nutrient budget
  • Financial budget
  • Monitoring locations and guidelines
  • Timetable for plan review
On-Site Mineral Resource Consideration
Consider making optimum use of on-site mineral nutrient resources

- Agricultural soils contain substantial quantities of mineral nutrients, but most are unavailable to plants
- Steps for optimizing the availability of on-site nutrient sources
  - Add mineral amendments as needed to neutralize pH
  - Regularly add organic amendments
Small increases in OM make large & varied contributions

- Promote nutrient release from minerals
- Serve as a source of mineral nutrients
- Enhance the root environment
- Conserve topsoil & its fertility
- Buffer the supply of mineral nutrients
- Impart resistance to large chemical changes
- Suppress root damaging organisms
- Increase uniformity in the mineral nutrient supply
Example Mineral Nutrient Budget for Wine Grapes
Mineral Nutrient Management Plan Example - Primary Goals, Wine Grapes

• Location = the Sierra Foothills
• Target yield = 3.5 tons/acre
• Optimize wine grape quality
  • Balanced growth
  • Fruit exposure to intermittent &/or dappled sunlight
  • Timely fruit ripening
• Maximize use of on-site nutrient resources using a cover crop as a source organic matter
Mineral Nutrient Management Plan
Example - Secondary Goals

- Optimize soil conditions for root growth and function, including nutrient uptake
- Promote a supply of mineral nutrients in the soil solution that is balanced with internal vine demand
- Ensure vines are well nourished during all developmental stages
# Fruit Nutrient Content at Harvest

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Average (lb/ton)</th>
<th>High (lb/ton)</th>
<th>Low (lb/ton)</th>
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<tbody>
<tr>
<td>N</td>
<td>2.92</td>
<td>4.12</td>
<td>1.80</td>
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<tr>
<td>P</td>
<td>0.56</td>
<td>0.78</td>
<td>0.44</td>
</tr>
<tr>
<td>K</td>
<td>4.94</td>
<td>7.38</td>
<td>3.18</td>
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<tr>
<td>Ca</td>
<td>1.00</td>
<td>1.86</td>
<td>0.34</td>
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<tr>
<td>Mg</td>
<td>0.20</td>
<td>0.32</td>
<td>0.10</td>
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</table>

Source: Mullins, et. al. (1992)
Seasonal Mineral Nutrient Demand

Foliage Growth

Fruit Development

BERRY GROWTH CURVE

FOLIAGE GROWTH CURVE

BLOOM

VERAISON

HARVEST
Designing an In-Season Fertilization Budget

- Start with nitrogen (N)
  - N is a growth accelerator
  - Improper N application will have adverse effects on soils & crops
- Use N-P-K formulations to balance P & K, if possible
- Use calcium nitrate with N-P-K to regulate soil pH
- Apply supplemental calcium & magnesium as needed
- Beware of quantities of applied sulfate & chloride
Example Fertigation Plan for Wine Grapes in the Sierra Foothills

<table>
<thead>
<tr>
<th>Fertigation Period</th>
<th>Fertilizer Formulation</th>
<th>Fertilizer/ Acre</th>
<th>N</th>
<th>P</th>
<th>S</th>
<th>K</th>
<th>Ca</th>
<th>Mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoot</td>
<td>3-12-14-4(S) CN 9</td>
<td>4 gal, 1.3 lb/ac</td>
<td>2.3</td>
<td>1.8</td>
<td>5.1</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Emergence</td>
<td></td>
<td>0 gal, 0.0 lb/ac</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td>4 gal, 1.3 lb/ac</td>
<td>2.3</td>
<td>1.8</td>
<td>5.1</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Post bloom</td>
<td>3-12-14-4(S) CN 9</td>
<td>5 gal, 1.7 lb/ac</td>
<td>2.9</td>
<td>2.3</td>
<td>6.4</td>
<td>0.0</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 gal, 2.2 lb/ac</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>2.7</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td>7 gal, 3.8 lb/ac</td>
<td>2.9</td>
<td>2.3</td>
<td>6.4</td>
<td>2.7</td>
<td>0.1</td>
<td>0.0</td>
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<tr>
<td>Post Harvest</td>
<td>3-12-14-4(S) CN 9</td>
<td>7 gal, 2.3 lb/ac</td>
<td>4.1</td>
<td>3.2</td>
<td>9.0</td>
<td>0.0</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 gal, 2.2 lb/ac</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>2.7</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td>9 gal, 4.5 lb/ac</td>
<td>4.1</td>
<td>3.2</td>
<td>9.0</td>
<td>2.7</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>SEASONAL TOTAL</td>
<td></td>
<td>20 gal, 9.6 lb/ac</td>
<td>9.3</td>
<td>7.2</td>
<td>20.6</td>
<td>5.4</td>
<td>0.2</td>
<td>0.0</td>
</tr>
</tbody>
</table>
Thank You