Strawberry nutrient management

Thanks to:
California Strawberry Commission
Community Foundation for Monterey County
Cooperating growers
2009-11 strawberry nutrient management projects:

- Survey of > 50 ‘Albion’ fields in the Watsonville-Salinas and Santa Maria areas to reset leaf and petiole nutrient diagnostic levels
- Monitoring of irrigation and fertility practices in 26 fields in the Watsonville-Salinas area
- Measurement of nutrient uptake in 10 fields of day-neutral berries
Tissue analysis:

- Leaf and petiole samples collected 5 times from early spring through early fall; macro- and micronutrient concentrations measured.
- Nutrient ‘optimum ranges’ determined through DRIS analysis (a system that mathematically compares high yield and low yield fields).
DRIS leaf ‘optimum ranges’:

High yield, nutritionally balanced fields
DRIS leaf ‘optimum ranges’:  
- Mid-season leaf N lower than existing UC recommendations  

--- = Existing UC ‘critical level’  

High yield, nutritionally balanced fields
DRIS leaf ‘optimum ranges’:  
- Mid-season leaf N lower than existing UC recommendations  
- P and K much higher, indicates that current fertilizer rates are probably much higher than necessary

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= Existing UC ‘critical level’

High yield, nutritionally balanced fields
DRIS petiole ‘optimum ranges’:
- More highly variable than leaf values, especially NO$_3$-N
- P and K currently maintained at high levels

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= Existing UC ‘critical level’

High yield, nutritionally balanced fields
DRIS micronutrient ‘optimum ranges’:
- Agree with prior UC recommendations, except for zinc

<table>
<thead>
<tr>
<th></th>
<th>DRIS optimum range</th>
<th>Prior UC recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Ca</td>
<td>1.0 - 2.2</td>
<td>0.4 - 2.7</td>
</tr>
<tr>
<td>% Mg</td>
<td>0.28 - 0.42</td>
<td>0.3 - 0.7</td>
</tr>
<tr>
<td>% S</td>
<td>0.15 - 0.21</td>
<td>&gt; 0.10</td>
</tr>
<tr>
<td>PPM B</td>
<td>40 - 70</td>
<td>35 - 200</td>
</tr>
<tr>
<td>PPM Zn</td>
<td>11 - 20</td>
<td>20 - 50</td>
</tr>
<tr>
<td>PPM Mn</td>
<td>65 - 320</td>
<td>30 - 700</td>
</tr>
<tr>
<td>PPM Fe</td>
<td>85 - 200</td>
<td>50 - 3,000</td>
</tr>
<tr>
<td>PPM Cu</td>
<td>2.6 - 4.9</td>
<td>3 - 30</td>
</tr>
</tbody>
</table>
Determination of nutrient uptake by strawberry:

- Monthly whole plant samples collected from day-neutral cultivars - 7 fields in Watsonville-Salinas, 3 in Santa Maria

- Nutrient uptake in fruit estimated from commercial yield and fruit nutrient concentration
strawberries have limited N uptake until fruiting starts; by first harvest, cumulative crop N uptake typically about 30 lb / acre
from that point forward, N uptake averages about 1 lb / acre / day
over the season, total crop N uptake approximately 180-240 lb / acre (including runners, roots and cull fruit)
Approximate N / P / K uptake for a 30 ton/acre crop:

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>P</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant</td>
<td>110</td>
<td>20</td>
<td>90</td>
</tr>
<tr>
<td>Fruit</td>
<td>90</td>
<td>20</td>
<td>140</td>
</tr>
<tr>
<td>Total</td>
<td>200</td>
<td>40</td>
<td>230</td>
</tr>
</tbody>
</table>

Each ton of fruit contains approximately:
- 2.5 lb N
- 4.0 lb K
- 0.6 lb P
Fertilization practices:

40 commercial fields in Watsonville-Salinas and Santa Maria

<table>
<thead>
<tr>
<th></th>
<th>Ave</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preplant</td>
<td>106</td>
<td>24</td>
<td>234</td>
</tr>
<tr>
<td>Fertigated</td>
<td>93</td>
<td>3</td>
<td>304</td>
</tr>
<tr>
<td>Total</td>
<td>200</td>
<td>118</td>
<td>424</td>
</tr>
</tbody>
</table>
How about P and K?

- Soil tests are not guiding fertilization decisions
Preplant fertilization:

- how to handle controlled release fertilizer (CRF)?
  - what release characteristic best fits the plant uptake?
  - how much preplant vs. in-season fertigation?
- Manufacturers’ CRN release ratings are pretty good estimates of field behavior.
- Soil temperature affects release rate (Sept - Oct release higher than Jan - Feb).
- There is an unavoidable mismatch in CRF N release and strawberry N uptake.
Example:
- An 6-8 month release product applied at 150 lb N / acre in mid-September will likely have released *at least* half the N by mid January
- Crop uptake by mid January likely to be no more than 30-40 lb N/acre
So, how to handle preplant CRF?

- A modest amount of CRF is a reasonable protection against loss of soil nitrate by irrigation for crown establishment, or from winter rain.
- The faster the release rating, the greater the mismatch between N release and crop uptake.
How to handle fertigation?

- Once fruit harvest begins, crop N uptake is quite consistent, so fertigation should be as well.
- Because berry N uptake is slow, a large soil nitrate reserve is not needed - the majority of monitored berry fields were maintained at < 10 PPM soil NO₃-N during the harvest season.
In summary:

- Updated strawberry tissue nutrient diagnostic levels are now available.
- Strawberry nutrient uptake pattern is clear and dependable.
- Potential for NO$_3$-N leaching loss is greatest during the winter.