Development of Leaf Sampling Methods and Nutrient-budget fertilization

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Objectives
• Determine variation in leaf nutrient status between sites, within tree canopy and throughout the year
• Develop a phenology and yield based nutrient model for almond
• Develop fertilizer response curves for fertigation systems
• Determine nutrient use efficiency of various N and K rates and sources

Methods

Variability assessment
Four representative orchards
Belridge (Kern), Madera (Madera), Modesto (Stanislaus), Arbuckle (Colusa); 54 trees

Fertigation trial at Belridge (Kern County)
Samples taken 5 times during the season for four years (3 completed). Samples analyzed for N, P, K, B, Zn, Ca, Mn, Mg, Fe, S, Cu at UC Davis DANR lab

Table 1. In Season Prediction using N-P-K-Ca from F2 leaves collected in April 2009. Model selected through Stepwise method using RMSE criteria. R² = 0.62 RMSE = 0.12

<table>
<thead>
<tr>
<th>Site</th>
<th>Real F2 Nitrogen (%) in July 2009</th>
<th>Predicted F2 Nitrogen (%) in July 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arbuckle</td>
<td>1.86</td>
<td>1.99</td>
</tr>
<tr>
<td>Arbuckle</td>
<td>2.06</td>
<td>2.03</td>
</tr>
<tr>
<td>Arbuckle</td>
<td>1.62</td>
<td>1.87</td>
</tr>
<tr>
<td>Belridge</td>
<td>2.36</td>
<td>2.21</td>
</tr>
<tr>
<td>Belridge</td>
<td>2.18</td>
<td>2.06</td>
</tr>
<tr>
<td>Belridge</td>
<td>2.06</td>
<td>2.23</td>
</tr>
<tr>
<td>Madera</td>
<td>2.28</td>
<td>2.17</td>
</tr>
<tr>
<td>Madera</td>
<td>1.95</td>
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<tr>
<td>Modesto</td>
<td>2.39</td>
<td>2.35</td>
</tr>
</tbody>
</table>

Results

Variability Assessment
• Leaf samples collected from fruiting spurs are more sensitive than non fruiting spur leaves in predicting July leaf N
• Model selecting techniques allow accurate N prediction early in the season (Table 1)
• Leaf nutrient concentrations follow a similar patterns between season and between locations (Fig. 1)
• Mg and Ca concentrations are closely associated with leaf age and/or water use (Fig. 1)

Fertigation Trial

Data for two sampling seasons have been fully evaluated, two additional years of data collection are planned.

• There is significant N treatment effect on yield and fruit nitrogen removal in 2009 (Fig. 2)
• Remobilization of N from fruit to perennial parts was observed after hull split (Fig. 2)
• Fruit K removal is > N removal in all treatments however no significant effect of K rate on yield been detected (Fig. 3)
• Nitrogen efficiencies of 50 to > 75% have been observed in this trial.

Preliminary conclusions

Results presented here represent only part of a long-term experiment and must be interpreted with caution.

• Substantial variability in nutrient concentrations within field, between field and within trees was observed.
• Data from fruiting spur leaves suggest that selection of these leaves is superior to selection of non fruiting spur leaves.
• Significant N remobilization from fruit to tree at fruit maturity may contribute to spur health and survival. The significance of these findings is being examined.

Acknowledgments
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