In-field plant monitoring as a tool for N management in small grains

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Why should we care about site-specific N management in small grains?
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**N costs as a proportion of material costs in wheat**

- Nitrogen Costs ($84/A): 37%
- Other Material Costs ($50/A): 63%

*Based on 2008 UCCE Cost Study for irrigated wheat in Sac. Valley

**N costs as a proportion of total, direct operating costs in wheat**

- Nitrogen Costs ($100/A): 28%
- Other Costs ($251/A): 72%

*Based on 2008 UCCE Cost Study for irrigated wheat in Sac. Valley*
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**Effect of 50lb N topdress at flowering**

- **50lb @ Flowering**
- **No Flowering topdress**

Δ protein = 1.8 ± 0.8%;
Net value = $50-100/acre*

*For $7.50/bu wheat with $0.01/ lb premium or discount / % above or below target (11%).
What tools are available to assist in real-time N management in small grains?
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FieldScout GreenIndex+ Nitrogen App and Board
$49.00 - $99.99
What tools are available to assist in real-time N management in small grains?
Background: Spring wheat production in California

- Season (November to June) coincides with the rainfall (Mediterranean climate)
- Irrigation varies by region:
  - More opportunistic in the northern part of the state
  - More of a given in the southern part of the state
- Many growers split N applications between sowing and tillering-stem elongation
  - Total rates: 120 – 225 lb acre\(^{-1}\)
Demand for N by irrigated wheat in the Sacramento Valley (7500 lb/acre; 11.5% protein)
Fertilizer N contributions to wheat yield and protein content

Image courtesy: S. Orloff
Proximal sensing devices

atLEAF chlorophyll meter
• SPAD proxy (660 and 940 nm)
• Suitable proxy for yield leaf N concentration?
• Retail: $250

Trimble Greenseeker handheld
• NDVI (660 and 770 nm)
• Suitable proxy for yield potential?
• Retail: $500
Methods: Crop environments

<table>
<thead>
<tr>
<th>Fertilizer treatments</th>
<th>PREPLANT % of N fertilizer applied</th>
<th>TILLERING 0 - 100%</th>
<th>BOOT 0 - 50%</th>
<th>FLOWERING 0 - 20%</th>
<th>TOTAL 0 - 335 kg/ha</th>
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Field 1: fully irrigated
Field 2: not irrigated, supplemental irrigation

Field 1: Variety: hard white
Field 2: Variety: hard red

Field 1: Soil: Entisol, preplant NO3-N = 1 ppm, 0 - 60 cm
Field 2: Soil: Alfisol, preplant NO3-N = 10 ppm, 0 - 60 cm

Gradients (HIGH to LOW):
- Nitrogen availability
- Water availability
Results: Calibration

**Flowering reading and N applied**

- **AtLeaf chlorophyll index**
- **N fertilizer (kg / ha)**

- Field 1, fully irrigated
- Field 2, supplemental irrigation
- Field 2, not irrigated

**Greenseeker NDVI**

- **N fertilizer (kg / ha)**

- Field 1, fully irrigated
- Field 2, supplemental irrigation
- Field 2, not irrigated

Images of equipment used in the experiment.
Results: Calibration

Flowering reading and N applied

AtLeaf chlorophyll index vs N fertilizer (kg/ha)

Field 1, fully irrigated
Field 2, supplemental irrigation
Field 2, not irrigated

Greenseeker NDVI vs N fertilizer (kg/ha)

Field 1, fully irrigated
Field 2, supplemental irrigation
Field 2, not irrigated
Results: Calibration

Flowering reading and protein outcome

- AtLeaf chlorophyll index vs Protein (%)
  - Field 1, fully irrigated
  - Field 2, supplemental irrigation
  - Field 2, not irrigated

- Greenseeker NDVI vs Protein yield (kg/ha)
  - Field 1, fully irrigated
  - Field 2, supplemental irrigation
  - Field 2, not irrigated
Results: Decision support

Combined sensor indication of response

Protein yield (kg/ha)

Greenseeker (H/L) AtLeaf (H/L) Late N (Y/N)
Results: Decision support

Combined sensor indication of response

Protein (%)

Greenseeker (H/L)  AtLeaf (H/L)  Late N (Y/N)
1 2 3 4 5 6 7

≈ $40/acre

≈ $50-100/acre
Summary

1. The use of in-field sensors provided actionable, real-time information as to the protein and protein-yield outcomes of the crop.

2. Combining information from more than one sensor resulted in additive information that improved the in-season ability to predict outcome.

3. More work is needed to validate these results and explore whether other in-field measures can add valuable information.
DYI calibration?

Image courtesy: Oklahoma State University
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Thank you!

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