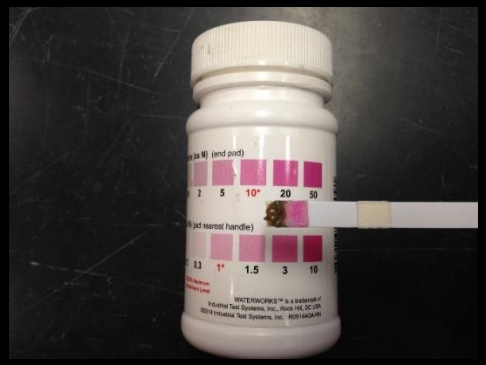
In-season, in-field N fertilization decision making for wheat



Mark Lundy, Steve Wright, Bob Hutmacher, Nicholas Clark, Steve B. Orloff

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Background: Nitrogen-related management in CA spring wheat

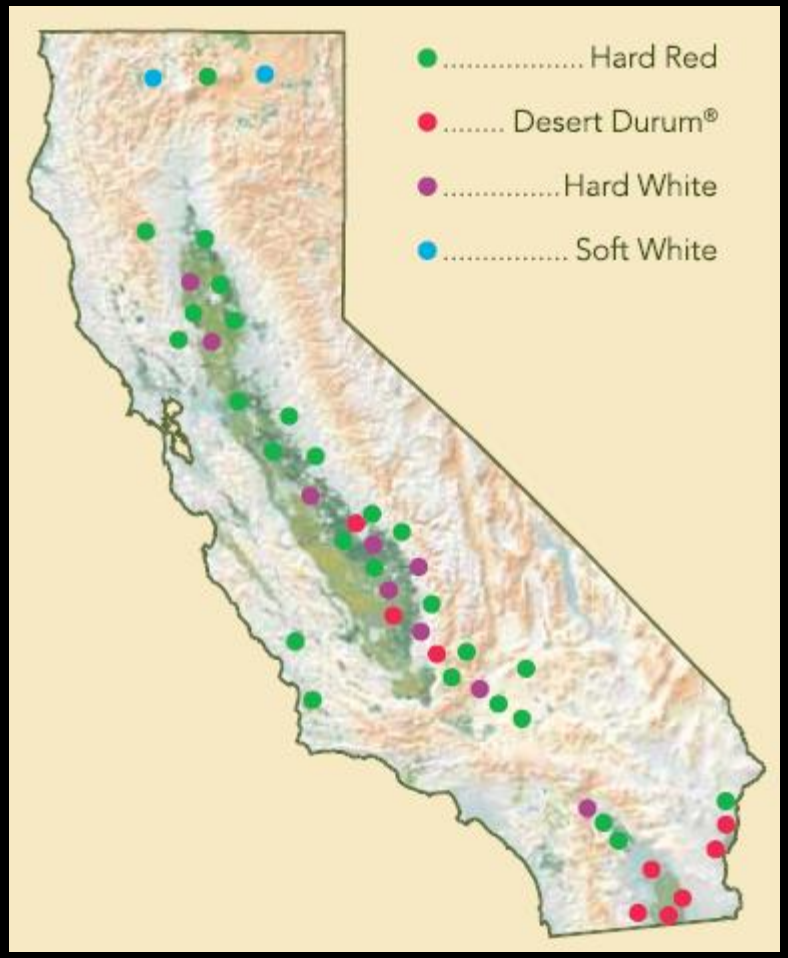
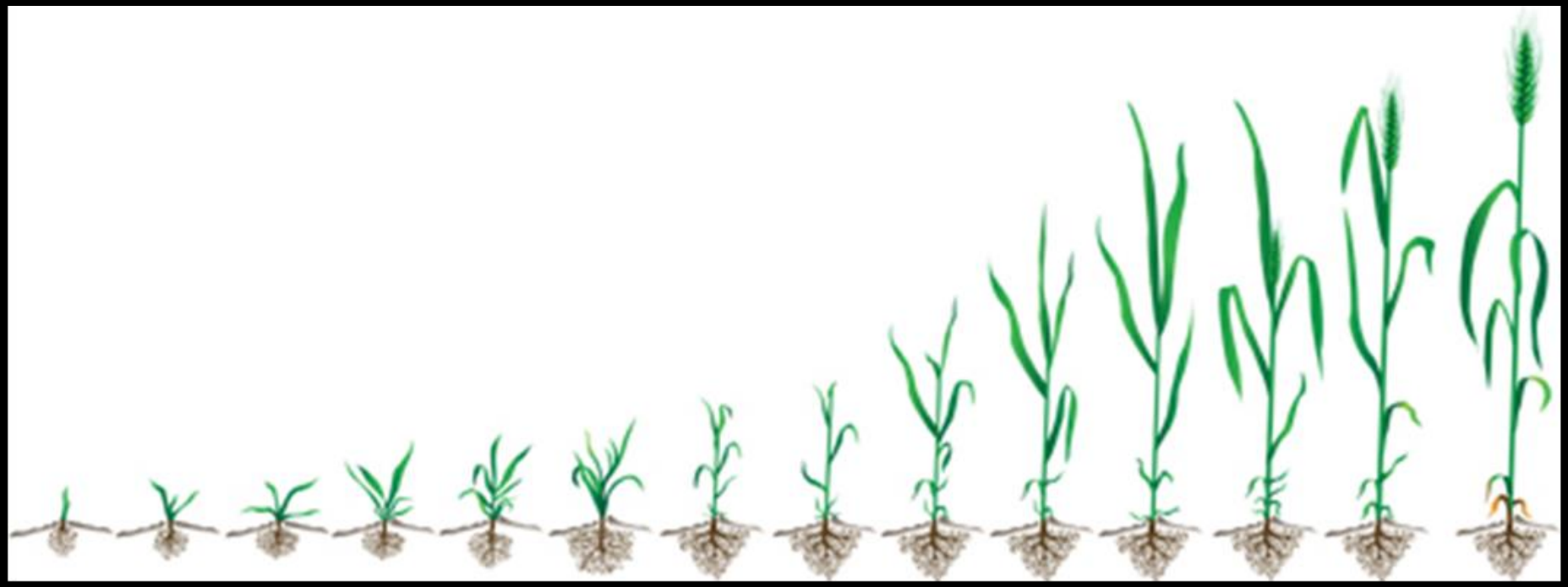


Image courtesy: California Wheat Commission

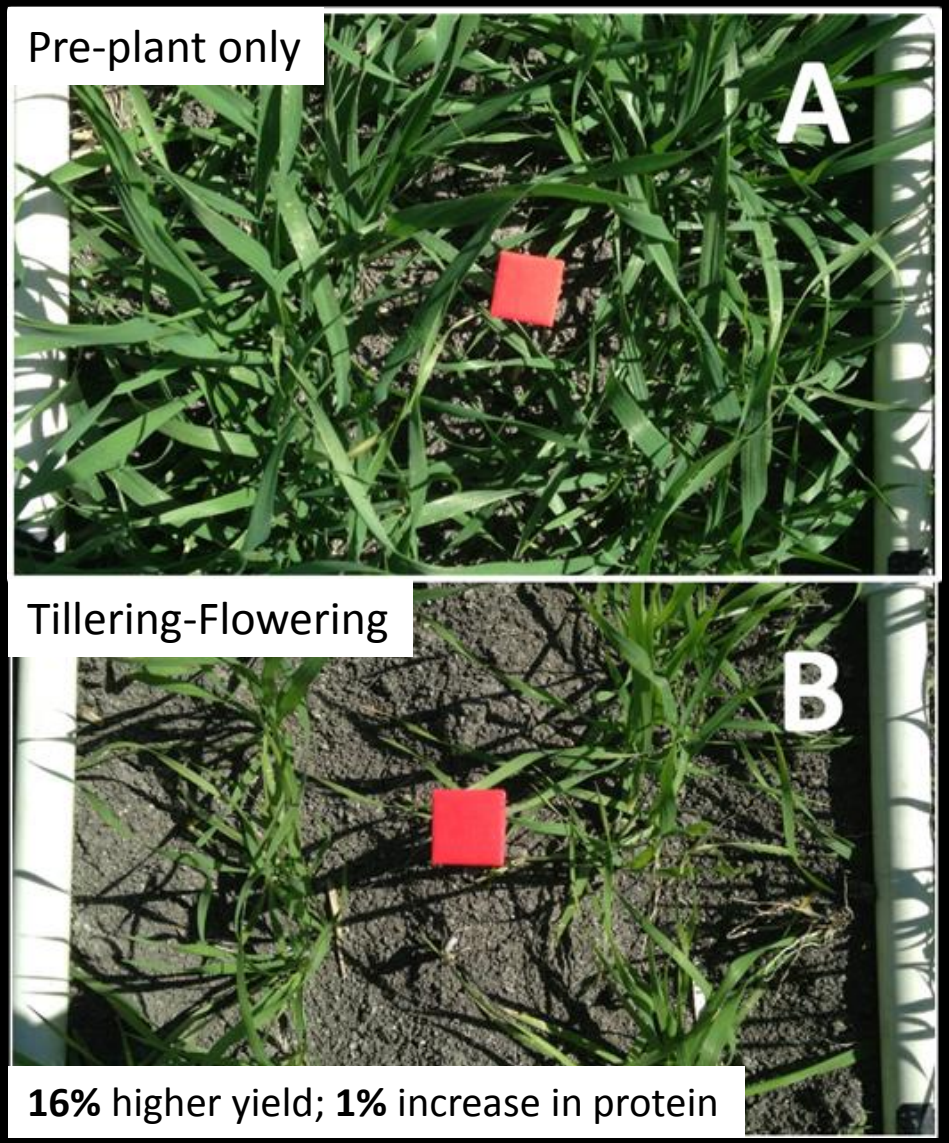
- N and water interact
  - Irrigation varies by region:
    - Opportunistic in the Sacramento Valley
    - Standard in the southern part of the state and Intermountain area
- Many growers split N applications between sowing and tillering-stem elongation
  - Total rates: 100 – 250 kg ha^{-1}
- Increasing regulations on N use

Wheat growth stages



planting/early emergence tillering stem elongation boot/heading flowering grain fill

In-season (topdress) N applications increase yield and protein relative to pre-plant



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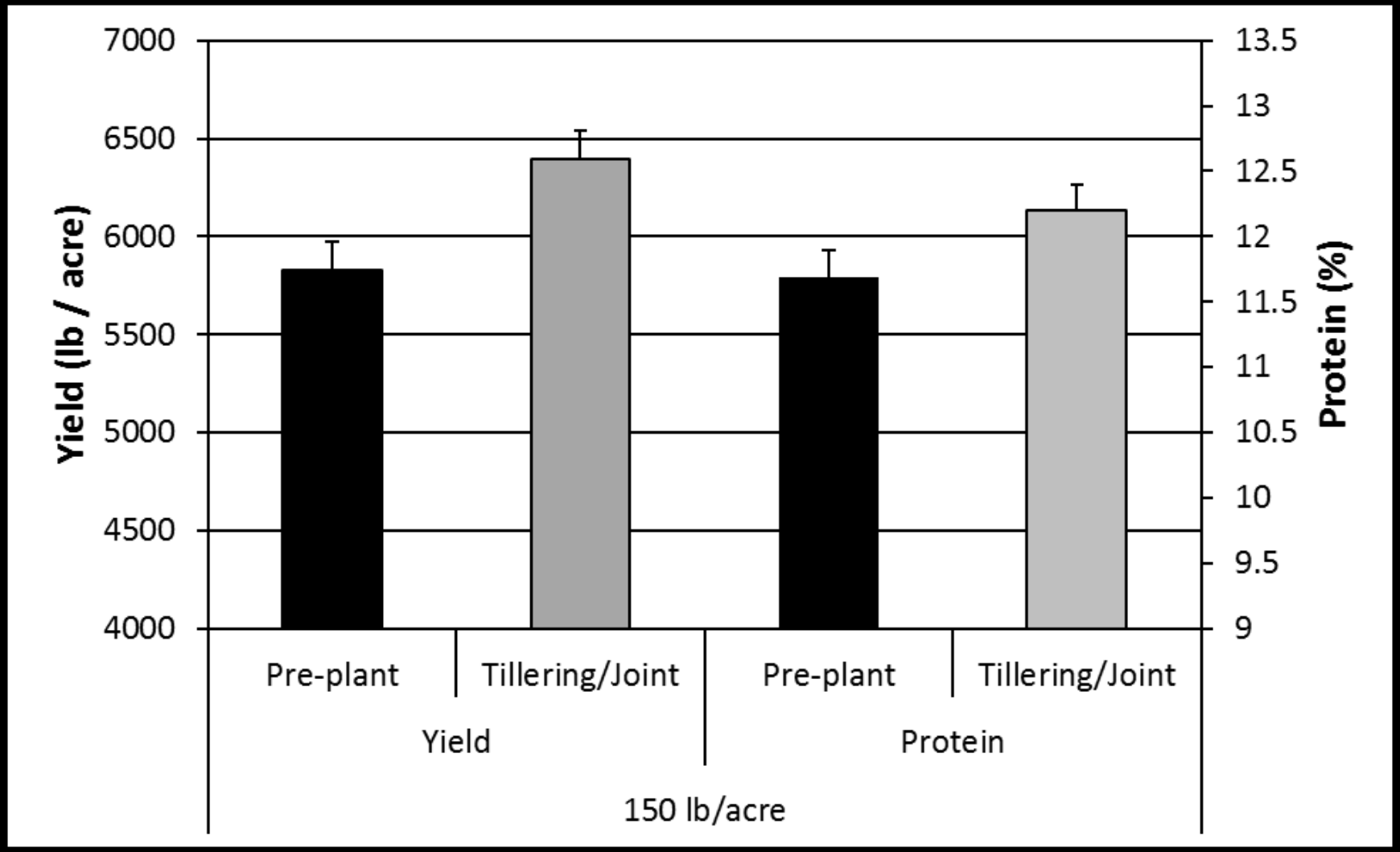
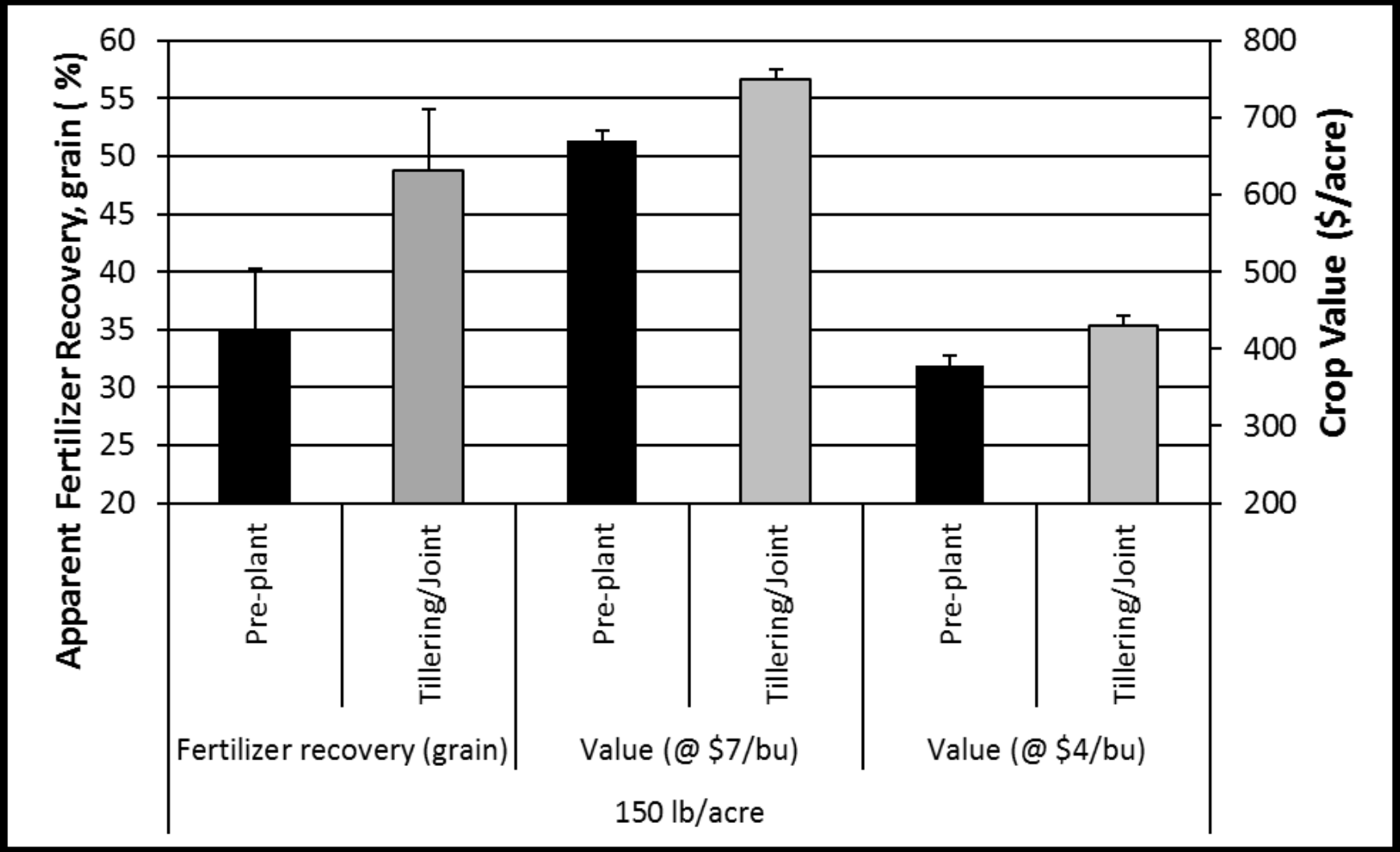


Tillering/Joint vs Preplant

In-season (topdress) N applications increase fertilizer use efficiency and crop value relative to pre-plant



Tillering/Joint vs Preplant

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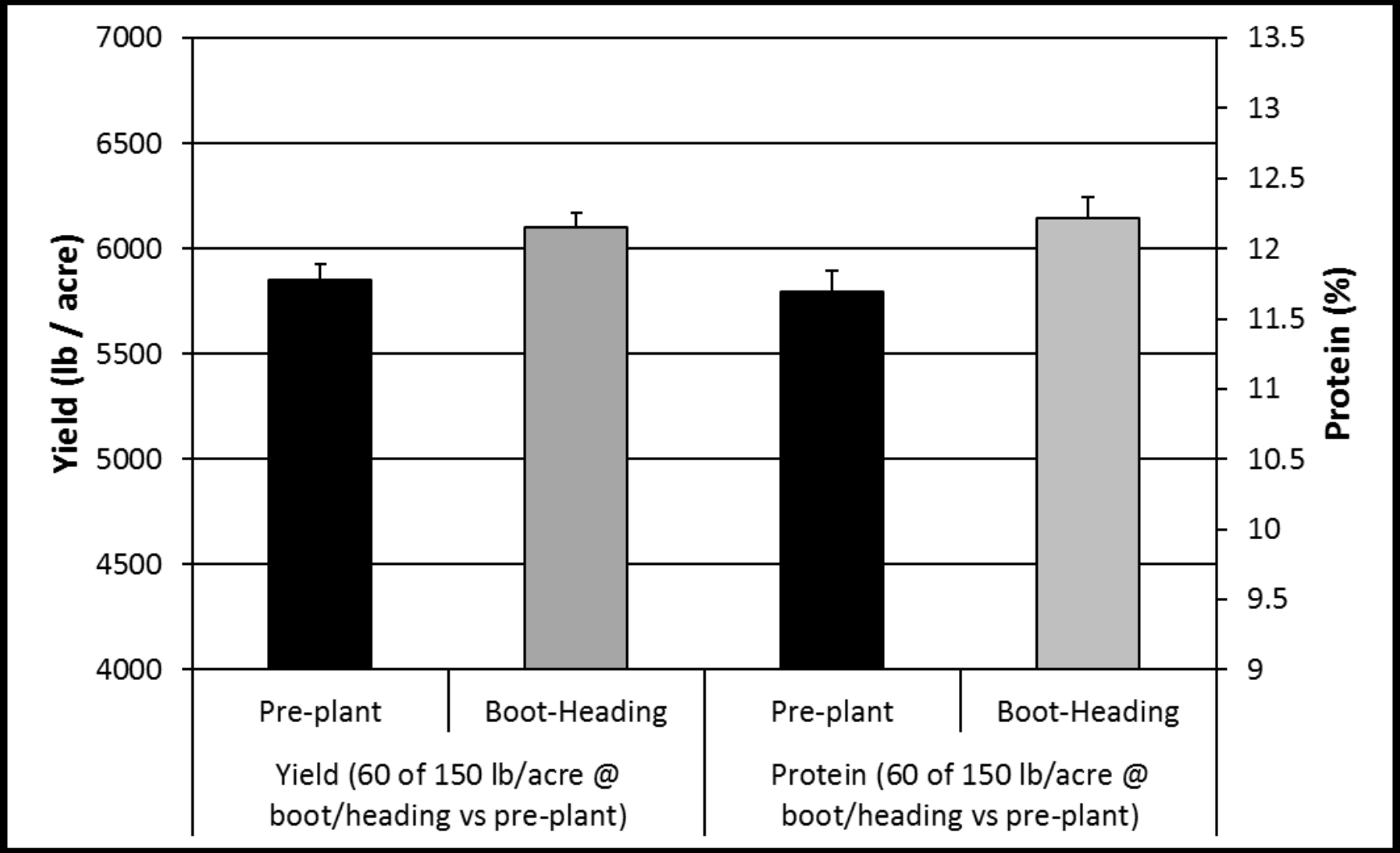
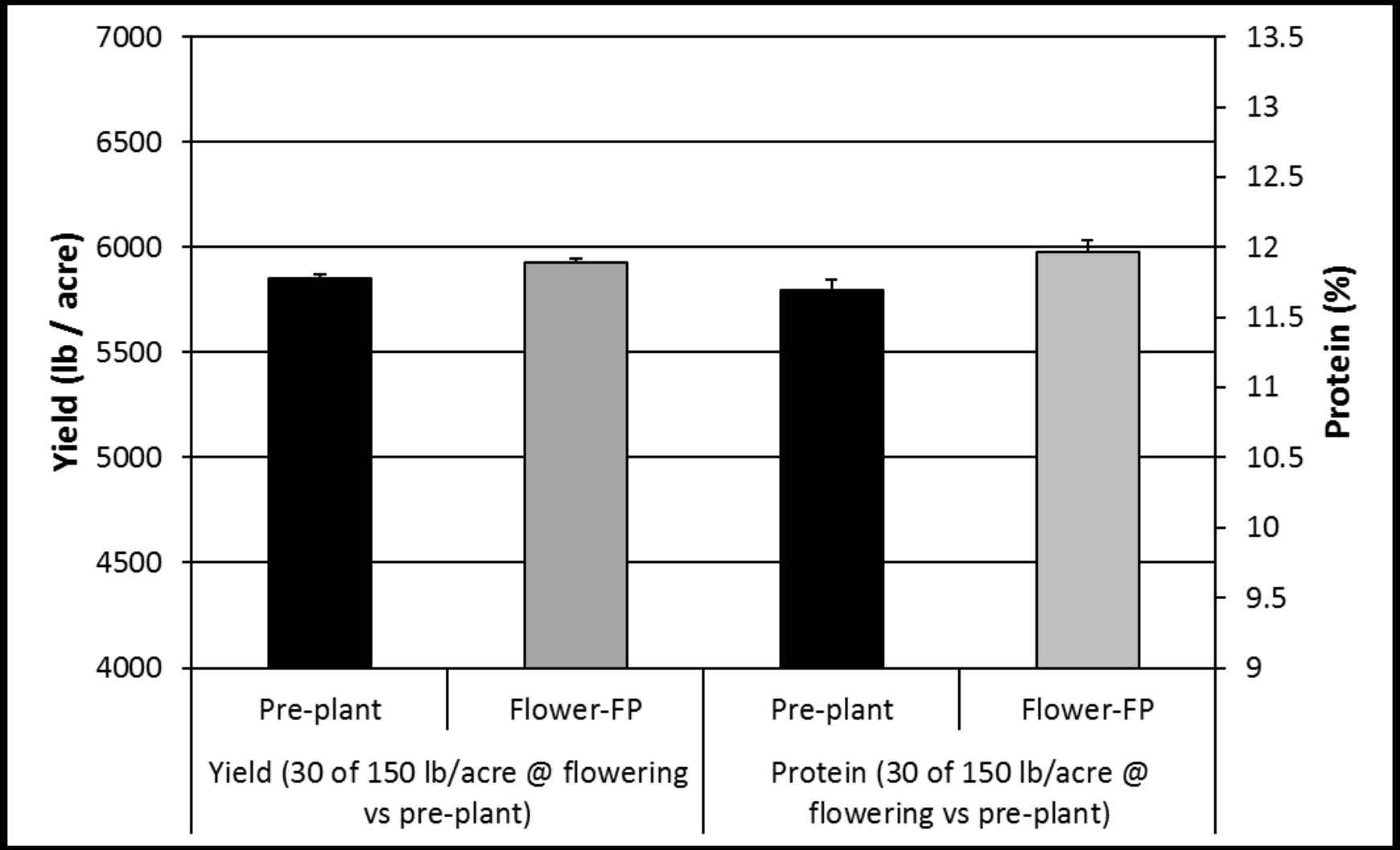


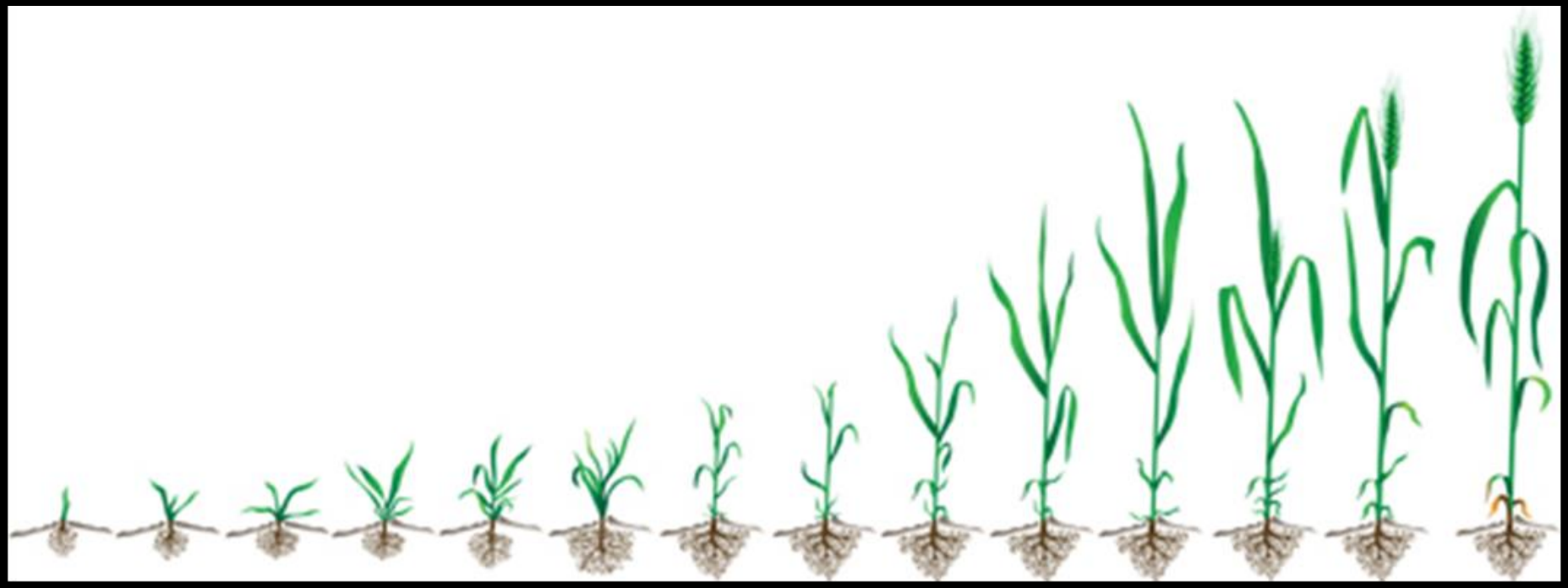
Boot/Heading vs Preplant

In-season (topdress) N applications increase yield and protein relative to pre-plant

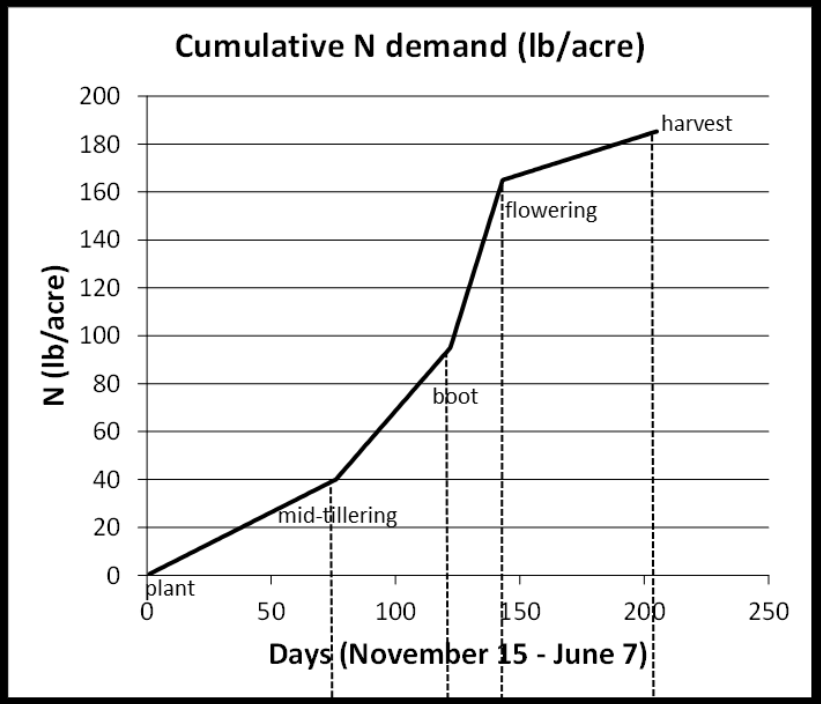


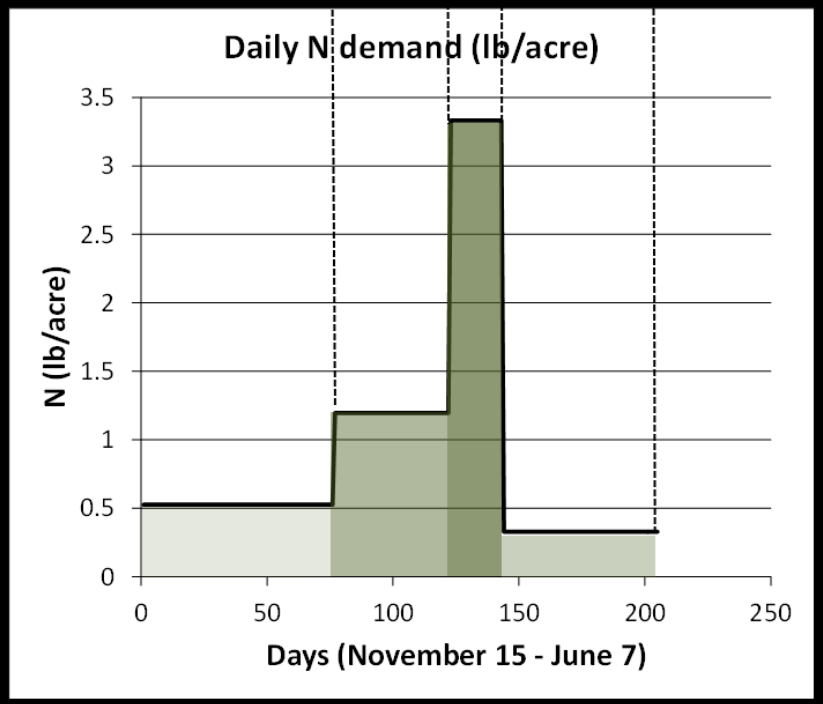
Flowering vs Preplant

Plant demand for N changes across the season



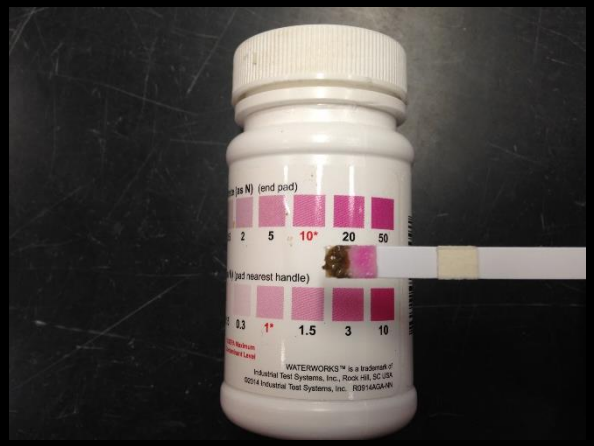
planting/early emergence tillering stem elongation boot/heading flowering grain fill





- Plant demand changes across season.
- How can we best match fertilizer supply to crop demand ?
- At a particular site in a particular season?

Real-time tools



Soil nitrate quicktest

- Retail: < $50

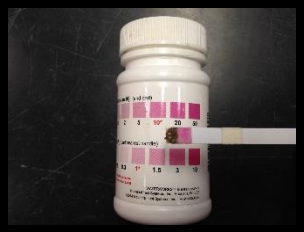
Trimble Greenseeker handheld

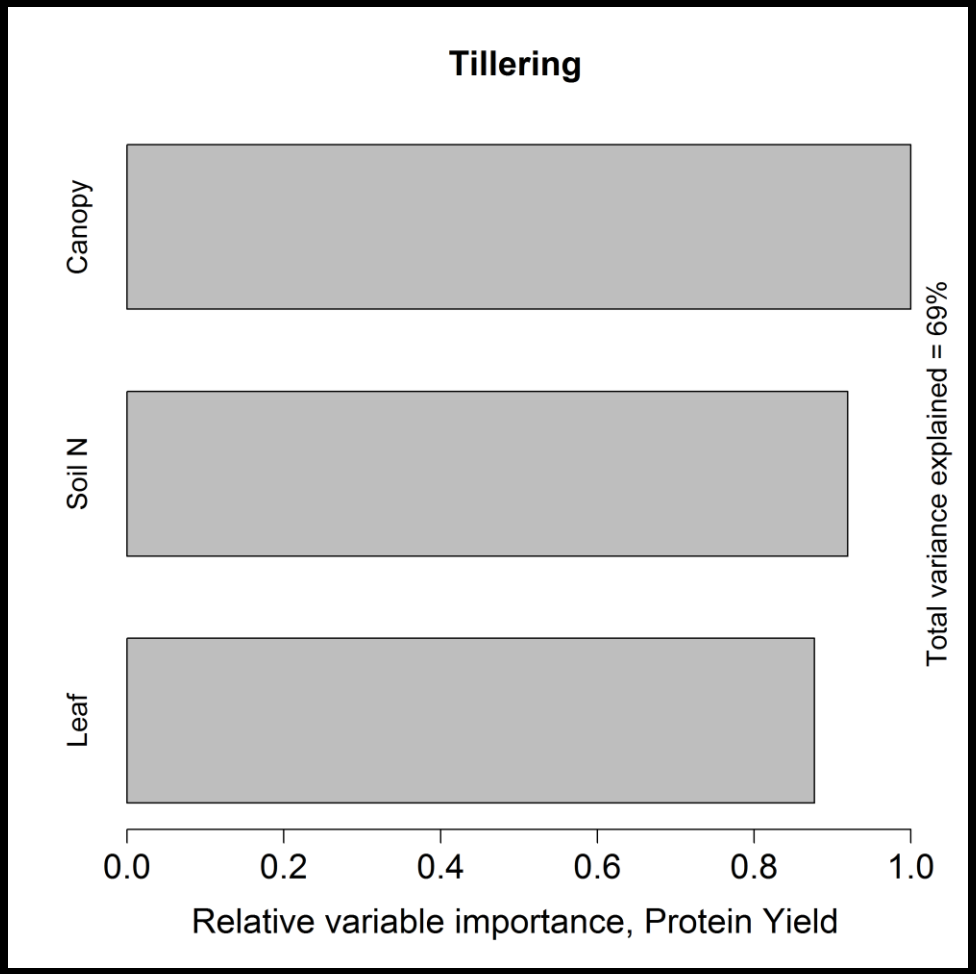
- Retail: ≈ $500
- NDVI (660 and 770 nm)

atLEAF chlorophyll meter

- Retail: ≈ $250
- SPAD proxy (660 and 940 nm)
- Proxy for leaf N concentration

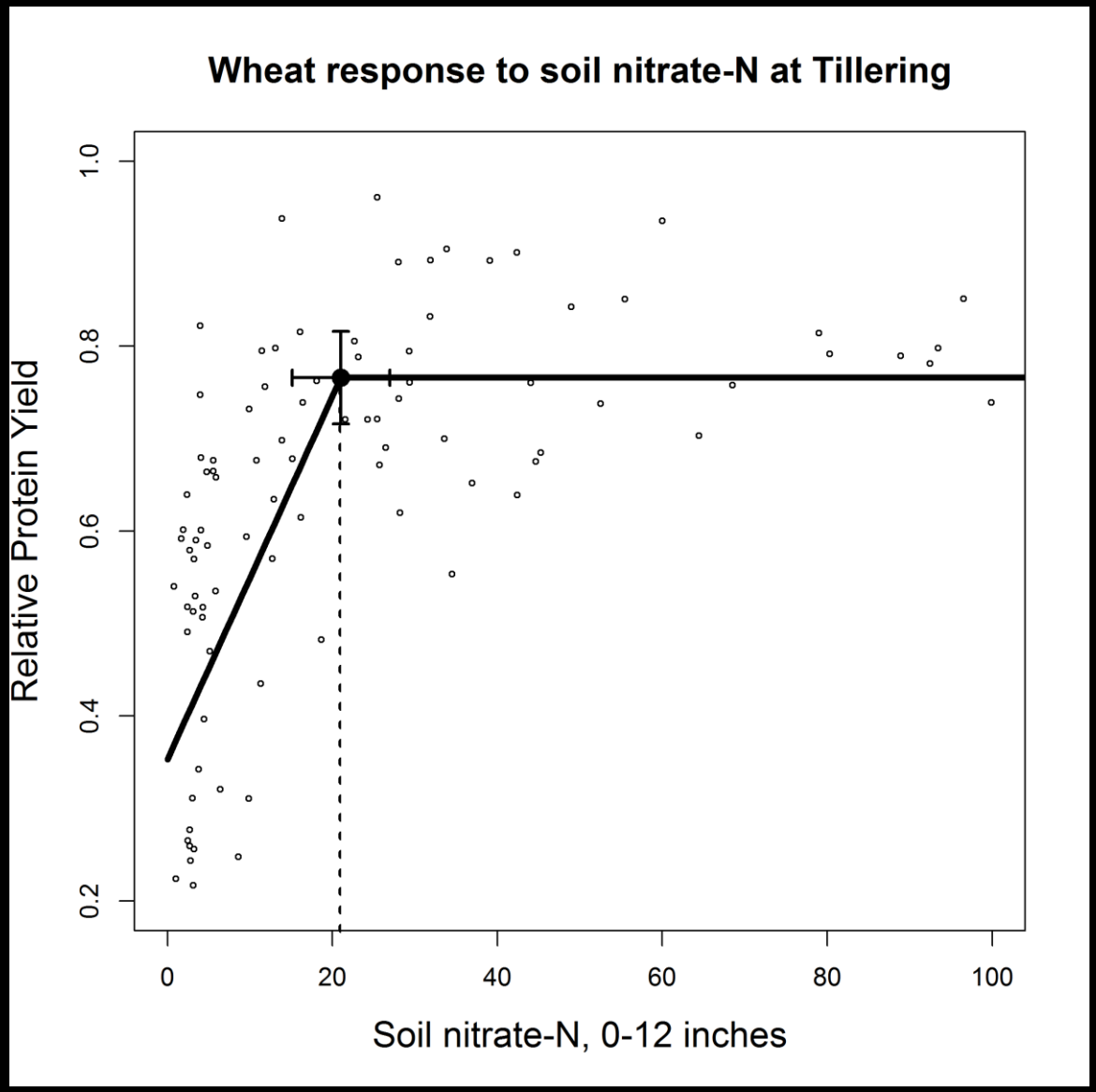
Proportion of grain N uptake predicted by plant-soil N status measured in soil, canopy and leaf at tillering



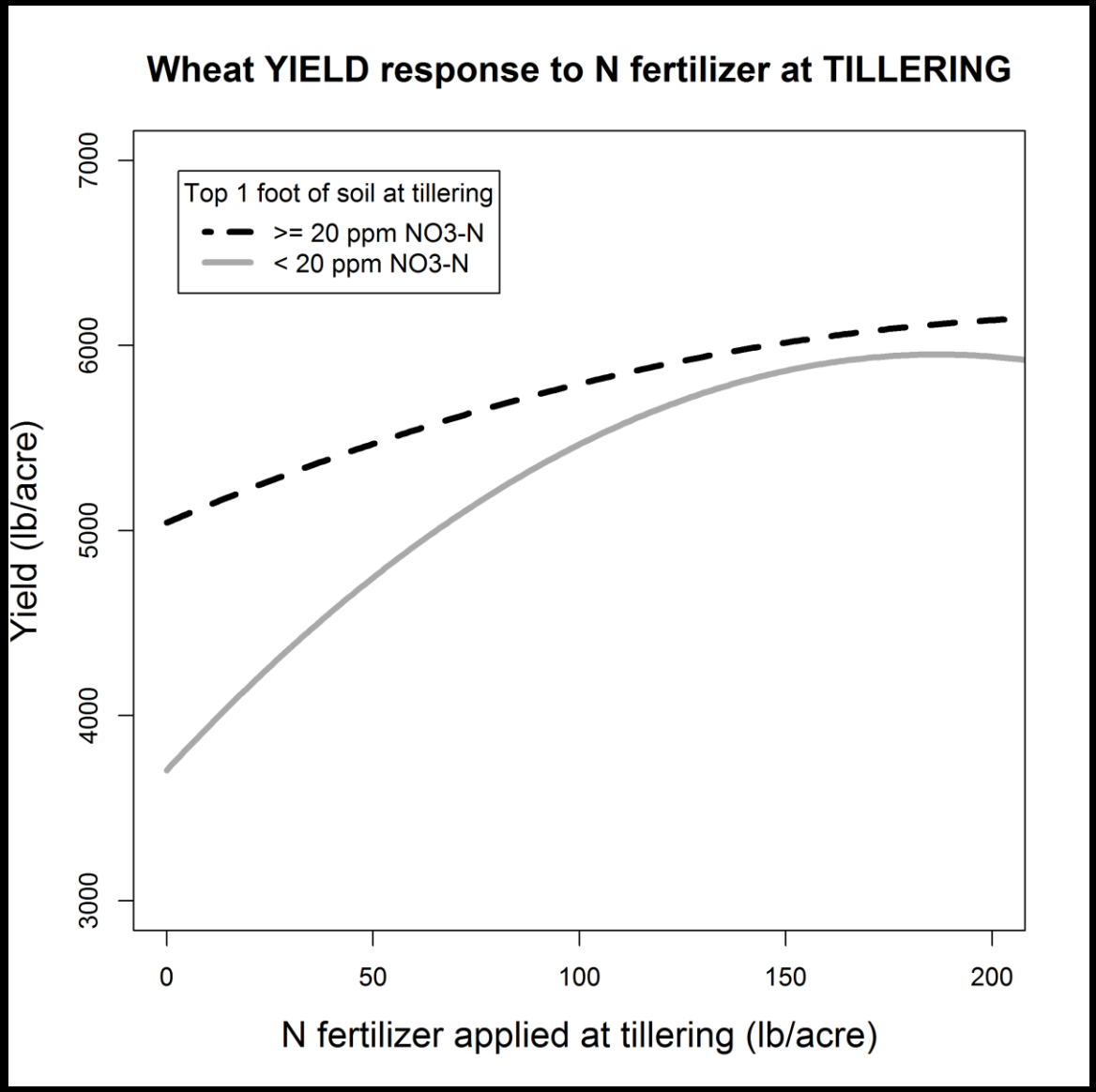


- For measurements made at tillering, a combination of soil, canopy and leaf measurements can explain/predict much of the N response

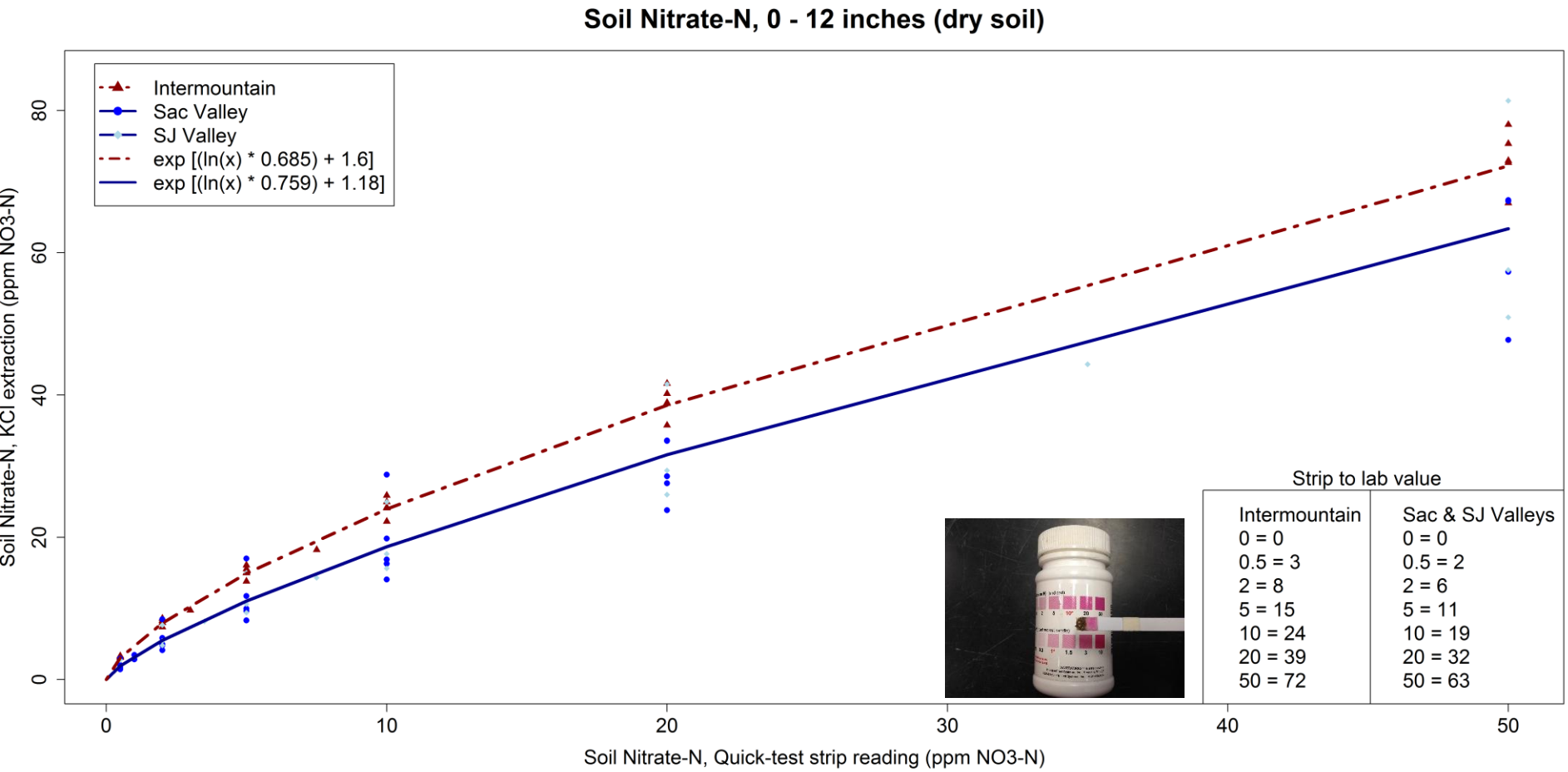
Identifying N saturation thresholds



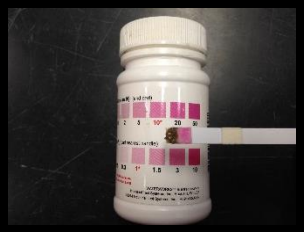
Crop response to fertilizer N application at tillering differs in high vs low NO_3-N soils

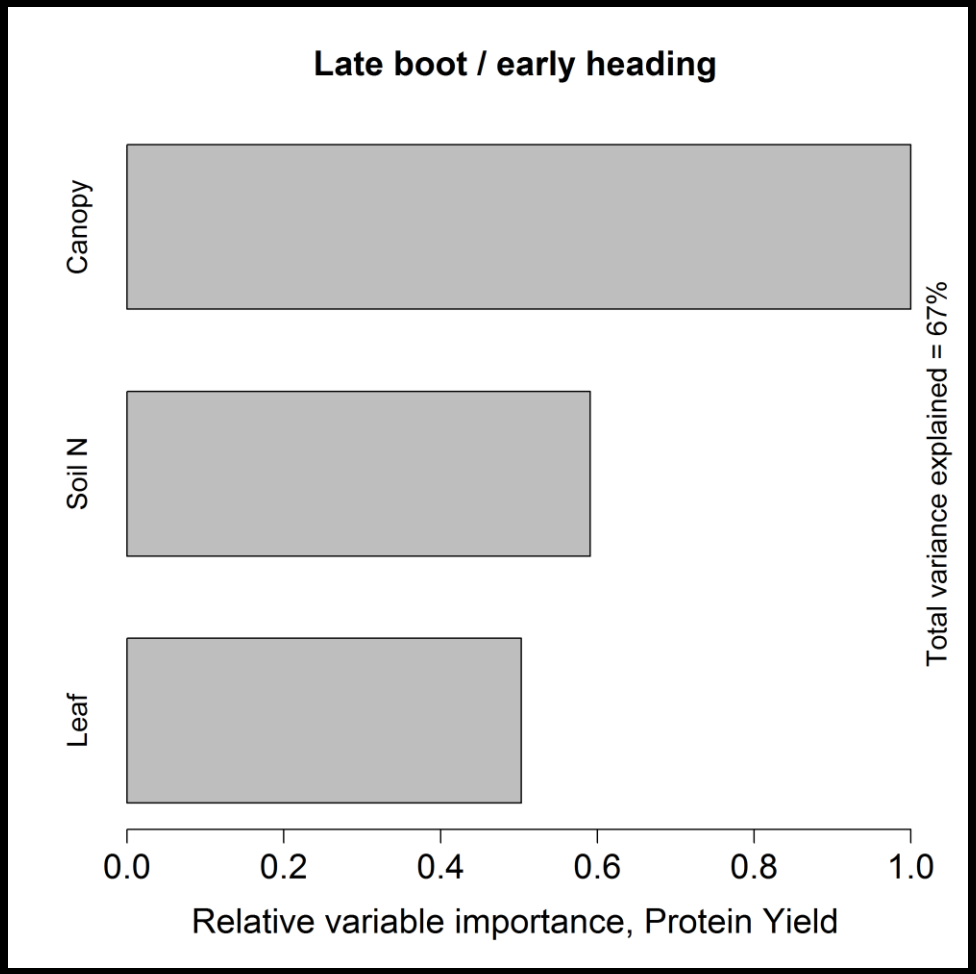


High vs low residual NO_3-N can be determined via simple, in-field test



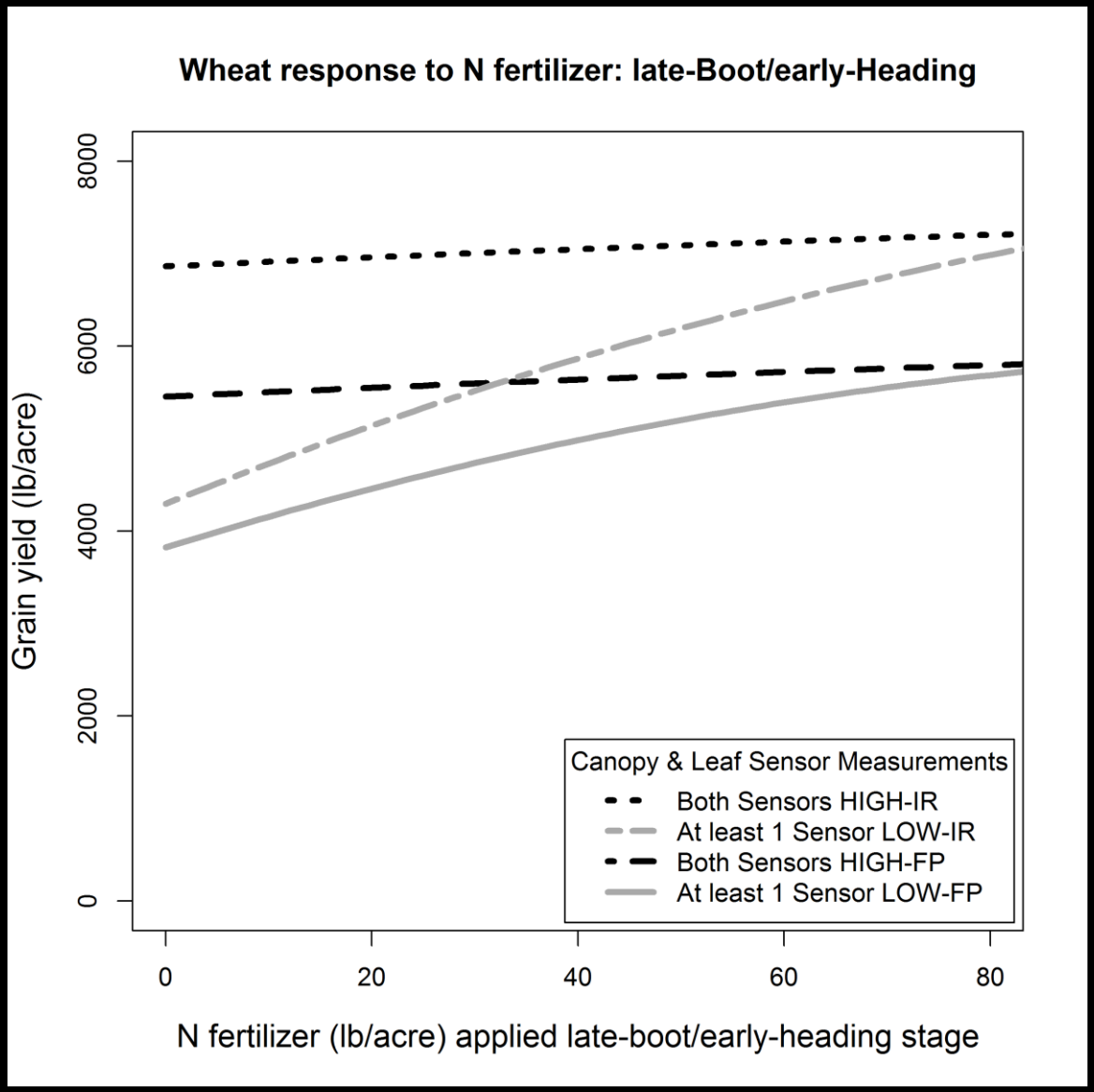
Proportion of grain N uptake predicted by plant-soil N status measured in soil, canopy and leaf at <u>boot/heading</u>





- For measurements made at boot/heading, plant measurements begin to explain more of the N response than soil measurement

Differential response to fertilizer N at boot/heading can be predicted via canopy/leaf sensors



DIY calibration?

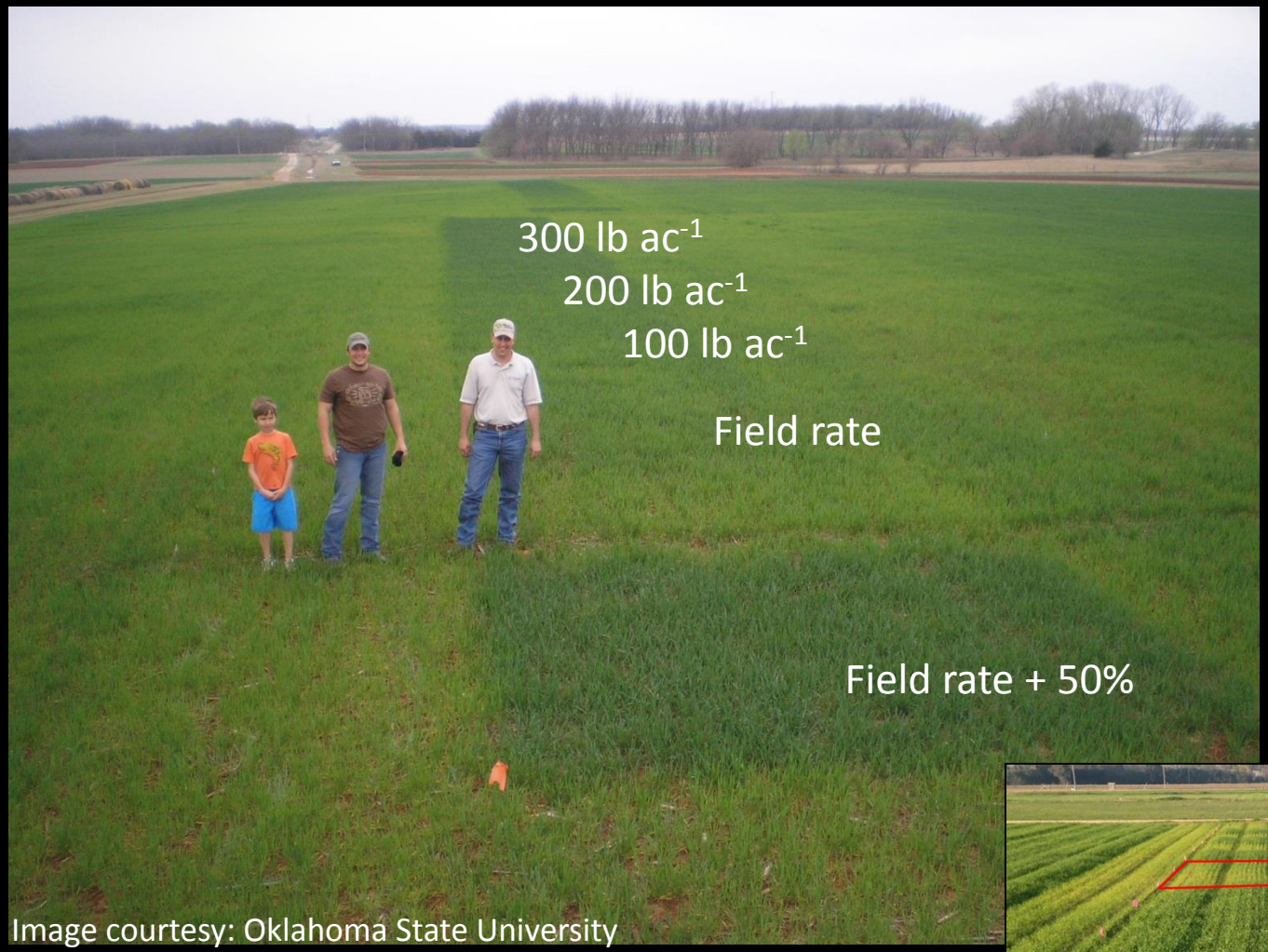


Image courtesy: Oklahoma State University

Summary and Discussion

- In-season applications of N are more valuable than preplant applications and permit more information about likely crop response

- Simultaneous soil nitrate-N and site-calibrated canopy & leaf measurements indicate whether wheat is likely to respond to N topdress in real-time

- Soil nitrate-N is of greater predictive value at the tillering stage of growth than at the late-boot / early-heading or flowering stages

- Canopy and leaf proximal sensing devices provide more information as crop biomass increases and produce additive information

Acknowledgments

Our thanks to the California Wheat Commission and the California Department of Food and Agriculture Fertilizer Research and Education Program for their partial funding of this research. Thanks as well to the staffs of the UC Westside REC, UC Intermountain REC and the UC Davis Agronomy Farm, as well as to the following individuals who contributed to the research: Ryan Byrnes, Jason Tsichlis, Phil Mayo, Gerry Hernandez, Israel Herrera, Emma Torbert, Rika Fields, Katy Mulligan, Eric Lin, Dan Putnam, Chris de Ben, Israel Herrera, Jessica Schweiger, and Michael Rodriguez.

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Topdress of nitrogen at tillering stage is something to seriously consider over the coming weeks

Author: Mark Lundy
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Published on: January 27, 2017

Over the past 4+ seasons, a UCCE team (Lundy, Orloff, Wright and Hutmacher) has revisited nitrogen (N) fertilization recommendations for hard spring wheat specific to California conditions. We have grown wheat under a wide range of conditions and soil types, while varying the timing and quantity of N fertilizer to create conditions of N deficiency and sufficiency at the various times in the season when a grower might consider a N topdress.

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Questions