University of California
Agriculture and Natural Resources

Managing N fertilizer to optimize protein and yield in California wheat

The goal of this project, which is being funded by the California Wheat Commission and the CDFA Fertilizer Research and Education Program (FREP), is to be able to determine whether adding nitrogen (N) fertilizer at a given point in the season is likely to increase wheat yields and/or protein content, and to develop tools and metrics that indicate how much fertilizer to apply to meet yield and protein goals. This information will lead to more precise and efficient N management, resulting in a more productive and profitable wheat crop in the state of California.

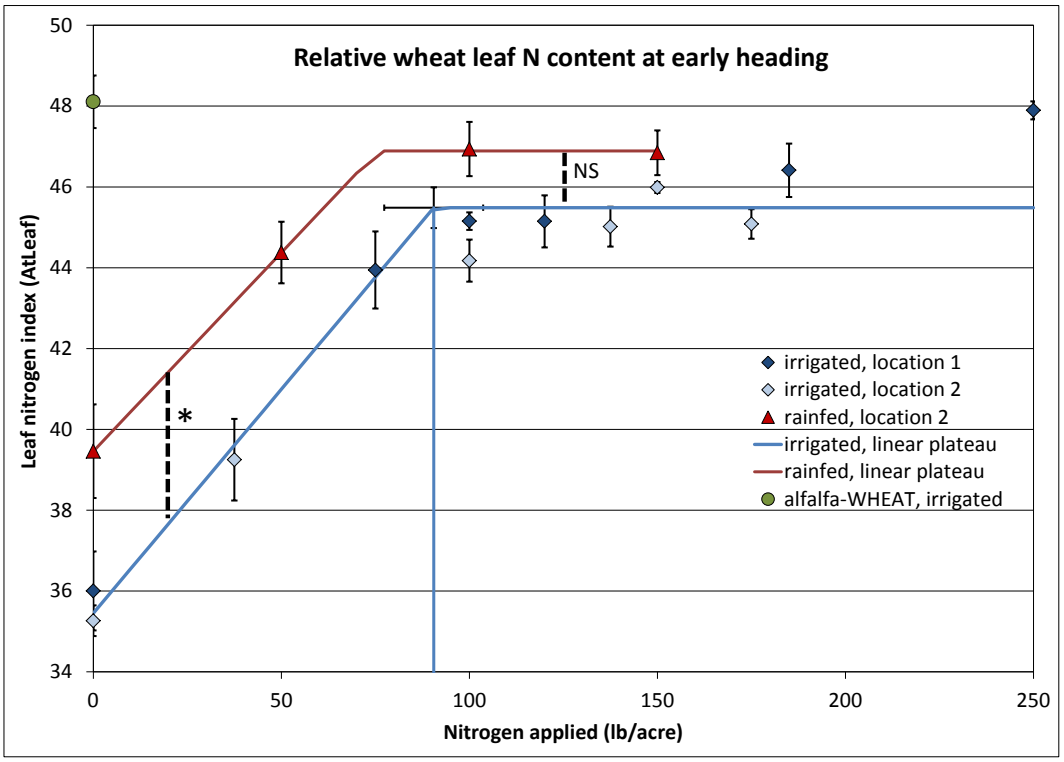
In order to accomplish these objectives, in several locations throughout the state, wheat is being grown with variations in the rate and timing of N fertilizer applied. These fertility experiments include N rates ranging from **0 – 300 lb/acre N** and applications occurring **preplant**, at **tillering**, **boot** and **flowering**, and in various combinations of these timings. The idea is that split fertilizer applications will improve the nitrogen use efficiency of the crop and give the grower an opportunity to adapt their fertility plan to the in-season conditions of their wheat crop.

To assess the status of the wheat crop in real-time, we are also calibrating sensors and tools designed for in-field use that give immediate feedback as to the N status and overall health of the crop. Two of the tools showing some promise are the AtLeaf meter (below, left) and the Greenseeker handheld NDVI meter (below, right).

The AtLeaf meter gives an indication of the leaf N content, while the Greenseeker gives an idea of the overall vegetative health of the canopy. As is shown in the figures on the reverse side of this page, thus far these devices have produced information that is complementary and may be best used in combination.

Figure 1. Depicts AtLeaf [1] measurements taken from the 2nd to last leaf at early heading from wheat fertilized with different N rates. The AtLeaf meter successfully distinguished between wheat growing under different N and water conditions. For example, the rainfed wheat was water-limited for much of its vegetative growth period, reducing its absolute demand for N and increasing its leaf N content in the 0 lb/acre and 50 lb/acre treatments relative to the irrigated wheat. This tool might be useful for quickly deciphering whether or not leaf N is sufficient at the various growth stages when a N topdress might be applied.

[1] The AtLeaf meter gives an indication of chlorophyll content based on measurements of leaf color in the visible and infrared spectrum. Leaf chlorophyll content is highly correlated with leaf N content.



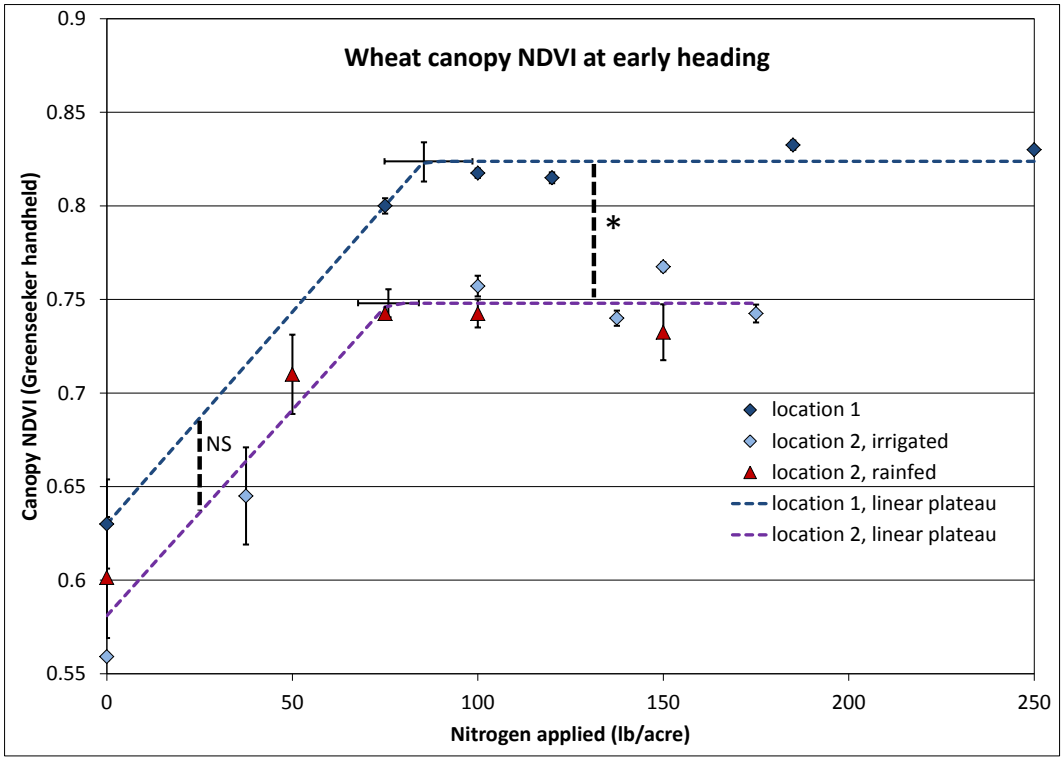


Figure 2. Depicts the normalized difference vegetation index (NDVI) as measured by the Greenseeker handheld [2] at early heading from wheat fertilized with different N rates. Greenseeker appears to be less sensitive to the leaf N concentration than the AtLeaf meter. However, it provides a more integrated picture of the stand health and might serve as a better proxy for yield potential across different growing conditions. For example: the wheat in location 1 had good early establishment and no water limitations, whereas the wheat in location 2 had more variable establishment, more water limitation, and more weed and disease pressure.

[2] The Greenseeker measures reflected canopy color in the visible and infrared spectrum as an indication of canopy health.

Conclusion: While this data is very preliminary (no wheat harvest yet!), the information from the AtLeaf and Greenseeker devices seems to be complementary and, used together or in combination with some other measurements, they may be able to give an immediate, in-field indication about whether and how much N to apply as a topdress to meet grain protein goals.

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