

## CONCEPT PROPOSAL – 2013 Fertilizer Research and Education Program, CDFA

**Project Title:** Evaluation of Nitrogen Fertilization Practices to Improve Wheat Yield, Protein Content and N-Use Efficiency in California Wheat

**Project Leaders:**

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**Proposed Project Locations:** San Joaquin Valley sites: Two locations in central San Joaquin Valley area of Tulare, Kings, or Fresno Counties, on-farm site plus one at the Univ. CA West Side REC or Kearney REC. Northern CA location(s): Siskiyou County farm site, Univ. CA Intermountain REC site.

**Proposed Project Duration:** Three years FREP project funding requested (if funded will supplement support from CA Wheat Commission for related work initiated in advance of FREP project funding)

**Summary of Problem and Issues:**

Wheat is an extremely important crop in California with approximately 800,000 acres grown every year. About 75 percent of the production is in the southern San Joaquin Valley. To maximize profits, wheat growers seek a combination of high yield and protein content. Unfortunately, wheat yield and protein content are often inversely related and it is difficult to achieve both at the same time, especially with some of the newer high-yielding varieties. The price a producer receives for hard red spring wheat is determined by the grain protein content; there is a discount for wheat with less than 13% grain protein in California and 14% for grain marketed in the Pacific Northwest. These protein thresholds are often elusive for wheat producers, especially at today's high yield levels of 4 or even 5 tons per acre. The possibility of both high yields and non-discount protein percentages serves as an incentive for growers to consider higher fertilizer nitrogen (N) applications.

In previous research conducted in California, late-season N applications (boot to flowering stages) have been shown to increase grain protein content by 0.5 to 2 percent depending on rate and timing. Initial results from more recent research by Orloff, Wright, and Hutmacher has indicated that preplant N applications may not be as important as once believed and that applying a higher proportion of the total N at tillering and later growth stages (more closely matching peak N uptake) may have a greater effect on yield and especially protein content (Wheat Commission 2011/2012 project reports: Orloff et al; Wright et al; <http://www.californiawheat.org>). However, these results are preliminary and more research is clearly needed in this area over more years and locations and with several different cultivars before this can become a standard recommendation. Improvements in protein levels alone, however, should not dictate grower N management practices for wheat grown for grain.

Within the past year, applications of N in the form of fertilizers or manure to cropland have come under increased scrutiny as a result of studies by the United States Geologic Survey and UC Davis. These

studies claim that agricultural applications of N are largely responsible for the high nitrate levels observed in groundwater in the study areas (Tulare Basin and Salinas Valley), with the suggestion that similar losses are also probable in other crop production regions within California. Small grain production was implicated as a primary contributing source of the elevated nitrate levels, underscoring the importance of further studies on the N needs of wheat in California.

### **Objectives.**

The intent of the proposed study is to determine the optimum rate and timing of split nitrogen applications to achieve the highest economical yield, maximize protein content, improve nitrogen use efficiency, and minimize nitrate leaching. Research is needed to improve our understanding of the effect of wheat nitrogen management on current cultivars of interest in southern San Joaquin Valley and northern CA. The objectives of this study are:

- (1) Determine the effectiveness of different nitrogen application rates on grain yield and protein content for commonly grown wheat cultivars including hard red, hard white and durum wheat.
- (2) Define the optimum growth stages to apply supplemental N to maximize N uptake, yield and protein content.
- (3) Evaluate the use of plant analysis of different plant parts to determine the value of plant sampling at flag leaf growth stage to assess needs for late-season N applications to meet yield and protein requirements.
- (4) Estimate potential for nitrate accumulation or movement within and below the root zone under different N fertilization strategies by determining soil nitrate concentrations at different depths (surface to 8 feet) in the soil profile pre- and post-season.

### **General Research Approach.**

We will investigate crop response to both total fertilizer rate and timing using different split applications at multiple growth stage-based timings (pre-plant, tillering, jointing, boot, and flowering stages). Total within-season N application amounts will range from a zero applied N control to split applications that total from 150 to 300 lbs N per acre. Initial early-season N applications will be adjusted to account for residual soil nitrate using preplant soil sampling in the upper 2 to 3 feet of the soil profile.

Plant tissue analysis of different plant parts (stem, flag leaf, and leaf below the flag leaf) will be performed at the flag leaf growth stage to determine which plant part is most diagnostic and to evaluate the value of plant sampling to assess the need for late-season N applications to meet protein requirements. Soil samples will be collected in one foot increments to a depth of six to eight feet close to planting timing and again post-harvest to determine changes in soil nitrate-N status with depth associated with growing wheat crops under the different N management schemes. These data will be used to provide a crop nitrogen utilization estimate (applied N plus estimate of residual soil nitrate-N use) during the growing season, and to describe whether or not management practices used produce net gains (additions) or net losses (use) of nitrate-N in different parts of the soil profile.

### **Description of the Target Audience.**

The information provided by this project will improve the knowledge base for wheat producers, consultants and regulatory agencies, better defining N applications needed to produce profitable wheat crops with high yield and quality while reducing the risk of nitrate leaching. This research should directly benefit producers, advisors and consultants by providing them with regional recommendations for target N rates and timing. This project addresses the Fertilizer Research and Education Program's goals to increase the availability of information about the efficient use of nitrogen fertilizers, add to Best Management Practices, and better manage agricultural N.