# N-Rich Reference Zone Case Study: Yolo County (rainfed) 2020-21

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Three Nitrogen rich (N-rich) reference zones were created in a rainfed wheat field in the Hungry Hollow area of Yolo County (near Esparto).

**N rich reference zone creation**:

- 50 lb/ac N were applied to the field in the form of a poultry manure application during summer 2020.
- Pre-plant soil samples taken from the top 0-12 in. of soil on 10/27/20 (after poultry manure application) indicated a fertilizer equivalent of 80 lb/ac N as nitrate.
- Three 90ft x 180ft N-rich reference zones were fertilized on 12/11/20 with an additional 60 lb/ac N in the form of prilled urea applied ahead of a rainstorm that resulted in 0.43 in. of rain. Field was planted on 12/23/20 with an additional 24 lb/ac N applied in-line with the planter.

**Plant and Soil Measurements:**

- Late December emergence was followed by a few small rainstorms and long periods of drought.
- NDVI measurements were recorded from the N-rich reference zones and the surrounding field using handheld devices, drone and satellite imagery on 2/09/21 and 2/26/21, respectively. These measurements were expressed as a Sufficiency Index (SI). A SI is the ratio of the measurements taken from the broader field to the measurements taken in the N rich zone. SI values less than 0.97 indicate possible crop N deficiency, and values less than 0.93 indicate likely crop N deficiency.
- In early-February and late-February, the SI values were 1.0 and 0.98, respectively. This means that the canopy in the field was as vigorous as the conopy in the N-rich reference zones, indicating no N deficiency present at that stage.

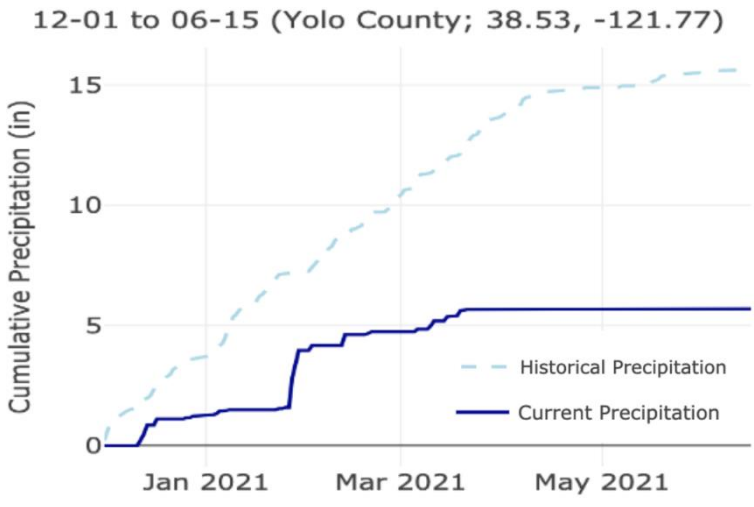


*Figure 1. The graph shows cumulative precipitation over the course of the season compared to the historical precipitation patterns. The dark blue lines shows the long periods of drought that occurred this season.*

## SITE INFORMATION

**Location:** Yolo County
**Soil type:** Rincon silty clay loam
**Previous crop:** Garbanzo/ fallow (planted late Jan, disked early April)
**Variety:** Summit 515
**Seeding method:** Seed drill
**Seeding rate**: 1 million plants/ac
**Planting date:** 12/23/20
**Bedded:** No

## Pre-plant N Management

**Field rate:** ~50 lb/ac N (summer fallow poultry manure) + 24 lb/ac N (in-line fertilizer with planting)
**N-rich zone:** 134 lb/ac N (field rate + 60 lb/ac N as urea)

- On 2/26/21, when the decision to fertilize was being made, the crop had taken up 24% of the total nitrogen for the season
- Soil volumetric water content declined from 20% to 8% during the month of February (2/9/21-2/26/21).
- Yield expectations were adjusted to account for severe stress. Soil nitrate in the top 0-12 in. (~56 lb/ac nitrate-N) was sufficient for the adjusted yield expectations.

**Fertilizer recommendations and in-season management actions:** The lack of rain pushed the decision point for a topdress into late February. At that time, seeing that seasonal rainfall was well below average, the grower adjusted yield expectations from 4000 lb/ac to 2500 lb/ac, the protein goal remained at 10.5%. The SI value of 0.98 indicated that plant N was not deficient. Because there was no plant deficiency signal from the N-rich reference zone and soil nitrate-N levels were sufficient to meet the N requirements of the expected yield, the The Nitrogen Fertilizer Management Tool for California Wheat estimated that the crop would not respond to in-season fertilizer. Based on this information, the grower decided not to add fertilizer. On 3/16/21, researchers applied an additional 64 lb/ac N as urea to a section of the field to test what would have happened had the grower added fertilizer. The lack of rainfall prevented this application closer to when the measurements and decisions had been made.

OUTCOMES:

- In-season N recommendation
  - 0 lb/ac N
- In-season N fertilizer applied
  - 0 lb/ac N
- Yield
  - 2253 lb/ac (56% historical avg.)
  - No difference between field and N-rich reference zone yields
- Total N fertilizer applied
  - Pre-season: 74 lb/ac N
  - In-season: 0 lb/ac N
  - Grower usually applies topdress, but refrained this year.

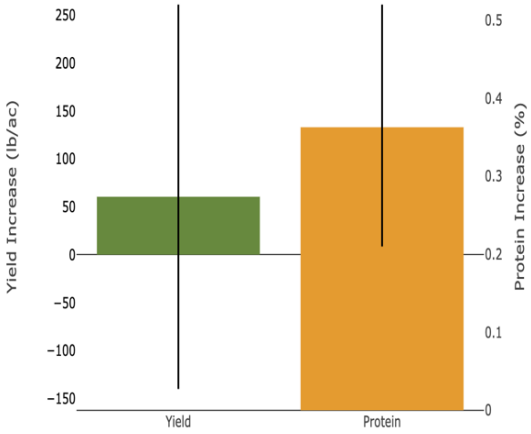


*Figure 2. Webtool yield and protein estimates when adding 10 lbs of additional fertilizer. Note that the error bars go into the negative, indicating no significant increase can be predicted.*

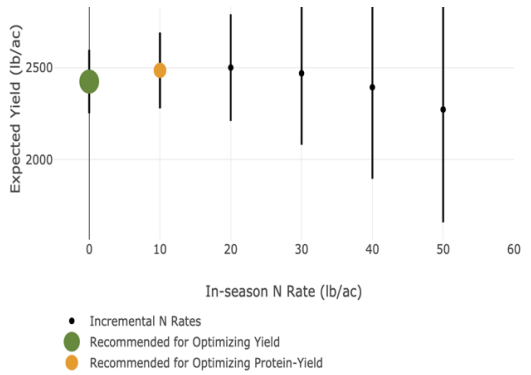


*Figure 3. Webtool yield and protein projections with increasing in-season fertilizer rate. The grower can expect ~2500 lb/ac if no additional in-season fertilizer is added. Note that error bars for increasing rates of in-season N extend below the 2500 lb/ac baseline, meaning that there is no significant benefit from additional in-season N applications.*

**End of season results:** Despite severe drought conditions, plants were able to produce a low-yielding grain crop due to some residual soil moisture at depth from the preceding fallow period. Neither the N-rich reference zone, nor the areas of the field where an in-season top-dress was simulated showed a significant difference from the field in terms of yield. In other words, the crop was water-limited; if the grower had applied additional pre-plant or in-season fertilizer, yield would not have increased. Because there would not have been a yield response to in-season fertilizer, the grower chose to refrain from additional applications this year. Cost savings from not applying 60 lb/ac in-season N amounted to roughly $45 saved per acre.

The grower's adjustment of yield is a good example of how grower intuition and familiarity with their fields should not be overlooked. In this case there was an abundance of nitrogen in the soil at decision time and the webtool would not have called for additional fertilizer applications even if the yield were at 4000 lb/ac. However, there are other instances where yield estimates will impact the in-season fertilizer recommendations. It is important that growers readjust their yield expectations accordingly in times of drought, poor stand, physical damage, or other yield-affecting in-season events.

Not applying all N fertilizer pre-plant gave the grower the opportunity to readjust yield expectations accordingly due to drought and save N fertilizer.