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N-Rich Reference Zone Case Study: Kings County 2019 - 20

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Four nitrogen (N) rich reference zones were set up on a 300 acre triticale field in Kings County where average grain yields are approximately 6000-8000 lb/ac.

N-rich reference zone set up:
One hundred lb/ac of mono-ammonium phosphate (11-52-0) was broadcast on 11/9/19. The next day pre-plant soil samples of the top foot were taken. Soil nitrate quick tests done on these samples measured an average of 54 lb/ac nitrate-N fertilizer equivalent in the Gepford clay soil. Just before the field was irrigated to germinate the seed, an extra 60 lb/ac N as urea was applied to the N-rich reference zones on 11/21/19. Each of the four N-rich reference zones were 90ft x 180ft rectangles. The zones were placed in two separate irrigation checks with two near the head and two near the tail of the flood irrigated field.

Early season conditions:
The field was planted by broadcasting and disking on 11/15/19. Prior to irrigating the seed up on 11/22/19, 60 lb/ac N as urea was broadcast by ground. On 12/23, the crop was at the 3-leaf stage and 77 lb/ac N as urea was broadcast by airplane immediately prior to a rainfall event. By the in-season assessment of field N status on 2/24/20, the crop had received 3.3 in. of rainfall and 6 in. of irrigation. Rainfall during this period was 0.7 in. less than historical average. The crop was at the mid-tillering stage of growth and about 35% of total seasonal N uptake had occurred to this point.

Plant and Soil Measurements:
Drone imagery using normalized difference red edge (NDRE) on 2/13/20 showed a sufficiency index (SI) of 0.95 in the NW corner of the field – a possible N deficiency. 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. On the same day, both the broader field and the N-rich reference zones had approximately 12 lb/ac nitrate-N fertilizer equivalent in the top foot of soil. Shortly after, on 2/24/20, normalized difference vegetative index (NDVI) measured with the handheld GreenSeeker resulted in an average SI of 0.98 in the whole field. However, the SI in the NW corner of the field was 0.93 which suggested a growing N deficiency in that part of the field.

Fertilizer recommendations and in-season management actions:
To predict the optimal N application rate, SI, soil nitrate-N, the yield goal of 8000 lb/ac grain at 12% protein and remaining N uptake of about 136 lb/ac N were all considered (Figure 1). A positive crop response from an N fertilizer application range of 33-84 lb/ac N was predicted. On 2/28/20, 30 lb/ac N as NH_3 was applied in the irrigation water. Then on 3/9/20, 31 lb/ac N as UAN-32 + humic acid solution was flown on by plane to achieve foliar absorption of N. Some temporary foliar burning was observed on leaf margins after the foliar application of UAN-32 + humic acid. The symptoms were no longer noticeable at heading. Monitoring

SITE INFORMATION

Location: Kings County
Soil type: Gepford clay
Previous crop: Cotton
Variety: Swift 77
Seeding method: Broadcast and disked
Seeding rate: 122 lb/ac
Planting date: 11/15/19
Irrigated up: 11/22/19
Bedded: No

Pre-plant N Management

Field rate: 71 lb/ac N
N-rich zone: 131 lb/ac N
N Form: 11-52-0 & urea

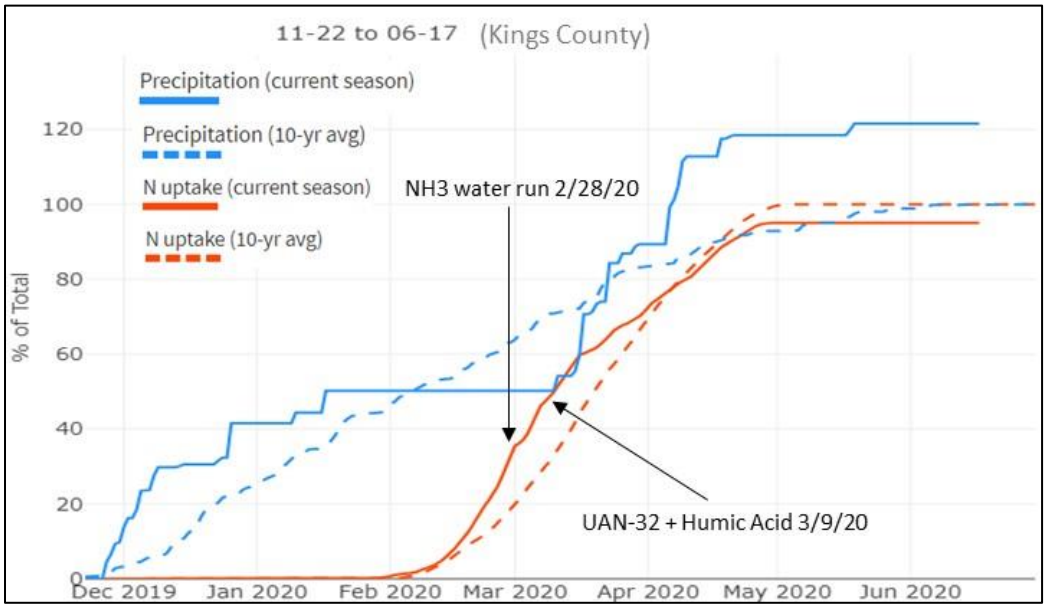

Figure 1. Fertilization of about 60 lb/ac N beginning with the first in-season irrigation and just before a rain event.

continued with the GreenSeeker and atLEAF CHL, which measures leaf chlorophyll concentration, on 3/31/20. The GreenSeeker showed an average SI of 1.00 with little variation across the field. The atLEAF CHL showed an average SI of 0.99, but the NW corner of the field had an SI of 0.95. Though there was a predicted crop response to N fertilizer ranging from 25-45 lb/ac N in the NW corner of the field, the overall recommendation was no further N fertilizer. This was recommended because the crop was predicted to have taken up 75% of the seasonal N. Additionally, only a small portion of the field was showing a possible N deficiency. No more N fertilizer was applied to this field.

End of season results:

The average grain yield for this field was 7820 lb/ac. This yield is near the high end of the range for the region. Grain protein was not measured because the crop was being grown to produce triticale seed for planting. The fertilizer recommendations based on plant and soil N measurements between the N-rich reference zones and the rest of the field were followed and proved to be accurate. The predictions made by these tools and the field outcomes were not surprising as they reflected the normal N fertilization level and expected yield. Of note is that the N-rich reference area in the NW corner of the field had higher yield and protein than the surrounding field and took up approximately 40 lb/ac more N. This confirms that the in-season measurements were detecting crop deficiency in that area.

OUTCOMES:

- In-season N fertilizer application recommended:
  - 58 lb/ac N
- In-season N fertilizer applied:
  - 61 lb/ac N (in two applications)
- Yield = 7820 lb/ac
  - Normal yield for the area and grower
- Crop N removal
  - 180 lb/ac N
- Total N fertilizer applied
  - Pre-season: 71 lb/ac
  - In-season: 138 lb/ac
  - For this grower and region this N management was typical

The large size of this field, which is typical for the region, made using the small plot N-rich reference zones challenging. Drone imaging of vegetation indices for the previous cotton crop and the triticale crop showed distinct variability within the field. The agronomist for this site has suggested that the sheer size of the field and the variability within it lend to the need for increased reliance on drone imagery for plant N measurements. Larger N-rich reference zones that can be applied with commercial field equipment will probably increase the accuracy of the N fertilizer predictions as well.

Given the large size of this grower's fields, there is strong interest in prioritizing the use of drone imagery to capture plant reflectance data for N fertilizer decision making.