Top-Dress Nitrogen Application Timing in Winter Wheat

J. L. B. Souza, V. Reed, J. M. Abit, D. B. Arnall

Oklahoma State University

DEPARTMENT OF Plant & Soil Sciences

Introduction

- Oklahoma farmers plant 1.5-2.5 million hectares of winter wheat every year.
- Nitrogen (N) timing application can modify grain yield, N accumulation pattern and N remobilization impacting directly the grain yield and protein content.
- The timing of N applications can also impact nitrogen use efficiency of the crop
- The use the of the N-Rich Strip N recommendation method requires the field to be N deficient in season.

Objectives

This study was conducted to determine the impact of delaying top-dress application of N in winter wheat yield and protein. Also, will attempt to identify critical thresholds for days after response or response index at which maximum yield can no longer be achieved.

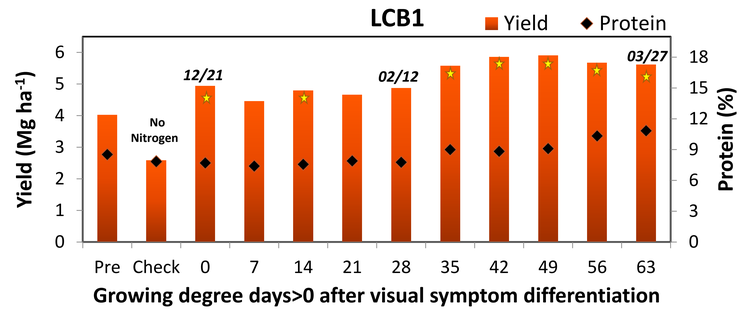
Materials and Methods

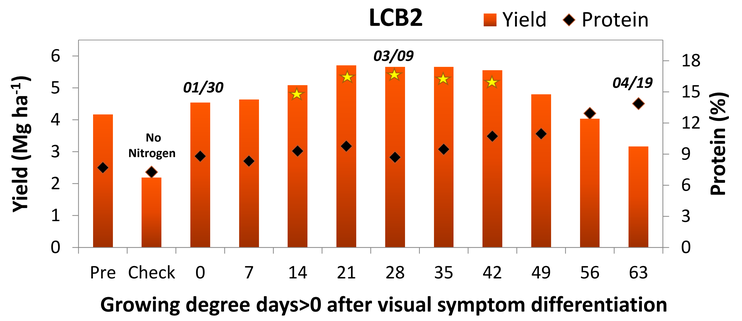
- Conducted in 2016-2017 season in dryland conditions.
- Four trials were establish in 3 locations: Stillwater, OK, Perkins, OK and Lake Carl Blackwell (2 trials), near Stillwater, OK
- Treatments were arranged in randomized complete block with three replications.
- Prior to planting, soil sample were collected and appropriate fertilizer were applied at planting based on the pre-plant soil analysis except for N.
- A pre-plant treatment of 100 kg ha^{-1} of N was broadcast applied as ammonium nitrate (AN) on treatment 1.
- The top dress applications started after visual symptom difference (VSD) was observed between the pre-plant treatment and the check (no N applied). VSD was confirmed with NDVI sensor readings. When difference were bigger than 0.2, AN was broadcasted at a rate of 100 kg ha^{-1}.
- Fertilizer N were applied at 0, 7, 14, 21, 28, 35, 42, 49, 56, and 63 growing degree days, greater than 0 (GDD>0) after VSD.

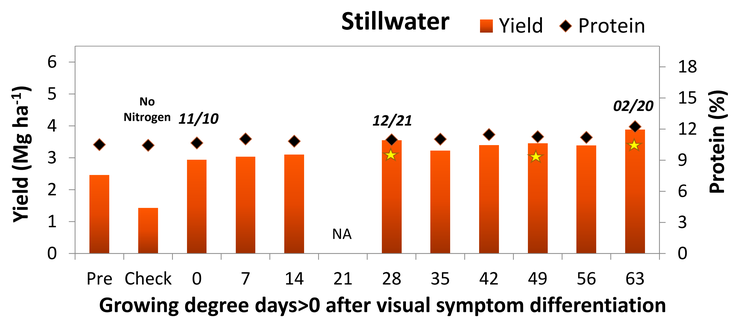
Table 1. Treatment structure of the study. GDD >0 = Growing degree day greater than 0 and VSD = Visual symptoms difference

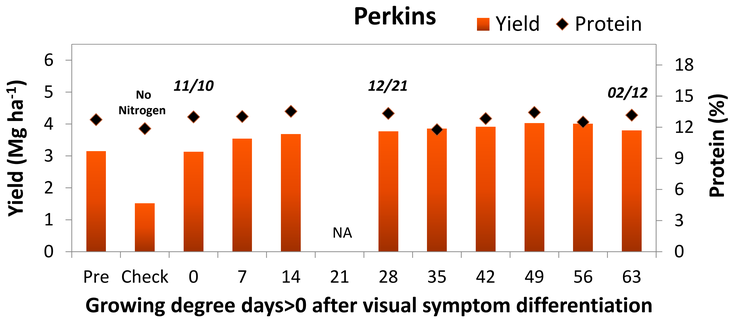
Treatment	Fertilization Timimg	N Rate (kg ha^{-1})
1	Pre-plant	100
2	Check (no N)	0
3	0 GDD>0 after VSD	100
4	7 GDD>0 after VSD	100
5	14 GDD>0 after VSD	100
6	21 GDD>0 after VSD	100
7	28 GDD>0 after VSD	100
8	35 GDD>0 after VSD	100
9	42 GDD>0 after VSD	100
10	49 GDD>0 after VSD	100
11	56 GDD>0 after VSD	100
12	63 GDD>0 after VSD	100

Results









Figures 1-4 . Winter wheat grain yield and protein response to the application of 100 kg N ha^{-1} as affected by the timing of application at four locations in Oklahoma, 2016-2017. The yield of treatments with a ☆ are significantly greater than the pre-plant treatment (Dunnet test, α<0.05)

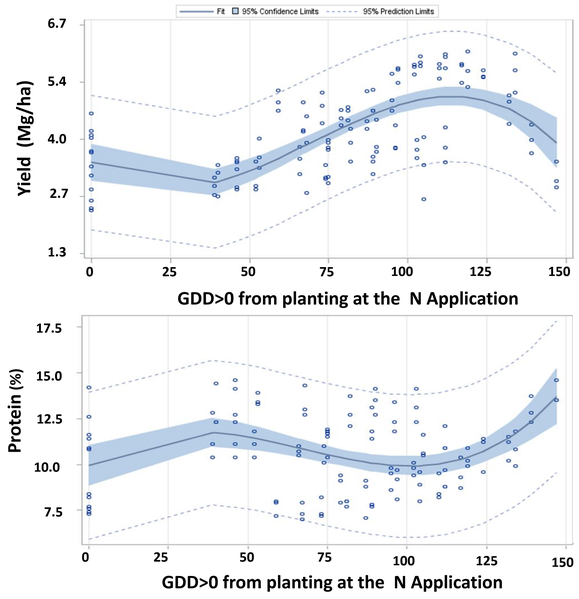


Figure 3 and 4. Winter wheat grain yield (Mg ha^{-1}) and grain protein (%) plotted by GDDs>0 (number of growing degree days above zero) from planting to application across all locations.

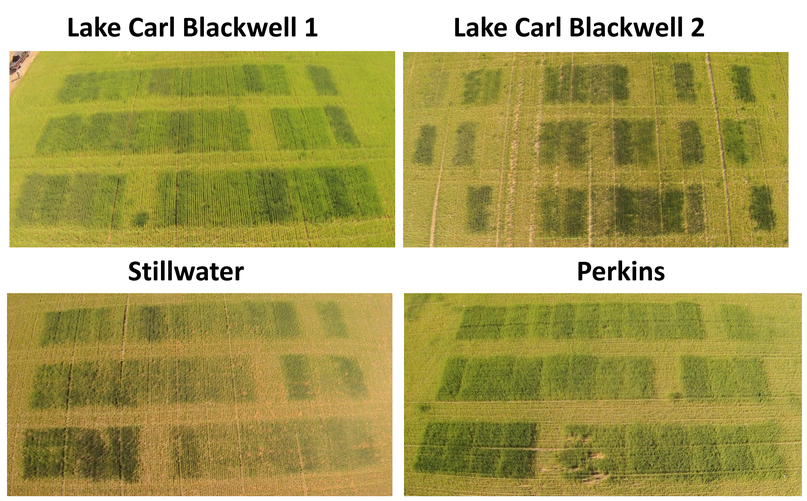


Figure 5. Aerial images of the four delayed nitrogen trials in march 2017 at flag leaf stage.

Discussion

- There was significant effect of N timing on yield for all location and significant response for protien at two locations.
- At all locations, the application on N in Febuary (100-115 GGD>0 from planting) preformed as well or better than when N was applied pre-plant.
- In the first year if N was applied prior to flag-leaf there was no yield loss. Indicating the N-Rich Strip method could have been used with no risk of yield loss due to delayed N.
- Five more trials will be conducted in the season 2017-18 in Oklahoma to try to identify better the critical time of N application in winter wheat to reach higher yields.
- If 2017-18 results mirror 2016-17 then the study will conclude it is more important to time N application with proper weather than at first sign of N stress.