Winter Wheat Cultivar Affect on Optimum Nitrogen Management

DEPARTMENT OF PLANT AND SOIL SCIENCES

R. L. Sharry, M. Smith, B. Finch, B. Arnall

Plant and Soil Sciences Department, Oklahoma State University

DEPARTMENT OF PLANT AND SOIL SCIENCES

Introduction

Optimal nitrogen (N) management in winter wheat (*Triticum aestivum*) maybe influenced by differences in genetics, particularly when considering some cultivars express distinct N uptake patterns that could influence optimum N application timing and rate. Two particular cultivars, Gallagher and Green Hammer, both Oklahoma State University releases have shown differing N uptake patterns, specifically after the Feekes 6 (jointing) stage through maturity. This first year study looks to determine possible differences between these two cultivars affect on optimum nitrogen management and potential impact on the use of sensor based N recommendation tools.

Methodology

This experiment was initiated at the Lake Carl Blackwell Research Farm near Perry, OK (LCB) and the Cimarron Valley Research Station at Perkins, OK (Perk). The two sites were planted on 10/21/21 and 10/19/21 respectively at a seeding rate of 66 kg ha^{-1}. Plots measured 6 m x 3 m at both locations. 15 cm depth composite soil samples were taken at both locations and results are presented in Table 1. The two varieties used in the study (Gallagher and Green Hammer) were planted in adjacent blocks to simplify management and harvest. These studies consisted of 13 treatments of which 10 are used for this particular presentation and are listed in Table 2. Ammonium nitrate (34-0-0) was utilized as the nitrogen source and was applied in some combination of rates and three timings; pre-plant, January top-dress (Applied 01/10/22), and March top-dress (Applied 03/24/22). Grain was harvested using a Kincaid 8-XP plot combine with a 1.5 m platform head. Grain was analyzed for nitrogen content as whole kernels using near-infrared spectroscopy (NIR). Statistical analysis was completed using SAS 9.4.

Site	Series	Description	OM%	$N0_3$- NH_4+ mg kg^{-1}
Lake Carl Blackwell	Port	Fine-silty, mixed, superactive, thermic Cumulic Haplustolls	1.42%	52
Perkins	Teller	Fine-loamy, mixed, active, thermic Udic Argiustolls	0.68%	19

Table 1. Soil description and pre-plant composite soil sample results from 0-15cm depth.

TRT	Pre-Plant	January TD	March TD	Total N
1	0	0	0	0
2	100	0	0	100
3	50	50	0	100
4	50	0	50	100
5	33	33	33	100
6	33	66	0	100
7	33	0	66	100
8	0	50	50	100
9	0	100	0	100
10	0	0	100	100

Table 2. Treatment descriptions of NH_4+NO_3- applications across three timings; pre-plant, January 18th , and March 24th.

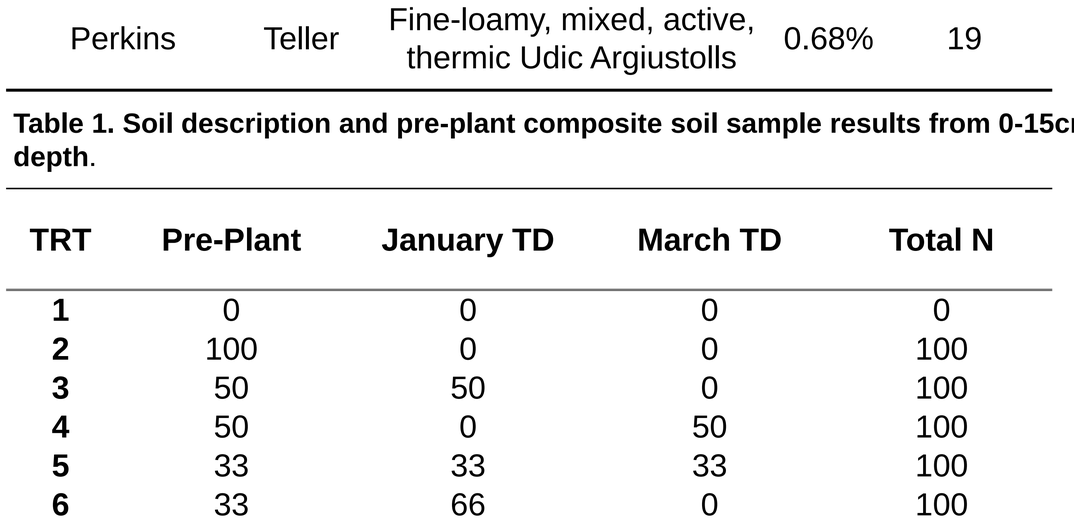

Figure 1. Precipitation (mm) at the Lake Carl Blackwell and Perkins locations during the 2021-2022 growing season.

Results

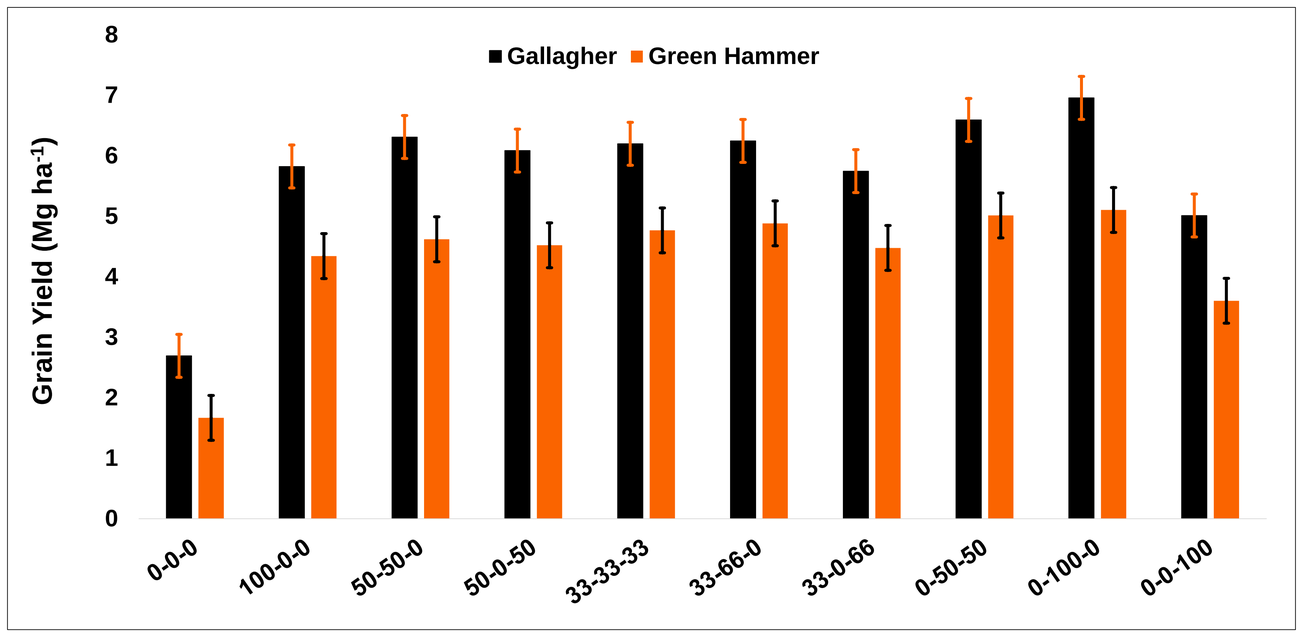

Figure 2. Grain Yield of two winter wheat cultivars (Gallagher and Green Hammer) subjected to 10 different nitrogen management strategies. LSD: (Gal=0.0584 Mg ha^{-1}), (GH=0.0612 Mg ha^{-1})

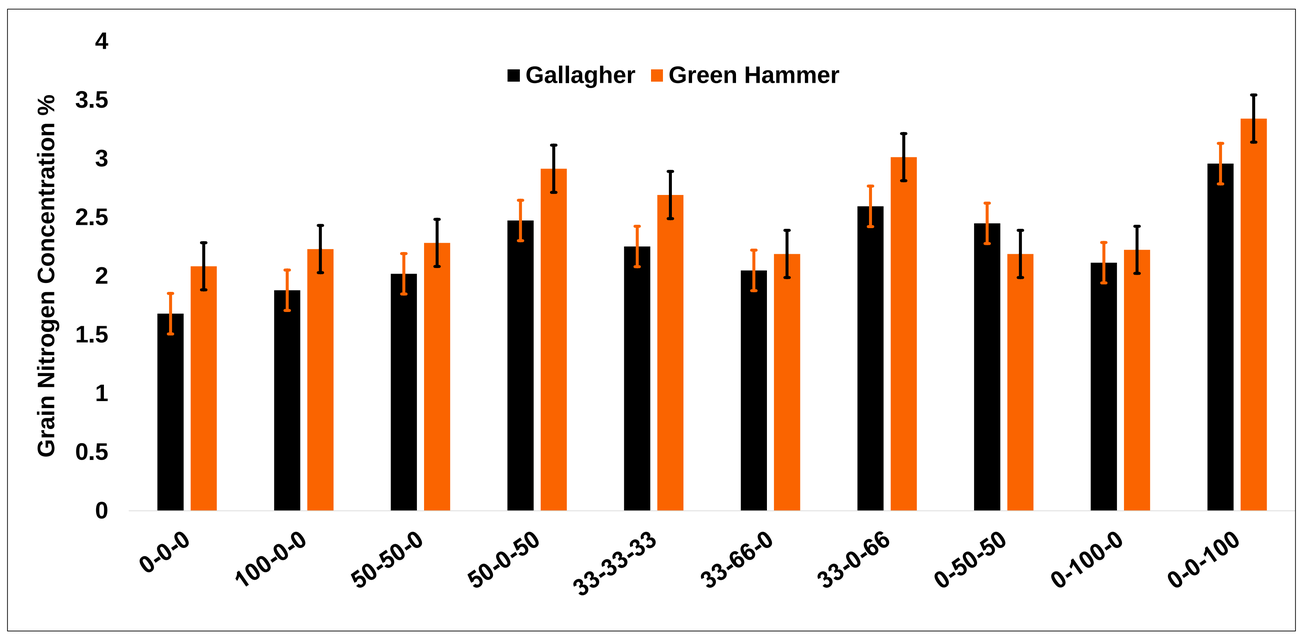

Figure 3. Grain nitrogen concentration of two winter wheat cultivars (Gallagher and Green Hammer) subjected to 10 different nitrogen management strategies. LSD: (Gal=0.1726, GH=0.2009)

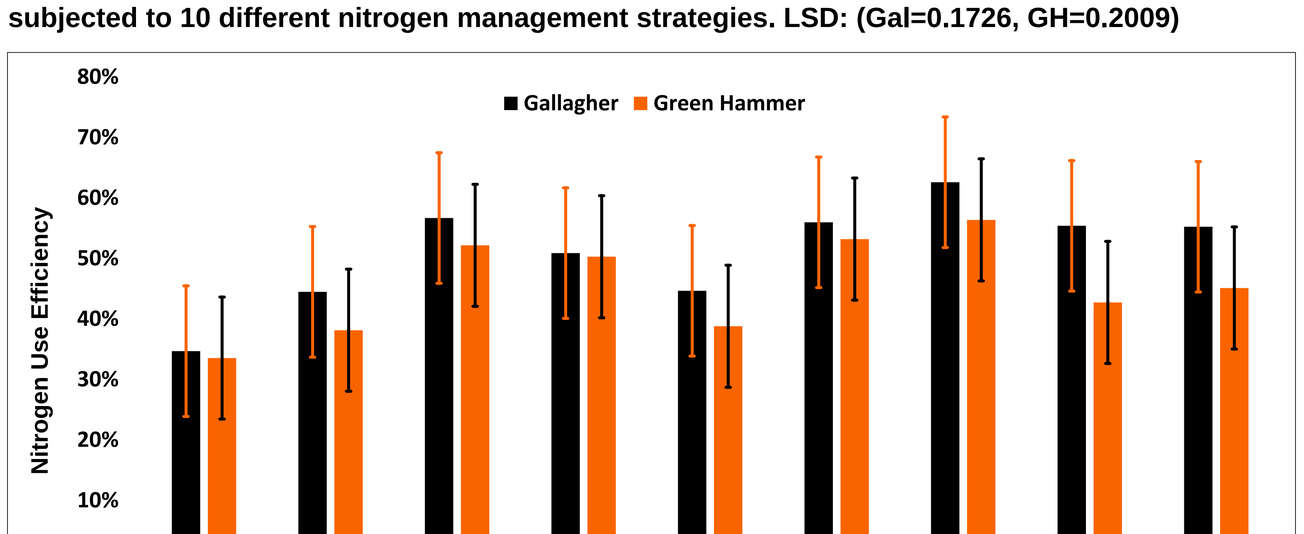

Figure 4. Nitrogen use efficiency of two winter wheat cultivars (Gallagher and Green Hammer) subjected to 10 different nitrogen management strategies. LSD: (Gal=0.1079, GH=0.1009)

Results

- Yield was optimized at 100 kg ha^{-1} rate applied only at the January timing. However, this application was not significantly different than the 0-50-50 no matter the cultivar planted (Figure 2).
- Grain nitrogen concentration (Figure 3) increased significantly as N was applied at the March timing for both varieties.
- NUE was consistently greater for Gallagher than Green Hammer even though GN concentration follows an inverse trend. This points to reduced yields of Green Hammer relative to Gallagher possibly exasperated by drought conditions following the march application.

Discussion

- Split Application of N fertilizer did not provide any increase in grain yield over the January 100 kg N ha^{-1}, regardless of cultivar.
- Delayed incorporation by precipitation of the March fertilizer application inhibited grain yield.
- Increased NUE overall by Gallagher may be indicative of differing N uptake curves between the varieties as Green hammer has been shown to rely on late season uptake and translocation of N, hence reduced N uptake due to drought conditions following the March application.
- Application earlier than March 24th for the late timing may have drastically changed results of this work. This could highlight possible impacts on optimum sensor based N management.