IMPACT OF POST-FEEKES 6 NITROGEN APPLICATION IN WINTER WHEAT FORAGE PRODUCTION.

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ABSTRACT

Producers have options when choosing how to utilize their wheat acreage in Oklahoma. These include, grain harvest only, dual-purpose grazing and grain, and graze-out where the wheat crop is used solely for grazing cattle. Many producers take advantage of graze out wheat as a forage for cattle during the winter season. With acreages of approximately 400,000 acres of winter wheat grown for graze out production in the state of Oklahoma in 2018, many questions regarding management of wheat for grazing purposes have arose. This study, in conjunction with the Noble Research Institute, attempts to answer these question. Graze-out winter wheat trials were established in three locations across the state of Oklahoma. Each of these trials were planted to Gallagher variety, developed by Oklahoma Wheat Research Foundation, with three nitrogen treatments at 60 lb N ac^{-1}, 120 lb N ac^{-1}, and a 60 lb N ac^{-1} split application (60 lb N ac^{-1} pre-plant and 60 lb N ac^{-1} top-dress) applied following Feekes 6. Grazing management was simulated mechanically with two harvests at Chickasha and Lake Carl Blackwell locations and Dupy Farm only being harvested once. Final grazing of all locations was conducted at Feekes 11.1 with biomass and quality samples taken from each plot for protein, moisture, acid detergent fiber (ADF), total digestible nutrients (TDN) and, energy content analysis. Biomass yield increases were observed for with both the increase of pre-plant nitrogen and the delay of top-dress application. This study aims to evaluate the effect of a late season, post Feekes 6, application of nitrogen on wheat forage production. Another objective of the study was to evaluate management strategies for maximizing forage production and crop sustainability.The Chickasha and Lake Carl Black Well locations reported yield increases of 8% and 19%, respectively, when pre-plant nitrogen application was increase to 120 lbs N ac^{-1} as compared to the 60 lb N ac^{-1} application. A 29% and 60% increase was observed when the additional 60 lbs N ac^{-1} application was delayed until after Feekes 6 for Chickasha and Lake Carl Blackwell, respectively. Nitrogen uptake of wheat biomass followed a similar trend at all locations, with the exception of the 60 lbs N ac^{-1} and 120 lb N ac^{-1} pre-plant rates at the Dupy Farm location. The results from one year of this study demonstrates the impact of nitrogen application on the forage biomass yield of winter wheat, and provides insight on the impact of delaying N top-dress applications beyond the Feekes 6 stage of winter wheat.

INTRODUCTION

Large amounts of the winter wheat acres planted in the southern Great Plains is utilized for cattle grazing, and much of that land is grazed completely instead of being harvested for grain yields. On an annual basis in the southern Great Plains approximately 30% to 80% of planted wheat acreage is grazed with 10 to 20% grazed out completely, rather than harvested for grain(Pinchak et al., 1996). In the state of Oklahoma, it is reported that 9% of all wheat acreage is used for grazing only purposes(Epplin, True, & Krenzer Jr, 1998). Oklahoma wheat acres for 2018 were reported as having approximately 4.4 million acres planted, which would result in almost 400,000 acres being used solely for grazing purposes(NASS, 2018). Many producers have taken advantage of the opportunity to utilize wheat for winter grazing, leading to much interest in management strategies to improve their graze out system. Epplin et. al (1996) also report the state average application rate for nitrogen on forage only wheat is 78 lbs N ac^{-1}. A study conducted in Texas reported the greatest yield response occurs with the top dress of 45 lbs N ac^{-1} of nitrogen was applied to pre-plant applications of 0 and 30 lbs per acre(Sij, Belew, & Pinchak, 2016). This study, in conjunction with Noble Research Institute, is evaluating the effect of a late season, post-Feekes 6, application of Nitrogen on the production of winter wheat forage production, management strategies to improve crop yield and sustainability.

MATERIALS AND METHODS

This trial was conducted over the 2018-2019 winter wheat growing season in no-till dryland conditions, as a portion of a larger on going trial evaluating winter wheat forage management strategies for improving crop yield and sustainability. The trials were established at three locations spanning the central region of Oklahoma at Lake Carl Blackwell (LCB) near Stillwater, the South Central Research Station in Chickasha, and the Noble Research Dupy Farm (DUPY) near Gene Autry. A three by four by two factorial was established with the primary factor, wheat nitrogen application, of three applications of nitrogen (N) in the form of urea (46-0-0) at 60 lbs N ac^{-1} and 120 lbs N ac^{-1} and a split application of 60 lbs N ac^{-1} at pre-plant and 60 lbs N ac^{-1} top-dress application. The secondary factor treatments were summer rotation crops, with a cow pea (*Vigna unguiculata*) planted at 60 lb ac^{-1}, pearl millet (*Pennisetum glaucum*) planted at 20 lb ac^{-1}, a mixture of Cow pea at 30 lb ac $^{-1}$ and Pearl millet at 10 lb ac^{-1}, and an unplanted summer fallow. The tertiary factory of the trial was summer nitrogen application of no nitrogen or 30 lb N ac^{-1} in the form of urea-ammonium nitrate (UAN, 28-0-0).

Soil samples were taken to 6 inch depth in each plot to evaluate the soil nutrient levels for nitrogen, organic matter content and total carbon content at prior to each wheat season, with 18 inch samples collected for soil physical properties. Gallagher variety was planted at all locations at a rate of 116, 120, 130 lbs ac^{-1} for Dupy Farm, Lake Carl Blackwell, and Chickasha locations, respectively. The planting dates for the LCB and Chickasha locations was mid-September, and mid-November for the Dupy Farm. Pre-plant fertilizer was applied prior to planting, while top dress nitrogen application was delayed until spring green-up was visually detected. In the 2018-2019 winter wheat season top dress applications were applied in the form of urea following the Feekes-6, or “first hollow stem”, stage due to increased precipitation preventing an ideal application timing.

An initial in-season harvest was taken for the LCB and Chickasha locations, by simulated grazing using a Carter Manufacturing flail-type 3 ft harvester, over both halves of the primary factor plots in preparation for tertiary factor implementation. A final harvest was collected at the end of the season prior to heading stages of maturity, near Feekes 10, at all locations. All winter wheat biomass greater than two inches in height was harvested for yield by weight. Grab samples were collected for moisture content and quality analysis from each sub-plot. Wheat forage collected was analyzed by Oklahoma State University Soil Water and Forage Analytic Laboratory for protein, moisture, acid detergent fiber (ADF), total digestible nutrients (TDN) and, energy content. For the purpose of these proceeding the primary factor treatments were analyzed statistically, using SAS 9.4, which resulted in three treatments with thirty-two replicates.

RESULTS AND DISCUSSION

Wheat yields from the first year of this trial resulted in minimal significance during the first harvest, with only the Lake Carl Blackwell resulted in 0.3 tons ac^{-1} increase in forage biomass yield from the increased 60 lbs of nitrogen application. Final harvest results in significant nitrogen application response at two, with yields being increased with the increase in nitrogen application as well as with the delay of the increase to an in-season application (Figure 1). Chickasha and LCB resulted in a 0.4 and 0.9 tons ac^{-1} biomass yield increase with increased rate,respectively, however the split application with the delay of the addition 60 lbs further increased yields of the two locations. Yield increases from the delayed top dress application resulted in 0.8 and 1.7 tons ac^{-1} for Chickasha and LCB, respectively. The Dupy location resulted in no significant yield differences in biomass production for the 2018-2019 wheat growing season.

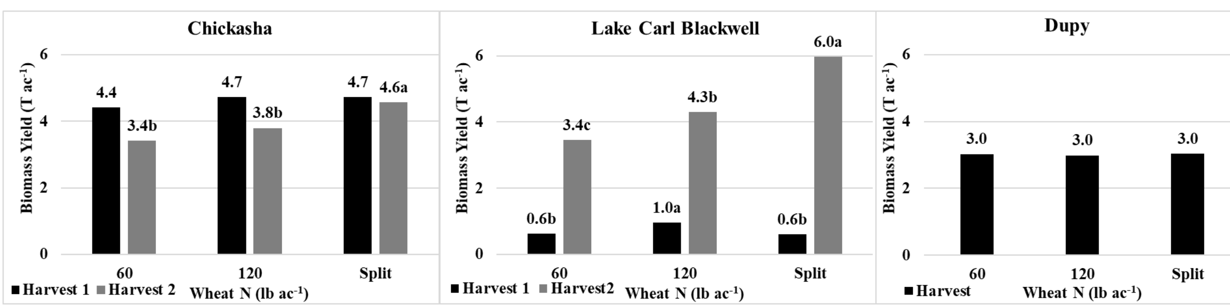

Figure 1. Dry matter harvest results (T ac^{-1}) for each of the harvest dates at each location. Wheat nitrogen rates 60lbs N ac^{-1}, 120lbs N ac^{-1}, and a split application of 60 lbs N ac^{-1}at pre-plant and 60lbs N ac^{-1} applied as top-dress. Dupy location only received a final harvest.

The Chickasha and Lake Carl Blackwell locations increased total yield with the increase in pre-plant nitrogen as well as with the delay of the additional 60 lbs nitrogen application (Figure 2). The additional 60 lbs at pre-plant resulted in a 0.7 and 1.2 ton ac^{-1} yield increase in biomass over the 60 lb pre-plant application at Chickasha and Lake Carl Blackwell, respectively. When the application of the additional 60lb nitrogen was delayed until after the achievement of Feekes 6 stage; forage biomass yields were increase over the 120 lb application by 0.8 and 1.3

tons ac^{-1} for Chickasha and LCB, respectively. Chickasha produced over greater biomass production than LCB due to increased residual N present in the soil.

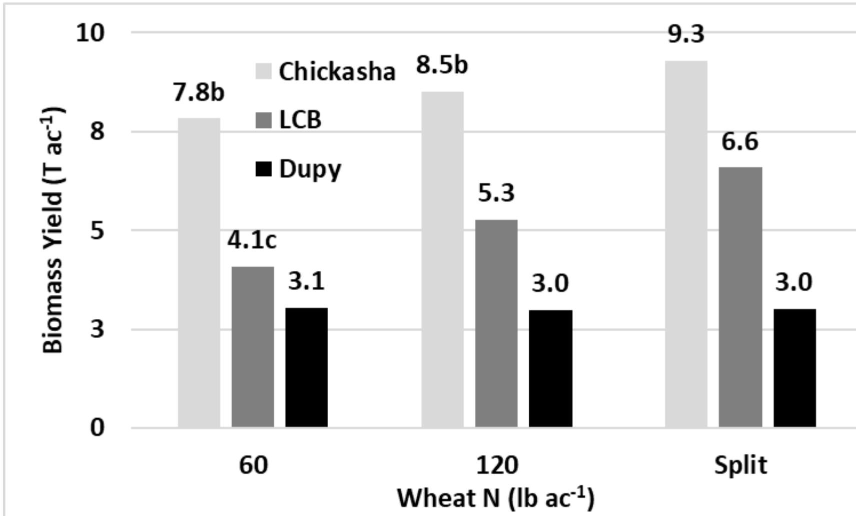

Figure 2. Total dry matter (T ac^{-1}) harvest results for each location. Wheat nitrogen rates 60lbs N ac^{-1}, 120lbs N ac^{-1}, and a split application of 60 lbs N ac^{-1}at pre-plant and 60lbs N ac^{-1} applied as top-dress.

Nitrogen uptake also revealed increases with the increased application as well as delayed addition of N fertilizer. Evaluation of the nitrogen uptake (%) as a factor of nitrogen content of the biomass by the amount of biomass harvested resulted in a 20% or greater N uptake at Chickasha and LCB with the additional 60 lbs of pre-plant nitrogen. Delay of the additional 60 lb N increase resulted in 3, 27, and 27 percent increases in uptake for Chickasha, LCB, and Dupy, respectively, over the 120 lb pre-plant application (Figure 3).

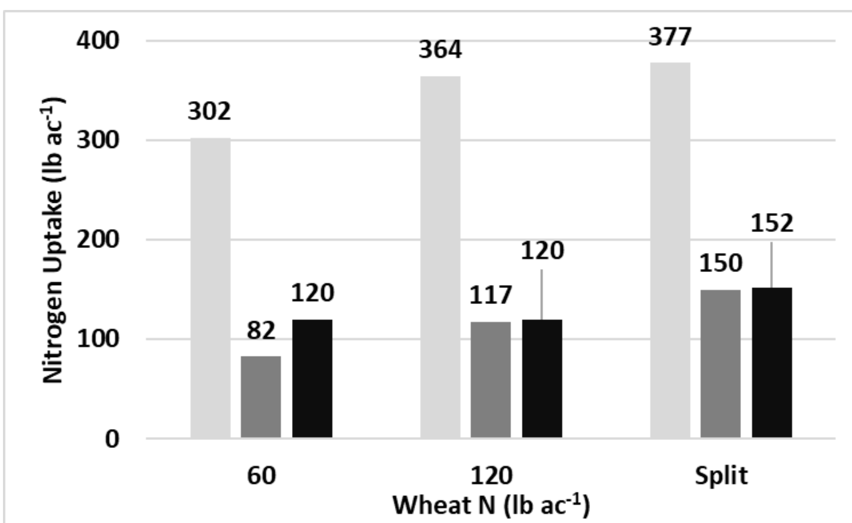

Figure 3. Nitrogen uptake (lb ac^{-1}) results for each location. Wheat nitrogen rates 60lbs N ac^{-1}, 120lbs N ac^{-1}, and a split application of 60 lbs N ac^{-1}at pre-plant and 60lbs N ac^{-1} applied as top-dress. Nitrogen uptake is nitrogen content of biomass by the amount of biomass harvested.

Year one results provide insight to the potential increase in forage biomass yields from the increase in nitrogen application. These increases in nitrogen application rate resulted in up to a 52% increase in forage biomass yield when applied as a pre plant application. The additional 60 lbs of nitrogen delayed until after Feekes 6 produced up to 95% increase in biomass production. These results support the finding of Belew et. al (2016) that state the addition of top-dress nitrogen increase biomass yield most effective and efficiently. While these results are only a portion of a larger study evaluating systems for winter wheat forage management, they can stand alone in showing the impact of nitrogen on the forage production yield potential.

REFERENCES

Epplin, F. M., True, R. R., & Krenzer Jr, E. G. (1998). Practices used by Oklahoma wheat growers by region. *Okla. Curr. Farm Econ, 71*(1), 14-24.

NASS, U. (2018). United States Department of Agriculture National Agriculture Statistics Service. Retrieved from https://quickstats.nass.usda.gov/results/F9921891-EE24-384D-B996-17D1B51311B7

Pinchak, W., Worrall, W., Caldwell, S., Hunt, L., Worrall, N., & Conoly, M. (1996). Interrelationships of forage and steer growth dynamics on wheat pasture. *Rangeland Ecology & Management/Journal of Range Management Archives, 49*(2), 126-130.

Sij, J., Belew, M., & Pinchak, W. (2016). Nitrogen management in no-till and conventional-till dual-use wheat/stocker systems. *Texas Journal of Agriculture and Natural Resources, 24*, 38-49.