EVALUATION OF WARM-SEASON PERENNIAL GRASSES UNDER THREE IRRIGATION REGIMES AS POSSIBLE ALTERNATIVES TO IRRIGATED ROW CROPS

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Summary

A multi-year study is being conducted to evaluate production and nutrient composition responses of 6 warm-season perennial grasses under 3 irrigation regimes. Irrigation regimes include: 1) dryland, 2) limited, and 3) full. The first year of the study has been completed and data were collected and analyzed. Grass plots were harvested four times during the growing season to determine dry matter yield at each harvest and total dry matter yield over the growing season. Nutrient analysis was performed on the final harvest sample only. Irrigation, grass species, and their interaction affected dry matter forage yield ($P < 0.001$). Crude protein content of forage was affected by both irrigation and grass species ($P < 0.01$), but not the interaction ($P = 0.192$). A significant irrigation by grass species interaction was also detected for *in vitro* true digestibility ($P = 0.028$).

Introduction

The Ogallala Aquifer is declining by an average of almost 1.5 feet each year, with agriculture as the major consumer of water, particularly for irrigation purposes. With increasing concerns of water availability in the region, alternatives to corn and other high water use crops are needed. Perennial summer grasses could potentially be used as a cropping alternative, however many of the introduced grasses use as much or more water to produce high yielding, high quality forage. Our hypothesis is that some of the improved varieties of native warm-season grasses could be highly productive under limited irrigation schemes, replacing row crops that consume large amounts of water each year from the Ogallala Aquifer.

Experimental Procedures

The study was initiated in 2006 at the Texas AgriLife Research field lab near Etter, TX. Six grass species were planted in May 2006. Late planting and above average temperatures during the early summer of 2006 led to unsatisfactory plant establishment by early fall of 2006. The decision was made to reseed plots in 2007. By spring of 2008, grasses were well established, irrigation treatments were initiated, and data collection began. The six grass species being examined are:

- Wrangler bermudagrass
- Hatchita blue grama
- Texoka buffalograss
- WW Spar old world bluestem
- Haskell sideoats grama
- Blackwell switchgrass

Treatments included irrigation level (dryland, limited, and full) and warm-season grass species (previously mentioned). Each treatment combination appeared in three replicated 30 × 70 ft plots arranged in a split plot randomized complete block design. Irrigation level served as the main plot and grass species served as the sub-plot for analysis of variance. Irrigation level was determined based on the reference evapotranspiration (ET) value of bermudagrass as estimated by the North Plains ET Network for the location at Etter. Plots assigned to full irrigation received water equal to the bermudagrass ET value minus any rainfall that occurred in the preceding seven days. Plots on the limited irrigation treatment received one-half of the amount of water for full irrigation plots. During the growing season, irrigation water was applied in 1 or 2 applications each week as needed using a linear move sprinkler system. From June 9 to August 28, 14.7 inches of irrigation water was applied to plots in the full irrigation treatment and 7.33 inches of irrigation water was applied to limited irrigation plots. Additionally, during that same time period, plots received 5.82 inches of rainfall. Plots were fertilized as needed based on soil sample analysis.

Grass was harvested 4 times during the growing season using a Carter Harvester. Samples were weighed and dried to determine yield and dry matter. A sub-sample from each plot from the final harvest was analyzed for nutrient composition.

Soil core samples were collected at the beginning of the growing season and after the last harvest to determine total water use and water use efficiency. Total water use (ET) was calculated as the sum of soil water balance, irrigation, rainfall values. Water use efficiency was determined as the ratio of dry biomass yield and seasonal ET.

Results and Discussion

Perhaps not surprising, forage dry matter yield increased ($P < 0.001$) as irrigation level increased (1.1, 2.7, and 5.2 tons/acre for dryland, limited, and full irrigation, respectively). A significant irrigation × grass species interaction was detected ($P < 0.001$, Figure 1) for dry matter yield. Under full and limited irrigation, old world bluestem and bermudagrass yielded the greatest forage dry matter. Buffalograss tended to yield the lowest amount of dry matter at each irrigation level. Crude protein content of the forage was affected by irrigation ($P < 0.01$), with grasses grown under dryland conditions containing the highest amount of crude protein (16.4%). Grasses under limited irrigation contained the lowest amount (13.3 %) and grasses under full irrigation were intermediate (15.0 %). No interaction was detected for crude protein ($P = 0.19$, Figure 2). The highest amount of crude protein in any of the treatments was 20% CP for the bermudagrass grown under dryland conditions; however, dry matter yield was only 1.1 tons/acre. There was little difference in crude protein content between bermudagrass, blue grama, and switchgrass species under full and limited irrigation. In vitro true digestibility of forage was similar across irrigation all treatments ($P = 0.67$). The irrigation × grass species interaction was significant for in vitro true digestibility ($P < 0.05$; Figure 3). Under full and limited irrigation, digestibility tended to be highest for switchgrass, followed by blue grama. Under dryland conditions, digestibility was greater than 75% for switchgrass, bermudagrass, and sideoats grama.

Implications

Care should be taken in drawing conclusions from one year of a multi-year study. Data presented here is from the first year of a planned 3-year study.

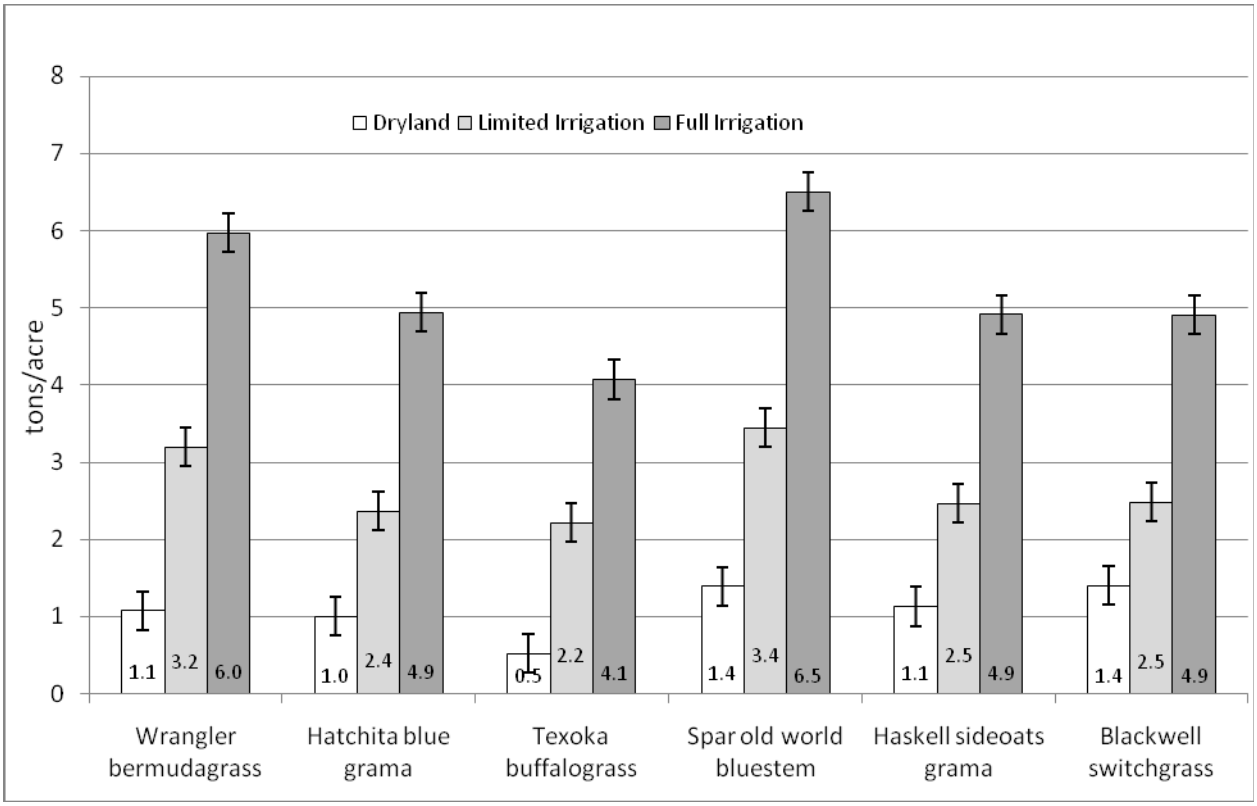

Figure 1. Forage dry matter yield (tons/acre) of grass species at each irrigation level. Standard error bars are attached to the means. Irrigation, grass species, and irrigation × grass species interaction effects ($P < 0.001$).

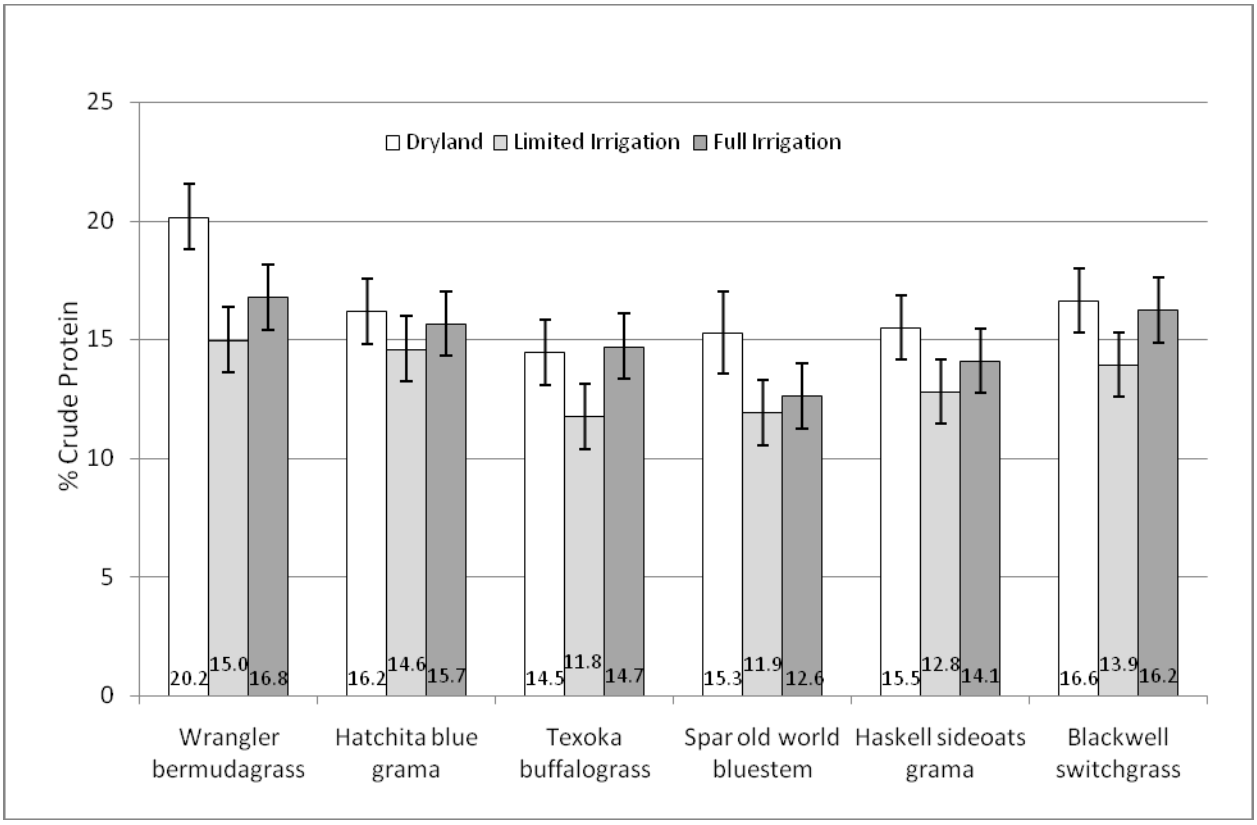

Figure 2. Crude protein content (%) of grass species at each irrigation level. Standard error bars are attached to the means. Irrigation and grass species effects ($P < 0.005$). Irrigation × grass species interaction ($P = 0.19$).

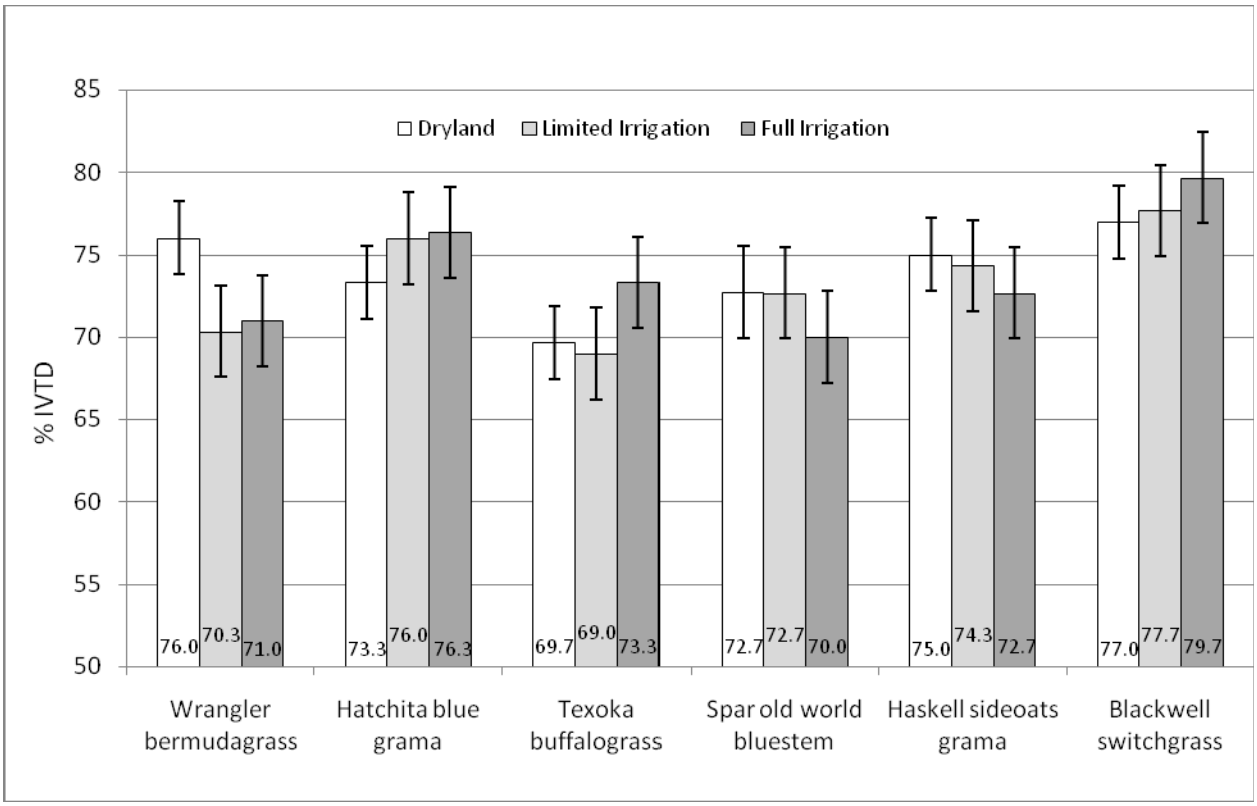

Figure 3. In vitro true digestibility (%) of grass species at each irrigation level. Standard error bars are attached to the means. Irrigation × grass species interaction (P = 0.028).