

GETTING THE MOST FROM DUAL-USE WHEAT: SEEDING RATE AND GRAZING INTENSITY MATTER

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BACKGROUND

Producers and ranchers in Texas rely on integrated crop-livestock approach to diversify income, reduce economic risks and increase profitability. Wheat in Texas and in neighboring states is produced for grain, forage and as a dual-purpose crop. Almost 50% of wheat planted in Texas is used for grazing and a wide range of seeding rates and grazing management are practiced by producers. However, it is not well understood how seeding rate and grazing intensity affect wheat forage and grain yield and quality when livestock are removed at different times. In addition, optimizing seeding rate and grazing intensity may provide producers an opportunity to reduce input costs while maintaining or improving forage and grain productivity and quality. Therefore, scientific evidence is required to better understand the impacts of these management practices and to optimize the efficiency of dual-purpose production systems.

RESEARCH TRIALS

To evaluate the effects of various seeding rate and grazing management strategies and help answer the questions on potential opportunity to enhance the production efficiency of dual-purpose production systems, TAMU Agronomy program conducted the research trials over three site-years at Millersview (2019, 2020) and San Angelo (2020), TX. Hard Red winter wheat (TAM 114) was planted in late September at four seeding rates: 44, 65, 88, and 109 lb acre ¹. Forage was harvested prior to stem elongation at 2.0-, 2.5-, 3.5-, and 4.0-inches cutting heights (Photo 1) to simulate various grazing intensities and ungrazed plots were maintained as control (Photo 2). Wheat heads were harvested at maturity from the sampled areas to analyze grain yield and yield components (number of heads, seeds per head and seed weight) under grazing, and the remainder of the plot was combine harvested to determine grain yield without grazing pressure. Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) were analyzed, and Crude Protein (CP) and Relative Feed



Photo 1: Difference between grazing intensities at 2.0" (right) and 4.0" (left) cutting heights.



Photo 2: Mature wheat following maintained ungrazed plots (left) vs grazing at 2.0" (right) cutting heights.

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Value (RFV) were used to evaluate forage nutritive value. Data collected from applied management scenarios with four experimental replicates from three site-years was analyzed to evaluate the fixed effects of seeding rates, grazing heights, and interactions whereas; means were separated using Fisher's Protected LSD ($\alpha = 0.05$).

RESEARCH RESULTS

FORAGE AND GRAIN YIELDS

Statistical evaluation indicated that forage and grain yields of dual-use wheat were not affected by seeding rate (Figure 1A). This indicates that higher seeding rates may not be beneficial and provide an opportunity to reduce seeding rates and save input costs. In contrast, grazing intensity significantly influenced forage and grain yields (Figure 1B). Ungrazed wheat resulted in the greatest grain yield (2128 lb acre⁻¹) whereas grazing at 2" stem height resulted in the least (1461 lb acre⁻¹). Grazing at 4" stem height produced statistically similar grain yields (2099 lb acre⁻¹) indicating that grain yields can be maintained with optimal grazing (Figure 1B). This can be achieved by removing livestock from wheat in a timely fashion. Higher forage yields were obtained at higher grazing intensity and grazing at 2" stem height resulted in highest forage yield (1370 lb acre⁻¹). Grazing at 3.5" and 4" stem heights resulted in statistically similar grain and forage yields, however the grain yield was lower in 3.5" (Figure 1B). This suggests that excessive grazing may provide similar forage yields but will incur grain yield penalty.

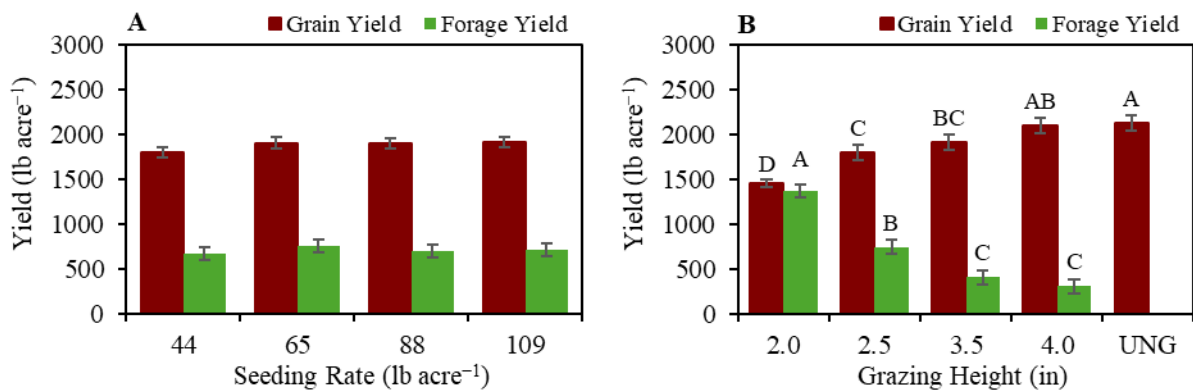


Figure 1: Grain yield and forage yield of dual-use wheat observed under different seeding rates (A) and grazing management simulated by cutting heights (B) from three site-years.

SEEDING RATE AND YIELD COMPONENTS

Higher seeding rate resulted in higher number of heads per acre however, number of seeds per head were reduced with increase in seeding rate (Table 1). Seeding at 109 lb acre⁻¹ resulted in highest number of heads (1.14 million acre⁻¹) whereas seeding at 44 lb acre⁻¹ resulted in highest number of seeds per head (28 seeds) (Table 1). Number of heads and number of seeds per head were statistically similar at 65, 88 and 109 lb acre⁻¹ seeding rates. This trend indicates that wheat yield will be compensated if the producers reduce the seeding rate to a threshold and grain and forage yield potential will still be achieved.

Table 1: Effect of seeding rate on yield components of dual-use wheat.

Seeding rate (lb acre ⁻¹)	Heads (million acre ⁻¹)	Seeds per head (no.)
44	0.91 b	27.70 a
65	1.04 a	26.65 ab
88	1.04 a	25.04 b
109	1.14 a	24.63 b

GRAZING INTENSITY AND YIELD COMPONENTS

Grazing intensity influenced yield components and intense grazing significantly reduced the number of heads and number of seeds per head (Table 2). Grazing at 3.5" and 4" stem heights produced statistically similar number of heads whereas number of seeds per head were similar at 2.5", 3.5" and 4" grazing intensities. Similar performance of yield components for grazing at 3.5" and 4" aligns with forage and grain yield trends (Figure 1B) indicating that optimizing grazing by removing livestock in a timely manner will ensure dual-use wheat potential while maintaining yields.

Table 2: Effect of grazing intensity (cutting height) on yield components of dual-use wheat.

Grazing height (in)	Heads (million acre ⁻¹)	Seeds per head (no.)
2.0	0.88 c	22.95 b
2.5	1.00 b	27.10 a
3.5	1.11 a	26.72 a
4.0	1.15 a	27.24 a

PERFORMANCE EVALUATION OVER SITE-YEARS

Grain and forage yields varied among the three site years (Figure 2). Grain yield was highest at Millersview in 2020 (2358 lb acre⁻¹) and lowest at San Angel0 in 2020 (1446 lb acre⁻¹). Forage yield was highest in 2019 (1127 lb acre⁻¹) and lowest in 2020 (266 lb acre⁻¹) at Millersview. Performance of yield components (Table 3) also varied among three site-years which possibly contribute to differences in yields. These findings indicate that a uniform seeding rate or grazing management may not be applicable to different geographical locations over years. Hence seasonal or site-specific management may be required.

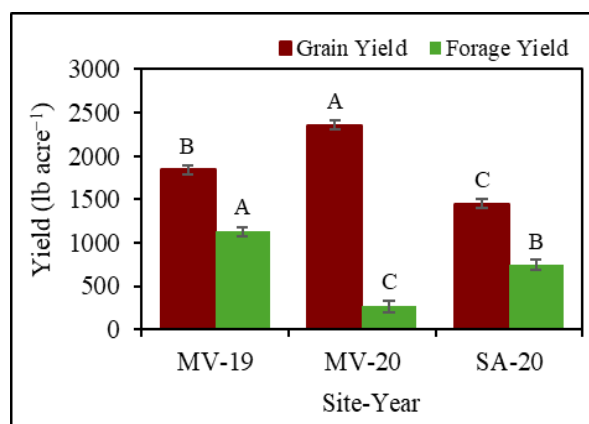


Figure 2: Grain and forage yields of dual-use wheat over three site-years.

Table 3: Performance of yield components including number of heads, seed weight and number of seeds per head over three site-years.

Site-Year	Heads (million acre ⁻¹)	Seed weight (g)	Seeds per head (no.)
Millersview-19	1.50 a	0.03 a	22.40 c
Millersview -20	0.66 c	0.02 b	26.52 b
San Angelo-20	0.94 b	0.02 b	29.10 a

FORAGE QUALITY

Neutral detergent fiber (NDF) and Acid detergent fiber (ADF) reduced with taller stubble height (lower grazing intensity) and intense grazing resulted in higher NDF and ADF proportions (Figure 3). This was because of greater proportion of young, leafy tissues were collected and less structural stem material was included. Low grazing intensity limits the harvest of mature stems, which are higher in structural carbohydrates, resulting in forage with improved quality. Lower NDF and ADF concentrations are desirable in harvested forage as they are associated with greater intake potential and higher digestibility, ultimately improving feed value for livestock.

Crude protein and relative feed value (RFV) (Figure 4) increased with low grazing intensity and vice versa. Young and leafy tissues are higher in nitrogen content and optimal grazing limited the inclusion of lignified stems resulting in higher protein content and improved forage quality. Producers should consider that intensive grazing in dual-purpose wheat systems may reduce animal performance or milk and weight gains due to higher proportion of stem material in the forage. At the same time, excessive grazing pressure can increase the risk of harvestable yield losses by reducing plant recovery potential and delaying regrowth. Maintaining moderate grazing intensity will help balance forage quality, animal gains, and grain yield protection.

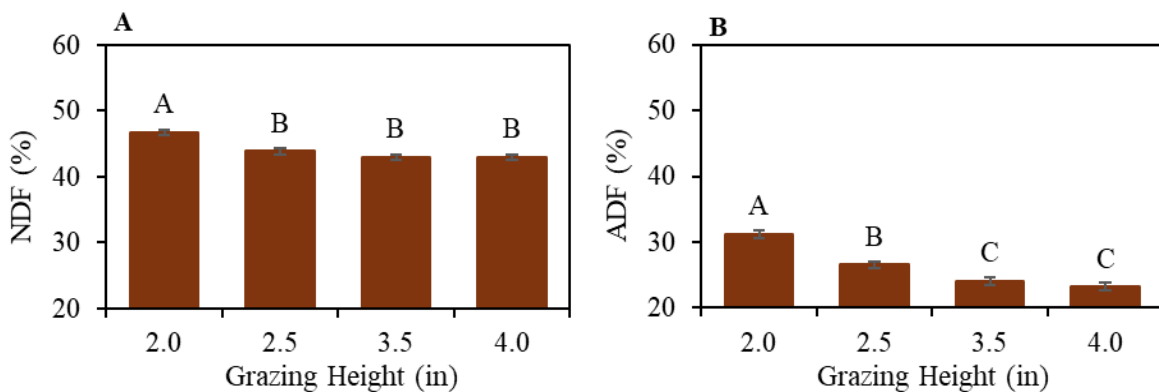


Figure 3: Effect of grazing intensity on forage quality: NDF (A) and ADF (B) of dual-use wheat.

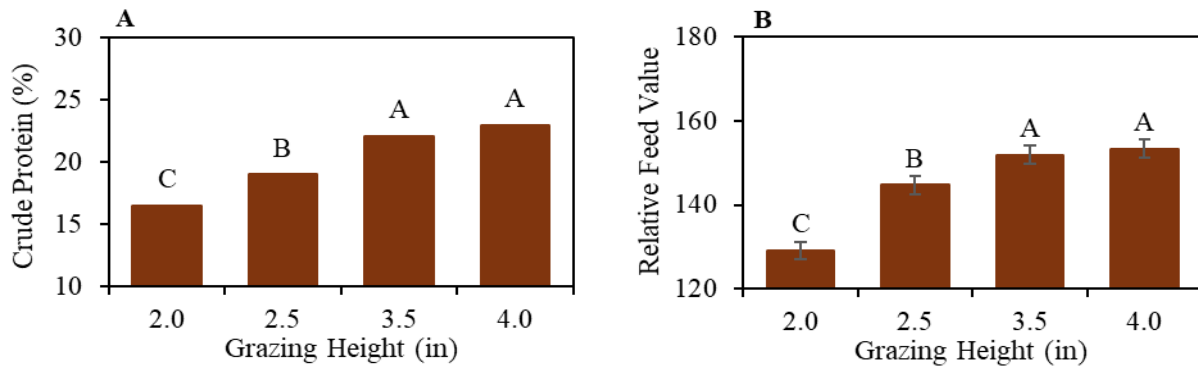


Figure 4: Effect of grazing intensity on forage quality: crude protein (A) and relative feed value- RFV (B).

IMPLICATIONS FOR PRODUCERS

Forage and grain yields were not affected by seeding rates and yield plateaus were obtained at 80 and 92 lb acre⁻¹, respectively (Figure 5). Increased yields at seeding rates lower than the highest applied seeding rate indicate an opportunity for producers to improve cost efficiency. Grazing intensity had a strong influence on system performance. Grazing at 2" stubble height reduced grain yield by approximately 30% compared to ungrazed wheat. While excessive grazing increased forage yield, it resulted in low forage quality and substantial grain yield losses. Seeding rate and grazing intensity significantly affected yield components. Effects of seeding rates were compensated by either number of heads or number of seeds per head due to compensatory nature of wheat, higher grazing intensity in contrast, significantly reduced both number of heads and number of seeds per head, indicating that yield losses incurred with higher grazing intensity were largely irreversible and could not be compensated later.

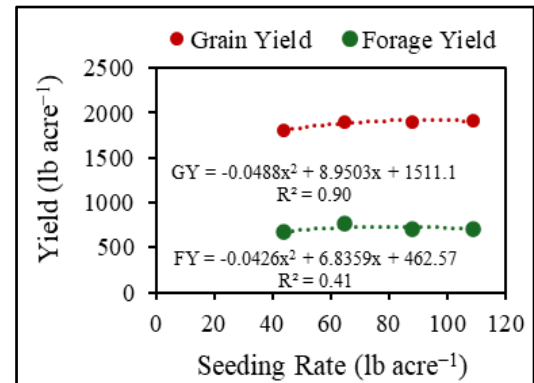


Figure 5: Quadratic responses for grain and forage yields of dual-use wheat to applied seeding rates.

Intensive grazing increased NDF and ADF concentrations while reducing crude protein and relative feed value, indicating that intense grazing can compromise forage quality in addition to reducing grain yield. Grain and forage yields, as well as yield component responses, varied across site-years, suggesting that a single or uniform seeding rate or grazing intensity recommendation may not be universally applicable. Instead, seasonal and site-specific management strategies are required. Market trends, livestock needs, and equipment capacity may further influence in-season dual-use management decisions.

Overall, this research indicates that once producers decide to graze wheat at high intensity, much of the yield penalty has already occurred. Therefore, timely livestock removal is critical, as delayed removal under intensive grazing can lead to significant and unavoidable reductions in grain yield.

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FURTHER INFORMATION: Specific questions can be directed to reagan.noland@ag.tamu.edu.