Long-term Performance of Steers Grazing Smooth Bromegrass Pastures

Table 1. Number of grazing days and precipitation (inches) data from 2005 to 2021

	Grazing Days	Month						Grazing Season Total Rainfall	Annual Total Rainfall
		Apr	May	Jun	Jul	Aug	Sep		
Minimum[1]	112	0.29	1.38	0.97	0.26	0.77	0.89	11.7	16.8
Maximum	168	4.92	7.87	9.89	7.22	10.2	7.66	32.7	42.3
17-yr average	151	2.98	5.07	5.05	2.89	4.48	3.44	23.9	32.0

[1] Minimum and maximum precipitation values are shown for each month and all months within a row are not from the same year; therefore, the sum of the months does not add up to the total listed for the grazing season.

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Summary with Implications

Body weight gain of yearling steers grazing smooth bromegrass pastures was measured across 17 years from 2005 to 2021. Three treatments were applied, (1) control pastures with no additional inputs, (2) pastures fertilized with 80 lb of N per acre, and (3) pastures grazed with cattle supplemented daily with approximately 5 lb of dry distillers grains. The control treatment pastures (1.4 acres/steer) were stocked 30% lighter than the fertilized and supplemented pastures (1.0 acre/steer). Across the 17 years, the supplemented cattle gained 2.24 lb/day while the non-supplemented cattle (both control and fertilized treatments) gained 1.57 lb/day. Body weight gain per acre was greatest for the supplemented cattle (358 lb/acre), intermediate for cattle grazing the fertilized pastures (251 lb/acre) and least for the control pastures (172 lb/acre). Fertilizing smooth bromegrass pastures directly or through supplementation of cattle improved land use efficiency in eastern Nebraska, while supplementation also improved cattle body weight gain.

Introduction

Land used for agriculture purposes has been steadily declining while agriculture production expenses, such as fertilizer, have increased, especially during the past two decades. Land use efficiency and utilization of economically advantageous management practices will be critical to the long-term survivability of agriculture operations. Moving forward, producers will need to factor energy costs, forage production, and animal performance into management decisions in forage-based livestock production systems. Backgrounding growing cattle on pasture prior to feedlot placement can be an economically favorable option due to fluctuating market conditions and grain prices.

Supplementation of dried distillers grains plus solubles (DDGS) can improve cattle weight gain, reduce forage intake, and result in excess nitrogen excreted on pastures. The objective of this experiment was to examine the long-term effects of DDGS supplementation and nitrogen fertilization on animal performance and pasture productivity. Seventeen years of cattle performance data were analyzed.

Procedure

This experiment was conducted at the Eastern Nebraska Research, Extension, and Education Center near Mead, NE. A randomized complete block design consisting of three blocks (pastures) and three treatments was used for this experiment. The following treatments were applied: 1) **SUPP**–calves grazed non-fertilized smooth bromegrass pasture and were supplemented daily with DDGS at 0.6% of body weight (BW) on a dry matter basis (adjusted throughout the grazing season for years 2005 through 2016 and set at 5 lb/day throughout the grazing season for years 2017 through 2021); 2) **FERT**–calves grazed smooth bromegrass pastures fertilized with 80 lb of N/acre; and 3) **CONT**–calves grazed unfertilized smooth bromegrass pastures without supplementation. At the start of the experiment, each pasture was divided into 3 sections with treatments assigned to these areas. The treatment assignments remained the same throughout the 17 years.

In late April, 45 steer calves weighing 730 ± 59 lb were identified from a pool of approximately 1,000 calves. Each year from 2005 through 2021, steers rotationally grazed smooth bromegrass pastures for a total of 17 grazing seasons. Within each year, cattle were stratified by BW and assigned to a group (n = 9). Groups were then assigned to one of three treatments with three replications per treatment and 5 calves in each group. The FERT and SUPP pastures were 4.97 acres and the CONT pastures were 7.17 acres. Cattle rotated through all pastures 5 times throughout the grazing season. In a few years, the grazing season was shortened due to weather events, a hailstorm in 2010 and drought conditions in 2012, 2013, and 2020. Precipitation data for the site are described in Table 1.

Table 2. Performance of yearling steers grazing smooth bromegrass pastures during the grazing season from 2005 to 2021

	Treatment1				
	CONT	FERT	SUPP	SEM	*P*-value
Initial BW, lb	728	728	726	14.2	0.80
Ending BW, lb	961[a]	966[a]	1065[b]	12.2	< 0.01
ADG, lb/d	1.56[a]	1.58[a]	2.24[b]	0.07	< 0.01
BW gain, lb/acre	172[a]	251[b]	358[c]	3.68	< 0.01
AUM/acre[2]	3.14[a]	4.55[b]	4.83[c]	0.16	< 0.01

[a,b,c] Means within a row with differing superscripts were significantly different ($P < 0.05$).

1Treatments include 1) SUPP—calves grazing non-fertilized smooth bromegrass pasture supplemented daily with DDGS at 0.6% BW on a DM basis; 2) FERT—calves grazing smooth bromegrass pastures fertilized with 80 lb N/ac; and 3) CONT—calves grazing unfertilized smooth bromegrass pastures without DDGS supplementation.

[2]AUM = animal unit month, calculated based on average body weight of steers divided by 1,000 lb standard animal unit and number of grazing days each year.

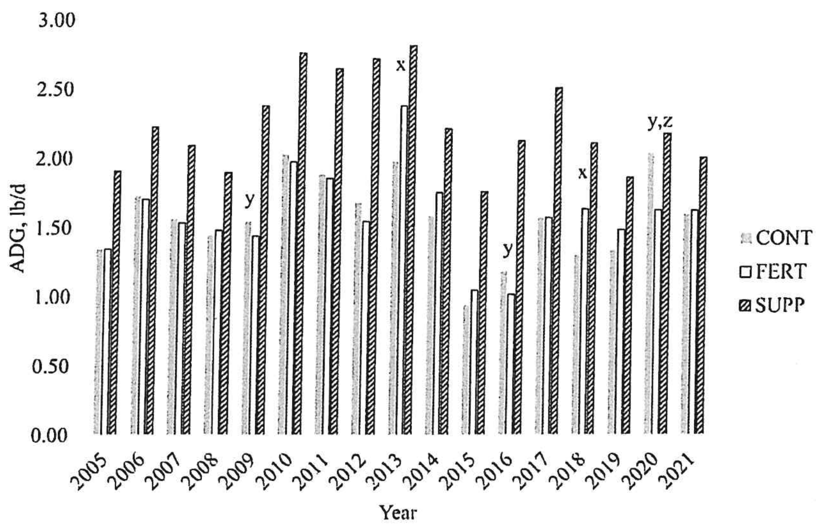

Fig. 1. Average daily gain (lb) of yearling steers grazing smooth bromegrass pastures during the grazing season from 2005 to 2021. Main effects of year, treatment, and treatment × year interactions were significant ($P < 0.01$). Treatments include 1) SUPP—calves grazing non-fertilized smooth bromegrass pasture supplemented daily with DDGS at 0.6% of body weight on a DM basis; 2) FERT—calves grazing smooth bromegrass pastures fertilized with 80 lb of N/acre; and 3) CONT—calves grazing unfertilized smooth bromegrass pastures without DDGS supplementation. Across 12 years, the SUPP treatment had the greatest ADG ($P < 0.01$) while CONT and FERT treatments did not differ ($P = 0.60$). Five years deviated from this norm and are noted with x, y, and z superscripts. [x] Years that ADG of SUPP and FERT treatments were the same (2013, 2018; $P \geq 0.11$). [y] Years that ADG of FERT and CONT treatments differed (2009, 2016, and 2020; $P \leq 0.07$). [z] Years that ADG of SUPP and CONT treatments were the same (2020; $P = 0.43$)

Cattle did not receive an implant from 2005 to 2009. All cattle received a Revalor-G (Merck Animal Health) implant in 2010 through 2014 and 2017 through 2021. In 2015 and 2016 cattle received a Ralgro (Merck Animal Health) implant. Performance measurements were taken using five steer calves that remained on each pasture at all times. From 2005 through 2016 additional cattle were added or removed from the pastures as needed throughout the grazing season to manage grass growth. From 2017 through 2021, only 5 calves grazed in each group season long. Initial BW and ending BW measurements were taken following five days of cattle being limit fed at approximately 2% BW. The diet fed was 50% alfalfa hay and 50% Sweet Bran (Cargill Corn Milling, Blair, NE; DM basis). Measurements were taken in the morning before feeding daily for three days and averaged with adjustments made for BW gain during the weighing procedure.

Statistical analysis was performed using the GLIMMIX procedure of SAS. The model tested for effects of block, year, treatment, and year × treatment interactions for each response variable.

Results

Results discussed below are calculated from a total of 149 observations (9 observations per year for 17 years with 4 observations excluded). Excluded observations included one rep of the CONT treatment in 2017, due to 2 calves having to be removed from 1 pasture. In 2020 one replication (1 pasture, 3 treatments) was excluded due to an overlapping experiment that required different supplementation strategies. The number of grazing days per year averaged 151 days, with a low of 112 days in 2020 and a high of 168 days in 2009 and 2011.

Cattle performance data are summarized in Table 2. Year × treatment interactions ($P < 0.01$) and year effects ($P < 0.01$) were detected for ADG, ending BW, and BW gain. Initial BW did not differ between treatments ($P = 0.80$). Across all years, the SUPP cattle had the greatest ADG at 2.24 lb/d ($P < 0.01$). Average daily gain for CONT and FERT cattle were similar (1.56 and 1.58 lb/d, respectively; $P = 0.60$) across all years. Similar ADG of the FERT and CONT cattle demonstrates that forage availability was the same and appropriate paddock sizes were used for this experiment. However, treatment × year interactions were observed ($P < 0.01$) and there was variation in ADG. The CONT cattle ranged from 0.95 lb/d to 2.02 lb/d, while FERT and SUPP cattle ranged from 1.01 lb/d to 2.38 lb/d and 1.72 lb/d to 2.82 lb/d, respectively.

Average daily gain over time is summarized in Figure 1. Across the 17 years, there were 5 years that did not follow the same pattern as the overall summary. In 2009, 2016, and 2020, ADG of FERT was less than the CONT treatment ($P = 0.03$, $P = 0.07$, $P = 0.07$, respectively). In 2020, the CONT treatment had similar ADG to the SUPP treatment ($P = 0.43$), and both were greater than the FERT treatment ($P \leq 0.07$). In 2013 and 2018 the ADG of SUPP and FERT treatments did not differ (P = 0.24, P = 0.11, respectively), while ADG of the FERT treatment did not differ from the CONT ($P \geq 0.24$). Annual precipitation and grazing season precipitation levels were below the 17-year average (32.0 in and 23.9 in, respectively) in 2009, 2013, and 2020 and above the 17-year average in 2016 and 2018. This suggests in dry years the N fertilizer was not effectively used and the FERT treatment was at a disadvantage. In wetter than average years treatment differences were minimized, although timing of rainfall and temperatures also play a critical role. In all years, the DDGS supplement helped alleviate weather risks with cattle maintaining at least 1.7 lb/d ADG, at least partly due to protein supply.

Ending body weight (EBW) also differed among treatments ($P < 0.01$). As a result of the increased ADG, SUPP cattle also had the greatest EBW (1065 lb; $P < 0.01$). Increased ADG is likely a result of supplementation of both protein and energy in the DDGS. The FERT and CONT cattle had similar EBW (P = 0.70) at 966 and 961 lb, respectively. Body weight gain per acre was 172 lb/ac for CONT cattle, 251 lb/ac for FERT cattle, and 358 lb/ac for SUPP cattle ($P < 0.01$). Stocking rate was greatest for the SUPP treatment (4.83 AUM/ac) and least for the CONT treatment (3.14 AUM/ac; $P < 0.01$). These data indicate that pasture use efficiency is increased through DDGS supplementation and fertilization of pastures, with the SUPP treatment being the most productive per ac.

The chemical properties of the soil at this pasture site were measured in 2020 (0 to 8 in) and reported by Anastasios Mazis (2023 article in Agriculture, Ecosystems, and Environment). The pH of grazed CONT soils (5.97 ± 0.03) was greater than the grazed SUPP and FERT soils (5.83 ± 0.07 and 5.87 ± 0.06, respectively). Soil organic matter did not differ across all treatments at 4.30%. Soil nitrate did not differ between the SUPP (2.07 ± 0.12 ppm N) and FERT (2.13 ± 0.35 ppm N) treatments and was lower in CONT pastures, 1.60 ± 0.10 ppm N. Cation exchange capacity per 100 g (a measure of the soil's ability to hold onto essential nutrients with a greater number being better) differed between the CONT (17.30 ± 0.25), FERT (18.00 ± 0.41) and SUPP (18.43 ± 1.42) treatments. Mazis also found that fertilization improved pasture biomass, specific leaf area, leaf area index, and forage quality compared to the CONT. The use of N fertilization did not offer an advantage over DDGS supplementation.

Conclusion

Supplementing cattle daily with DDGS at 0.6% of BW on a DM basis demonstrated positive effects on cattle daily gain and ending body weight. Cattle supplemented with DDGS were also more resilient to changes in precipitation. This may serve as a risk management strategy that protects against the negative impacts that adverse weather conditions can have on cattle performance. Additionally, fertilizing pastures with 80 lb of N/ac and supplementing cattle daily with DDGS increased body weight gain per acre and improved carrying capacity of smooth bromegrass pastures.

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