EXTENSION
BEEF CATTLE RESEARCH UPDATE
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Efficacy of Mineral Supplementation to Growing Cattle Grazing Winter-Wheat Pasture in Northwestern Oklahoma

Winter-wheat pasture is an economically important resource in the Southern Great Plains because income is derived from both the grain and the cattle body weight (BW) gain from the grazing cattle. The analyzed mineral composition of wheat forage indicates that it contains sufficient phosphorus and magnesium, excessive potassium but inadequate calcium to meet metabolic needs of growing cattle. Wheat forage can contain more than 4% potassium and as little as 0.22% calcium in the spring, while wheat is rapidly growing.[1] Thus, calcium is the most limiting mineral in most wheat pasture grazing situations.

Research from central Oklahoma has indicated improved performance by stocker cattle when provided a complete free-choice mineral supplement high in calcium and low in phosphorus.[2] Two experiments were conducted at the Southern Plains Experimental Range of the USDA, Agricultural Research Service near Ft. Supply, OK to evaluate the efficacy of mineral supplementation to cattle grazing winter-wheat pasture in northwest Oklahoma.[3] In both experiments, stocker calves grazed wheat pasture for 84 days and were either fed no supplement of any kind or were offered a free-choice mineral mixture containing 15 to 17% calcium, 4% phosphorus, 5.5% magnesium, and 18.5 to 22% salt.

In experiment 1 (fall grazing), 120 steers and heifers (512 lb) were assigned randomly to four blocks of replicated pastures during the second week of November in 2008 and 2009. In experiment 2 (spring grazing), 216 steers (547 lb) were assigned randomly to five blocks of replicated pastures during the second week of February in 2009 and 2010. Half the pastures in both experiments received the free-choice mineral mixture and mineral feeders were weighed weekly to determine mineral intake.

The results of these experiments are shown in Table 1. In Experiment 1, calves offered mineral gained 43% faster than calves not offered mineral (P = 0.02, 1.61 vs. 1.12 lb/day) and thus were 5.5% heavier (P = 0.04, 631 vs. 598 lb) after 84 days than non-supplemented cattle. Gain per acre tended to increase (P = 0.08) 20 lb with mineral supplementation. Similarly, in Experiment 2 calves fed mineral gained 20.7% faster than control calves (P = 0.01, 2.16 vs. 1.79 lb/day) resulting in 4.9% greater final weights (712 vs. 679 lb). Gain per acre tended to increase (P = 0.08) 19 lb with mineral supplementation. Mineral intake in Experiments 1 and 2, respectively averaged 4.8 and 4.4 oz/day compared to the manufacturers' suggested intake range of 2 to 4 oz/day. The cost of mineral per lb of added weight gain was $0.24 and $0.29 in Experiments 1 and 2, respectively (assuming a mineral cost of $0.40/lb).

Table 1. Performance of stocker cattle grazing wheat pasture.

	Experiment 1			Experiment 2		
Item	No Mineral	Mineral	P-value	No Mineral	Mineral	P-value
Initial weight, lb	452	452	0.99	540	542	0.91
Day 84 weight, lb	589	631	0.04	679	712	0.01
ADG, lb	1.12	1.61	0.02	1.79	2.16	0.01
BW Gain/acre, lb	53	73	0.08	85	104	0.08
Mineral intake, oz	---	4.76	---	---	4.37	---
Mineral cost/lb added gain, $	---	0.24	---	---	0.29	

Adapted from Gunter and Combs, 2019.

The mineral concentrations (dry matter basis, DM) of the wheat pasture over each 84-day experiment is compared to estimated requirements[4] in Table 2. Both the calcium and phosphorus concentrations in the pasture samples collected during experiments 1 (fall) and 2 (spring) were less than what NASEM (2016) has stated as necessary for optimal performance. These researchers noted that "contrary to other reports for ruminants grazing winter-annual type pastures in other locations, wheat pasture herbage in northwest Oklahoma was deficient in phosphorus as well as calcium. They suggested that the 4% phosphorus mineral mix that was fed might be slightly deficient in phosphorus. The concentrations of the trace mineral, copper and zinc, were also deficient compares to estimated requirements. The concentrations of the other minerals were sufficient compared to concentrations needed for optimal performance.

Table 2. Minerals concentration in wheat forage (average over entire 84-day experiments on DM basis) compared to estimated nutrient requirements.

Mineral	Experiment 1	Experiment 2	Requirement
Calcium, %	0.27	0.35	0.64 – 0.70[a]
Phosphorus, %	0.21	0.20	0.31 – 0.39[a]
Magnesium, %	0.14	0.14	0.10[b]
Potassium, %	1.7	1.8	0.60[b]
Sulfur, %	0.21	0.22	0.10[b]
Copper, ppm	4.0	4.4	10[b]
Iron, ppm	1018	599	50[b]
Manganese, ppm	185	115	20[b]
Zinc, ppm	15.1	17.3	30[b]

Adapted from Gunter and Combs, 2019.

[a] Estimated using the NASEM (2016) "Nutrient Requirements of Beef Cattle" model with data from experiments 1 and 2 by Gunter and Combs, 2019.

[b] Recommendations from NASEM. 2016.

These researchers concluded that supplementing a free-choice mineral that is high in calcium and low in phosphorus to cattle grazing wheat pasture in Northwest Oklahoma will increase daily gains and likely yield a positive return on investment. They also reported that mineral analysis of the pasture herbage shows multiple mineral deficiencies and justifies the mineral supplementation both from economic and animal welfare viewpoints.

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[1] Fieser, B. G., G. W. Horn, and J. T. Edwards. 2007. Effects of energy, mineral supplementation, or both, in combination with monensin on performance of steers grazing winter wheat pasture. J. Anim. Sci. 85:3470–3480.

[2] Horn, G., C. Gibson, J. Kountz, and C. Lunsford. 2002. Two-year summary: effect of mineral supplementation with and without ionophores on growth performance of wheat pasture stocker cattle. In: Horn, G. W., editor, Wheatland Stocker Conference, Enid (OK). p. A2–A19.

[3] Gunter, S. A. and G. F. Combs, Jr. 2019. Efficacy of mineral supplementation to growing cattle grazing winter-wheat pasture in northwestern Oklahoma. Transl. Anim. Sci. 3: 1119-1132.

[4] National Academy of Science, Engineering, and Mathematics (NASEM). 2016. Nutrient requirements of beef cattle, 8th revised ed. Washington, (DC): National Academy Press.