Evaluation of Salt, Trace Mineral Sources, and Growth Implants on Performance of Stocker Cattle Grazing Native Flint Hills Pasture

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Introduction
Graber et al. (1985) studied mineral supplementation with stockers grazing Flint Hills native grass pastures and concluded that improvements in performance may or may not occur when investing in this management practice. While most stocker operations today utilize some source of complete mineral, some producers use only salt while their calves are on pasture. The objective of this study was to determine the efficacy of providing salt alone or with injectable trace minerals compared to a complete mineral supplement and growth implants for improving the growth of stocker calves grazing native grass pastures in the Flint Hills region of Kansas.

Experimental Procedures
Crossbred steers originating from Texas and New Mexico (n = 248; 697.8 lb ± 9.6) were randomized by initial weight across 15 pastures. All steers in this study were previously used in a receiving study that focused on limit feeding either wet distillers grains or corn gluten feed at 2% of their body weight (Spore et al., 2018). The final weights of the receiving trial were used to randomly assign each animal to a treatment.

Pastures were randomly assigned to three different treatment groups: (1) Salt block only; (2) Salt block and Multimin90; and (3) a Kansas State University complete mineral (Brazle, personal communication; Table 1) formulated for 3 oz/day daily consumption. Multimin90 is an injectable chelated aqueous supplemental source of trace minerals administered at 1 mL/100 lb body weight (1 mL contains 60 mg zinc, 10 mg manganese, 5 mg selenium, and 15 mg copper).

Within each pasture treatment group, equal number of steers were randomly given either: Ralgro (36 mg zeranol) or Revalor-G implants (40 mg of trenbolone acetate and 8 mg estradiol; Merck Animal Health, Madison, NJ), or no implant. Stocking rates
were based on pasture size (avg: 250 lb/acre ± 5.2). All steers were weighed individually on days 0 and 90.

On a weekly basis, the mineral feeders and salt blocks were weighed to determine consumption. The collected data were used to calculate the previous week’s intake of mineral. Consumed mineral was replaced and the distance to a water source was adjusted as needed to achieve 3 oz per head daily target. The movement and opening of mineral feeders were done in pasture blocks to ensure intake differences were due to mineral and not to human error.

All calves were inspected multiple times weekly throughout the trial for pinkeye, lameness, and other ailments. If diagnosed with foot rot or pinkeye, cattle received Bio-Myocin 200. Upon conclusion of the study, all steers were weighed and placed in a small pasture overnight before shipping to a commercial feedlot.

Data were analyzed using the MIXED procedure (version 9.4, SAS Inst. Inc., Cary, NC). Data were arranged in a randomized incomplete block design, with pasture serving as the experimental unit for growth and health outcomes as impacted by treatment. In the model, the fixed effects were treatment and pasture while the random effects were pasture × treatment, pasture, and animal identification.

**Results and Discussion**

There were no statistical interactions; therefore, only the main effects of mineral supplementation and implant are presented in Tables 2 and 3, respectively. There were no significant differences in average daily gain (P=0.40) from salt or mineral supplementation (Table 2). It should be noted that all steers in this study were previously used in a 90-day growing study with diets well-fortified with macro and trace minerals that may have influenced the results observed. The results in Table 4 show the forage quality at three time points of the experimental pastures during the course of the experiment. Overall, the crude protein levels in the complete salt and mineral supplement pastures were significantly higher (P<0.02) than the other two treatments.

Compared to non-implants, calves gained significantly faster when implanted with either Revalor-G or Ralgro (average of 8.9%, P=0.02). The average block salt intake was approximately 1.43 oz/head daily while the daily intake of the K-State complete mineral was 3.3 oz/head. Salt and complete mineral intakes of the stockers were fairly consistent throughout the 13-week trial, with greater usage rates associated with periods of high precipitation (Figure 1). Two calves were pulled or treated during the course of the trial; one for a broken leg and the other for lameness.

**Implications**

While there was no growth response to salt block and injectable trace mineral supplementation when compared to a complete mineral supplementation, there was a significant growth response with growth implants.
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Table 1. K-State complete mineral

| Ingredient                          | lb per ton |
|-------------------------------------|------------|
| Dicalcium phosphate                 | 450        |
| White salt                          | 650        |
| Ground limestone                    | 350        |
| Dried distillers grains             | 349        |
| Dried molasses                      | 100        |
| Magnesium oxide                     | 40         |
| Mineral/soybean oil                 | 20         |
| Zinc oxide                          | 20         |
| Copper sulfate                      | 10         |
| Vitamin A (30,000 IU/g)             | 10         |
| Iodine (EDDI)                       | 1          |
| Total                               | 2000       |

Mineral

| Calculated concentration in mineral |
|-------------------------------------|
| Calcium, %                          | 11.9       |
| Phosphorus, %                       | 3.9        |
| Magnesium, %                        | 1.3        |
| Potassium, %                        | 0.6        |
| Salt, %                             | 32.5       |
| Sulfur, %                           | 0.2        |
| Copper, ppm                         | 1,278      |
| Cobalt, ppm                         | 0.2        |
| Iodine, ppm                         | 394        |
| Iron, ppm                           | 126        |
| Manganese, ppm                      | 6.1        |
| Vitamin A, kIU/lb                   | 68.1       |
| Zinc, ppm                           | 7,812      |

1Designed for a 650-lb steer; 3 oz intake per day.
2Dr. Frank Brazle, 2017, personal communication.
### Table 2. Effects of mineral supplementation on stocker performance

| Item                    | Salt block | Salt block and injectable trace mineral | Complete salt and mineral supplement | Standard error of mean¹ |
|-------------------------|------------|-----------------------------------------|--------------------------------------|-------------------------|
| Number of pastures      | 5          | 5                                       | 5                                    |                         |
| Day 0 weight, lb        | 698        | 695                                     | 700                                  | 9.6                     |
| Day 90 weight, lb       | 847        | 838                                     | 856                                  | 13.6                    |
| Average daily gain, lb  | 1.63       | 1.61                                    | 1.73                                 | 0.07                    |

¹Greatest standard error of the mean among treatments reported.

### Table 3. Effects of implant on stocker performance

| Item                    | No implant | Ralgro | Revalor-G | Standard error of mean¹ |
|-------------------------|------------|--------|-----------|-------------------------|
| Number of steers        | 82         | 82     | 81        |                         |
| Day 0 weight, lb        | 693        | 699    | 702       | 7.9                     |
| Day 90 weight, lb       | 830        | 857    | 855       | 10.9                    |
| Average daily gain, lb  | 1.53ᵃ      | 1.75ᵇ  | 1.70ᶜ     | 0.07                    |

ᵃᵇᶜMeans within a row with uncommon superscripts differ (P<0.05).
Table 4. Forage quality of Flint Hills pasture by date of sampling<sup>a,b</sup>

| Nutrient composition        | May 16 |                | June 16 |                | July 31 |                | Standard error of the mean | P-value<sup>b</sup> |
|-----------------------------|--------|----------------|---------|----------------|---------|----------------|---------------------------|-------------------|
|                             | Salt block and injectable trace mineral | Complete salt and mineral supplement | Salt block and injectable trace mineral | Complete salt and mineral supplement | Salt block and injectable trace mineral | Complete salt and mineral supplement |                     |                   |
| Dry matter, %               | 32.20  | 37.30          | 31.90   | 41.10          | 41.40   | 41.70          | 49.70                      | 47.90             | 51.70             | 2.14  | 0.79     |
| Crude protein, %            | 11.87  | 10.90          | 13.56   | 7.68           | 7.82    | 8.36           | 5.40                       | 5.96              | 6.11              | 0.50  | 0.02     |
| Acid detergent fiber, %     | 35.80  | 39.90          | 35.00   | 38.10          | 38.10   | 37.00          | 40.70                      | 43.70             | 40.80             | 0.91  | 0.0001   |
| Neutral detergent fiber, %  | 57.30  | 57.70          | 55.70   | 61.70          | 61.10   | 59.50          | 64.20                      | 65.50             | 61.50             | 1.40  | 0.07     |
| Net energy-maintenance, Mcal/lb | 0.50   | 0.41           | 0.52    | 0.46           | 0.46    | 0.47           | 0.40                       | 0.33              | 0.39              | 0.01  | 0.0001   |
| Net energy gain, Mcal/lb    | 0.25   | 0.17           | 0.26    | 0.21           | 0.20    | 0.23           | 0.15                       | 0.09              | 0.15              | 0.02  | 0.0001   |
| Total digestible nutrients, % | 54.20  | 48.60          | 55.30   | 51.10          | 51.10   | 52.50          | 47.60                      | 43.50             | 47.40             | 1.20  | 0.0001   |
| Calcium, %                  | 0.66   | 0.80           | 0.67    | 0.58           | 0.62    | 0.71           | 0.68                       | 0.69              | 0.92              | 0.07  | 0.21     |
| Phosphorus, %               | 0.18   | 0.20           | 0.21    | 0.11           | 0.11    | 0.12           | 0.08                       | 0.09              | 0.09              | 0.01  | 0.01     |
| Potassium, %                | 1.80   | 1.60           | 1.85    | 1.38           | 1.51    | 1.41           | 0.91                       | 0.96              | 1.03              | 0.13  | 0.74     |
| Magnesium, %                | 0.18   | 0.19           | 0.20    | 0.19           | 0.19    | 0.19           | 0.16                       | 0.21              | 0.21              | 0.02  | 0.30     |
| Sodium, %                   | 0.01   | 0.01           | 0.01    | 0.02           | 0.01    | 0.01           | 0.01                       | 0.24              | 0.01              | 0.08  | 0.39     |
| Sulfur, %                   | 0.12   | 0.13           | 0.16    | 0.07           | 0.07    | 0.08           | 0.09                       | 0.10              | 0.12              | 0.01  | 0.10     |
| Cobalt, ppm                 | 0.39   | 0.39           | 0.47    | 0.54           | 0.46    | 0.54           | 0.24                       | 0.31              | 0.33              | 0.08  | 0.52     |
| Copper, ppm                 | 7.30   | 7.60           | 8.10    | 4.20           | 4.20    | 5.10           | 4.70                       | 5.30              | 5.55              | 0.58  | 0.25     |
| Manganese, ppm              | 45.30  | 36.60          | 46.30   | 26.20          | 27.60   | 29.90          | 30.50                      | 39.60             | 44.40             | 6.60  | 0.55     |
| Molybdenum, ppm             | 1.02   | 1.16           | 1.25    | 0.82           | 0.67    | 0.93           | 1.26                       | 1.57              | 1.54              | 0.18  | 0.31     |
| Zinc, ppm                   | 24.30  | 27.30          | 25.70   | 13.00          | 12.60   | 16.00          | 18.10                      | 20.00             | 25.70             | 2.37  | 0.20     |

<sup>a</sup>Each value represents the average of 5 forage samples. One sample was collected from each treatment pasture per time period and composited into one sample.

<sup>b</sup>Significance by date of sampling.
Figure 1. Calculated intake of salt and mineral provided to steers.

* = Estimated values obtained from Climate Fieldview.