Effects of pre-breeding administration of injectable trace mineral supplements on subsequent reproductive performance in beef herds

Mellissa. R. Crosswhite[1], Lourens. J. Havenga[2] and Carl. R. Dahlen[1]

The objective of this study was to evaluate the effects of injectable trace mineral supplements administered 30 days before the start of the breeding season on reproductive performance when natural-service breeding was used. Results indicate that pregnancy rate and calving distribution were not changed when an injectable trace mineral supplement was used.

Summary

One thousand three hundred eleven commercial beef cows originating from four herds in North Dakota were stratified within herd by days postpartum, then randomly assigned to receive one of two treatments: 1) Cows received no additional treatments prior to bull turnout (CON; n = 638) or 2) Cows were administered an injectable trace mineral supplementation (60, 10 and 15 milligrams per milliliter (mg/mL) of zinc, manganese and copper as disodium EDTA chelates, and 5 mg/mL of selenium as sodium selenite) subcutaneously on day minus 30 relative to bull turnout (TM; n = 673). On the day of mineral administration, blood samples were collected immediately prior to mineral injection via jugular venipuncture in 10-mL Vacutainer tubes (BD Worldwide, Franklin Lakes, N.J.). Samples were analyzed for baseline mineral status on a subset (10 randomly selected females) of cows within each herd. Total mixed rations also were collected for the animals still in confinement prior to pasture/bull turnout. Water samples were collected from all available water sources for each herd. Herd bulls were turned out to a common pasture and remained there for the duration of the producer-defined breeding season. The presence of a viable fetus was determined at least 45 days after the conclusion of the breeding season. At parturition, birth date was recorded. We found no difference ($P = 0.41$) in the proportion of females that became pregnant between treatments. Weaning weights of calves on the side of cows receiving treatments also were similar ($P = 0.90$). At calving, date of birth in the calving season was not different ($P = 0.99$) for those calves born from TM cows or control cows. When evaluating the distribution of calves born in the calving season by 21-day increments, the proportion of calves born in the first 21, 22-42 or more than 42 days of the calving season were similar ($P = 0.40$) between groups.

Introduction

Reproductive performance and overall herd health are vital to a successful and profitable cow herd. Deficiencies of trace minerals can lead to anemia, immune suppression, decreased ovulation, irregular estrous cycles, fetal malformations and abortions because these minerals are vital to fetal development and nutrient transfer (Hostetler et al., 2003). Increased reproductive failure and potential for animal death could result in decreased profitability for cattle producers.

Mineral supplementation, as well as the mineral composition of forages and individual animal intake, is highly variable. Palatability, individual requirements, mineral content of available water sources, season of the year and individual animal intake are all factors that must be considered (McDowell, 1996). Injectable trace mineral products are available and may be used for a more targeted supplement. However, injectable products are not blanket nutrients or broad spectrum, but contain only a few trace minerals.

Injectable supplementation advantages include the targeted delivery of known trace mineral elements and the ability to distribute those minerals when previous management delivery was not a viable option due to terrain or environment (rough country, pastures that routinely flood, etc.; Arthington et al., 2014). Administering injectable trace mineral supplements 30 days before breeding resulted in a greater proportion of females becoming pregnant to artificial insemination (AI), compared with females not receiving supplements (Mundell et al., 2012).

The objective of this study was to evaluate the effects of injectable trace mineral supplements administered 30 days before the start of the breeding season on reproductive performance when natural-service breeding was used.

[1]Department of Animal Sciences, NDSU
[2]Multimin USA, Fort Collins, Colo.

Experimental Procedures

One thousand three hundred eleven commercial beef cows originating from four herds in North Dakota were stratified within herd by days postpartum, then randomly assigned to receive one of two treatments: 1) Cows received no additional treatments prior to bull turnout (CON; n = 638) or 2) Cows were administered an injectable trace mineral supplementation (6 mL of MultiMin; 60, 10 and 15 mg/mL of zinc, manganese and copper as disodium EDTA chelates; and 5 mg/mL of selenium as sodium selenite) subcutaneously on day minus 30 relative to bull turnout (TM; n = 673). The TM treatment cow will receive a single injection prior to breeding, as opposed to the label recommendations of an injection prior to calving and prior to breeding for mature females.

On the day of mineral administration, blood samples were collected immediately prior to mineral injection via jugular venipuncture in 10-mL Vacutainer tubes (BD Worldwide, Franklin Lakes, N.J.). Serum samples were analyzed for baseline mineral status on a subset (10 randomly selected females) of cows within each herd. Samples were analyzed for concentrations of cobalt (Co), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), selenium (Se) and zinc (Zn).

Total mixed rations also were collected for those animals still in confinement prior to pasture/bull turnout. Water samples were collected from all available water sources for each herd. Feed and water samples were analyzed for toxic levels of the minerals (Table 1 and 2, respectively). Blood samples were averaged for each herd and are presented in Table 3.

Cows within each herd and treatment were housed in common pastures and exposed to common management. Natural-service bulls were turned out to all cows 30 days after treatment administration and remained with the cows for the duration of the producer-defined breeding season. Transrectal ultrasonography or rectal palpation was used to determine the presence of a viable fetus at least 45 days after the end of the breeding season by a herd veterinarian.

Weaning weights were collected at the time of weaning for the year of administration. At the time of calving, birth date and calf sex were recorded. Cows continued to be managed on similar pastures throughout the grazing season and through the wintering period.

The MIXED procedure of SAS (SAS Inst. Inc., Cary, N.C.) was used to analyze all continuous data (calf birth date and calf weaning weights). The GENMOD procedure of SAS was used to analyze the binomial data (pregnancy rate calving

Table 1. Mineral composition of feed samples[1].

		Herd		
Mineral	Max. Levels[2]	1	3	4
Copper	10	4.2	20.5	6.1
Iron	50	225	965	917
Manganese	1200	63.1	134.9	71.5
Molybdenum	-	3	< 1.0	1
Phosphorus	1,700-2,200	1,928	2,747	1,685
Selenium	0.1	< 10.0	< 10.0	< 10.0
Sulfur	1,500	1,095	2,210	1,568
Zinc	30	10.5	53.2	20.7

[1]Mineral values given in parts per million.
[2]Maximum tolerable levels based on 1996 Beef Cattle National Research Council (NRC). Levels given for lactating cows.

Table 2. Mineral composition of water samples[1].

		Herd								
Mineral	Max. Levels[2]	1a	1b	2a	2b	2c	2d	2e	3	4
Copper	10	< 1.3	< 1.3	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	0.031	< 0.025
Iron	50	< 0.30	< 0.30	0.716	0.44	0.193	0.649	0.125	1.404	3.429
Manganese	0.12	< 0.05	< 0.085	0.108	0.064	0.094	0.418	< 0.025	0.716	0.051
Molybdenum	–	–	–	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phosphorus	1,700-2,000	< 10.0	< 10.0	< 0.50	0.6	0.7	0.9	< 0.5	< 0.50	< 0.50
Selenium	0.1	< 0.050	< 0.050	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Sulfur	1,500	< 250.0	< 250.0	186.3	464.3	284.5	62.1	267.8	78.4	271.2
Zinc	30	< 5.0	< 5.0	0.059	0.075	0.118	0.069	0.108	0.29	0.091

[1]Mineral values given in parts per million.
[2]Maximum levels based on 1996 Beef Cattle NRC. Levels given for lactating cows.

distribution). Each model included the effect of treatment (control or injectable trace mineral supplementation).

When analyzing the effects of days postpartum (DPP) and body condition score (BCS), categories were created to determine differences in groups of data and included in the model. For DPP, cows were at or less than 60, 61 to70, 71 to 80 or greater than 80 based on the time between their last calving and current breeding date. For BCS, cows were less than 4, 4, 5 or greater than 5 based on their condition at the time of treatment administration. Significance was declared at $P \leq 0.05$.

Results and Discussion

Prior to treatment administration, free-choice mineral was available for all cows or was included in a total mixed ration (TMR). Tables 1 and 2 illustrate the feed and water analysis for each herd. Blood samples (Table 3) were averaged for each herd.

Selenium and manganese levels were high in some females, while copper and zinc were lower than adequate. While ranges exist, what is important to note is that ranges can be variable based on the type of sample and the laboratory conducting the analyses.

The current study was conducted to evaluate the effect of an injectable trace mineral supplement on reproduction of commercial beef herds in North Dakota. The injectable trace mineral supplement was administered at one of the label-recommended time points, 30 days prior to breeding. A similar (P = 0.36) proportion of cows became pregnant by the end of the producer-defined breeding season between treatments (TM: 92 percent and CON: 93 percent).

We found an effect (P = 0.05) of days postpartum (DPP) on the attainment of pregnancy, which followed a predictable trend (at or less than 60: 88 percent and greater than 80: 99 percent) All other groups were similar (P = 0.10) between treatments (61 to 70, 71 to 80). Differences in cow body condition scores were highly variable but did not affect (P = 0.83) the proportion of cows that became pregnant in the breeding season.

Calves suckling cows at the time of treatment administration were weighed at the time of weaning. Weights of calves at this time were recorded to determine if the injectable trace mineral supplement may have had an effect on nutrition of the dam and, therefore, the weight of the calf at her side.

Weights of calves from dams administered the injectable trace mineral supplement were not different (P = 0.90) than of calves born from dams in the control group (622.8 ± 4.4 pounds and 631.3 ± 4.6 pounds, respectively). The proportion of females that weaned a calf also was similar (P = 0.55) between treatment

Table 3. Mineral composition of blood samples[1].

		Herd[2]			
Mineral	Serum Levels[3]	1	2	3	4
Cobalt	> 0.0001	0.00019	0.00021	0.00079	0.00047
Copper	0.6-0.8	0.61	0.51	0.67	0.57
Iron	110-180	124.5	148.88	158.22	162.10
Manganese	0.0015-0.0025	0.00505	0.00289	0.00688	0.00078
Molybdenum	0.004-0.1	0.02332	0.03159	0.00652	0.01244
Selenium	0.07-0.1	0.1015	0.127	0.10756	0.125
Zinc	0.9-2	0.73	0.94	0.93	0.86

[1]Mineral values given in parts per million.
[2]Serum levels are presented as averages for each herd. Eight to 10 animals were sampled from each herd.
[3]Serum levels based on Michigan State University Diagnostic Center for Population and Animal Health. Levels are determined to be adequate if within listed ranges.

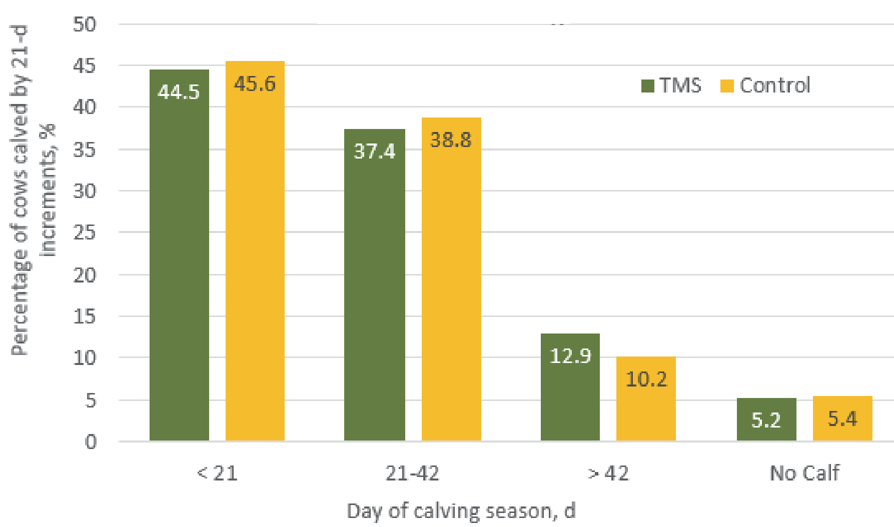

Figure 1. Effect of injectable trace mineral supplemention on the distribution of calving.

groups (CON: 92 percent and TM: 92 percent).

At parturition, birth dates and sex were recorded. Date of birth in the calving season was not different (P = 0.99) for calves born from dams administered the injectable trace mineral supplementation, compared with calves born from control dams (25.7 ± 0.75 pounds and 24.6 ± 0.72 pounds, respectively). In addition, we found no difference (P > 0.40) in the distribution of calving when the calving season was divided into 21-day increments (Figure 1).

The incorporation of an injectable trace mineral supplement administered 30 days prior to bull turnout did not affect pregnancy attainment, weaning weights of calves or calving distribution. Although reproduction was not affected by treatments in this study, what is important to note is that overall pregnancy rates and calving were very good across herds.

Literature Cited

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