COPPER AND/OR SELENIUM BOLUSES FOR STOCKER CATTLE

S.C. Smith[1], B.L. Peverley[1], K.S. Lusby[2],
J.L. Bullard[3], R.K. Martin[3], and T.E. Evicks[3]

Story in Brief

Three hundred thirty-six stocker cattle were used to evaluate the effects of supplemental copper and selenium, singularly or in combination, on weight gain of stocker cattle in five trials at four eastern Oklahoma locations. The minerals were provided in bolus form (Copasure® 25 and Dura Se-120®, Schering-Plough Animal Health). Trials were conducted similarly in that cattle were individually identified, weighed, and allotted randomly to treatment groups receiving either a bolus of copper oxide needles, a slow-release selenium bolus, copper and selenium boluses, or no bolus. The copper bolus was not used in Trials 1 and 2; and the selenium bolus was not used in Trial 5. Treated and untreated cattle grazed together. Cattle were allowed access to mineral supplements that did not contain copper or selenium. Forage species grazed included fescue, clover, wheat, rye, bermudagrass and native grasses. Mineral analyses of forages indicated that copper and selenium concentrations were less than NRC recommended target but still within the NRC recommended range. No difference in weight gain due to treatment was found in the five trials. No benefit from copper or selenium supplementation of gain by purchased stocker cattle grazing pastures in eastern Oklahoma was evident.

(Key Words: Minerals, Copper, Selenium, Grazing, Beef Cattle.)

Introduction

Trace minerals are those minerals required by animals in very small quantities. These minerals are primarily obtained via the animal's diet. Although some data exist detailing levels of trace minerals in forages grown in Oklahoma (Lusby and Selk, 1991), little information is available documenting geographic areas where grazing cattle may be at risk of clinical or subclinical trace mineral deficiencies (Owens, 1988a,b).

Two trace minerals, copper (Cu) and selenium (Se), have been suspected or perceived to reduce animal performance by producers, the popular press and several commercial mineral companies. Copper is required for hemoglobin and connective tissue formation, and iron absorption and utilization. Copper absorption and utilization is dependent on copper source, dietary level, and presence, and level of other cations; sulfur and molybdenum are the most

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[1]Extension Livestock Specialist [2]Professor [3]Extension Agricultural Agent

common antagonists. Selenium is a constituent of glutathione peroxidase, an enzyme which acts as an antioxidant.

The use of boluses in trace mineral supplements can be an adequate administrative route. Selenium boluses increased blood Se levels in cattle with marginal blood levels (McCollum, 1992). Copper oxide needles increased serum ceruloplasmin and Cu concentrations in stocker cattle (Coffey et al., 1992), but neither Cu or Se improved cattle performance in these trials. The purpose of these five Oklahoma trials was to determine the effect of supplemental Cu and/or Se supplements on the performance of stocker cattle grazing forages marginally deficient in those minerals.

Materials and Methods

Trials 1 and 2. Twenty-nine healthy, locally-purchased, stocker steers and heifers averaging 461 lb were utilized to evaluate the effect of a Se bolus on stocker weight gain in 1992. Thirty-three steers, 533 lb average weight, were similarly purchased, treated, and grazed the same 30 acre fescue pasture the following year. During both years, cattle were accumulated over the 30 days prior to initiation of the experiments, vaccinated for IBR, PI3, Lepto, and blackleg, dewormed with Ivomec® and implanted with Ralgro®. The trials were conducted in Haskell County in southeastern Oklahoma from late spring to mid-August; 125 days and 103 days, respectively, for Trials 1 and 2. Cattle were weighed, individually identified with numbered ear tags and assigned randomly to a treatment receiving a Se bolus (Se, Dura Se-120®) or a control group. Treated and control cattle grazed together. During summer months the cattle were fed 10 lb of a 12% crude protein grain pellet per head, each day. A salt:dicalcium phosphate mineral was available free-choice. Forage samples were collected in July of each year. Cattle were weighed full without shrink.

Trial 3. Seventy-two healthy 519 lb stocker heifers were weighed, individually identified, and randomly assigned to treatments receiving a Cu bolus (Cu, Copasture 25®), Se bolus (Se), Cu and Se boluses (C/S), or no boluses. The cattle were purchased and processed over 30 days prior to beginning the trial in February. All treatment groups grazed together in adjoining pastures of fescue and wheat, rye and ryegrass. Cattle were supplemented with a grain-based pellet throughout the trial along with a salt:dicalcium base mineral provided free-choice. Forage samples were collected in May. The trial lasted 98 days and was conducted in Pittsburg County.

Trial 4. One hundred eighteen newly-received stocker steers and heifers were vaccinated for IBR, PI3, BVD, Blackleg, Lepto, and malignant edema, and dewormed with Valbazen and implanted with Ralgro. Steers were branded, castrated, individually identified with numbered ear tags and weighed. Eighty-

seven of the 118 cattle were assigned to control or a Cu bolus. The remaining 31 head received treatments of a Se bolus or Cu and Se boluses. Subsequent to processing, cattle were maintained in a small trap and observed for illness. Few cattle were pulled for antibiotic treatment though two steers died and two others were removed from the trial as chronics. The dead steers were autopsied and were determined to have died from excessive blood loss from castration and pneumonia. Steers and heifers later were separated and grazed only in pastures with cattle of the same sex in the Latimer County trial. Cattle were supplemented with a 38% crude protein-ionophore cube from June to the end of the trial in August. Forage samples were taken from the grazed pastures in June and again in July. Trial steers were weighed on day 141 and shipped to market. Heifers were weighed on day 147.

Trial 5. Eighty-four crossbred heifers, most having a Brahman influence were utilized in the Osage County study. Cattle grazed a native range in good condition. Cattle had been turned out on pasture the first week of May almost three weeks prior to the start of the study. Heifers were identified individually and allotted randomly across the treatment and control groups. Heifers received 1 lb/head daily of a 38% crude protein range cube for the last 40 days of the study. The trial lasted 79 days. Analysis of variance was conduced for each study using the GLM procedure of SAS (1985). The model included treatment (Trials 1, 2, 3, 4 and 5) and breed in Trial 4.

Results and Discussion

The recommended values for dietary mineral requirements for beef cattle (NRC, 1984) are listed in Table 1. Forage mineral analyses are listed in Table 2. Forage Cu levels generally were less than NRC values but still within the recommended range. Se analyses in forage samples from Trials 1, 2 and 4, being were at or below the NRC recommended range for Se.

General observations of remaining minerals include high sulfur levels (twice NRC recommendations), high potassium levels (three times the NRC range), high magnesium levels, low sodium levels, manganese at 2 to 7 times NRC recommendations, and similarly high iron concentrations. Sulfur and magnesium approached the maximum tolerance in Bermudagrass and fescue, respectively.

Cattle gained well in all trials (Table 3). The treatment of cattle with Cu and/or Se boluses did not significantly increase weight gain in any of the trials ($P>.4$). Results indicated that copper and selenium level in forages consumed by stocker cattle typically purchased for grazing in eastern Oklahoma are probably adequate for the levels of performance attained.

Copper concentrations in forage samples ranged from 4 to 9 PPM, and selenium concentrations ranged from .05 to .15 PPM, within the range

Table 1. Mineral requirements and maximum tolerable levels for beef cattle (NRC, 1984).

Mineral	Requirement		Maximum tolerable level[b]
	Suggested value	Range[a]	
Calcium, %	-	-	2
Copper, ppm	8	4 to 10	115
Iron, ppm	50	50 to 100	1000
Magnesium, %	.10	.05 to .25	.40
Manganese, ppm	40	20 to 50	1000
Molybdenum, ppm	-	-	6
Phosphorus, %	-	-	1
Potassium, %	.65	.5 to .7	3
Selenium, ppm	.20	.05 to .30	2
Sodium, %	.08	.06 to .10	10[c]
Sulfur, %	.10	.08 to .15	.40
Zinc, ppm	30	20 to 40	500

[a] The listing of a range in which requirements are likely to be met recognizes that requirements for most minerals are affected by a variety of dietary and animal (body weight, sex, rate of gain) factors. Thus, it may be better to evaluate rations based on a range of mineral requirements and for content of interfering substances than to meet a specific dietary value.

[b] From NRC (1984).

[c] 10% sodium chloride.

recommended by NRC (1984) for both trace minerals. McCollum (1991) demonstrated appreciably higher protein levels in esophageal masticate versus hand clipped forage suggesting that clipped forages samples might underestimate actual dietary Cu and Se intake. However, Arthington et al. (1994) reported little difference in trace mineral concentrations between hand-clipped and animal-selected forage samples even though protein levels were higher in animal-selected samples.

Levels of potassium, sulfur, magnesium and iron apparently were not high enough to hinder the utilization of forage Cu and Se. Supplemental Cu and Se were not needed.

Table 2. Forage mineral analyses (DM Basis) and sampling dates for Trials 1-5.

	Cu PPM	Se PPM	P %	Ca %	K %	Mg %	S %	Na %	Zn PPM	Mn PPM	Fe PPM	Al PPM
Trial 1.												
Fescue. Sampled 07/29/92.												
	9	<.05	.23	.44	1.93	.30	.35	.059	42	225	100	90
Trial 2.												
Fescue. Sampled 07/02/93.												
	7	<.05	.21	.44	2.20	.27	.36	.08	31	175	147	56
Trial 3.												
Fescue. Sampled 05/06/93.												
	7	.08	.38	.60	3.33	.21	.38	.007	31	131	107	33
Wheat, Rye. Sampled 05/06/93.												
	7	.11	.45	.58	2.88	.17	.25	.034	30	129	107	35
Trial 4.												
Fescue clover. Sampled 06/17/93.												
Steers	7	.14	.28	.68	2.11	.21	.29	.051	24	326	252	64
Heifers	5	.07	.23	.72	1.82	.31	.36	.048	25	133	225	96
Bermuda grass. Sampled 07/29/93.												
Steers	4	.11	.20	.57	1.06	.36	.29	.05	29	248	165	83
Heifers	4	.05	.18	.73	1.25	.28	.23	.14	21	374	99	31
Trial 5.												
Native grass. Sampled 07/13/93.												
	6	.15	.15	.75	1.36	.20	.16	.024	37	183	424	161

[a] Sample analyzed by Midwest Laboratories, Inc. Omaha, NE.

Table 3. Effect of copper and/or selenium boluses on stocker cattle weight gain.

	Control	Cu	Se	C/S
Trial 1. 04/08/92 - 08/11/93 (125 days)				
#Cattle	14	-	15	-
Initial wt, lb	448	-	474	-
Total gain, lb	201	-	222	-
Daily gain, lb	1.61	-	1.78	-
Trial 2. 05/07/93 - 08/17/93 (103 days)				
# Cattle	17	-	16	-
Initial wt, lb	543	-	523	-
Total gain, lb	171	-	171	-
Daily gain, lb	1.66	-	1.66	-
Trial 3. 02/05/93 - 05/14/93 (98 days)				
# Cattle	18	18	18	18
Initial, wt, lb	506	514	516	540
Total gain, lb	183	177	179	181
Daily gain, lb	1.87	1.80	1.83	1.84
Trial 4. 03/10/93-08/05-93 (143 days)				
#Cattle	41	46	17	14
Initial, wt, lb	411	416	408	425
Total gain, lb	263	265	271	250
Daily gain, lb	1.82	1.85	1.90	1.75
Trial 5. 05/18/93-08/05/93 (79 days)				
# Cattle	42	42	-	-
Initial, wt, lb	471	451	-	-
Total gain, lb	189	187	-	-
Daily gain, lb	2.39	2.38	-	-
Overall least squares means				
Daily Gain, lb	1.87	1.86	1.92	1.84

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