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J. K. Farney
Kansas State University, jkj@ksu.edu

M. E. Reeb
Kansas State University, maciereeb@ksu.edu

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Abstract

This study aims to evaluate effectiveness of two operational management systems for steer gains and fly control. The first strategy evaluated was pasture burn date of March (MAR) or April (APR). The second management strategy was free-choice mineral with spices (SPICE) or without spices (CON). Eight pastures (n = 281 steers; initial weight 612 ± 57 lb) were used in a 2 × 2 factorial treatment structure. Steers were weighed individually, randomly assigned to treatment, and grazed for 85 days. Weekly, 33% of steers were photographed to count flies and evaluated for hair coat score. Cattle on the APR-SPICE treatment had a greater average daily gain (ADG) than MAR-SPICE and APR-CON with MAR-CON intermediate. Cattle on SPICE were 10 lb heavier than cattle consuming CON mineral. In general, APR-SPICE steers had a greater number of flies on weeks 8, 10, and 11, corresponding to a time when mineral intake averaged 72% of the formulated intake. Additionally, steers on SPICE had a greater number of flies than CON steers. In year 2 of 4 for this study, there was minimal difference in gain based on burn date, primarily because burn dates were only 12 days apart. The use of spices increased weight in cattle but resulted in more flies than control steers. The addition of these spices added $0.02/hd/day to cost of production and the improved gains resulted in a positive return on investment.

Keywords

essential oils, average daily gain, smoke management

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Stocker Steer Gains and Fly Numbers as Impacted by Burn Date and Type of Mineral on Tallgrass Native Range

J.K. Farney and M.E. Reeb[1]

Summary

This study aims to evaluate effectiveness of two operational management systems for steer gains and fly control. The first strategy evaluated was pasture burn date of March (MAR) or April (APR). The second management strategy was free-choice mineral with spices (SPICE) or without spices (CON). Eight pastures (n = 281 steers; initial weight 612 ± 57 lb) were used in a 2 × 2 factorial treatment structure. Steers were weighed individually, randomly assigned to treatment, and grazed for 85 days. Weekly, 33% of steers were photographed to count flies and evaluated for hair coat score. Cattle on the APR-SPICE treatment had a greater average daily gain (ADG) than MAR-SPICE and APR-CON with MAR-CON intermediate. Cattle on SPICE were 10 lb heavier than cattle consuming CON mineral. In general, APR-SPICE steers had a greater number of flies on weeks 8, 10, and 11, corresponding to a time when mineral intake averaged 72% of the formulated intake. Additionally, steers on SPICE had a greater number of flies than CON steers. In year 2 of 4 for this study, there was minimal difference in gain based on burn date, primarily because burn dates were only 12 days apart. The use of spices increased weight in cattle but resulted in more flies than control steers. The addition of these spices added $0.02/hd/day to cost of production and the improved gains resulted in a positive return on investment.

Introduction

Essential oils/spices have been offered as a potential method to control insects in cattle (Showler, 2017; Massariol et al., 2009), alter rumen microbial population (Elcoso et al., 2019), and replace feed antibiotics, all of which may improve production responses in beef as well as dairy cattle. In feedlot studies, cattle consuming a blend of essential oils had similar average daily gain, final body weight, gain to feed ratios, and carcass characteristics as steers fed monensin with or without tylosin (Araujo et al., 2019). Grazing stocker cattle on cool-season annual grass pasture or summer pasture did not show improvements in gains when cattle received a cinnamon and garlic essential oil product by either free-choice or handfeeding (Beck et al., 2017). However, other studies at Kansas State University have found that the feeding of spices in mineral have increased gain in growing cattle on grass (Farney, 2020a; Farney, 2020b).

[1] Undergraduate intern, Department of Animal Science, College of Agriculture, Kansas State University.

Burning pasture in April results in about 20 pounds more gain in cattle than burning a pasture in March (Owensby, 2010). Smoke management plans are important for the state of Kansas as high smoke production in April creates smoky conditions that drift to large metropolitan areas. If gains and plant population changes are not too different when burning in March instead of April, it would provide the opportunity to develop a smoke management plan that allows for an increased burning season to dilute a single month's smoke.

The overall objective of this study is to evaluate management practices that may impact stocker steer gains on a 90-day double stocking grazing system in tallgrass native range. Specific objectives include evaluating timing of burning, addition of spices in a complete free-choice mineral, and determining if the effects are additive.

Experimental Procedures

The study was conducted at the Bressner Research unit in Yates Center, KS. The unit consists of eight pastures on 625 acres of tallgrass native prairie. Two management strategies were evaluated to determine effects on stocker steer gains in a 2 × 2 factorial arrangement. The two management strategies were timing of pasture burning and free-choice mineral supplementation. Within each management strategy there were two treatments being evaluated, thus a total of four treatments were applied to the cattle at the unit. The pasture burning management strategies evaluated were burning in March or burning in April. The pastures for the March burn treatment were burned on March 27, 2020, while the April burned pastures were burned on April 9, 2020.

The free-choice mineral supplementation strategies evaluated consisted of two treatments: (1) free-choice complete mineral (CON) where 25% of magnesium (Nuplex Mg/K, Nutech Biosciences, Inc., Oneida, NY), copper, zinc, and manganese came from chelated organic sources (Nuplex Chelate-3 blend, Nutech Biosciences) and (2) the same base mineral with the addition of spices (SPICE). The spices included were powdered forms of oils from garlic and the product Solace (proprietary blend of four spices; Wildcat Feeds Inc., Topeka, KS). The mineral analysis is listed in Table 1. The minerals were formulated for a 4 ounce/head/day intake and were offered free choice. Every week 125% of that week's formulated mineral consumption for each pasture was placed into feeders and weighed. Any remaining mineral from the previous week was also weighed.

Gain Measures

Two hundred eighty-one steers (612 ± 657 lb) were weighed individually on April 23, 2020, and assigned to pasture randomly based on order through the chute. Cattle were weighed at the end of the study on July 16, 2020, for a total of 87 days of grazing. Four head were not weighed on the final weigh date so only 277 head were included in the analyses. Data collected included initial and final weights and then average daily gain and total gain were calculated.

Fly Counts and Hair Coat Score

Weekly, 33% of the steers in each pasture were photographed with a Nikon digital camera with a 300 mm zoom lens with the photographer's back to the sun. The steers were photographed with their entire side filling the viewfinder. Then photos were processed with ImageJ and flies counted (Figure 1). Additionally, hair coat score was recorded from the photos with a score of 1–5, where a 1 was a 100% slick haired animal; 2 had 25% of body with long hair; 3 had 50% of body covered in long hair; 4 had 75% of body covered in long hair; and 5 was 100% long haired. Data collected included number of flies and hair coat scores for each week.

Results and Discussion

Performance of Steers

Burn date did not alter steer gain (Table 2). This result is in contrast to most other studies that showed that APR burning results in greater gain than MAR burning. In these same pastures in 2019, steers grazing pasture burned in April gained 29 pounds more than steers grazing pasture burned in March (Farney, 2020b). With the 2020 data, there were only 12 days between burned dates, instead of a full month like in 2019. The 2020 March burn was moved later than originally planned as rains in the beginning of March prevented fire success.

Similarly to 2019, steers on the spice mineral were heavier coming off-grass than steers on the control mineral (Table 2). There was an interaction in burn date and mineral for ADG, total gain, and final weight (Table 2). Steers on the APR-SPICE treatment had the greatest gain, with MAR-SPICE and APR-CON having the lowest gains and MAR-CON being intermediate. In 2019, even though there was no statistical difference in gains, the greatest gains were still observed in the APR-SPICE treatment with the lowest gain in MAR-CON. The MAR-CON cattle had greater gains than anticipated; gains may have been affected by the fly numbers, which will be discussed. One of the MAR-SPICE treatment pastures had a heavy infestation of *Serecia lespedeza*, which may have hampered gains due to this weed's unpalatability for cattle, and its competition with more desirable plant species.

Fly Counts

Flies increased through the summer and by week 9 all treatments had more than 200 flies on steers (Figure 2). Two hundred total flies is the economic threshold where cattle start having reductions in performance enough to negatively impact economic returns. The MAR-CON steers had one extra week (Week 8) where they had fly numbers less than the economic threshold. This one week worth of lower fly counts may have contributed to the cattle having a greater gain than APR-CON and MAR-SPICE treatments. The hypothesis is that the MAR-CON cattle should have the lowest gain of all the treatments, yet with the second highest gains in 2020, the fly numbers may have been a contributing factor to the greater than hypothesized gain for MAR-CON.

Interestingly, the steers on the SPICE treatment had a greater number of flies than steers consuming the CON mineral. This was in opposition of what was hypothesized—that the spices would have some deterrent capabilities towards the flies. Some

studies that have found that consumption of the spices does not have fly repellency, whereas spraying the spices on the animals does lead to reductions in fly populations (summarized in Showler, 2017). The APR-SPICE steers had more flies than all other treatments during weeks 8, 10, and 11 (Figure 2). Outside of week 8, those weeks were times when SPICE mineral intake was 72% of formulated intake amount. This may have been part of the reason these steers had an elevated fly population. As with most free-choice options, there is a wide range of intakes through the season and within animal groups. With the apparent trend of low SPICE mineral intake and corresponding high numbers of flies, this may indicate that the evaluated SPICE products do not have a long systemic life in the animal, thus a more consistent intake is needed if there is a fly repellency effect of the spices.

Hair Coat Scores

The addition of SPICE in mineral resulted in steers with a slicker hair coat through the entire grazing season (average hair coat score 2.08 for SPICE vs. 2.39 for CON). The highest gaining steers (APR-SPICE) also were the slickest hair coated steers, with the APR-CON steers have the longest hair of all the treatments (Table 2). The importance of hair coat comes into effect when it is marketing time for the steers. Cattle that have a long hair coat are discounted at sale as they are perceived to either have been on fescue, sick at one point, or overall be poorly performing, unthrifty animals. The SPICE addition in the mineral helped the steers to slick up and this may also have played a role in temperature control as long haired calves during the summer have increased panting, spend more time in water and shade, and less time grazing—all of which decrease gains. A reduction in a combination of several of those behaviors may have occurred that led to the highest gains being observed with APR-SPICE steers.

Economics

The SPICE adds $0.02/head/day to mineral cost. Over the entire grazing period, the cost of the mineral was $1.74/head. The steers on SPICE were 10 pounds heavier coming off-grass and netted $9.80 more than CON steers. This resulted in a 5.6× return on investment of the spice in the mineral.

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Table 1. Analysis of minerals

Item (on dry matter basis)	Control mineral	Spice mineral[1]
Crude protein, %	5.69	5.50
Calcium, %	16.67	16.17
Phosphorus, %	3.33	3.44
Salt, %	22.54	22.53
Magnesium, %[2]	2.51	2.48
Potassium, %	0.89	0.88
Iron, ppm	5,546	5,529
Copper, ppm[3]	1,153	1,153
Zinc, ppm[3]	3,471	3,471
Manganese, ppm[3]	1,817	1,818
Selenium, ppm	22	22
Iodine, ppm	333	333
Cobalt, ppm	13	13
Vitamin A, IU	141,667	141,667
Vitamin D, IU	14,167	14,167
Vitamin E, IU	172	172

[1]Spice mineral with similar base as control mineral with the addition of 3 pounds per ton garlic oil and 18 pounds per ton of Solace (Wildcat Feeds Inc., Topeka, KS) that replaced dried distillers grains and limestone in control mineral.
[2]Nuplex Mg/K (Nutech Biosciences Inc., Oneida, NY) contributed 25% of the magnesium in the minerals.
[3]Nuplex 3-chelate blend (Nutech Biosciences Inc., Oneida, NY) contributed 25% of the copper, zinc, and manganese of the total trace mineral supplied in the minerals.

Table 2. Performance measures and fly counts based on mineral and burn dates

	March		April			*P*-value		
Item	Control	Spice	Control	Spice	SEM	Burn	Mineral	Burn × mineral
In wt., lb	619	623	600	606	7.8	0.06	0.53	0.88
Out wt., lb	824[a]	815[ab]	802[b]	829[a]	6.7	0.58	0.10	< 0.01
Gain, lb	209[ab]	200[b]	193[b]	218[a]	5.8	0.88	0.22	< 0.01
ADG, lb/d	2.46[ab]	2.34[b]	2.27[b]	2.56[a]	0.07	0.88	0.22	< 0.01
Fly counts, n	141	133	127	172	19	0.80	< 0.01	0.97
Score coat score	2.25[b]	2.19[b]	2.53[a]	1.98[c]	0.07	0.67	< 0.0001	< 0.001

SEM = standard error of the mean. ADG = average daily gain.

Figure 1. Illustration of the photos taken and fly count method.
A. Original photo taken with Nikon camera with 300 mm zoom lens.
B. Same image in ImageJ with flies highlighted in yellow.

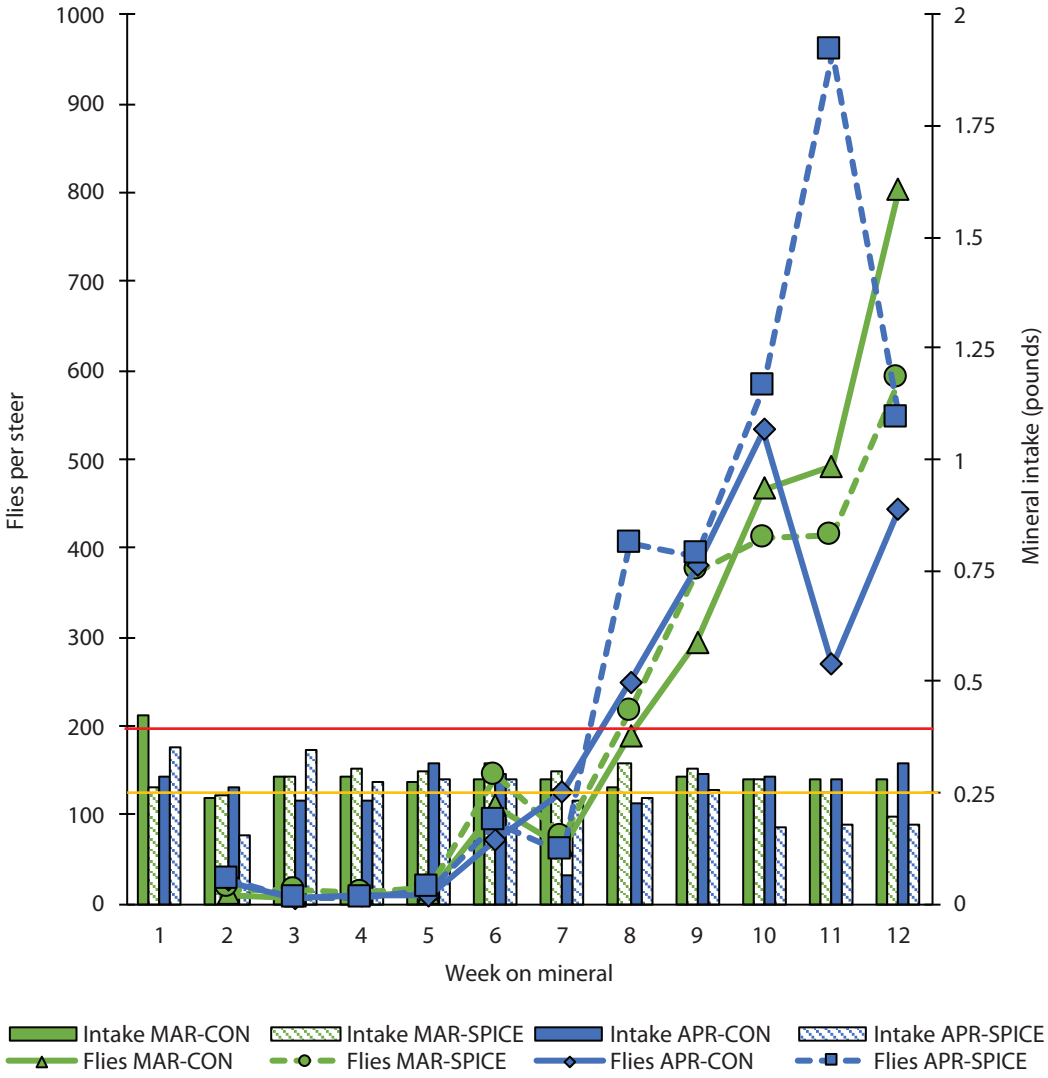

Figure 2. Average number of flies per steer per week and average weekly intake of mineral by treatments.

Average number of flies per steer per week ($P < 0.001$) are represented in the line chart while weekly average mineral intake is the bar charts. Red line at 200 indicates economic threshold for horn flies. Yellow line at 0.25 indicates the formulated mineral intake of 4 oz/head/day.

MAR-CON: Fly numbers are represented in green solid line with triangle markers. Mineral intake is represented by solid green bars.

MAR-SPICE: Fly numbers are in dashed green line with circle markers. Mineral intake is represented by green striped bars.

APR-CON: Fly numbers are in solid blue line with diamond markers. Mineral intake is represented by solid blue bars.

APR-SPICE: Fly numbers are in dashed blue line with square marker. Mineral intake is represented by blue striped bars.