EFFECTS OF MONENSIN AND 4-PLEX ON GROWTH AND PUBERTY OF BEEF HEIFERS

C.R. Floyd[1], H.T. Purvis II[1], K.S. Lusby[2] and R.P. Wettemann[3]

Story in Brief

The effects of ionophores and trace minerals on puberty were studied using 60 spring-born beef heifers in trial one and 64 in trial two that were wintered on dormant native range. Heifers in trial one were fed 5 lb/day of a 25% protein supplement with either 0 (control) or 200 mg/day of monensin. Heifers in trial two were allotted in a 2 X 2 factorial arrangement to receive 0 or 14.2 grams/day of 4-Plex (copper lysine, manganese methionine, zinc methionine, and cobalt glucoheptonate) and 0 or 200 mg/day of monensin (control, 4-Plex, monensin, and combination). In trial one, monensin did not influence ADG (.53 lb/day), age or weight at puberty. In trial two, monensin improved daily gain over control heifers (.81 vs .68 lb), and decreased age at puberty by 17 days. As a result, more monensin-fed heifers were pubertal at the start of the breeding season compared to controls. When heifers are able to achieve a minimum gain of .68 lb/day, feeding monensin can decrease age at puberty, and increase daily gains and the number of heifers pubertal before the breeding season. Feeding organic/trace mineral complexes may not affect puberty or weight gains in heifers. Withdrawal of monensin may cause a decrease in daily gains.

(Key Words: Beef Heifers, Native Range, Puberty, Monensin, Trace Minerals.)

Introduction

Monensin has been suggested to decrease age at puberty in heifers. In a review, Sprott et al. (1988) reported that a greater percentage of heifers fed monensin were pubertal 40 days prior to breeding compared to controls. In the trials where monensin reduced age at puberty, daily gains of the heifers were .88 to 1.32 lb/day. Additionally, trace mineral deficiencies increased age at puberty and some trace minerals have low absorption rates (Corah and Ives, 1991). This trial was conducted to determine the effects of monensin and an organic/trace-mineral complex on age and weight at puberty of beef heifers.

---

[1] Graduate Assistant [2]Professor [3]Regents Professor

Materials and Methods

This trial was conducted at the Range Cow Research Center, located twelve miles west of Stillwater, OK. Sixty spring-born Hereford or Hereford x Angus cross heifers were used in trial one and sixty-four in trial two.

Trial 1. Heifers grazed dormant tallgrass native pastures and were allotted by breed and weight to two treatments. All heifers were individually fed 5 lb/day of a 25% CP soybean meal-based supplement (Table 1), prorated to a 5-day/wk feeding schedule in a covered stall barn. Treatments provided 0 (control) or 200 mg/day of monensin. Free-choice prairie hay (CP=4.4%) was offered from January 9 through March 29, 1993. All weights were taken after an overnight withdrawal of feed and water.

Beginning on April 27, all heifers were exposed in one pasture to two bulls for 60 days. Weekly blood samples were taken via tail venipucture beginning March 3, 1993 and analyzed for progesterone to determine puberty. Puberty was defined as the first of two consecutive weekly plasma samples with progesterone greater than 1 ng/ml. Pubertal weights were calculated by a linear interpolation of weights taken just before and after the puberty date. Heifers with a concentration of progesterone greater than 1 ng/ml on the first sample on March 3 were determined to be pubertal on that date.

Trial 2. Heifers were allotted by weight and breed to four treatments using a 2 x 2 factorial design. All heifers were fed 5 lb/day of the 25% CP supplement used in Trial 1 that delivered 0 or 14.2 grams/day of 4-Plex (copper lysine, manganese methionine, zinc methionine, and cobalt glucoheptonate, Zinpro Corporation, Edina, MN) and 0 or 200 mg/d of monensin (control, monensin, 4-Plex, and combination). Supplement feeding was conducted and heifer weights and blood samples were taken as described for Trial one. Supplementation ended on April 12, 1994, and all heifers were exposed to two bulls in one pasture from April 29 to June 29, 1994. The GLM procedure of SAS (1985) was used to conduct analysis of variance for both trials. The model included dietary treatment, date of birth and inital weight. Heifers which had not reached puberty by the end of the breeding season were excluded from the analyses of age and weight at puberty. Data for gains after the supplementation period were pooled over both years to determine the effect of dietary treatment and year being independent sources of variation and Julian birth date and initial weight as covariates.

Results and Discussion

Trial 1. Supplementation gains were similar for control and monensin heifers (.53 lb/day). However, control heifers gained .24 lb/day more ($P<.05$) than monensin heifers during the breeding season. Treatment did not influence the percentage of heifers that were pubertal by May 1 (Table 2). However, more control heifers compared with monensin heifers were pubertal by June 29 (84% vs. 75%, P<.10). This may have occurred because monensin and control heifers had similar weight gains during supplementation but monensin-fed heifers had reduced gains after the end of supplementation compared to control heifers, which may have caused them to achieve pubertal weight later than control heifers. Conception rates were less than optimal, reflecting inadequate growth of the heifers during the winter. Age and weight at puberty were similar for both control and monensin treated heifers.

Trial 2. Heifers fed monensin and the combination had greater daily gains (Table 3) during supplementation than control heifers (.81 and .79 vs .68 lb/day respectively; P<.05), with 4-Plex heifers intermediate (.75 lb/day). During the 2-week period from the end of supplementation to the beginning of breeding, weight gains tended to be less for monensin (P=.16) and combination (P=.12) than for control. Heifers previously fed the combination gained .33 lb/day less than control heifers (P<.02) during the breeding season. The combination heifers had breeding season gains of .26 lb/day less than monensin (P<.05) and .22 lb/day less than 4-Plex heifers (P<.10). An explanation for these gains is not apparent. A significant monensin by 4-Plex interaction was found for age at puberty and percent of heifers pubertal by April 1 and May 1. More monensin-fed heifers were pubertal by April 1 (P<.05) than control, 4-Plex, or combination heifers (42% vs 8%, 16%, and 5% respectively). By May 1 (start of breeding) 52% of the monensin heifers were pubertal, which was not different from 4-Plex (44%), but greater (P<.05) than for combination (17%) and control heifers (22%).

Monensin-fed heifers reached puberty 17 days younger than control or combination heifers (P<.05) with 4-Plex heifers intermediate. Weight at puberty was similar for all treatments, suggesting that the advantage in the decreased age at puberty given by feeding monensin was a function of weight gain. Fewer combination heifers were pubertal by April 1 and May 1 compared with monensin heifers (5 and 17 vs 42 and 52%; P<.05), suggesting that 4-Plex may have an antagonistic effect on the influence of monensin on puberty.

In Trial 1, winter gains may have been insufficient for monensin to improve weight gains, but in Trial 2, environmental conditions were more desirable, which permitted greater gains and monensin increased winter gains, reduced age at puberty, and increased the number of heifers which were pubertal by the beginning of the breeding season. Compared to Trial 1, heifers in Trial 2 were 50 lbs heavier and 15 days younger at puberty, and had better conception rates, reflecting the greater winter gains in Trial 2.

Pooled Data. With no year by treatment interaction, daily gains after the end of the supplementation peroid were pooled over the two years to analyze the effect of withdrawal of monensin on daily gains (table 4). In period one (first 28 days without supplementation), control heifers gained .33 lb/day ($P<.01$) more than monensin heifers. Similarly, control heifers tended to gain more than monensin heifers during the second 28-d period following the end of supplementation (.18 lb/day, $P=.11$). Throughout the entire non-supplemented period, control heifers gained .24 lb/day ($P<.01$) more than the monensin-fed heifers. Monensin heifers consistently had reduced gains after supplementation ended compared with control heifers regardless of monensin's effect on gains during supplementation. Monensin has been observed to reduce rumen turnover rate from 7 to 44% and to increase rumen fill from 9 to 24% (Schelling, 1984). It is possible that decreased rumen fill of monensin-fed heifers accounted for the reduced gain following monensin withdrawal.

Conclusions

The use of monensin in supplements for replacement heifers grazing low-quality dormant winter forages can cause varying results. When winter daily gains exceed .68 lb/day, monensin may decrease age at puberty, probably because of increased gains, resulting in a greater percentage of heifers that are pubertal before the beginning of the breeding season. However, weight gains may be reduced after removal of monensin regardless of its effect during supplementation. Organic/trace-mineral complexes may not affect puberty in beef heifers.

Literature Cited

Corah, L.R. and S. Ives. 1991. Vet. Clinics of N. Amer. 7:41.
SAS. 1985. SAS Inst. Inc., Cary NC.
Schelling, G.T. 1984. J. Anim. Sci. 58:1518
Sprott, L.R., et al. 1988. J. Anim. Sci. 66:1340.

Table 1. Supplement composition (as-fed basis).

Ingredient	Control	Monensin	4-Plex	Combination
Soybean meal	37.29	37.27	37.06	37.03
Wheat middlings	56.45	56.41	56.09	56.05
Cane molasses	4.03	4.02	4.00	4.00
Dicalcium phosphate	0.58	0.58	0.58	0.58
Limestone	1.61	1.61	1.60	1.60
Vitamin A-30,000	0.04	0.04	0.04	0.04
Monensin 60g/lb	0.00	0.07	0.00	0.07
4-Plex	0.00	0.00	0.63	0.63

Table 2. Daily gains and pubertydata for heifers fed 0 or 200 mg/day of monensin in trial 1.

	Monensin level		
	0 mg/d	200 mg/d	SE
No. of heifers	30	29	
Initial Weight, lb	438	442	40
ADG, lb			
Supplementation[a]	.53	.53	.02
Breeding[b]	1.58[c]	1.34[d]	.04
Pubertal by 5/1, %	9	5	4
Pubertal by 6/29, %	84	75	6
Age at puberty, days	460	460	5
Weight at puberty, lb	607	594	8
Pregnant, %	55	65	10

[a]Period between 11/2/92 and 4/27/93.

[b]Period between 4/27/93 and 6/29/93.

[c,d]Means within a row differ (P<.05).

Table 3. Effects of Monensin, 4-Plex, and Combination on daily gains and puberty in trial 2.

Treatment	Control	Monensin	4-Plex	Combination	SE
No. of heifers	16	15	16	16	
Initial weight, lb	477	493	482	480	37
ADG, lb					
Supplemented[a]	.68[c]	.81[d]	.75[cd]	.79[d]	.02
Non-Supplemented[b]	.88	.48	.70	.46	.20
Breeding[c]	2.38[d]	2.31[df]	2.27[de]	2.05[e]	.09
Pubertal by 4/1, %	8[d]	42[e]	16[d]	5[d]	9
Pubertal by 5/1, %	22[d]	52[e]	44[de]	17[d]	11
Pubertal by 6/29,%	100	91	100	88	5
Age at puberty, days	445[d]	428[de]	436[e]	445[d]	6
Weight at puberty, lb	651	651	645	651	13
Pregnant, %	94	93	81	88	8

[a]Period between 11/2/93 and 4/14/94.

[b]Period between 4/14/94 and 4/27/94.

[c]Period between 4/27/94 and 6/29/94.

[d,e]Means within a row lacking a common superscript differ (P<.05).

Table 4. Pooled Monensin effects on non-supplemented daily gains in Trials one and two.

	Monensin level		
	0 mg/day	200 mg/day	SE
No. of Heifers	62	60	
ADG, lb			
Period 1[a]	1.43[d]	1.10[e]	0.09
Period 2[b]	2.02	1.85	0.07
Non-supplemented[c]	1.83[d]	1.58[e]	0.04

[a]First 28 days without supplement (Year 1: 4/01 to 5/25, Year 2: 4/12 to 5/10).

[b]Second 28 days without supplement (Year 1: 5/25 to 6/22, Year 2: 5/10 to 6/8).

[c]Period from end of supplementation to end of breeding season (Year 1: 4/28 to 6/22, Year 2: 4/12 to 6/29).

[d,e]Means within a row lacking a common superscript differ ($P<.01$).