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The Effects of Intensive Early Stocking and Early Weaning on the Onset of Puberty and Reproductive Success in Beef Replacement Heifers

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Abstract

Management practices utilizing genetics, nutrition, and growth have commonly been studied to maximize the lifetime productivity of female beef cattle. However, heifers managed to have their first calf by 24 months of age have the greatest chance of achieving maximum lifetime productivity.

One way for a heifer to calve by 24 months of age is to decrease the age at which she reaches puberty. Heifers reaching puberty 1 to 3 months before exposure to breeding maximized conception success, as was shown when heifers bred during their third estrus were 21% more likely to conceive than heifers that were bred during their first or second estrus. Also, heifers fed a high-energy diet during the post-weaning period displayed a decreased age at puberty and an increased pregnancy rate. Additionally, early-weaned heifers fed a high-energy diet at an early age reached puberty at younger ages than those fed a low-energy control diet or those fed a high-energy diet beginning at six months of age.

We hypothesized that heifers that were weaned at 120 days of age and provided a high-energy diet compared to the diet consumed by heifers weaned at a more conventional time of 205 days of age would display puberty at an earlier age and have improved first service conception and overall pregnancy rate.

Keywords

body condition score; estrus synchronization; first service conception; ultrasonography

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Introduction

Management practices utilizing genetics, nutrition, and growth have commonly been studied to maximize the lifetime productivity of female beef cattle. However, heifers managed to have their first calf by 24 months of age have the greatest chance of achieving maximum lifetime productivity.

One way for a heifer to calve by 24 months of age is to decrease the age at which she reaches puberty. Heifers reaching puberty 1 to 3 months before exposure to breeding maximized conception success, as was shown when heifers bred during their third estrus were 21% more likely to conceive than heifers that were bred during their first or second estrus. Also, heifers fed a high-energy diet during the post-weaning period displayed a decreased age at puberty and an increased pregnancy rate. Additionally, early-weaned heifers fed a high-energy diet at an early age reached puberty at younger ages than those fed a low-energy control diet or those fed a high-energy diet beginning at six months of age.

We hypothesized that heifers that were weaned at 120 days of age and provided a high-energy diet compared to the diet consumed by heifers weaned at a more conventional time of 205 days of age would display puberty at an earlier age and have improved first service conception and overall pregnancy rate.

Experimental Procedures

Angus and Angus × Hereford cross heifers (n = 166) were used for this experiment. Heifers were the offspring of cows used in a 5-year project that measured cow and calf growth and performance when managed with traditional continuous season-long stocking compared to those managed with modified-intensive-early stocking, in which early season stocking density was increased to 1.45 × that of season-long stocking. Heifers for this experiment were born in 2018 and 2019 and were weaned from cows assigned to each stocking treatment. Each year, weaning took place in August for early-weaned calves (approximately 120 days of age) from the modified-intensive-early stocking treatment group while conventionally-weaned calves (approximately 205 days of age) were weaned from the season-long stocking cows in October. Each year, heifers from both treatments were maintained in drylot pens from weaning until February (approximately 185 days for early-weaned calves and 105 days for conventionally-weaned calves).

Following the drylot weaning period, heifers were maintained as a single group on one of eight pastures, averaging 36.8 acres, that were rotationally grazed from February through May. Supplemental protein was provided via dry distillers grain to meet National Research Council recommended crude protein intake for growing heifers. The vegetation was typical of shortgrass prairie. Dominant species were western wheatgrass, buffalograss, and blue grama. Subdominant species were Japanese brome and western ragweed. Available herbage dry matter (DM) was estimated using a calibrated falling plate meter along established transects.

Body weight and body condition scores were recorded monthly from February through May. Two blood samples were collected each month. Monthly samples were collected via puncture of the caudal vein at 10-day intervals for later assessment of serum progesterone. Blood tubes were stored on ice, transported to the lab, stored at 40°F for 24 hours. After storage, samples were centrifuged at 1,000 × *g*, and the resulting serum was harvested and frozen at - 4°F for later analyses. Serum concentrations of progesterone from paired blood samples collected monthly from heifers were measured in duplicate. Progesterone concentrations were categorized as high (≥1 ng/mL) or low (<1 ng/mL). Heifers with a high progesterone status on either sampling day were assumed to have achieved puberty, whereas heifers with low progesterone were considered prepubertal.

At the end of the pasture supplementation period, ovulation was synchronized using the 7 d Co-Synch + CIDR (EAZI-Breed CIDR, Zoetis, Parsippany, NJ) protocol. Heifers received 100 µg of GnRH intramuscularly (d -10 relative to fixed-time breeding; 2 mL Cystorelin; Merial Animal Health, Duluth, GA) and a CIDR insert for 7 days, followed by an injection of 25 mg $PGF_{2\alpha}$ (5 mL of Lutalyse; Zoetis, Parsippany, NJ) intramuscularly and CIDR removal (d -3 relative to fixed-time breeding;). Fixed-time artificial insemination took place 54 h after the CIDR was removed and heifers received a second 100 µg injection of GnRH (d 0). Heifers were exposed to fertile bulls 10 d after FTAI for the remainder of the 45-d breeding season.

At 35 d after AI, pregnancy was confirmed by transrectal ultrasonography (Aloka 500V, 5 MHz transrectal transducer, Wallingford, CT). A positive pregnancy outcome required the presence of an embryo and uterine fluid consistent with early term of pregnancy. A final pregnancy diagnosis (PR) was determined 35 d after the end of the breeding season via transrectal ultrasonography.

Results and Discussion

Heifer body weight and body condition scores were not different between treatments at the end of each 28-day period during winter grazing of dormant native range (Table 1). All heifers lost weight during the first 28 days after being moved from drylot to pasture and transitioning from an energy-dense diet to a low-quality forage diet with protein supplementation. During the second 28-day period, body weights remained constant for all heifers. Heifers from both treatments displayed a modest weight gain during the last 28-day period before being moved to summer pasture for synchronization and breeding. Likewise, body condition scores decreased for heifers from both treatments following the transition to dormant native range pasture, and they continued to decline slightly during the remainder of the winter grazing period (Table 1).

Although not statistically different, a numerically greater proportion of early-weaned heifers from the modified intensive early cows, compared to conventionally-weaned heifers from normal stocking rate cows, were pubertal for most months during the winter grazing period (February-May) before exposure to estrous synchronization (Table 2). Any increase in the number of pubertal and estrus-cycling heifers in the months preceding their first breeding season improves final reproductive success and extends lifetime productivity. Additionally, 13.8% more early-weaned heifers conceived to first service during the breeding season compared to their conventionally-weaned contemporaries (55.1 vs. 41.3%, respectively; Table 2). Becoming bred early in the breeding season will help ensure there is a sufficient period after calving to reestablish estrual behavior, rebreed, and achieve the greatest lifetime productivity possible. Final pregnancy rate was not affected by time of weaning and averaged 84.9% for all heifers. Although similar proportions of heifers from each grazing and weaning strategy became pregnant, greater numbers of early-weaned heifers from cows managed in a modified intensive early stocking system became pregnant early in the breeding season. This management system should help ensure the majority of these early-weaned heifers will have greater longevity and productivity compared to conventionally-weaned heifers from cows managed in a conventional continuous stocking system.

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Table 1. Body weight and body condition score of heifers following conventional weaning (weaned at 205 days of age) or early weaning (weaned at 120 days of age) during winter grazing of dormant native range after being fed a high-energy diet after weaning in drylot for 185 or 105 days

	Treatment	
	Conventional weaned	Early weaned
Body weight, lb		
February	761	756
March	725	718
April	730	718
May	732	725
Body condition score*		
February	5.4	5.5
March	5.2	5.2
April	5.0	5.0
May	4.9	4.9

*Body condition score using a 9-point scale (1 = emaciated, 9 = obese).

Table 2. Reproductive performance of heifers following conventional weaning (weaned at 205 days of age) or early weaning (weaned at 120 days of age) during winter grazing of dormant native range after being fed a high-energy diet after weaning in drylot for 185 or 105 days

	Treatment	
	Conventional weaned	Early weaned
Puberty, %		
February	52.5	62.7
March	63.2	62.0
April	70.2	72.2
May	70.7	75.6
June	71.3	74.7
First service conception rate	41.3*	55.1*
Final pregnancy rate	86.9	82.8

*Indicates values in a row are significantly different at $P \leq 0.10$.