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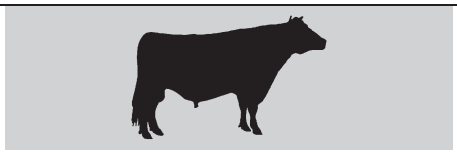

Relationship between residual feed intake and female reproductive measurements in heifers sired by high– or low–residual feed intake Angus bulls[1]

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ABSTRACT

Animals need to be feed efficient and reproductively sound for cow-calf producers to optimize profits. The objective of this study was to determine the relationship between feed efficiency and reproductive performance. Angus-based commercial cows were bred to Angus sires that had divergent residual feed intake (RFI) estimated breeding values published by the Angus Society of Australia. Data for this study included 136 crossbred females with multiple parity information. Feed-efficiency measures included RFI and daily DMI. The RFI was calculated by regressing actual feed intake on mid-test metabolic BW and ADG. Heifers were synchronized and mated by AI one time; natural-service sires followed. Pregnancy was determined approximately 60 d after the end of the breeding season. Reproductive measurements were pregnancy rate, first-service conception rate, calving percentage, and calving day. These data showed no relationship between pregnancy rate, first-service conception rate, calving rate, or calving date and phenotypic RFI or DMI ($P > 0.10$). Heifers that were sired by efficient RFI estimated breeding value bulls tended to have an improved calving rate in parity 2 ($P < 0.10$), but sire groups did not differ in pregnancy rate, first-service conception rate, or calving day ($P > 0.10$). This study showed no apparent unfavorable relationship between RFI and fertility as measured by pregnancy rate, first-service conception rate, calving rate, or calving day. Further research with larger numbers of females is needed to determine the relationships between feed efficiency and female reproduction.

Key words: breeding value, residual feed intake, reproduction

INTRODUCTION

Both efficient use of feed by beef cattle and optimal female reproductive traits are important for profitable cow-calf enterprises. The price of feed affects the profitability of the beef-cattle industry, so genetic improvement in feed efficiency is important in industry sustainability. Several moderately heritable traits are used as estimates of feed efficiency. One such trait is residual feed intake (**RFI**). Although first defined by Koch et al. (1963), RFI has recently gained popularity as a selection tool for improving feed efficiency in beef cattle. Residual feed intake can be calculated by measuring an animal's actual feed intake and estimating what the animal should be eating based on gain and production. An efficient RFI animal will eat less than estimated, resulting in a negative number. The calculation for an inefficient RFI animal will be positive, because the animal consumes more than expected. Selection for DMI alone does not necessarily

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identify an efficient animal because it does not account for the output of the animal.

It is possible that cattle with the ability to meet their maintenance and growth requirements on lesser feed intake than cattle with similar maintenance and growth requirements might also have the ability to more efficiently meet nutrient requirements for reproduction. However, there has been little research conducted in the area of relating feed efficiency and reproductive performance. Basarab et al. (2007) divided dams of 134 RFI-tested calves into low, medium, and high groups based on calf RFI. They found no differences in pregnancy rate, calving rate, or calf birth weight between cows that had high, medium, or low RFI calves; however, cows that had low-RFI progeny calved later as heifers and in the subsequent year than did cows that had medium- or high-RFI progeny (Basarab et al., 2007). Australian researchers have developed selection lines for high and low RFI. Arthur et al. (2005) studied reproductive and maternal performance of females (n = 184 in year 1, n = 153 in year 2, and n = 132 in year 3) from the RFI selection lines and found no differences between the lines in pregnancy rate, calving rate, weaning rate, milk production, calf birth weight, calf preweaning ADG, calf weaning weight, weight of calf born per cow exposed, or weight of calf weaned per cow exposed (Arthur et al., 2005). Low-RFI cows tended ($P < 0.10$) to calve later in the calving season and tended ($P = 0.07$) to have a higher percentage of calved sired by natural-service bulls as opposed to conceiving by AI (Arthur et al., 2005). Herd et al. (2008) confirmed this result when testing calves (n = 198) from the high- and low-RFI lines. Calves from the low-RFI line were significantly younger at the start of the test than were calves from the high-RFI line (Herd et al., 2008). The authors concluded that this trend needed to be examined further to determine if low RFI is correlated with delayed return to estrus after calving (Arthur et al., 2005). The objective of this study was to determine the relationship between RFI measured in developing heifers produced by sires selected for high or low RFI estimated breeding values (**EBV**) and their future reproductive performance.

MATERIALS AND METHODS

This study was conducted under guidelines established by the Kansas State University Institutional Animal Care and Use Committee. A total of 136 Angus-based females from the Kansas State University commercial cow herd over 4 yr were used in this study. All heifers were sired by bulls selected for high or low RFI EBV calculated by the Australian Angus Association (Armidale NSW, Australia; Table 1). Twenty-six 2004-born heifers and 50 2005-born heifers were tested for feed intake at Kansas State University facilities using Calan Gates (Northwood, NH). Heifers born in 2007 (n = 47) were tested at Green Springs, Missouri, using a Grow Safe (Airdrie, Alberta, Canada) system. In 2009, reproductive traits were measured on 13 heifers, but heifers were not tested for feed intake. Details concerning the ration and methods of testing can be found in a previous publication by Bormann et al. (2010).

Table 1. Sire residual feed intake group (I = inefficient, E = efficient), residual feed intake estimated breeding value (EBV, kg) from the Australian Angus Association, and number of daughters

Sire	Sire group	EBV	Daughters
1	I	0.29	18
2	I	0.26	10
3	I	0.30	3
4	I	0.31	27
5	I	0.19	4
6	E	−0.54	8
7	E	−0.72	14
8	E	−0.41	10
9	E	−0.51	14

Reproductive traits were collected for each of the calving seasons that the dam remained in the herd. Reasons for culling included being open at fall pregnancy check, failing to conceive to AI service, bad eyes, bad udders, or any other health problems. The number of heifers culled from each sire group was not different ($P = 0.59$). In 1 yr, a subset of bred heifers was sold after pregnancy check; therefore, first-calving performance was not analyzed. Calving data were collected on all other parities for the females in the herd.

Heifer breeding contemporary group definition included year and intake test group. Later parity contemporary group definition included year. At least 5 sires were represented in each contemporary group, with at least one efficient and one inefficient RFI EBV sire. The only exception is 2009-born heifers. Because of the small sample size and large number of bull calves born that year, there were only efficient RFI EBV sires represented in the heifers. Breeding treatment (synchronization protocol) was found to be nonsignificant, so it was eliminated from the model. All females were bred for a spring calving season ranging from February through May. Females were bred once by AI and then turned out to pasture with multiple bulls. First-service conception was determined 30 d after AI. The females were diagnosed pregnant by ultrasonography from a single technician, and if ultrasonography was unavailable, first-service conception was determined by palpation results and calving date. Rectal palpation was done in the fall to diagnose final pregnancy status of all females.

Reproductive measurements that were collected for each parity included pregnancy diagnosis (**PREG**), first-service conception (**FS**), calf produced (**CPD**), and calving day within the season (**CD**). The binomial trait of PREG was coded as 1 if the female was pregnant or 2 if the female was open at the fall palpation pregnancy check. The binomial trait of FS was scored as 1 if dams were pregnant to the AI service at the 30 to 35 d ultra-