



Phenotypic Relationship of Feed Efficiency and Fertility in Angus and Red Angus Bulls

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INTRODUCTION

In order to reduce financial inputs for beef enterprises, selecting feed efficient animals is a common practice. However, there is an increased concern that selecting such animals with low residual feed intake (RFI) will decrease bull fertility and compromise the integrity of reproductive success of the herd. If producers can select individuals based upon feed efficiency measures without concern that this may compromise the integrity of reproductive success of the herd, they may effectively reduce input costs.

Previous studies have suggested that selection of bulls for lower RFI (higher feed efficiency) has a negative effect on fertility traits where greater feed efficiency exhibited decreased sperm motility, viability, and scrotal circumference (Awda et al., 2013). Additionally, Wang et al. (2011) reported that a large proportion of low RFI bulls failed to meet a minimum threshold for sperm motility requirements. Similarly, Fox et al. (2004) found that lower RFI was negatively correlated with scrotal circumference, but sperm motility and overall breeding soundness were not affected.

Previous research has shown an inverse relationship between feed efficiency and reproductive performance in beef bulls; however, extensive research has not been conducted to determine the influence of these relationships (Fontoura et al. 2016). Therefore, it was hypothesized that feed efficiency and fertility were negatively correlated in Angus and Red Angus yearling bulls.

OBJECTIVE

Determine the relationship between feed efficiency and fertility traits in growing Angus and Red Angus bulls



Figure 1. Commercial Angus and Red Angus cattle are shown on pasture at the CSU, Chico Beef Unit prior to acclimation period.



Figure 2. The GrowSafe Feed Intake System is equipped with a scale and electronic identification tag reader that collects data on individual animals.

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MATERIALS AND METHODS

Feeding Trials:

- All procedures were approved by the CSU, Chico Animal Care and Use Committee
- Two feeding trials were conducted at the CSU, Chico University Farm (Chico, CA) in 2017 (87 d) and 2018 (84 d).
- Each year, Angus (n = 14) and Red Angus (n = 12) bulls were randomly assigned to 7 x 18 m pens equipped with GrowSafe feed intake units and allowed *ad libitum* access to water and feed (CP: 15.6%, TDN: 56.22%, NDF: 52%, DM basis) following a 21-day adaptation period.
- Breeding soundness exams (BSE) were conducted at 18 mo. of age

Data Collection:

- Feed and growth traits: feed conversion ratio (FCR), RFI (i.e., measured as the difference between predicted dry matter intake (PDMI) and actual dry matter intake (DMI)), start weight (SWT), end weight (EWT), metabolic mid-weight (MMWT), residual average daily gain (rADG) and average daily gain (ADG).
- Reproductive Traits: scrotal circumference (SC), sperm motility (MT), and sperm morphology (MP).

Data Analysis:

- Residual feed intake was calculated by regressing DMI on ADG and MMWT. The RFI group was categorized as low (0.5 SD below the RFI mean), marginal (\pm 0.5 SD about the RFI mean), and high (0.5 SD above the RFI mean) by year (Basarab et al., 2003)
- Data were analyzed using analysis of variance (ANOVA), blocking on year-pen and fitting breed and RFI group as independent factors. Tukey pairwise contrasts were run (SPSS ver. 25, 2017).
- Motility among breeds and RFI group were analyzed using chi-square.
- Pearson correlations were calculated between growth, feed efficiency, and BSE measures of SC and MP.

RESULTS

Table 1. Average (SD) for RFI group effects on growth, efficiency and breeding soundness characteristics in Angus (n = 14) and Red Angus (n = 12) yearling bulls.

Trait, Units	RFI Group			P-Value
	Low	Marginal	High	
SWT, kg	340.41 (37.62)	342.32 (28.43)	348.30 (32.10)	0.94
EWT, kg	439.82 (28.31)	445.39 (39.63)	449.40 (34.76)	0.82
MMWT, kg	72.00 (4.36)	72.51 (4.29)	73.20 (4.31)	0.89
ADG, kg/d	1.16 (0.24)	1.19 (4.29)	1.78 (0.27)	0.67
DMI, kg/d	8.35 (0.70)	9.79 (1.48)	10.36 (1.40)	0.00
FCR, kg feed/kg gain	7.43 (1.33)	8.62 (1.79)	9.05 (1.38)	0.22
RFI, kd/d	-1.01 (0.41)	0.84 (0.45)	-0.06 (0.23)	0.00
SC, cm	39.20 (1.07)	38.79 (1.93)	39.14 (1.07)	0.80
Morphology, %	79.60 (12.38)	83.93 (10.69)	88.58 (5.22)	0.08

- High and marginal RFI groups had greater DMI compared to low RFI group ($P < 0.05$).
- There were no differences ($P > 0.05$) among RFI groups for SWT, EWT, MMWT, rADG, SC, and MT.
- Correlations were not significant ($P > 0.05$) between growth, efficiency, and fertility measures.

RESULTS

Table 2. Mean (SD) for breed effects on growth, feed efficiency and breeding soundness characteristics in Angus (n = 14) and Red Angus (n = 12) yearling bulls.

Trait, Units	Breed		P-Value
	Angus	Red Angus	
SWT, kg	348.32 (30.59)	338.02 (29.75)	0.64
MMWT, kg	75.20 (3.59)	71.50 (4.64)	0.37
EWT, kg	454.21 (27.47)	435.11 (41.535)	0.20
ADG, kg/d	1.23 (0.29)	1.13 (0.30)	0.01
DMI, kg/d	9.67 (1.42)	9.66 (1.60)	0.63
FCR, kg feed/kg gain	8.13 (1.46)	8.93 (1.81)	0.04
RFI, kg/d	-0.17 (0.62)	0.20 (0.79)	0.04
SC, cm	38.93 (1.77)	39.00 (1.95)	0.36
Morphology, %	84.21 (10.54)	84.50 (9.81)	0.78

- There were no differences ($P > 0.05$) among breeds for SWT, EWT, MMWT, rADG, SC, and MT.
- Angus bulls were superior to Red Angus bulls in ADG, FCR, and RFI.
- No interaction was detected between breed and RFI group with exception of MP ($P = 0.049$; Figure 3).

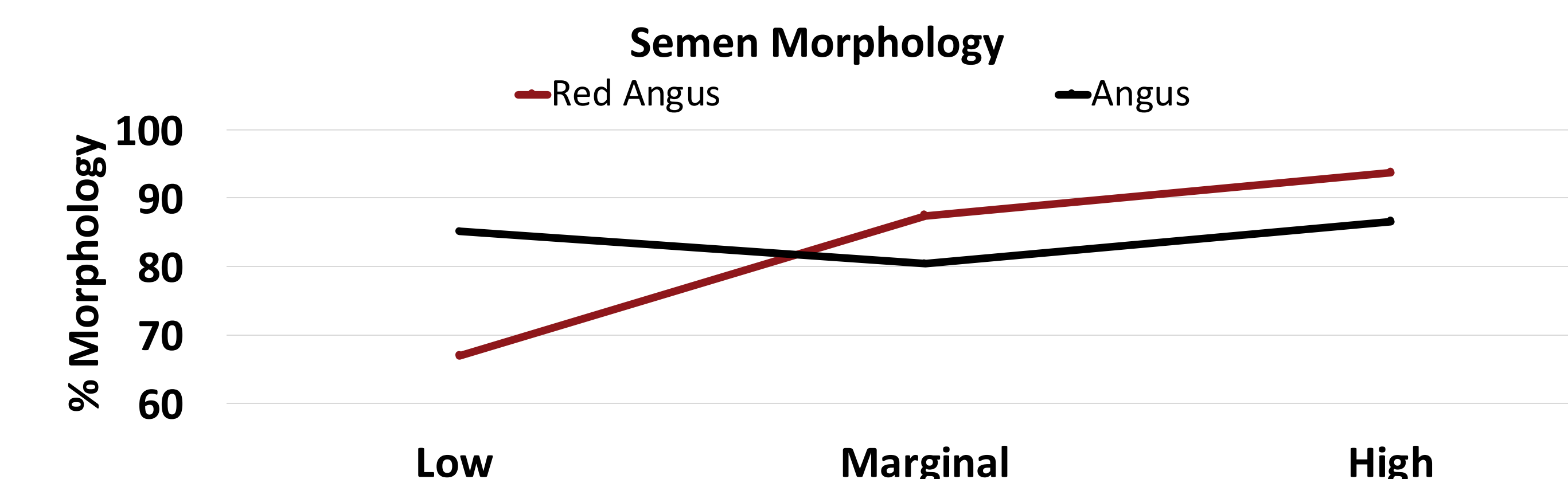


Figure 3. Percent morphology of Angus (n = 14) and Red Angus (n = 14) yearling bulls phenotyped for low (n = 5), marginal (n = 14), and high (n = 7) RFI. Interaction was detected ($P = 0.049$).

CONCLUSION

Results from this study indicate that SC and MT were not affected in bulls that were phenotyped as low for RFI (i.e., efficient bulls); however, semen morphology does not follow this relationship and should be investigated further. Furthermore, producers can continue to select for feed efficient bulls without compromised fertility. Future studies with greater experimental units and within specific breed groups should be conducted in the future to limit random error, generate higher accuracy, and detect any breeding effects.

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