Maternal Performance of Four Divergent Biological Types Resulting from Angus, Brahman, and Reciprocal Cross Cows Grazing Endophyte-Infected Tall Fescue or Common Bermudagrass

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Story in Brief

Maternal performance of four divergent biological cow types of Angus, Brahman, and reciprocal cross cows were evaluated over a 4-yr period. Growth curve parameters of mature weight (A) and rate of maturing (k) were estimated for 177 cows using the growth curve model as described by Brody. Cows were assigned to one of four biological types: large late maturing (LL, A > 1,283 lb, k < 0.045%), large early maturing (LE, A > 1,283 lb, k ≥ 0.045%), small late maturing (SL, A ≤ 1,283 lb, k < 0.045%), and small early maturing (SE, A ≤ 1,283 lb, k ≥ 0.045%). Measurements on 374 calves over the 4-yr period included: birth weight, weaning weight, and weaning height. Distribution of calf measurements by biological type included: LL (n = 98), LE (n = 52), SL (n = 78), and SE (n = 146). Included in the models for analysis of birth weight, weaning weight, weaning height and weaning weight:weaning height ratio were the independent variables of forage, biological type, calf birth year, age of dam, significant interactions and residual error. Calf birth year was significant (P < 0.05) for all reported traits. Age of dam was significant (P < 0.05) for weight:height ratio only. The interaction of biological type x forage was significant (P < 0.05) for all traits with the exception of weight:height ratio. These data suggest that biological type may have an effect on maternal performance.

Introduction

It is widely known that maternal effects have a substantial impact on early stages of growth (i.e. birth to weaning). The Germ Plasm Evaluation Program was established at the Roman L. Hruska U.S. Meat Animal Research Center (MARC) in 1969 (Cundiff et al., 1985) to characterize a broad range of biological types of cattle as represented by breeds that differed widely in genetic potential for milk production, growth rate, carcass composition, and mature size. Larger or smaller body size may have important biological advantages for adaptation to climate, feed resources, seasonal grazing, and marketing. By dividing animals into biological types, some of the variation in determining which biological type would perform best in a certain environment could be eliminated. Therefore, the objective of this study was to evaluate maternal performance of four biological types of cows resulting from Angus, Brahman, and reciprocal crosses grazing common bermudagrass or endophyte-infected tall fescue.

Experimental Procedures

Approximately 177 Angus (AA), Brahman (BB), Angus x Brahman (AB), and Brahman x Angus (BA) heifers born from 1988 to 1991 and 374 of their calves from 15 Polled Hereford sires born from 1991 to 1994 were evaluated in this study. The heifers were assigned to 40-acre endophyte-infected tall fescue pastures (100% infected) or 40-acre common bermudagrass pastures and were managed on these forages through their first four calf crops (1991 to 1994). Each pasture was stocked with approximately equal numbers of AA, BB, AB, and BA cows.

Heifers were bred as 2-yr-olds to calve at 3 yr of age to preclude introducing parity differences into the study due to the low percentage of purebred Brahman reaching sexual maturity at 15 mo of age. The breeding seasons were early May through mid-July of each year. Calves were born from late February through May in 1991 through 1994. Calves were weighed at birth and tagged. and bull calves were castrated by banding. Calves were weaned at an average age of 205 d, and were weighed and hip height measurements were taken.

The growth parameters of A and k were estimated on these cows using the three-parameter growth curve model as described by Brody (1945). Upon estimation of these parameters, cows were stratified into four biological types: large late maturing (LL, A > 1,283 lb, k < 0.045%, n = 98 calves), large early maturing (LE, A > 1,283 lb, k ≥ 0.045%, n = 52 calves), small late maturing (SL, A ≤ 1,283 lb, k < 0.045%, n = 78 calves), and small early maturing (SE, A ≤ 1,283 lb , k ≥ 0.045%, n = 146 calves). All breed types were represented in all biological types with the exception of straightbred Brahman in the large framed-early maturing type group (Table 1).

Data were analyzed by the GLM procedure of SAS (SAS Inst., Inc., Cary, NC). Included in models for birth weight, weaning weight, weaning height and weaning weight:weaning height ratio were the independent variables of forage, biological type, calf birth year, age of dam, biological type x forage interaction and a residual error term.

Results and Discussion

Presented in Table 2 are the least-squares means and standard errors for birth weight for the interaction of biological type and forage. This interaction was significant (P < 0.05) for all traits measured in this study with the exception of weight:height ratio.

Calves from LE cows grazing endophyte-infected fescue were larger (P < 0.05) at birth than calves from the LE cows on bermudagrass, LL on endophyte-infected fescue, SE on either forage, and SL on bermudagrass (84 lb vs. 73, 77, 73, 77 and 73 lb), respectively. Large-late maturing cows grazing bermudagrass had calves with heavier (P < 0.05) birth weights than did SE or SL cows on bermudagrass (79 lb vs. 73 and 73 lb, respectively). Small-late maturing cows

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grazing bermudagrass had calves with lighter ($P < 0.05$) birth weight than any cows grazing endophyte-infected fescue (73 lb v. 84, 77, 77, and 79 lb, respectively). Small-late maturing cows managed on endophyte-infected fescue had heavier ($P < 0.05$) birth weights than did LE, SE, or SL cows grazing bermudagrass (79 lb vs. 73, 73 and 73 lb, respectively).

Table 3 shows least-squares means and standard errors for the biological type x forage interaction for weaning weight. The LL cows grazing endophyte-infected fescue had smaller ($P < 0.05$) mean weaning weights than did the LE on bermudagrass and endophyte-infected fescue, the LL on bermudagrass, and the SE on endophyte-infected fescue (440 lb vs. 585 lb, 556 lb, 550 lb and 486 lb, respectively). The SE cows grazing bermudagrass weaned heavier ($P < 0.05$) calves than did the LL on endophyte-infected fescue (565 lb vs. 440 lb). Small-framed, early maturing cows on endophyte-infcected fescue had calves with lighter ($P < 0.05$) weaning weights than did the LE cows on either forage, or LL and SE on bermudagrass (486 lb vs. 585 lb or 556 lb, 550 lb and 565 lb, respectively). The SL cows grazing bermudagrass had calves with lighter ($P < 0.05$) weaning weights than did the LE and SE bermudagrass (528 lb vs. 585 lb and 565 lb). However these SL cows on bermudagrass weaned heavier ($P < 0.05$) calves than did the LL, SE, and SL on endophyte infected-fescue (528 lb vs. 440 lb, 486 lb and 449 lb, respectively). The SL on endophyte-infected fescue had smaller ($P < 0.05$) mean weaning weights than all other combinations with the exception of the LL grazing endophyte-infected fescue.

In general weaning weights of calves from early maturing cows were higher and weaning weights on bermudagrass were also generally higher than on endophyte-infected fescue. One likely reason for LE having higher weaning weights was the distribution of breed type x biological type in this group. There was only one purebred animal in this group of LE and the remainder were crossbreds. These crossbred animals may have exhibited heterosis thus increasing average weaning weight. Reynolds et al. (1990) found that calves from large sire breeds and from high-milk-level sire breeds were heavier at weaning than calves from their medium-sized, medium- milk production counterparts. Reported regression coefficients of weaning weights of progeny on weight of dams suggest that weaning weights increased by 8 to 24 lb for each additional 220 lb of dam weight (Benyshek and Marlowe, 1973).

Presented in Table 4 are least-squares means and standard errors for weaning hip height for the interaction of biological type x forage. Weaning hip height was greater ($P < 0.05$) in LE cows on endophyte-infected fescue than all other biological types on endophyte-infected fescue. The LL cows grazing endophyte-infected fescue had shorter ($P < 0.05$) mean hip heights at weaning than all other combinations with the exception of SL on endophyte-infected fescue. The LE on bermudagrass also had a higher ($P < 0.05$) mean weaning height than did the LL, SE or SL on endophyte-infected fescue. The SL cows grazing endophyte-infected fescue weaned calves with shorter ($P < 0.05$) mean weaning heights than did the LE or LL on bermudagrass and SE on either forage (44 in vs. 46 in, 45 in, 45 in and 45 in, respectively).

The interaction of biological type and forage was non-significant ($P > 0.05$) for the ratio of weaning weight:height. Table 5 shows least-squares means and standard error for the ratio of weaning weight: height for biological type. This ratio is often used to estimate condition at weaning. Klosterman et al. (1968) stated that this ratio can be used as a predictor of body composition in mature cows and is useful in describing the condition of cows that vary widely in type and size. Early maturing cows had greater ($P < 0.05$) mean ratios than the late maturing cows. This makes sense because late-maturing cows would have less condition at a constant age than the earlier maturing biological types. As expected the cows on bermudagrass weaned a more ($P < 0.05$) conditioned calf, and therefore yielded a higher value for this ratio than did the cows on endophyte-infected fescue (2.18 vs. 1.97; Table 6). This may indicate that endophyte-infected fescue had an effect on overall body condition score at weaning.

In our study, calf birth year was a significant ($P < 0.05$) source of variation for all traits with the exception of weaning height. This is expected due to temporary environmental effects because it is impossible to exactly duplicate pastures from year to year. Age of dam was a significant ($P < 0.05$) source of variation for the ratio of weaning weight: height, but not for other traits reported in this study. As expected the 6-yr-old cows had calves with a higher ($P < 0.05$) mean ratio than the 3 and 5-yr old cows, but there was no difference ($P > 0.05$) between the 6 and 4-yr old cows. This implies that the older cows are producing a more conditioned calf than are the younger dams.

Implications

These data suggest that biological type may need to be considered when choosing the correct match of genetics to production resources. Our data suggest that different combinations of rate of maturing and mature weight in Angus and Brahman cattle yield different results in maternal performance on two different types of forage.

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Table 1. Frequency of biological type by breed type

	Biological type[a]			
Breed type[b]	LE	LL	SE	SL
AA	1	43	31	34
AB	25	11	65	11
BA	26	27	30	4
BB	0	17	20	29

[a]LL=large framed, late maturing; LE = large framed, early maturing; SE=small framed, early maturing; SL=small framed, late maturing.
[b]AA=Angus x Angus; AB=Angus x Brahman; BA=Brahman x Angus; BB = Brahman x Brahman.

Table 2. Least-squares means and standard errors of birth weight (lb)for the interaction of biological type and forage

	Forage Environment[a]	
Biological type[b]	BG	E+
LE	73 + 2^{fgh}	84 + 2^{c}
LL	79 + 2^{cde}	77 + 2^{defg}
SE	73 + 2^{fgh}	77 + 2^{def}
SL	73 + 2^{h}	79 + 2^{cd}

[a] E+ = endophyte-infected tall fescue; BG = common bermudagrass.
[b] LL = large framed, early maturing; LE = large framed, early maturing; SE = small framed, early maturing; SL = small framed late maturing.
[cdefgh] Means in the table with no superscript in common differ (P < 0.05).

Table 3. Least-squares means and standard errors of weaning weight (lb) for the interaction of biological type and forage

	Forage Environment[a]	
Biological type[b]	BG	E+
LE	585 + 18^{c}	556 +13^{cde}
LL	550 + 11^{cdef}	440 + 15^{i}
SE	565 + 11^{cd}	486 + 11^{h}
SL	528 + 11^{efg}	449 + 7^{i}

[a] E+ = endophyte-infected tall fescue; BG = common bermudagrass.
[b] LL = large framed, early maturing; LE = large framed, early maturing; SE = small framed, early maturing; SL = small framed late maturing.
[cdefghi] Means in the table with no superscript in common differ (P < 0.01).

Table 4. Least-squares means and standard errors of weaning height (in) for the interaction of biological type and forage

	Forage Environment[a]	
Biological type[b]	BG	E+
LE	46 + 1^{cd}	47 + 1^{c}
LL	45 + 1de	44 + 1^{i}
SE	45 + 1^{def}	45 + 1^{efg}
SL	45 + 1^{efgh}	44 + 1^{h}i

[a] E+ = endophyte-infected tall fescue; BG = common bermudagrass.
[b] LL = large framed, early maturing; LE = large framed, early maturing; SE = small framed, early maturing; SL = small framed late maturing.
[cdefghi] Means in the table with no superscript in common differ (P < 0.05).

Table 5. Least-squares means and standard errors of weaning weight:height ratio for biological type

Biological type[a]	Weaning weight:height ratio
LE	2.19 + 0.03^{b}
LL	1.97 + 0.03^{c}
SE	2.06 + 0.02^{b}
SL	1.96 + 0.03^{c}

[a] LL = large framed, early maturing; LE = large framed, early maturing; SE = small framed, early maturing; SL = small framed late maturing.
[bc] Means with no superscript in common differ (P < 0.05).

Table 6. Least-squares means and standard errors of weaning weight:height ratio for forage

Forage[a]	Weaning weight:height ratio
E+	1.92 + 0.03^{b}
BG	2.19 + 0.03^{c}

[a] E+ = endophyte-infected tall fescue; BG = common bermudagrass.
[bc] Means with no superscript in common differ (P < 0.05).