Milk Production in Four Divergent Biological Types Grazing Common Bermudagrass or Endophyte-Infected Tall Fescue

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Story in Brief

Milk yield and quality were measured on four divergent biological types resulting from Angus, Brahman, and reciprocal cross cows grazing either common bermudagrass or endophyte-infected tall fescue. Data were collected over a 4-yr period to evaluate the effect of biological type and forage on milk production traits. The growth curve parameters of mature weight (A) and rate of maturing (k) were estimated for 121 cows using the growth curve model as described by Brody (1945). Cows were assigned to one of four biological types: genetic potential for large mature size-late maturing (LL, A > 1254 lb, k < 0.047 %, n = 35), large mature size-early maturing (LE, A > 1254 lb, k ≥ 0.047 %, n = 19), small mature size-late maturing (SL, A ≤ 1254 lb, k < 0.047 %, n = 25), and small mature size-early maturing (SE, A ≤ 1254 lb, k ≥ 0.047 %, n = 42). Milk yield was estimated by milking machine, and milk fat, protein, and somatic cell counts were evaluated in a commercial laboratory. Included in the final models for milk yield and quality traits were the independent variables of forage, biological type, biological type x forage and residual error. Biological type was significant (P < 0.10) for average milk yield, average milk protein and average somatic cell count. Forage was a significant source of variation for average milk yield and butterfat percentage (P < 0.05). The cows grazing bermudagrass had higher (P < 0.01) milk yields and butterfat percentage than their counterparts grazing endophyte-infected fescue. These results suggest that biological type and forage have varying effects on milk production traits.

Introduction

In the cow-calf business, maternal traits such as milk production and weaning weight have substantial economic implications. Increased weaning weights in turn increase economic returns. Weaning weights are a result of the genetic potential of the calves for growth as well as the maternal environment provided to them in the pre-weaning phase. A vital component in this pre-weaning environment is milk production. Milk production has been shown to account for 40% of the variation in 205-d weights (Robinson et al., 1978). How nutritional environment of the dam influences both quality and quantity of milk produced has been widely studied. Previous research has shown that cows grazing endophyte-infected fescue have decreased milk production compared to those grazing endophyte-free forages (Holloway and Butts, 1983).

The application of biological typing has seen limited use. Most biological type studies separate types by breed, relative to size, milking ability and various other traits. Separation of biological types by growth parameters is an option that has not been extensively explored. This may allow biological typing to help make the correct match of animal to production system. Therefore, the objective of this study was to evaluate milk production traits of four divergent biological types of cows grazing common bermudagrass or endophyte-infected tall fescue.

Experimental Methods

One hundred twenty-one Angus (AA), Brahman (BB), Angus x Brahman (AB), and Brahman x Angus (BA) heifers born from 1988 to 1991 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.

Milk yield was estimated using a single-cow portable milking machine. Milk production was estimated in all years at an average 61, 90, 117, 145, and 173 d postpartum. Dates of estimates were early May to late September. Cows and calves were separated at approximately 1700 h the evening before milking and held for 14 h overnight with hay and water provided. There was no milk-out prior to separation. Ten-minutes before milking, cows were sedated with 1.5 ml of acepromazine, and 1.0 ml of oxytocin also was administered immediately before milking to induce milk let-down. After milking was complete, milk was weighed and triplicate samples were taken for estimates of milk fat, milk protein, and somatic cell count. Milk fat, milk protein, and somatic cell counts were estimated by a commercial laboratory using a Milkoscan System 4000® (AOAC, 1990). Daily milk yield was estimated as twice the net weight of milk adjusted linearly to a 12-h basis ([milk weight/14] X 12). Somatic cell counts were transformed using natural logarithms prior to analysis.

The growth parameters of mature weight (A) and maturing rate (k) were estimated on 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 > 1,254 lb, k < 0.047%, n = 35); large, early maturing (LE, A > 1,254 lb, k ≥ 0.047%, n = 19); small, late maturing (SL, A ≤ 1,254 lb, k < 0.047%, n = 25); and small, early maturing (SE, A ≤ 1,254 lb , k ≥ 0.047%, n = 42). All breed types were represented in all biological types.

Data were analyzed by the GLM procedure of SAS (SAS Inst., Inc., Cary, NC). Data were averaged over month within year. The model included the dependent variables of overall average milk

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yield, butterfat, protein, and somatic cell count as well as individual records for 61, 90, 117, 145, and 173 d postpartum milk production.

Results and Discussion

Presented in Table 1 are least-squares means and standard errors for average milk production (lb/24 h) by biological type. There were no differences (P > 0.05) in average milk yield between the two early maturing types or between the two late maturing types. There were also no differences (P > 0.05) between the large, late maturing and the small, early maturing types for average milk yield.

The cows grazing endophyte-infected fescue had lower (P < 0.05) average milk yield and butterfat percentage than their counterparts grazing bermudagrass (16.1 lb vs 24.0 lb and 3.39 vs 3.86 %, respectively). This decrease was somewhat expected due to the documentation of the negative effects on milk production caused by the endophyte-infected fescue forage.

The least-squares means and standard errors for average milk protein (%) by biological type are shown in Table 2. The two large mature size types had a higher (P < 0.05) mean milk protein percentage than did their small mature size counterparts (3.37 and 3.34 vs. 3.25 and 3.21 %, respectively). There were no significant differences (P > 0.05) for milk fat percentage for either biological type or forage.

Table 3 shows the least-squares means and standard errors for the interaction of biological types and forage for somatic cell count. This interaction likely resulted from a change in ranking between the two production systems. In the bermudagrass system the biological types ranked numerically: LE > LL > SL > SE and in the endophyte infected tall fescue grazing system they ranked: SL > LL > SE > LE.

For individual monthly records, forage was a significant (P < 0.05) source of variation for all individual milk yield records 145 and 173 d postpartum for milk fat percentage; 117, 145 and 173 d postpartum for milk protein percentage; and 117, 145 and 173 d for postpartum somatic cell counts. Biological type was a significant source of variation (P < 0.05) for individual records at 145 and 173 d postpartum for milk yield, 61 d postpartum for milk fat percentage, 145 d postpartum for milk protein percentage and somatic cell counts.

As the milking season lengthened, overall milk yield, milk fat percentage, milk protein percentage, and somatic cell counts tended to decrease from 61 d postpartum to 173 d postpartum with a few exceptions. The LE cows actually increased milk fat percentage (+ 0.78 %) and the LL cows had an increase (+ 0.04 %) in milk protein percentage over the milking period.

Implications

These data suggest that biological type may have an effect on milk production and protein percentage, with early maturing types producing more milk than their later maturing counterparts and larger types having a higher percentage of protein. These results may aid in the use of biological type in determining the correct match of animal to production system. More research is needed to evaluate grazing systems involving both endophyte-infected fescue and common bermudagrass in an attempt to utilize both types of forage.

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Table 1. Least-squares means and standard errors for average milk production (lb/24 h) by biological type[a].

Biological type	Milk production (lb/24 h)
LE	22.3 ± 1.56[b]
LL	19.73 ± 1.06[cd]
SE	20.79 ± 0.95[bc]
SL	17.40 ± 1.21[d]

[a] LL= large mature size, late maturing; LE = large mature size, early maturing; SE = small mature size, early maturing; SL = small mature size, late maturing

[bcd] Means with differing superscripts differ (P = 0.06)

Table 2. Least-squares means and standard errors for average milk protein (%) by biological type[a].

Biological type	Milk protein (%)
LE	3.37 ± 0.054[b]
LL	3.34 ± 0.036[b]
SE	3.25 ± 0.033[c]
SL	3.21 ± 0.42[c]

[a] LL= large mature size, late maturing; LE = large mature size, early maturing; SE = small mature size, early maturing; SL = small mature size, late maturing

[bc] Means with differing superscripts differ (P = 0.06)

Table 3. Least-squares means and standard errors for somatic cell count (loge count) for the interaction of biological typea and forage[b].

	Forage environment	
Biological type	BG	E+
LE	4.93 ± 0.42[cd]	3.36 ± 0.25[efgh]
LL	4.04 ± 0.20[bd]	3.82 ± 0.26[defg]
SE	3.84 ± 0.19[def]	3.72 ± 0.22[defgh]
SL	4.02± 0.29[bde]	4.68 ± 0.25[cd]

[a] LL= large mature size, late maturing; LE = large mature size, early maturing; SE = small mature size, early maturing; SL = small mature size, late maturing

[b] E+ = Endophyte-Infected Tall Fescue; BG = Common Bermudagrass

[cdefgh] Means with different superscripts differ (P < 0.01)