Effect of Genetics Level of Beef Cow Milk Production on Longevity in Diverse Environments

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ABSTRACT: The study objective was to determine the effects of milk EPD of beef cows on ability to remain in the herd in different environments. We hypothesized those animals with higher milk EPD may be culled out of the herd at a younger age in forage limited environments. The Red Angus Association of America provided milk EPD and herd records for stayability. Based on location of the breeders, environments were assigned. The data was analyzed in ASREML3.0 using a mixed model with sire as a random effect, milk EPD and biomes as fixed effects. The interaction of milk EPD and environment was included in the model. The interaction term was significant (*P<.0001)* with regression coefficients of 0.0686, 0.066, 0.072, 0.040, 0.100, 0.073 and 0.057 for the seven biomes with significance of *P<.0001.* There were no negative effects of milk EPD on the animal's longevity.
Keywords: Beef cattle; Milk; Longevity

Introduction

In beef cow/calf operations the ability of cows to calve and rebreed annually is crucial to economic survival. In order for a cow/calf herd to be profitable, a cow must remain in the herd long enough to recoup the costs of heifer development, cow maintenance and the other females that leave the herd at young ages (Snelling et al. (2012)). A heifer needs to calve when she is 2 years of age and stay in the herd long enough to produce enough calves to recapture that investment. The cow's ability to remain in the herd hinges on her ability to maintain a yearly calving interval since most culling practices include removing cows that fail to rebreed within that interval (Snelling (1994)). On average, a cow has a 90 day postpartum period (PPI) to conceive following a 285 day average gestation length to maintain this yearly calving interval. The length of the postpartum period can be a determining factor in a cow's ability to stay in the herd (Williams (1990)).

Lactation and nutritional requirements can contribute to the length of the PPI (Short et al. (1990)). The requirements for lactation following calving are high and increase the nutritional requirements needed by the cow to resume estrous. The dairy industry has shown that cows with the highest milk production have the greatest incidence of infertility (Lucy (2001)).

However in extensive beef production, a calf's weaning weight is influenced by the dams milking ability and calves weaned from dams with higher milk EPD are heavier at weaning than calves from dams with lower milk EPD (Clutter and Nielsen, 1987). Consequently producers often select for higher milk production which could be antagonist to a cow's ability to remain in the herd. Providing adequate nutrition to meet the energy demands of lactation is crucial for a cow to resume estrous. Certain nutrient restricted environments may not provide adequate nutrition to meet the energy requirements for high milking cows to resume estrous, in turn leading to early removal from the herd for infertility as is common practice in most North American beef cow herds.

The objective of this study was to evaluate the effects of increasing genetic level of milk production (measured as weaning weight of the calf) of beef cows on their ability to remain in the herd under varying environmental conditions. Identification of maximal genetic milk level for a given environment would allow producers to select for more environmentally adapted genotypes. We hypothesized that cows with higher genetic levels of milk production would likely have shorter productive lifespans in restrictive environments than in less restrictive environments.

Materials and Methods

Data. The Red Angus Association of American (RAAA) provided milk EPDs on 3,185,914 individual animals and 313,363 animals with lifetime calf weaning records. Only data from cows with lifetime calf production records were used in this study in addition to data from breeders with more than 150 contemporary groups. The final dataset consisted of 120,196 animals corresponding to 8,616 sires and 229 breeders. Annual precipitation and biome class were assigned to each animal in the dataset based on the location of the breeder (via zip code) in the RAAA registry. Biomes were defined as geographical areas with similar climates and vegetation (Campbell (1996)) and were used to represent the various environments in this study. For the purpose of this study, lifetime calf production records were used to calculate longevity defined as the age at which a cow weaned her last calf.

Statistical Analysis. Summary statistics for each biome are presented in Table 1 and locations of each biome are in Figure 1. The data were analyzed in ASREML 3.0 (Gilmour (2009)) using a mixed model with sire as a random effect, milk EPD as a covariate and biome class as a fixed effect to predict cow longevity. An interaction between milk EPD and biomes was also included.

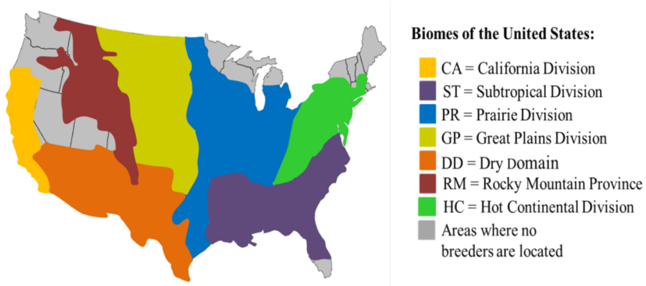

Figure 1. Map of the United States with biomes highlighted by color (www.marietta.edu).

Table 1. Summary statistics for longevity, milk EPD and annual precipitation within each biome

Biome[1]	N	Longevity[2]		Milk EPD		Annual Precipitation[3]	
		Mean	SD[4]	Mean	SD[4]	Mean	SD[4]
CA	4544	6.68	3.30	14.34	6.37	442.63	83.93
DD	2691	6.18	3.27	15.26	5.82	428.14	144.08
GP	52778	6.30	3.36	15.67	6.78	463.28	116.18
HC	8630	6.37	3.20	15.52	6.64	1121.94	131.81
PR	12177	6.71	3.38	16.48	6.52	910.38	138.15
RM	36853	6.10	3.48	16.56	6.31	361.17	107.15
ST	2523	6.33	3.42	19.52	6.14	1264.37	163.58

[1]Biomes = geographical areas with similar climates and vegetation
[2]Longevity = the age at which a cow had her last calf, measured in years
[3]Annual Precipitation = the average annual precipitation per biome measured in millimeters
[4]SD = Standard Deviation

Results and Discussion

Parameter estimates for the main effects of biome and milk EPD are presented in Table 2. The interaction of milk EPD and biome was found to be significant (*P<.0001*) and are shown in Table 3. The regression coefficients for each biome and milk EPD interaction suggested that as milk EPD increased, so did the longevity of the cows; however the regression coefficients were different for each biome resulting in the significant interaction. We anticipated that in very restrictive environments milk EPD would result in shorter cow lifespans. Based on the results of this study, we would reject our hypothesis. These general results are supported by other studies conducted with dairy cattle. Lorenzo and Everett (1981) found positive regression coefficients for the regression of stayability on milk yield. Lorenzo and Everett (1981) and Short and Lawlor (1992) both found positive genetic correlations between stayability and milk yield. While in all represented biomes, the trend was for increasing longevity as milk production continues to increase genetically for beef cattle, a threshold may be reached where the inverse relationship is seen. The use of irrigated pastures or farmland was not considered in this study but could add error to our evaluation as specific breeders may have access to these sources of forage.

Table 2. Estimates of the effect of biome on cow longevity (years).

Biome[1]	Estimates[2]	Standard Error
Dry Domain	0.00	0.19
Great Plains Division	0.12	0.20
California Division	0.42	0.25
Hot Continental Division	0.60	0.22
Rocky Mountain Division	-0.61	0.20
Subtropical Division	-0.03	0.320.20
Subtropical Division	-0.03	0.32

[1]Biomes=Geographical areas that are similar in climate and vegetation
[2]Estimates = Parameter estimates for each biome

Table 3. Regression coefficient estimates for the regression of cow longevity(years) on milk EPD by biome class

Biome[1]	Estimates[2]	Standard Error
Dry Domain	0.069	0.012
Great Plains Division	0.066	0.012
California Division	0.072	0.015
Hot Continental Division	0.040	0.013
Rocky Mountain Division	0.100	0.012
Subtropical Division	0.073	0.017
Prairie Division	0.057	0.013

[1]Biome = the parameter of the interaction of biome by milk EPD
All p-values were significant at α=0.05 *(P<0.0001)*

Conclusion

Results from this study show a genetic by environment interaction between a beef cow's milking ability and her environment. When making selection decisions producers should consider level of environment as milk production levels increase.

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