The effect of dam age on heifer progeny performance and longevity

Joslyn K. Beard,[†] Jacki A. Musgrave,[†] Kathy J. Hanford,[‡] Richard N. Funston,[†] and J. Travis Mulliniks[†,1]

[†]West Central Research and Extension Center, University of Nebraska, North Platte, NE 69101; and
[‡]Department of Statistics, University of Nebraska-Lincoln, Lincoln, NE 68583

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INTRODUCTION

Selection and development of heifers can have long-term impacts on production and profitability. Developing females to replace cull cows is costly and one of the most expensive management decisions for cow–calf producers. Several studies have examined methods to reduce heifer development costs without impairing reproductive function (Funston and Deutscher, 2004; Roberts et al., 2009; Mulliniks et al., 2013). Reducing heifer investment costs while maintaining reproductive performance is important for profitability due to the number of calf crops required to pay for development costs (Clark et al., 2005). In a review, Patterson et al. (1992) suggested heifer development should focus on increasing the percentage of heifers that attain puberty by the start of the breeding season. In addition, heifers that calve earlier in the calving season have been shown to have increased lifetime productivity (Cushman et al., 2013). Therefore, producers selecting replacement females place emphasis on both reproduction and growth value.

Preweaning heifer growth has been shown to have a larger influence on puberty than postweaning growth (Wiltbank et al., 1966; Cardoso et al., 2014). Mature beef cows typically wean heavier calves compared with younger cohorts (Stewart and Martin, 1981; Turner et al., 2013), which may increase the percentage of heifers to reach puberty by breeding. However, younger females are thought to be genetically superior to older cow due to the rate of genetic progress. Dam age is considerably varied within a herd and compounded with an array of effects on progeny performance, little is known regarding optimal dam age for selecting replacement females. Thus, we hypothesized heifer progeny from moderate and mature cows would have increased growth during development, reproductive performance, and longevity in the cow herd. The objective of this study was to evaluate dam age on female progeny performance and herd longevity.

MATERIALS AND METHODS

All animal procedures and facilities were approved by the University of Nebraska-Lincoln Institutional Animal Care and Use Committee.

Cow–Calf Data

Cow and calf performance data were collected from 2005 through 2017 at the University of Nebraska, Gudmundsen Sandhills Laboratory (GSL) near Whitman, NE. Cow and calf performance data were obtained from both March and May calving herds at GSL to determine the impact of dam age on subsequent heifer progeny performance and longevity. Cows (n = 1,059) used in this study were Husker Red (5/8 Red Angus, 3/8 Simmental) and ranged from 2 to 11 yr of age. To determine the effect of dam age on subsequent heifer progeny's growth development and reproductive efficiency, cows were also classified by age groups as young (2 to 3 yr old), moderate (4 to

[1]Corresponding author: travis.mulliniks@unl.edu
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6 yr old), and old (≥ 7 yr old). Heifer calves were weighed at birth and weaning each year. Weaning weights were adjusted for a 205-d weaning weight with no adjustments for sex of calf or age of dam.

Heifer Development Systems

Each year, all heifers were managed together within their respective breeding group. March-born heifers grazed meadow until early June then moved to upland native range, and May-born heifers continuously grazed upland native range. In each year, heifers were weighed at prebreeding and at pregnancy diagnosis. Before each breeding season, two blood samples were collected via coccygeal venipuncture 10 d apart to determine pubertal status (May for March-born heifers and early July for May-born heifers). Blood samples were placed on ice following collection and centrifuged at 2,500 × *g* for 20 min at 4 °C. Following serum removal, plasma samples were stored at –20 °C for pending progesterone analysis. Plasma progesterone concentration was determined via direct solid phase adioimmunoassay (Coat-A-Count, Diagnostics Products Corp., Los Angeles, CA). Heifers with serum progesterone concentrations greater than 1.0 ng/mL at either collection were considered pubertal. Heifers were synchronized with a single prostaglandin F2 alpha (Lutalyse, Zoetis, Parsippany, NJ) injection 5 d after bull placement (1:20 bull to heifer ratio) for a 45-d breeding season. All heifers grazed Sandhills upland range through final pregnancy diagnosis. Pregnancy diagnosis was conducted via transrectal ultrasonography (ReproScan, Beaverton, OR) 40 d from bull removal. Calving distribution in 21-d intervals was calculated with the start of the calving season coinciding with the first day 2 or more heifers calved.

Statistical Analysis

Data were analyzed using the GLIMMIX procedure of SAS (SAS Inst. Inc., Cary, NC). For reproduction and growth performance of heifer progeny, linear model included the linear fixed effect of the dam weight at the weaning (DAWW), linear fixed effect of the heifer progeny birthdate (BDATE), and fixed effect of age of the dam age (young, moderate, and old; AGEDAM). Owing to having data from two season of calving (March or May) nested within year are not independent (YRSEAS), additional random effects were included for testing of the fixed effects. Error terms used for testing DAWW, BDATE, and AGEDAM were DAWW × YRSEAS, BDATE × YRSEAS, and AGEDAM × YRSEAS, respectively. Puberty diagnosis, pregnancy rate, and calving within first 21 d of the subsequent calving season were analyzed using a binomial distribution. All other response variables were considered normally distributed. Data are presented as LSMEANS and P-values ≤ 0.05 were considered significant and tendencies were considered at a $P > 0.05$ and $P \leq 0.10$.

RESULTS AND DISCUSSION

Heifer Growth Performance Data

Heifer calves born to young cows had lighter ($P \leq 0.01$; Table 1) birth body weight (BW) and 205 d than heifer calves born to moderate and old cows. Milk production has been shown to increase with cow age, plateauing between 6 and 10 yr of age (Lubritz et al., 1989). This increase in milk production may partially be reflected in increased calf weaning weight and growth rates from mature cows (Renquist et al., 2006). In addition, young cows are a fraction of their mature BW, which is reflected in progeny with lighter BW (Coleman et al., 2017). Urick et al. (1971) reported the relationship between cow weights and calf weights within three breeds, reporting a correlation between increased mature cow sizes on increased calf weaning weight. Similarly, Stewart and Martin (1981) investigated mature cow weight across cattle breeds on calf growth performance and

Table 1. Effect of dam age on heifer progeny growth performance

	Dam age[1]				
Items	Young	Moderate	Old	SE[2]	*P*-value
Heifer BW, kg					
Birth	32[a]	34[b]	33[b]	0.4	<0.01
205 d	198[a]	206[b]	205[b]	3	0.01
Prebreeding	277	283	281	4	0.21
Pregnancy diagnosis	371	371	366	4	0.17

[a,b]Means with different superscripts differ $P \leq 0.05$.

[1]Dam age = dam age at time of calving, young (2 to 3 yr of age), moderate (4 to 6 yr of age), old (≥ 7 yr of age)

[2]SE is the SE of the difference between LSMeans.

Table 2. Effect of dam age on heifer progeny reproductive performance

	Dam age[1]				
Items	Young	Moderate	Old	SE[2]	*P*-value
Puberty, %	51.55[a]	69.64[b]	74.06[b]	9.7	<0.01
Pregnancy, %	80.44	84.08	85.89	2.5	0.15
Calved in first 21 d, %	73.34	77.88	78.94	3.0	0.28
Calf crop[3], *n*	3.1	2.8	2.2	0.7	<0.01

[a,b]Means with different superscripts differ $P \leq 0.05$.

[1]Dam age = dam age at time of calving, young (2 to 3 yr of age), moderate (4 to 6 yr of age), old (≥ 7 yr of age).

[2]SE is the SE of the LSMeans.

[3]Number of calf crops produced with dam age groups.

reported increased cow weight resulted in increased calf weight ($P < 0.01$). Although preweaning BW differences occurred, heifer pre-breeding BW and at time of pregnancy determination were not different ($P \geq 0.17$) among dam age groups.

Heifer Reproductive Performance and Longevity

Female progeny born to moderate and old cows had a greater ($P < 0.01$; Table 2) percentage reach puberty before breeding compared with heifers born to young cows. Previous research has reported a correlation between heifer growth rate and attainment of puberty (Taylor and Fitzhugh, 1971). Similarly, Short and Bellows (1971) reported a greater percentage of crossbred heifers reached puberty as BW increased linearly. However, dam age did not influence ($P = 0.15$) heifer progeny pregnancy rates. This could be attributed to postweaning growth, as no BW differences were observed among the groups suggesting heifer postweaning intake and plane of nutrition affected reproduction success. In the subsequent calving season, there were no differences ($P = 0.28$) among age groups for percentage of heifers who calved within first 21 d of calving. Timing of pregnancy and subsequent calving date have been shown to influence longevity and lifetime productivity (Gasser et al., 2006; Cushman et al., 2013). However, average number of calf crops from progeny within dam age was different among all groups ($P < 0.01$), with heifer progeny from young dams having more calves (3.1 ± 0.7) than moderate (2.8 ± 0.7) and old (2.2 ± 0.8). Similarly, Fuerst-Waltl et al. (2004) reported age of dam negatively affected daughter longevity, as dam age increased, progeny culling rate increased. These studies suggest as dam age increases, retention and productivity of female progeny decrease.

IMPLICATIONS

Results from this study suggest dam age will affect heifer progeny growth and reproductive performance. Heifer progeny from moderate and older dams tended to have increased performance up to first calving. However, heifer progeny from young dams had increased calf crops and productivity compared with their older counterparts. Depending on production goals, dam age may need to be considered for selecting replacement females with the goal of increased productivity and long-term profitability. Further research is warranted to investigate cow age on steer progeny growth and feed efficiency.

Conflict of interest statement. None declared.

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