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EFFECT OF PREVIOUS REPRODUCTIVE STATUS OF DAM ON THE PREADJUSTMENT OF WEANING WEIGHT FOR GENETIC EVALUATION IN TROPICAL BEEF BREEDS

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SUMMARY

The effects of dam previous reproductive status (PRS) on the pre-adjustment of weaning weight for genetic evaluation (WWT) was examined for Santa Gertrudis (SANTA), Brahman (BRAH) and Tropical Composite (TCOMP) breeds of beef cattle. Weaning weight records were classified into 3 groups according to the dam's PRS: whether in the last year, she had reared a bull calf (PBC), a heifer calf (PHC) or no calf (PNC). Least squares means showed that calves born to PNC dams had consistently higher WWT than those which had previously reared a calf. Calves born to PBC cows had the lowest weaning weight across the 3 groups and were 5.9 to 16.6 kg lighter than the calves born to PNC cows across the 6 dam age classes studied for SANTA. When age of calf at weaning was fitted as a covariate, the differences between the PRS groups reduced, with calves born to PBC cows being 0.5 to 4kg lighter than the calves born to PNC cows for SANTA. For BRAH and TCOMP the differences were 1.2 to 3.4kg and 5.6 to 10.1 kg respectively. For TCOMP, adjusting for weaning age reduced the effect, though WWT differences between PNC and the PHC and PBC categories remained significant. These results demonstrate that differences in weaning weight across the 3 PRS groups were due primarily to PNC cows calving earlier, and producing older and heavier calves at weaning than dams which had reared calves in the previous year.

INTRODUCTION

The prediction of breeding values in BREEDPLAN requires pre-adjustment for systematic environmental effects. For weaning weight (WWT), records are adjusted for calf age, age of dam and contemporary group effects as defined by Graser *et al*. (2005). Weaning rates in northern Australia can be low (Rendel 1980), and it is common to retain cows which do not calve every year in seed stock herds. Cows which failed to conceive are expected to gain more weight during the subsequent breeding season than their reproductively active contemporaries. A cow's previous reproductive status (PRS) may therefore influence its current calf's birth weight, preweaning growth rate and WWT. Furthermore, previous calf sex, through its effect on gestation length and preweaning growth rate, also influences post partum recovery and may influence birth weight, pre weaning growth rate and WWT of subsequent calves (Crews 2006). The objective of this study was to quantify the effect of PRS on WWT in 3 tropically adapted breeds of beef cattle.

MATERIALS AND METHODS

Dataset A. WWT records from the Santa Gertrudis (SANTA) BREEDPLAN evaluation, for calves of dams which produced their first progeny before 42 months of age were analysed for this study, and included calves born to cows up to 8 years of age (producing 6 dam age classes from 3 – 8 years). Previous reproductive status (PRS) identified whether in the last breeding season (12 - 16 months prior

[1] AGBU is a joint venture of Industry and Investment NSW and University of New England

to present calving) dams had reared a bull calf (PBC); a heifer calf (PHC); or no calf (PNC). PNC records were defined as those for which the current calf's dam had failed to calve within the last 16 months, but had calved within 23 months. Records for cows which had failed to calve in the 23 months prior to their current calving were omitted from the data. The model for WWT included contemporary group effects and dam age class as cross classified fixed effects (consistent with the fixed effects defined for BREEDPLAN by Graser, *et al*. 2005), and PRS as a nested term, fitted within each dam age class. Least squares means were generated using PROC MIXED in SAS (SAS Institute, Cary, NC, USA), with sire fitted as random. To determine whether any differences in weaning weight were due to PRS or simply due to previously dry cows conceiving earlier and weaning older and heavier calves, models were also re-run with weaning age (in days) fitted as a covariate (nested within sex).

Dataset B. The WWT records for progeny born to 4 and 5 year old Brahman (BRAH) and Tropical Composite (TCOMP) dams from the Beef CRC project described by Barwick *et al*. (2009) were analysed for this study. Models similar to SANTA were used to quantify the effect of PRS, with contemporary group defining the dam's mating group, and year and location of birth. For TCOMP animals, terms defining the genotype of their sire and dam were also fitted to account for any heterosis effects. Least squares means were computed using PROC MIXED in SAS (SAS Institute, Cary, NC, USA) for models which fitted or did not fit age at weaning to determine the effect of PRS on WWT.

RESULTS AND DISCUSSION

Table 1. Descriptive statistics for weaning age (days) and weaning weight (kg) of calves born to Santa Gertrudis (SANTA), Brahman (BRAH) and Tropical Composite (TCOMP) dams.

	SANTA		BRAH		TCOMP	
PRS[1]	**Number**	**Mean(SD)**	**Number**	**Mean(SD)**	**Number**	**Mean(SD)**
			Age at weaning (days)			
PNC	8053	221.5 (44.8)	629	189.6 (21.5)	439	195.4 (20.6)
PHC	17005	211.5 (40.0)	302	173.0 (24.2)	581	181.1 (23.6)
PBC	17624	210.7 (40.2)	245	174.3 (23.5)	543	180.7 (24.3)
			Weaning weight (kg)			
PNC	8053	263.9 (55.9)	629	199.4 (29.0)	439	210.9 (33.8)
PHC	17005	252.3 (51.2)	302	186.2 (30.8)	581	192.6 (31.9)
PBC	17624	252.0 (51.7)	245	185.3 (28.7)	543	191.3 (32.5)

[1] PNC=cows which previously reared no calf; PHC=previously reared a heifer calf or PBC=previously reared a bull calf.

Dataset A. The average weaning age of calves born to PHC and PBC cows was 211 days, where calves of the PNC cows were 11 days older (Table 1). Calves of PHC and PBC cows had similar raw mean WWT and were lighter than the calves of PNC cows. Results presented in Table 2 show that when age at weaning was not fitted, calves born to PNC cows had higher least squares means for WWT than those born to PHC and PBC cows. Calves born to PBC cows had the lowest least squares means for WWT among the 3 groups of cows compared. The differences in average WWT of the progeny of PNC and PBC ranged from 5.9 to 16.6 kg (Table 2). Average WWT of the progeny of PBC cows were lower than that for PHC, for all 6 dam age classes evaluated. On average, progeny of PBC cows were 1.6 kg lighter at weaning than the progeny of PHC cows across the 6 age classes.

When calf age was fitted as a covariate, least squares means for WWT of calves born to PNC cows were the highest and those for PBC cows were the lowest at all ages (Table 2), and these differences were statistically significant (P < 0.05) for all dam ages tested. The least squares means of PNC cows were also higher than those of PHC cows for all dam ages. The differences were only significant (P < 0.05), however, for the 5 and 6 years dam age classes. The WWT for progeny born to PHC cows were higher than those born to PBC cows, however the differences were not statistically significant except for dams which calved at 4 years of age.

Table 2. Least squares means of dam previous reproductive status and calf sex on weaning weight of Santa Gertrudis (SANTA), Brahman (BRAH) and Tropical Composite (TCOMP) calves when unadjusted and adjusted for age effect.

Breed	PRS[1]	Dam age (years)					
		3	4	5	6	7	8
		Unadjusted weaning weight					
SANTA	PNC	242.8±0.7^{a}	256.4±0.9^{a}	260.5±0.9^{a}	258.9±1.2^{a}	258.1±1.4^{a}	258.3±1.6^{a}
	PHC	232.1±0.9^{b}	242.9±0.7^{b}	249.2±0.8^{b}	253.1±0.8^{b}	254.6±0.9^{b}	252.7±1.1^{b}
	PBC	229.4±0.9^{c}	239.7±0.7^{c}	245.6±0.8^{c}	251.3±0.8^{b}	251.0±0.9^{c}	252.4±1.1^{b}
BRAH	PNC		201.0±2.6^{a}	207.3±1.8^{a}			
	PHC		183.7±2.9^{b}	189.8±2.3^{b}			
	PBC		185.7±3.2^{b}	188.3±2.5^{b}			
TCOMP	PNC		205.0±3.3^{a}	218.4±3.0^{a}			
	PHC		189.2±2.8^{b}	197.8±3.0^{b}			
	PBC		184.7±2.9^{b}	200.3±3.0^{b}			
		Weaning weight adjusted for age of calf					
SANTA	PNC	242.9±0.4^{a}	252.3±0.7^{a}	256.1±0.6^{a}	256.5±0.9^{a}	256.8±1.0^{a}	254.6±1.1^{a}
	PHC	243.0±0.6^{a}	251.0±0.5^{a}	253.8±0.6^{b}	254.3±0.6^{b}	255.6±0.7^{a}	253.2±0.8^{a}
	PBC	241.4±0.7^{b}	248.7±0.5^{b}	252.6±0.6^{b}	253.9±0.6^{b}	253.3±0.7^{b}	253.6±0.8^{a}
BRAH	PNC		191.6±2.1^{a}	201.8±1.5^{a}			
	PHC		188.3±2.3^{b}	200.5±1.9^{a}			
	PBC		190.4±2.5^{ab}	198.4±2.0^{a}			
TCOMP	PNC		200.8±2.8^{a}	215.2±2.5^{a}			
	PHC		194.6±2.4^{b}	205.9±2.6^{b}			
	PBC		190.7±2.5^{b}	209.6±2.6^{b}			

[1]PNC: cows previously reared no calf, PHC: previously reared a heifer calf or PBC: previously reared a bull calf. [a-c] In columns within breed, means without a common superscript letter differ (P<0.05)

Dataset B. Calves of BRAH and TCOMP PHC and PBC cows had very similar mean age at weaning and were approximately 2 weeks younger than the calves of PNC (Table 1). Mean WWT of the calves of PHC and PBC were very similar and were 14 – 20kg lighter than the calves of PNC cows. When the age effect was not fitted, average WWT of progeny born to 4 and 5 years old BRAH PNC cows were 15 and 19kg heavier than the progeny of PBC cows of the same age (Table 2). For TCOMP, the differences were 20 and 18kg, respectively. When the age effect was fitted, the differences between the progeny born to 4 and 5 years old BRAH PNC and PBC cows reduced to 1.2 and 3.4 kg, respectively and were not statistically different (P>0.05). For TCOMP cows, fitting age at weaning reduced the difference between PNC and PBC (10.1 and 5.6kg for 4 and 5 year old cows respectively), and PNC and PHC (6.2 and 9.3kg for 4 and 5 year old cows respectively), though these differences remained significant ($P \leq 0.05$). For both BRAH and TCOMP, WWT differences between PHC and PBC were consistently non-significant at the $P<0.05$ level, though approached significance for TCOMP in models which included weaning age for both 4 ($P=0.056$) and 5 ($P=0.057$) year old dams.

Comparisons of least squares means from both datasets indicated that a substantial proportion of the observed differences in WWT were due to age differences between PNC cows, and those which had reared a calf in the previous year. PNC cows calved earlier and raised calves with heavier WWT than PHC and PBC cows. The WWT differences were higher for young cows (3 to 4 years of age), with about 14 days difference in age between the PNC cows and those of PHC and PBC cows. Neville *et al*. (1990) found that cows which were non pregnant during their previous reproductive cycle gained more weight prior to the next breeding season, and conceived and calved earlier in the subsequent breeding period. The WWT differences between the calves of PNC and cows who reared a calf in their previous reproductive cycle are expected to be further reduced by age slicing of contemporary groups (at 45 days for weaning weight), as is implemented for BREEDPLAN evaluation. Additionally, the heritability of 0.2 for 200 day weight would also be likely to further reduce the magnitude of these differences when EBVs are estimated.

CONCLUSIONS

The effects of dam PRS on the genetic evaluation of WWT assessed in their current calf was examined for 3 tropically adapted breeds of beef cattle. When unadjusted for weaning age, the weaning weight of calves from PNC dams showed that the cows which had failed to calve during their previous year, raised calves which were heavier at weaning than their contemporaries, which had previously reared a calf. When the current calf's age at weaning was fitted in the model, comparisons of least squares means indicated that a substantial part of this difference was due to PNC cows calving earlier than their contemporaries who had reared a calf in their previous reproductive cycle. At a practical level, this demonstrates the importance of having accurate birth date for calf age adjustment. It also suggests that PRS may need to be added to the current contemporary group structure in BREEDPLAN, though the impact of further splitting contemporary groups need to be evaluated before proceeding.

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