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FACTORS INFLUENCING GESTATION LENGTH IN TROPICALLY ADAPTED BEEF CATTLE BREEDS IN NORTHERN AUSTRALIA

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SUMMARY

Records from artificial insemination programs and accurate birth date recording on 812 calves were used to compute gestation length (GL) for 3 tropically adapted beef breeds in northern Australia. Calves were a subset of those generated across 2 years and 2 locations as part of an ongoing beef genetics project in northern Australia. Analyses revealed few fixed effects were significantly influencing the trait, however calf sex was highly significant in all three breeds with males having 2.1, 3.0 and 3.7 days longer GL than females in Droughtmaster, Santa Gertrudis and Brahman, respectively. Large sire differences (up to 13 days) were also observed within each breed, and indicate a large degree of genetic control on the trait. These results have implications for breeding program design, parentage assignment and the development of a genetic evaluation for this trait, both within and across-breeds.

INTRODUCTION

Gestation length (GL) is a trait that can be easily generated from AI mating records, and is an important component of calving ease (Jeyaruban *et al.* 2016) and may be associated with increased calf losses from low birth weight calves in tropical breeds (Wolcott *et al.* 2016). However, few estimates exist of the heritability and associated fixed effects for GL in tropical beef breeds. The distribution of GL and magnitude of sire differences will have implications for management of AI programs and assigning of parentage. Therefore this study aimed to investigate factors influencing GL and estimate their size of effects in 3 tropically-adapted beef breeds.

MATERIALS AND METHODS

Animals. The animals used in this study were a subset of those from 2 research herds that are currently involved in a large genetics project in northern Australia (MLA *B.NBP.0759*) – known as the *Repronomics*™ project. In brief, the project aims to enable increased accuracy of genomic selection by collecting high quality female reproduction phenotypes and other economically important traits on influential sires in each breed. The phenotypic records will be combined with high density genotyping to drive new single-step genetic evaluation methods which are being developed for Australian beef industry (Johnston *et al.* 2017).

The research herds involved include Spyglass Research Facility (SPY) located 120km NW Charters Towers, QLD, comprising Brahman (BM) and Droughtmaster (DM) herds. The second location is the Brian Pastures Research Facility (BP), Gayndah, QLD, and includes BM and DM herds as well as a Santa Gertrudis herd. The calves used in this study were generated at each location using 2 rounds of fixed-time AI over 2 years. All cows were inspected daily over the calving season to establish accurate date of birth for each calf and sire parentage was determined by DNA verification.

For all breeds, common sires were used across years, and for DM and BM several sires were used across locations. Numbers of records by location, breed and across-location link sires are presented in Table 1. The smaller herd sizes at BP restricted the number of sires used compared to SPY, however

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all sires used at BP in BM and DM were also used at SPY (plus additional sires). At both locations all matings were as purebreds, however at BP the cow herd included Beef CRC tropical composite cows.

Table 1. Data description for gestation length (days) records in Brahman, Droughtmaster and Santa Gertrudis cattle at each location

Breed	Total N	Location	N	Mean (d)	Std	range	N sires	N progeny by link sires
Brahman	377	Brian Pastures	103	291.7	5.5	277-310	12	309
		Spyglass	274	292.3	5.5	278-309	18*	
Droughtmaster	337	Brian Pastures	52	290.8	5.5	278-303	8	200
		Spyglass	285	288.3	5.5	272-312	15*	
Santa Gertrudis	98	Brian Pastures	98	284.9	5.6	271-298	5	
Total	812						38	

* includes all sires used at Brian Pastures

Trait definition. Gestation length was computed as the number of days between the successful AI date and subsequent date of birth. Data edits included removing records from multiple births and one record was removed as a suspected premature birth GL=266 and only 22kg birth weight. All records were confirmed to be the result of AI mating by DNA sire verification. Two records were removed because the breed of sire was incorrect (i.e. AI straw error). Due to differences in cow age structures in the herds and breeds, cow age was grouped into 3 classes based on cow year of birth. At BP, cow genotype and cow age were confounded and were therefore fitted as a combined effect. Descriptive statistics of the raw data by breed and location are presented in Table 1.

Statistical methods. Analyses were performed for each breed separately using REML procedures in SAS (SAS Institute Inc. Cary, NC, USA). Gestation length (in days) was included in the mixed model as the dependent variable and the initial models included terms for year (year 1, year 2), cow lactation status at AI (wet, dry), sex of calf (male, female), cow age class (old, medium, young), and all first order interactions. For DM and BM analyses also included terms for location (BP, SPY), and importantly, a term for sire x location. For all analyses a term for cow was included as a random effect. Non-significant terms ($P > 0.05$) were sequentially removed to yield the final model for each breed. Least squares means were computed for significant fixed effects using the LSMEANS procedure in SAS.

RESULTS

a) Brahman. A total of 377 records were available for Brahmans from a total of 18 sires with an adjusted mean of 291.7 days. The final model included significant terms for sire, calf sex and location. Sire x location was not significant indicating that although SPY had longer GL there was no evidence of re-ranking of the sires.

Least squares means for gestation length in Brahmans are plotted in Figure 1. Calves from SPY had longer GL than BP, and male calves were 3.7 days longer gestation than females. Large differences also existed between the Brahman sires.

b) Droughtmaster. A total of 337 records were available for Droughtmaster from 15 sires with an adjusted mean of 288.4 days. The final model included significant terms for sire and calf sex. Location and sire x location effects were not significant. Least squares means are plotted in Figure 2 and show male calves were 2.1 days longer gestation than females. Large differences also existed between the sires with a range of almost 2 weeks.

c) Santa Gertrudis. A total of 98 records were analysed for Santa Gertrudis from 5 sires with an adjusted mean of 284.5 days. The final model included sire and calf sex. Male calves were 3.0 days longer GL than females (see Figure 3).

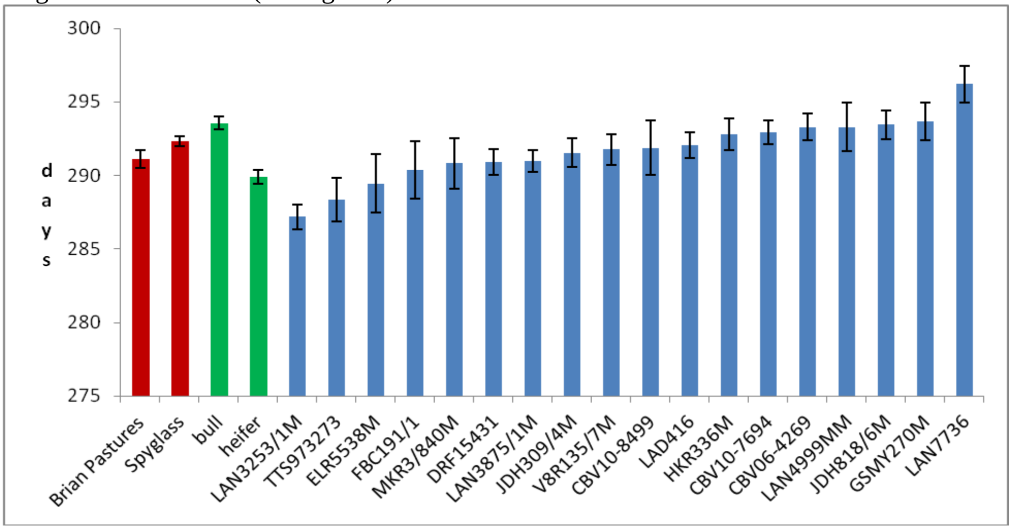

Figure 1. Brahman gestation length (days) least squares means for location (red), calf sex (green) and sires (blue).

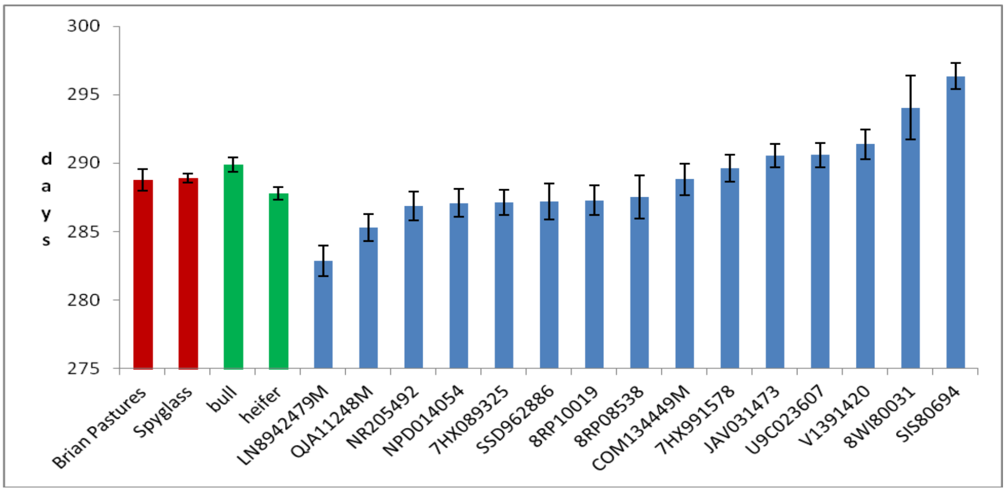

Figure 2. Droughtmaster gestation length (days) least squares means for location (red), calf sex (green) and sires (blue).

DISCUSSION

Although the results and least squares means are not directly comparable across breeds in the current analyses, the identified significant fixed effects and their magnitude of effect were consistent. The large sire differences were not surprising given the high heritability estimates of the trait in temperate beef breed (see Jeyaruban *et al.* 2016), however few estimates exist for tropical beef breeds.

Calf sex had a consistent and large effect in all breeds, with male calves having significantly longer GL than females. Plasse *et al.* (1968) reported a 1.9 day sex difference in purebred Brahmans.

Consistent with the results from the current study, few significant fixed effects were reported by Corbet *et al.* (1997) and Plasse *et al.* (1968). The extended GL of these tropically adapted breeds (especially Brahman) compared to temperate beef breeds is consistent with a review of Chenoweth (1994) and may indicate a mechanism of adaptation, possibly to high ambient temperatures. It could be due to *Bos Indicus* cattle having less uterine capacity as an evolutionary development to reduce internal heat production, and thus requires longer GL to produce a viable calf.

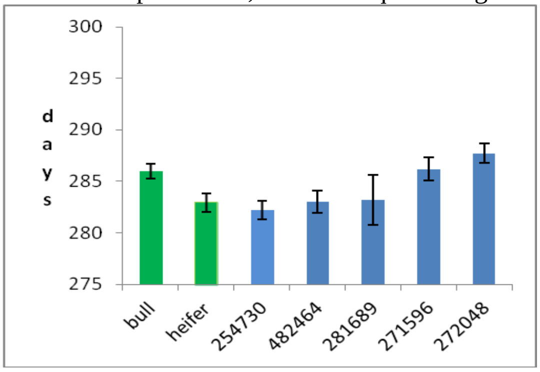

Figure 3. Santa Gertrudis gestation length (days) least squares means for calf sex (green) and sires (blue).

There was no evidence of *sire x location* interactions, however Brahmans had slightly longer GL at SPY compared to BP. This effect may been due to the slight difference in the sample of sires used or in the genetics of the cow herd, but may also be related to the hotter environment at SPY compared to BP, and may be further evidence of heat adaptation impacting GL.

CONCLUSIONS

This study confirmed the longer GL in these tropical breeds compared to temperate beef breeds and has ramifications for the design of breeding programs and parentage assignment. It also highlights the importance of modelling gender in genetic evaluations of the trait. In the future, these data will allow the estimation of genetic parameters (direct and maternal additive variance, and heritability) and this will contribute to each breed's genetic evaluation for GL, as well as to the development of an across-breed EBV for GL. Future work is also possible relating GL to its effects on calf birth weight and calf losses, and possible consequences on female reproductive performance.

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