Quantifying Differences in Genetic Merit Between Australian Angus Seedstock Herds

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ABSTRACT: Seedstock breeders involved in the Beef CRC Maternal Productivity Project detailed varying perspectives on the importance of genetic fatness for on-farm productivity. This paper quantifies differences in genetic merit for 10 Angus herds that contributed the majority of the data to the project. Overall differences in genetic merit as assessed by 17 BREEDPLAN EBVs together were relatively small, however important differences were identified. 98% of the variation between herds in genetic merit was accounted for by two principal components, the first relating primarily to carcass traits and the second growth traits. This variation is consistent with outcomes from the qualitative research such that the main differences in genetic merit between herds are associated with fatness. Moreover, differences in genetic merit between herds appear associated with divergence in on-farm management approach and breeder attitude towards selection emphasis for production traits compared with perceived resilience traits.

Keywords: beef cattle; genetics

Introduction

With the genetic evaluation system BREEDPLAN (Graser et al. 2005), Australian beef cattle breeders have the opportunity to identify and select superior animals to make genetic gain in many traits. This has led to substantial genetic gain, for example in the Angus B3 $Index, annual rate of gain from 1999-2004 was $4.69/cow/year (Barwick and Henzell 2005), however the rate of gain somewhat reduced after this period. The reduction in genetic gain may be partly caused by concerns of some breeders that genetic gain in traits such as retail beef yield could result in unfavourable changes to cow body composition ultimately impacting on-farm productivity (Pitchford et al. 2014). In part, the Beef CRC Maternal Productivity Project was established to address these concerns.

As part of the Maternal Productivity Project, seedstock breeders’ perspectives on topics associated with maternal productivity in beef cattle were investigated. Lee et al. (2014) reported considerable divergence in attitudes to cow management with regards to grazing management, body condition fluctuation and the utilisation of body fat reserves. Specifically, production systems diverged based on animal management characterised by either ‘controlled’ or ‘variable’ management strategies. Variation in management approach was associated with contrasting breeder perspectives on the importance of selecting for production traits including retail beef yield compared with selection for perceived resilience traits including increased subcutaneous fat depth. Breeders using a controlled input approach tended to describe greater relative selection emphasis on production traits. Conversely, breeders using a variable input management approach were likely to have greater selection emphasis on perceived resilience traits that were thought to enable cows to maintain production whilst meeting potential management system constraints.

When the results described above were presented to breeders in a member checking process there was divergence in perspective about how much variation existed in herd selection direction and genetic merit between herds involved. For example, one breeder who perceived themselves as variable input said; ‘We used to breed average for fat (e.g. Rump Fat EBV) and now we are nearly +1. That is a major change, it is a major change in the way we have put it in our selection criteria’. This was further supported by a breeder with a primarily controlled management approach who said; ‘the differences in genetic potential and the difference in our attitude to modifying the environment...is that actually creating much of a difference in the genetic outcome of what we produce? If you had to look at it, there is a difference, generally the herds that are variable input approach have a smaller mature size and also significantly more fat’. This paper quantifies differences in genetic merit between 10 Angus herds that contributed the majority of the data to see if herds that perceived themselves to be selecting differently for traits including Rib Fat and Rump Fat EBV were in need doing so.

Materials and Methods

Examining differences in genetic merit. Average herd BREEDPLAN EBVs for 17 traits for 2009 born calves were accessed from Angus Australia for the 10 primary contributors of Angus data to the project. Data was analysed using a cluster analysis to form a hierarchical tree based on euclidean distance using Genstat 11th edition (VSN International Ltd, Hertfordshire, UK). In addition, a principal component analysis was conducted to determine the number of components required to account for genetic differences between the 10 herds. For each herd the difference between 2009 born calves average EBV and the Angus breed average was determined on a standardised EBV standard deviation basis for each of the 17 EBVs:

HERD standardised EBV = (HERD 2009 EBV − Angus breeder average EBV) / (standard deviation of EBV)

A correlation matrix between studs was formed and analysis conducted using Genstat 11th Edition. Principal components were formed from the correlations. Correlations between principal components and herd genetic merit for each EBV were determined to understand which BREEDPLAN EBVs were more closely associated with each principal component.

Results and Discussion
Quantifying differences between herds in genetic merit. The cluster analysis demonstrated 8 of the 10 studs were closely associated for genetic merit (Figure 1). Only herds 10 and 9 could be considered significantly different to all other herds. Of the two herds that did differ substantially in genetic merit from the other herds, herd number 10 had lowest or second lowest average herd genetic merit for several weight EBVs but the second highest (positive) subcutaneous fat EBVs. Similarly, herd 9 differed markedly from other herds for many EBVs and had the lowest Milk, Rump Fat (negative) and 600 Day Weight EBVs and had the highest Mature Cow Weight and Retail Beef Yield EBVs.

Two principal components (PC1 and PC2) accounted for >98% of the variance in genetic differences between herds as measured by BREEDPLAN EBVs. PC1 accounted for 66% of the variance and PC2 accounted for 32% of variance in genetic differences between the herds. PC1 was primarily associated with carcass composition and had strong positive correlations with EBVs for Rib Fat (0.87), Rump Fat (0.84) and strong negative correlations for Birth Weight (-0.84) and Mature Cow Weight (-0.76) and Retail Beef Yield (-0.73). Herds with positive values for this principal component are expected to have higher Rib Fat and Rump Fat EBVs and low herd average EBVs for Birth Weight, Mature Cow Weight and Retail Beef Yield. When compared against relative genetic merit, herds with above average genetic merit for Rib Fat and Rump Fat had positive weightings on the principal component. In contrast, herds with negative EBVs for Rib Fat and Rump Fat recorded negative weightings for PC1. PC2 was primarily related to size and had very strong positive correlations with EBVs for 200, 400 and 600 Day Weight (range 0.93 to 0.95), and strong positive correlations with Carcass Weight (0.87) and Mature Cow Weight (0.70). Herds with the greater positive values for the second principal component had genetically larger cattle across all weight traits compared with Angus breed average. The herd with the lowest value for the second principal component had the lowest average herd EBV for all weight and growth traits out of the 10 herds studied.

Herds could be divergent for PC1 (predominantly carcass composition) yet record similar values for PC2 (predominantly growth and mature weight) (Figure 2). This is important as it indicates differences in average herd genetic merit for fatness was not always associated with average herd genetic merit for growth and size. This observation supports results of Lee et al. (2012) where, for example, breeders could have contrasting views on growth and mature weight traits but both be attempting to increase Rib Fat EBV. The principal component analysis gave additional insight to that of the cluster analysis in that it demonstrated that herds 9 and 10 differed markedly on PC1 (carcass composition) indicating the genetic differences of the two herds identified as significantly different in the cluster analysis were primarily associated with carcass composition.

Implications of selection direction and genetic merit. Overall differences in genetic merit between herds appeared small. However, closer assessment of the data revealed important differences. Results of the principal component analysis allowed variation in genetic merit between herds for carcass composition and weight traits to be identified. This variation is consistent with outcomes from the qualitative research that breeders could place high importance on genetic merit for positive subcutaneous fat EBVs but had varying attitudes towards weight EBVs despite breeding for the same target market (Lee 2012).

Differences in herd genetic merit appear to be primarily associated with perceptions on associations between genetic fatness and the ability to withstand environmental variation in management systems. An alternative to the controlled input is an adaptation management approach (ten Napel et al. 2006), which is similar to the variable input approach described by some breeders in this project. In variable management production systems there is expected to be greater environmental variation leading to greater differences between an animal’s energy requirements and available energy than in a controlled system. However, due to higher genetic fatness
individual animal production performance is expected to be less sensitive to this environmental variation. ten Napel et al. (2006) stated that producers’ aims in this system are for stable production such that productivity potential is traded for stability. In the case of some breeders in this project increased genetic merit for production traits, either retail beef yield or weight traits is traded for higher genetic fatness.

In management situations allowing high reproductive rate and thus lower variance in reproductive rate, the importance of both genetic and phenotypic fatness has been shown to change, such that the effect of Rib Fat EBV or pre-calving rib fat depth of the cow on reproductive rate and production efficiency may be not significant (Lee 2012). This has implications for selection and management of breeding cows in variable production systems and provides some justification for the varying perspectives and selection direction for Rib and Rump EBV amongst breeders depending on their on-farm management approach.

**Conclusion**

When considered together there were small differences in genetic merit across the 17 BREEDPLAN traits between herds. However, significant differences in merit for groups of EBVs, for example subcutaneous fat and weight was apparent. Interestingly, the differences amongst herds in genetic merit could be nearly fully accounted for by two principal components, the first relating primarily to carcass traits and the second growth and weight traits. This demonstrates important differences in genetic merit between herds targeting similar end markets. Key differences between herds appear associated with contrasting on-farm management approach and thus attitude towards selection emphasis for production traits compared with resilience traits.

**Literature Cited**