Differences in hair coat shedding, and effects on calf weaning weight and BCS among Angus dams

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\section*{Abstract}

The objective of the study was to assess variation in hair coat shedding of Angus cows, and its effect on adjusted weaning weight (d205wt) and BCS. Data were available from 532 Angus cows over 3 years of age. Beginning in March and for 5 months at 30-d intervals, trained technicians scored cows on a scale from 1 to 5, with 1 representing slick coats and 5 winter coats. For each cow, the first month with a score of 3 or less (MFS, 5 levels) was considered the beginning of winter coat shedding and used in the analyses. Association between MFS and d205WT or BCS, was investigated using the mixed procedure of SAS. Data were further analyzed by dividing cows into two groups, group one (Group 1) were cows with a shedding score of 3 or less by June 1st and group two (Group 2) consisted of cows with a shedding score of 4 or 5 on June 1st (AS, 2 levels). Calves from Group 1 dams were 11.1 \pm 2.8 kg heavier at weaning (P<0.01) than calves from Group 2 dams. No significant differences were found between shedding score and BCS. Variance components were estimated using THRGIBBS1P90 and heritability of AS was calculated (h\textsuperscript{2}=0.35) with a moderate genetic correlation with d205WT (r\textsubscript{gs} = -0.58). Hair coat shedding is a heritable trait and could be altered by selection. Producers within the Southeastern or Southern United States who are concerned about heat stress may want to select for cattle that shed their winter hair coat earlier in the season. In conclusion, cows who shed their winter coat by June 1st will weigh heavier calves on average.

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\section*{1. Introduction}

The principal method for heat dissipation in cattle is evaporative cooling. A bovine animal’s success in cooling itself is directly influenced by many factors including humidity, wind speed, and physiological factors like respiration rate and activity of sweat glands (Blackshaw and Blackshaw, 1994). As the ambient temperature and humidity exceed the animal’s thermal neutral zone, effectiveness of evaporative cooling through sweating and respiration decreases. When humidity is high, water from sweat or even sweat vapor gets trapped in spaces between the hair follicles causing the animal to expend more energy in thermoregulation by increasing its respiration rate and increasing the amount it sweats (Finch, 1985). Cattle with dark, thick, wooly coats are at a disadvantage in hot, humid climates and are at an increased risk of heat stress and dehydration. In the southeastern region of the United States, where the climate is sub-tropical, cattle that fail to shed in a timely manner tend to show more signs of heat stress when compared to their slick-coated contemporaries. Signs of heat stress include decreased mobility, decreased appetite, and poorer general health.

The objective of this study was to (1) adapt a method to assess hair coat shedding within purebred Angus cattle, (2) estimate variation in hair coat shedding among Angus cows and (3) estimate the relationship between hair coat shedding and both adjusted 205 d weight (d205wt) and cow’s body condition score (BCS).
2. Materials and methods

2.1. Animals

Registered Angus cows (n = 532) were used over a 3-year period in four different locations for this study. The first location was in Reidsville, NC, where the North Carolina State University historic Angus herd is maintained at the Upper Piedmont Research Station (UPRS) on wild-type endophyte-infected tall fescue pastures. Approximately half of the animals were observed at this location. The remaining cows were distributed over three other locations in Mississippi including Mississippi State (Starkville), Winona, and Okolona, MS. The cows grazed pastures consisting primarily of mixed warm-season grasses, annual ryegrass, and non-toxic endophyte-infected tall fescue. All cows were between 3 and 13 years of age. Cows calved in late autumn at the location in North Carolina and early autumn or late winter/early spring at the various Mississippi locations.

2.2. Data

In 2007, 2008, and 2009, beginning during the last week of March and continuing for 5 months at approximately 30-d intervals, two trained technicians scored cows using an adapted scoring system first introduced by Turner and Schleger (1960). The system used in this study differed such that it was on a scale from 1 to 5 similar to scores used by Williams et al. (2006). A score of 1 represented a slick, summer coat, and 5 represented a thick, winter coat. A score of 3 was halfway shed, while a score of 4 was a cow that started shedding but was not quite half way to a summer coat. A score of 2 was more than halfway shed but not shed completely (Table 1).

Cows were then grouped into 5 categories based on the month the cow had a shedding score of 3 or less (Fig. 1). Cows that never received a score of 3 or less (n = 13) during the 5 months of observation were few in number and were grouped with cows that shed in July. These categories will be referred to as month of first shedding (MFS).

Calves of cows were weaned at approximately 6 months of age. Cows that were sold or did not wean a calf were not included in the analysis (n = 57). Weaning weights were recorded and submitted to the American Angus Association. An adjusted 205-d weaning weight (d205wt) was then calculated by the American Angus Association adjusting for age of dam, and age of calf to 205 d. In this study, d205wt of the calf was considered to be a trait of the cow for both phenotypic and genotypic analysis.

2.3. Phenotypic analysis

The first model tested the association between MFS and d205wt or BCS using the mixed procedure of SAS. Models for d205wt and BCS included fixed effects of year (3 levels), location (4 levels), sex of the calf (2 levels) and MFS (5 levels) with a random effect of sire of calf (n = 86). Sire of calf was included in the model to adjust for genetic variation due to mate. Age of calf and age of cow (2 levels; heifer or cow) were added as a covariate and fixed effect, respectively, for BCS. They were not added to the d205wt model, because the trait already accounted for these factors.

Data were further analyzed by dividing cows into two groups. Cows were considered adapted to the subtropical climate when they had an MFS of March, April, or May, whereas the remaining animals were considered unadapted and undesirable. These two categories are referred to as the adapted score (AS).

The second model was similar to the first model except MFS was replaced with AS. All other effects included in the model were as before.

2.4. Genetic analysis

Variance components were estimated for d205wt and AS. Fixed effects included in the model were year (3 levels), sex of calf (2 levels) and location (4 levels). Random effects of cow and a permanent environmental effect were also included. Variance components were estimated using THRGB1F90 program (Miszal et al., 2002). A single chain consisting of 100,000 iterations was employed, with a burn-in period of 20,000 iterations. Convergence was assessed visually from the trace plot. Inferences on variables were obtained as mean of the respective posterior distributions.

3. Results

Two technicians collected all shedding scores within each location. Each technician's scores were analyzed separately. It was found that technicians scores had a strong correlation (r = 0.85), and only one technician score was used within each location for the remainder of the results.

All effects in the first model were significant (P < 0.01) for d205wt. For BCS, MFS was not significant; therefore, BCS was not considered in the rest of the analysis. Least square means of d205wt were calculated for MFS (Table 2). Cows that shed earlier in the year did not differ in their BCS but had calves that were heavier at weaning.

Differences in LS means were calculated as well. Adjusted weaning weight of calves out of cows that had MFS in March, April, and May tended to not differ from one another (P > 0.01). Calves' d205wt out of cows that had MFS in March, April, and May had an LS mean of 268 ± 2.3 kg and tended to differ from calves' d205wt out of cows that had MFS in June and July with LS mean 257 ± 3.0 kg (P < 0.10).

The second model takes advantage of this natural grouping found in the data using AS as the effect of interest. All remaining effects were similar to the first model, and all were significant (P < 0.01). Calves from cows that began to shed by the end of May had d205wt at 11.1 kg heavier than...
their contemporaries that were out of cows that began to shed after May.

Variance components were estimated for two traits and heritabilities and genetic correlations were calculated. Heritabilities of d205wt ($h^2 = 0.27$, 95% CI 0.212–0.410) and AS ($h^2 = 0.35$, 95% CI 0.261–0.587) were moderate, and the genetic correlation was moderately strong, negative, and favorable ($r_{d205}^2 = -0.58$) with a repeatability of 0.65. On average, cows which shed their hair coats by the end of May wean heavier calves than cows who take (Blackshaw and Blackshaw, 1994) longer to shed their hair coats.

4. Discussion

Scoring cattle on a scale of 1 to 5 starting in March provided phenotypic data which adequately described the variation that exists among hair coat shedding in Angus cattle located in the Southeastern region of the United States. It would be difficult to score cattle every month over a 5-month period within a normal production setting. To decrease the amount of labor and time needed to score cattle two groups were developed by grouping the shedding scores into the AS groups. The first model showed that an extended time of shedding in cows resulted in lighter calves at weaning (Table 2).

Heritability estimates for AS were similar to other methods of scoring hair coat shedding in other breeds of cattle (Schleger and Turner, 1960; Turner and Schleger, 1960; Williams et al., 2006). Genetic correlation between shedding scores and weaning weights were similar to those found in Turner and Schleger (1960) when a more complex 7 point subjective scoring system was used on different breeds of cattle.

Labor costs and time would prohibit monthly shedding scores to take place in most production settings; however, it has been shown that one score taken at a strategic time is sufficient for capturing the variation that occurs in hair coat shedding. In this sample, it was shown that by June 1st animals should be scored. This time may vary depending on the location, humidity, and overall environment of the herd in question.

Weaning weight is an economically important trait. This study shows that there is a moderate to high genetic correlation between weaning weight and hair coat shedding. It would seem reasonable that past selection for increased weaning weight would have improved hair coat shedding as a correlated response to selection. Although this does seem plausible, most drive for selection within the Angus breed occurs in cooler, less humid environments. There may be a genotype by environment interaction that is not evident in the more temperate regions where most of the selection occurs. This study provides evidence that there is a genetic component within select cattle to perform better in hot, humid, and otherwise less than ideal environments.

It is possible that early hair coat shedding does not necessarily cause heavier d205wt, but the genetic correlation provides evidence that there is an association between the traits. Hair coat shedding has a greater heritability than weaning weight; therefore, by including AS in an index, producers could potentially increase their response to selection of d205wt in sub-tropical climates.

A possible explanation for the relationship between hair coat shedding and weaning weight of calves could be differences in prolactin concentrations. Although prolactin has been shown to not increase milk yield directly in cattle one of its functions is associated with mammary development (Knight, 2000). Prolactin also influences hair regression regulation (Nixon et al., 2002). Therefore, hair coat shedding rate could be an indicator of the amount of prolactin available.

Table 2
LS means of adjusted weaning weights associated with the month the dam begins shedding.

<table>
<thead>
<tr>
<th>Month</th>
<th>d205wt (kg)$^1$</th>
<th>Standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td>March</td>
<td>272$^a$</td>
<td>3.0</td>
</tr>
<tr>
<td>April</td>
<td>270$^{ab}$</td>
<td>2.8</td>
</tr>
<tr>
<td>May</td>
<td>263$^{bc}$</td>
<td>3.5</td>
</tr>
<tr>
<td>June</td>
<td>258$^{cd}$</td>
<td>3.4</td>
</tr>
<tr>
<td>July</td>
<td>246$^d$</td>
<td>4.3</td>
</tr>
</tbody>
</table>

$^1$Months lacking a common superscript differ (P<0.05).
When cows are not shedding, it indicates that prolactin levels are low. Low prolactin levels may also affect milk production indirectly, which would directly affect d205wt.

Hair coat shedding has also been shown to be affected by diet. Toxic wild-type endophyte-infected tall fescue affects prolactin concentrations (Bernard et al., 1993) and hair coat shedding (McClanahan et al., 2008). Based on the results of this study, it was concluded that even while all animals in NC were on wild-type endophyte-infected tall fescue there still was variation within that herd. This provides evidence that some families are more adapted to this type of environment, and they are more productive even when fed a wild-type endophyte-infected tall fescue diet.

Temperature may also play an important role when cows begin to shed their winter coat (Blackshaw and Blackshaw, 1994). Further analysis needs to be performed to determine how much temperature affects rate of hair coat shedding within these herds.

Continued research will help to further our understanding of how shedding and productive traits like calf weaning weight are associated. This research does provide evidence that cows that shed late in the season wean lighter calves. Hair coat shedding is a heritable trait and could be altered by selection.

5. Implications

Producers seeking to reduce heat stress in their herds related to hair coat shedding should score their cows on a 1 to 5 scale in late May. Cows with hair coat shedding scores of 4 or 5, indicating little to no shedding, should be considered for culling. Increased weaning weights may be achieved within the Southeastern or Southern United States by selecting for hair coat shedding where producers have observed late hair coat shedding within their herd.

References


