Hair Coat Shedding in Angus Cows

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Introduction

The principal method for heat dissipation in cattle is evaporation 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 an extreme 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, it has been observed that cows that fail to shed in a timely manner tend to show more signs of heat stress when compared to slick-coated contemporaries. Signs of heat stress include decreased mobility, decreased appetite, and poorer general health. A common perception among producers in this region is that cows which shed late in the season are inferior dams with poor performing calves. The objective of this study was to (1) adapt a reasonable method to assess hair coat shedding within purebred Angus cattle, (2) determine how much hair coat shedding variation exists among Angus cows, (3) estimate its effects on adjusted 205 d weight (d205wt) and cow's body condition score (BCS).

Materials and Methods

Animals: Registered Angus cows (n = 532) were used over a 3-yr 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 in this location. The remaining cows were distributed over three other locations in Mississippi including Mississippi State, 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 2 and13 yrs of age with a calving season in NC in late autumn and calving seasons in MS was in the early autumn or late winter/early spring. A summary description of the data is shown in Table 1.

Data: In 2007, 2008, and 2009, beginning the last week in March for 5 mo at approximately 30-d intervals, two trained technicians scored cows on a scale from 1 to 5 (Table 2). 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 slick yet.

Table 1. Description of Data	
Registered Angus Cows	n = 532 (693 obs) , some repeated measures, only cows with calves were included in phenotypic analysis
Age of Cows	2 – 13 yr
Diet	UPRS – Wild-type endophyte-infected tall fescue, MS – warm-season mixed grasses, annual ryegrass, non-toxic endophyte-infected tall fescue
Location	UPRS, MS (3 locations)
Collection of Data	once per month for 5 mo beginning the last week in March over a 3-yr period
Scores	1 (slick) – 5 (full winter coat) scale
Calving Season	UPRS – Late Autumn (Nov – Dec); MS – Early Autumn (Sep – Nov), Late Winter/Early Spring (Jan – Mar)

Table 2. Description of hair coat shedding Scores

Hair Shedding Score	Definition
5	Full winter coat
4	Coat exhibits initial shedding
3	Coat is halfway shed
2	Coat is mostly shed
1	Slick, short summer coat

Cows were then grouped into 5 categories based on the month the cow began to shed her winter coat. A cow was considered to have begun shedding its winter coat when she received a score of 3 or less. Cows that never received a score of 3 or less (n = 13) during the 5 months of observation were small in number and were grouped with cows that shed in July. These categories will be referred to as month of first shedding (MFS).

All cows within the analysis weaned a calf at approximately 6 mo of age. Weaning weights were recorded and submitted to the American Angus Association. An adjusted weaning weight (d205wt) was then calculated by the association adjusting for age of dam, and age of calf to 205 d. In this study, d205wt was considered to be a trait of the cow for both phenotypic and genotypic analysis.

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 yr (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 any genetic advantage from certain sires. 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 sub-tropical climate when they had an MFS of March, April, or May, while 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.

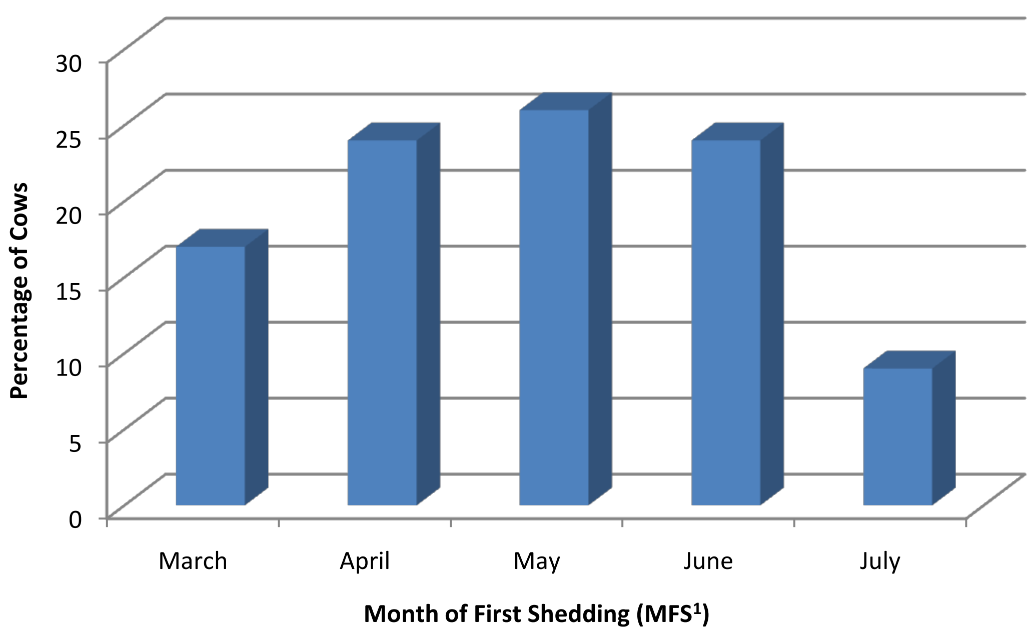
Genetic Analysis: Variance components were estimated for d205wt and AS. Fixed effects included in the model were yr (3 levels), sex of calf (2 levels) and location (4 levels). Random effects of cow and a permanent environmental effect were also included. Variance components were estimated using THRGIBBS2F90 program (Misztal et al., 2002). A single chain consisting of 100,000 iterations was employed, with a burn-in period of 25,000 iterations. Convergence was assessed visually from the trace plot. Inferences on variables were obtained as mean of the respective posterior distributions.

Results

Two technicians collected all shedding scores within each location. Each technician's scores were analyzed separately. It was found that technicians were in agreement in their scoring of the cows (data not shown), and only one technician score was used within each location.

Table 3. LS means of adjusted weaning weights associated with the month the dam begins shedding (MFS)

MFS	d205wt (lbs)	Standard Error
March	597	6.4
April	589	8.8
May	587	7.1
June	578	7.3
July	551	8.8



[1] First month in which a cow received a score of 3 or less using the following scoring system: 5 – Full winter coat, 4 – Coat exhibits initial shedding, 3 – Coat is halfway shed, 2 – Coat is mostly shed, 1 – Slick short summer coat

All effects in the first model were significant (P < 0.01) for d205 wt. 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 3). 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 for MFS (Figure above) were calculated as well (Table 3). Adjusted weaning weight of calves out of cows that had MFS in March, April, and May did not differ from one another. Calves' d205wt out of cows that had MFS in March, April, and May did differ from calves' d205wt out of cows that had MFS in June and July (P < 0.05).

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). Least Square means were calculated, and their differences appear in Tables 5 and 6, respectively. Calves from cows that began to shed by the end of May had d205wt at 24 lbs heavier than their contemporaries that were out of cows that began to shed after May.

Table 4. LS means differences of adjusted weaning weights of dams that began shedding in different months

Contrast	Difference	Standard Error	Pr > |t|
March – April	7.9	6.85	0.25
March – May	10.2	7.85	0.19
March – June	19.2	8.52	0.02
March – July	45.9	10.11	0.01
April – May	2.3	7.37	0.75
April – June	11.3	7.91	0.15
April – July	38.0	9.50	0.01
May – June	9.0	6.95	0.20
May – July	38.0	9.50	0.01
June - July	26.7	7.93	0.01

Table 5. LS means of adjusted weaning weights associated with cows that shed by the end of May or after May (AS).

AS	d205wt (lbs)	Standard Error
Shed by May	589	5.6
Shed after May	565	6.8

Table 6. Differences in LS Means of adjusted 205 d weaning weights of dams that began shedding by May vs. after May

Contrast	Difference	Standard Error	Pr > |t|
Shed by May – Shed after May	24.1	6.16	.01

Variance components were estimated for two traits and heritabilities and genetic correlations were calculated (Table 7). Heritabilities of d205wt ($h^2 = 0.27$) and AS ($h^2 = 0.35$) were low to moderately heritable, and the genetic correlation was moderately strong, negative, and favorable (r_g = -0.50). On average, cows which shed their hair coats by the end of May wean heavier calves than cows who take longer to shed their hair coats.

Table 7. Heritabilities on diagonal and genetic correlation below diagonal

	d205wt	AS
d205wt	0.27	
AS	-0.50	0.35

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. Some variation did occur among technicians when scores were 3 or less and between 4 and 5. To decrease the amount of variation that occurred among technicians, scores were grouped into two categories as explained above. Because this scoring system was used over multiple locations and technicians, grouping the shedding scores into these categories led to consistent measurement.

The first model showed that an extended time to shedding in cows resulted in lighter calves at weaning. Although this trend did hold over all 5 months, there was no significant difference between the first three months. For this reason animals were grouped using AS, which in reality is a more realistic approach for implementation. 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 the end of May animals should be scored to predict calf weaning performance. This time may vary depending on the location, humidity, and overall environment of the herd in question.

Weaning weight is an economically important trait. Angus producers have increased the weaning weights of their calves over the past 40 yr. This study shows that there is a high genetic correlation between weaning weight and hair coat shedding. It would seem reasonable that by default animals will continue to improve in hair coat shedding through correlated 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 certain sires will produce better calves in hot, humid, and otherwise less than ideal environments, but definite conclusions cannot be made until more data are collected in cooler environments with some of the same sire families represented.

It is possible that early hair coat shedding does not necessarily cause heavier d205wt. However, there is evidence that even if early hair coat shedding is not the cause, it is a good indicator of heavier weaning weights. 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. Prolactin has many functions within the cow. One of its functions is associated with lactation (Knight, 2000). Prolactin also influences hair regression regulation (Nixon et al., 2002). Therefore, it could be concluded that hair coat shedding rate could be an indicator of the amount of prolactin available. When cows are not shedding, it indicates that prolactin levels are low. Low prolactin levels may also affect the amount of milk available for the calf, 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 results of this study, it was concluded that even while all animals are on wild-type endophyte-infected tall fescue there still was variation within the herd. This provides evidence that some sire 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 in when cows begin to shed their winter coat. Further analysis will need to be performed to determine how much temperature affects rate of hair coat shedding within these herds.

Continued research will help to completely understand 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. Producers within the Southeastern or Southern United States that have observed late hair coat shedding within their herds can select for hair coat shedding earlier in the season. This should result in higher weaning weights, making the cow herd more productive.

Recommendation

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 or no shedding, should be considered for culling.

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