Effect of beef cow temperament at mid-gestation on reproductive performance

Ramanathan Kasimanickam
Department of Veterinary Clinical Sciences, College of Veterinary Medicine, Washington State University, Pullman, WA

Abstract

Temperament is defined by reaction characteristics in response to human handling. An excitable temperament has proven to have detrimental effects on production and reproduction traits. The objective of this study was to evaluate the effect of temperament at mid-gestation on reproductive performance of beef cows. Angus and Angus cross beef cows (n=1325) from seven locations were included in this study. Cows were grouped with bulls with satisfactory breeding potential and free of venereal disease at bull to cow ratios of 1:25 to 1:30. All cows were given a body condition score (BCS; 1-emaciated; 9-obese) and chute-exit and gait score (1 = slow exit, walk; calm temperament; 2 = jump, trot or run; excitable temperament) at pregnancy diagnosis six months after the beginning of the breeding season. Pregnancy status and stage of gestation were determined by per-rectal palpation and/or by ultrasonography. Cows that were excited had a lower breeding season pregnancy rate compared to calm cows (88.6% [599/694] vs. 92.7% [585/631]; $P<0.0001$). Cows with excitable temperament took 15 more days to become pregnant in the 85 day breeding season compared to calm cows (median days to pregnancy: 30 (20, 60) vs. 15 (10, 40) days; $P<0.0001$). In conclusion, the modified 2-point chute exit-gait scoring method can be used to identify cattle with calm temperaments at mid-gestation. Even though assessing temperament before breeding season makes sense, the producers still can make culling decisions at mid-gestation. Cows with calm temperaments in a beef operation will have a higher pregnancy rate and take less time to become pregnant during the breeding season. Reducing the proportion of excited cows could improve reproductive performance of the beef operation.

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Keywords: Beef cows; temperament; facility type; breeding season; pregnancy rate; days to pregnancy;

Introduction

Profitability of a beef operation is determined by the amount of calf crop produced in a year. Pregnancy achieved early in the breeding season and overall breeding season pregnancy rates are two determining reproductive parameters for the annual calf crop.[1,2] Many factors, including temperament of cattle, affect annual calf crop production. Temperament is defined by reaction characteristics of cattle when exposed to human handling.[3] Cattle with less than optimal temperaments are more excitable while those with better temperaments are calmer and more docile.[3-8]

Calm cattle are less stressed than excitable cattle, demonstrated by lower circulating blood cortisol, prolactin, and substance-P concentrations.[9,10] Cattle temperament has been studied extensively for its effect on production parameters such as decreased average daily gain,[5,6,11] dry matter intake,[12,13] feed efficiency,[14] and growth.[5,6,10] Further, excitable cattle tend to produce poor quality carcasses due to decreased marbling,[15] decreased meat tenderness,[16,17] and increased percentage of dark cutters.[15] Reproductive parameters previously studied include temperament's effect on fixed time artificial insemination success and pregnancy rates.[8,10,17-20]

Temperament scoring techniques used to identify calm or excitable cattle vary from computerized analysis to individual observation.[3,4,21,22] These methods are subjective and/or objective. Chute exit velocity and gait methods with 5 or 6 point scales have been studied.[19,21,22] Most studies that utilize the 5 point temperament scoring system categorized scores 1 and 2 as calm cattle and scores 3 to 5 as excited cattle for the analysis.[19,22] Hence, a modified two point scoring method[10,20] utilized in this study.

The ideal time to assess cattle temperament is before breeding. This will facilitate decision making on whether or not to include excited cows in the breeding program and for culling. Temperament scoring by chute exit and gait method requires individual cow handling. In western states of the USA, 36.6% operations utilize pregnancy diagnosis by palpation.[23] In a majority of these operations cattle are handled individually at the time of pregnancy diagnosis. Even though timely pregnancy diagnosis is

critical to cull open cows early in order to reduce feed cost, often pregnancy diagnosis was performed during mid-gestation, approximately 6 months after the beginning of the breeding season on these farms.

The objective of the study was to evaluate the effect of cattle temperament assessed at mid-gestation at pregnancy diagnosis on the reproductive performance in beef cows. The hypothesis was that beef cows with excitable temperaments at handling will have lower breeding season pregnancy rates and will become pregnant later in the breeding season.

Materials and methods

Angus and Angus cross beef cows (n=1325) from 2013 spring breeding at seven locations in Washington were included in this study. Angus bulls were grouped with cows (1:25 to 1:30 bull to cow ratio) for 85 days. Only bulls with satisfactory breeding potential and free of *Tritrichomonas fetus* were included. All cows were given a body condition score (BCS; 1-emaciated; 9-obese) and chute exit-gait score (1 = slow exit, walk; calm temperament; 2 = jump, trot or run; excitable temperament) at pregnancy diagnosis six months after the onset of the breeding season. Cows were maintained in the pasture, vaccinated against routine respiratory and reproductive diseases, and received ad libitum commercial mineral supplements. Cows' pregnancy status and stage of gestation were determined by per-rectal palpation and/or by ultrasonography (Aloka-500, Sysmed Lab Inc., Chicago, IL). The gestation length was determined by sizes of the placentomes and fetus.

Outcomes measured to assess reproductive performance were breeding season pregnancy rates (%) and interval from beginning of breeding season to pregnancy. Data were analyzed with a statistical software program (SAS, Version 9.4 for Windows, SAS Institute, Cary, NC. Mixed model (PROC GLIMMIX) was used to determine differences in breeding season pregnancy rates amongst temperament score groups. For the determination of pregnancy rates, temperament (calm vs. excitable), BCS (<5 and ≥ 5) and two-way interactions were included in the model. Locations, animal handlers (n=28) and natural service sires (n=51) were considered as random variables. Models were built by manual reverse stepwise elimination. The *P* value was set at <0.05 for inclusion and >0.10 for exclusion.

Kaplan-Meier survival estimates (PROC LIFETEST) were used to determine the differences in the crude median days to become pregnant during breeding season between calm and excitable groups. Graphs of cumulative pregnancy risk over time were generated. In Kaplan-Meier analysis, cows may either experience the "event of interest" (i.e. pregnancy) or 'censored' (i.e. non-pregnancy at the end of breeding season). This approach allows cows that are censored to contribute to the days at risk for pregnancy as long as they are in the 85-day study breeding season, without making assumptions about what would have occurred had they remained for a longer period of time. In this study, cows that were identified as non-pregnant at the time of the pregnancy examination were censored on the last day of the 85-day breeding period. The log-rank test was used to compare the overall equality of temperament score survivor functions, and follow-up pair-wise comparisons were conducted using a Bonferroni-corrected log-rank test to limit the experiment-wise Type-I error rate to 5%. Restricted mean survival times were obtained as the area under Kaplan-Meier survivor curves.

Univariate analysis, PROC GNEMOD, was used to determine the proportion of excited cows in different locations. *P*-values of <0.05 were considered statistically significant.

Results

Of the study population (n=1325), 52.3% (694) of cows were identified as excited and 47.4% (631) as calm. The percentage of excited cows in a location varied from 13.6%% to 70.3% ($P<0.01$). The mean BCS of the cows was not significantly different between calm and excited group (5.98±0.11 vs. 6.04±0.09).

Accounting for BCS categories ($P<0.0001$), breeding season pregnancy rate was different between calm and excited cows ($P<0.0001$; Table). The pregnancy rate was 92.7 (585/631) vs. 86.3% (599/694) for calm and excited cows, respectively. Cows with BCS ≤5 had lower breeding season pregnancy rates compared to cows >5 BCS, 74.5 (187/251) and 91.9% (987/1074) respectively

(P<0.0001). No significance in BCS by temperament score interaction on the breeding season pregnancy rate was observed (P>0.1).

Calm cows became pregnant earlier in the breeding season compared to excited cows (log rank test; chi-square -55.7; P<0.0001; Figure). The percentage of cows that remained non-pregnant at the end of the breeding season and median days to pregnancy (25th and 75th percentile) is given in the table presented below the Figure.

Discussion

This study observed that beef cows with calm temperament had a significantly higher probability of becoming pregnant early in the breeding season. In this study the temperament was assessed at mid-gestation.

In a normal physiological status, it is reasonable to expect that tw0-thirds of non-pregnant cows should become pregnant in each 21 day estrous cycle. If each cow gets three chances to become pregnant during the breeding season, then 97% cows should become pregnant at the end of the breeding season. In this study, 86% cows with excitable temperament compared to 93% of calm cows became pregnant at the end of the breeding season. Furthermore, excitable cows took longer time to become pregnant in this study.

Increased stress biomarkers, including elevated substance-P, prolactin and cortisol concentrations, in excited cattle suppress gonadotropin releasing hormone and luteinizing hormone.[10,21,22,24,26] Further, β-endorphin is involved in regulating luteinizing hormone secretion in postpartum beef cows.[23] These hormonal disturbances plausibly cause delay in resumption of ovarian cyclicity in excited cows after calving.[24-26] In addition, it is also possible that excitability affects follicular dynamics resulting in hindrance in estrus expression. Further, reduced ovarian steroidogenesis and increased prostaglandin$_{2\alpha}$ in excited cattle may have caused early embryonic death in this group.[10] It should be noted that lactation stress could also cause similar untoward physiological changes. However, the nutritional requirement (maintenance + lactation) should be adequate to prevent the lactation stress in most beef cows if not under environmental stress.[27]

Temperament was negatively associated with BCS and nutritional status in growing cattle.[5,6] In this study no BCS by temperament interaction effect on breeding season pregnancy rate was observed. Voisinet et al observed that cattle that became agitated during handling had 14% lower body weight gain compared to calmer cattle.[16] The reasons for reduced productivity in excitable cattle are: increased blood cortisol concentrations and other stress markers stimulate muscle and fat metabolism at a greater rate than calm cattle; and excitable cattle have more frequent meals, but overall decreased intake.[5] The excitable cattle had decreased time spent eating, and increased activity looking for "threats" rather than consuming, resulting in body condition loss.[5,6] Further, it is possible that excited cows also affect the temperament of other calm cows.

In this study the temperament was assessed at mid-gestation concurrent with pregnancy diagnosis. It should be noted that temperament scoring at two to four weeks prior to the beginning of the breeding season also associated with the reproductive performance of beef cattle.[10,20] Culling non-pregnant cows alone will remove an excitable cow 11.4% of the time. However, it would be prudent to exclude excited cows from the breeding program due to their lower reproductive performance. Moreover excitable cattle are dangerous to cattle handlers and to other animals and could also cause damage to the facility. Causes of cattle temperament include genetics, inappropriate cattle handling and poor facility design. Culling excited and non-pregnant cows and utilizing bulls with high docility expected progeny difference score offers options to reduce the number of excitable cows on a beef farm. Further acclimation of beef cattle to handling and proper facility design could reduce the excitability.[10,19,20,22]

The median days to become pregnant between calm and excited cows in the present study were shorter compared to previous study,[19] 15 and 30 vs 35 and 59 respectively. The observed differences in median days to become pregnant in these studies may plausibly be caused by other management factors. Nevertheless, the observed differences in median days to become pregnant between calm and excited cows were significant in these two studies.

Conclusion

The modified 2-point chute exit-gait scoring method can be used to identify cattle with calm temperaments at mid-gestation. Even though assessing temperament before breeding season makes sense, producers still can make culling decisions at mid-gestation. Cows with calm temperaments in a beef operation will have a higher pregnancy rate and take less time to become pregnant during the breeding season. Reducing the proportion of excited cows could improve reproductive performance of the beef operation.

Acknowledgements

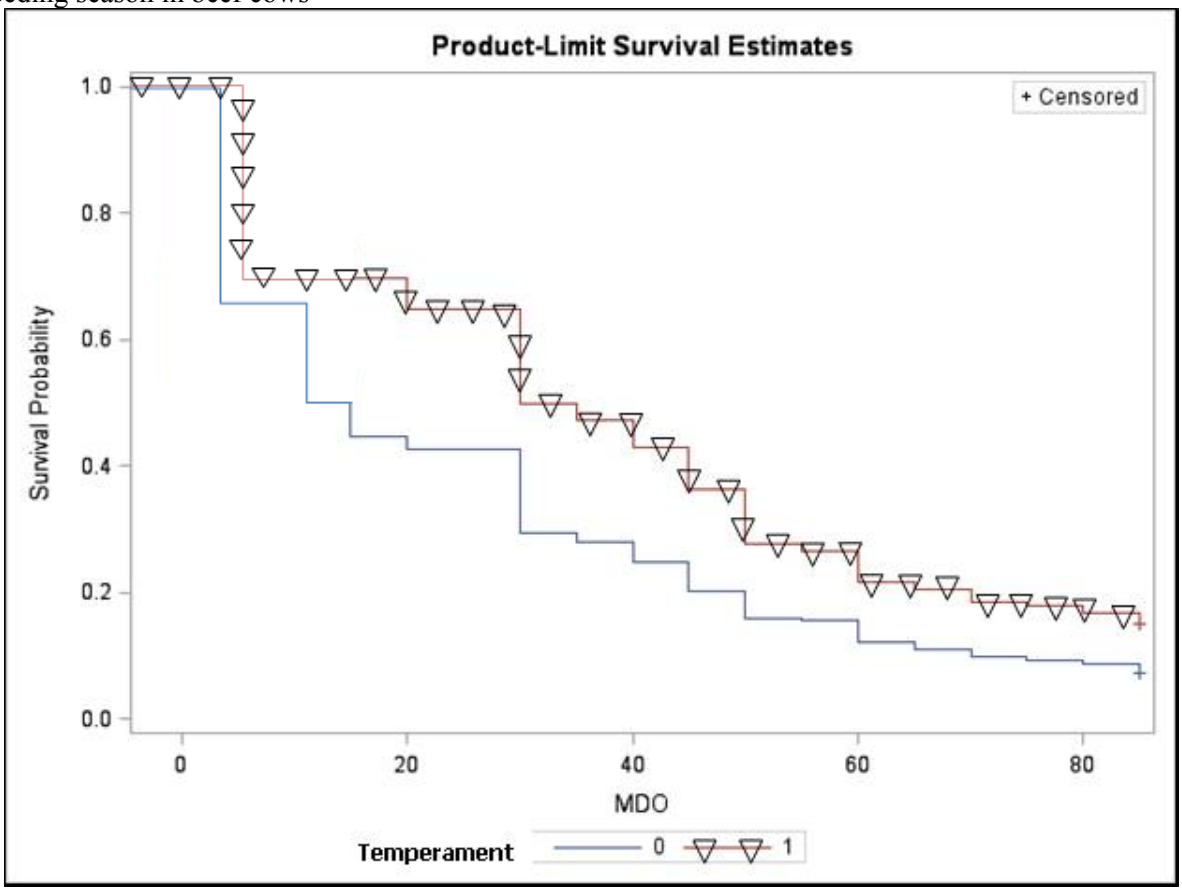
The author thanks all participating beef producers. The author also thanks veterinary students Stephanie Schroeder, Katy Hanson, Marion Fisher, Shelley Gerstner, Micall Gooderidge, Kathleen Gutierrez, and Vaughn Fish, College of Veterinary Medicine, Washington State University for their help.

Table. Explanatory variables*, temperament score, and body condition score (BCS) influencing pregnancy loss in Angus cross beef cows (n=1325)

Effect	Degrees of freedom	*F* value	*P* value
Temperament score	1	18.23	<0.001
BCS categories	2	15.80	<0.0001

Temperament score – 1, calm - slow, walking; 2, excited- jumping, trotting, or running;
BCS categories - ≤5 and >5; BCS- Body Condition Score 1-emaciated; 9-obese;
Natural service sires, locations and animal handlers were offered as random variables;
*Co-variance parameter estimates – Natural service sire 0.1977; Location 0.3898; Animal handlers 0.0946; Residual 0.1895; Fit statistics - BIC = 1442.6; -2 Res log likelihood =1388.3;

Figure. Survival curve for the effect of temperament on the probability of non-pregnancy* during the breeding season in beef cows



Temperament	% non-pregnant cows (censored)	Median days to become pregnant	Confidence limits	
			25th percentile	50th percentile
Calm (0)	7.3	15	10	40
Excited (1)	11.4	30	20	60

* Instantaneous relative risk of pregnancy on daily basis

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