Calm Temperament Improves Reproductive Performances of Beef Cows

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Abstract

Profitability of a beef operation is determined by breeding season pregnancy rates and proportion of cows attaining pregnancy early in the breeding season. Many factors including temperament contribute to these reproductive parameters. The objective of this study was to evaluate the effect of temperament on reproductive performances of beef cows. In experiment 1, Angus and Angus cross beef cows (n=1546) from 8 locations received 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). Cows were grouped with bulls (1:25 to 1:30; with satisfactory breeding potential and free of venereal disease) during the entire 85 day breeding season. Pregnancy status and gestation length of cows was determined by per-rectal palpation at 35 days after the end of the breeding season. Controlling for BCS ($P<0.01$) and handling facility ($P<0.0001$) and handling facility by temperament score interaction ($P<0.001$) the breeding season pregnancy rate was different between excited and calm cows [88.6% (798/901) vs. 94.1% (607/645); $P<0.001$]. Cows with excitable temperament took 24 more days to become pregnant in the 85 day breeding season compared to calm cows (median days to pregnancy: 35 vs. 59 days; $P<0.0001$).

In experiment 2, Angus and Angus cross beef cows (n=1407) from 8 locations received 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). All cows were grouped with bulls (1:25 to 1:30; with satisfactory breeding potential and free of venereal disease) during the entire 85 day breeding season. Pregnancy status was determined by per-rectal palpation at 2 and 6 months from the beginning of the breeding season to determine the pregnancy loss. Controlling for BCS ($P<0.05$), the pregnancy loss was different between excited and calm cows, 5.5 (36/651) vs 3.2 (20/623), respectively ($P<0.05$)

In conclusion, beef cows with excitable temperament had lower reproductive performance than calmer cows. The modified 2-point chute exit-gait scoring method is repeatable and can be used to identify cattle with excitable temperament.

Keywords: Beef cows; Temperament score; Facility type; Pregnancy rate; Days to pregnancy; Pregnancy loss;

Introduction

Overall productivity of a beef operation is determined by the percentage of annual calf crop produced in a year. Annual calf crop is defined by the total pounds of calf weaned divided by the number of cows exposed for breeding. Pregnancy achieved early in the breeding season and overall breeding season pregnancy rates are two determining reproductive parameters of the annual calf crop (Mathis and Sawyer, 2009; Rae, 2006).

Many factors, including temperament of cattle, affect annual calf crop production. Temperament is defined as the - reaction characteristics of cattle when exposed to human handling (Fordyce et al. 1988). Cattle with less than optimal temperaments are more excitable during human handling (Vetters et al. 2013). These cattle are described as nervous or having a poor disposition. Cattle with better temperaments or good dispositions are calmer and more docile during human handling (Fordyce et al. 1988; Burrows and Dillon, 1997; Voisinet et al. 1997; Cooke et al., 2009a; Café et al. 2011). Calm cattle are less stressed than excitable cattle, demonstrated by lower circulating blood cortisol concentrations (Curley et al., 2006). Cattle excitement could result from a genetic trait, a facility problem, or a cattle handling personnel problem.

Cattle temperament has been studied extensively for its role in feedlot performance, carcass quality, health, and safety. Excitable cattle in the feedlot tend to have decreased average daily gain (Voisinet et al. 1997; Café et al. 2011; Turner et al. 2011), decreased dry matter intake Fox et al. 2004; Nkrumah et al. 2007) , decreased feed efficiency (Petherick et al. 2002), and decreased growth ((Voisinet et al. 1997; Café et al. 2011; Turner et al. 2011). In addition, excitable cattle tend to produce lower quality carcasses due to decreased marbling (Hall et al. 2011), decreased meat tenderness (Voisinet et al. 1997; Behrends et al. 2009), increased percentage of dark cutters (Voisinet et al. 1997) and increased number of bruised carcasses (Burrows and Dillon, 1997). Reproductive parameters previously studied include temperament's effect on fixed time artificial insemination success and pregnancy rates in Bos indicus cattle and in Bos taurus beef heifers (Cooke et al. 2009a; Cooke et al. 2009b; Cooke et al. 2011; Kasimanickam et al. 2014).

Temperament scoring techniques can be used to identify calm or excitable cattle (Fordyce et al. 1988; Cooke RF, 2009; Vetters et al. 2013). There are multiple methods, subjective and/or objective, used to determine cattle temperament. These methods vary from computerized analysis to individual observation. Previous studies have shown that temperament scoring earlier in an animal's life increases overall accuracy of the score (Francisco et al. 2012).

Chute exit velocity and gait methods with 5 or 6 point scales have been studied to determine the effect of temperament on production and reproduction parameters. Most studies that utilize the 5 point temperament scoring systems categorized scores 1 and 2 as calm cattle, and scores 3 to 5 as excited cattle for the analysis. We simplified the 5 point scoring system to a modified two point scoring method, which was utilized in this study.

1. Cattle that exit the chute calmly- slow, walking
2. Cattle that exit the chute excited- jumping, trotting, or running

Further, the cattle handling facility should enhance free flow of animals without causing excitement. Even calm animals can become excited if they are stressed during handling. In this study we will determine how cattle handling facility types affect the cattle temperament, and temperament during handling has any value in determining reproductive performance of beef cows in a breeding season.

The objective of the study was to evaluate the effect of cattle temperament, measured by chute-exit and gait method using the modified two-point scoring system, on the reproductive performances of beef cows. The hypothesis was beef cows with excitable temperaments at handling will have lower breeding season pregnancy rates, will become pregnant later in the breeding season and will have higher pregnancy loss.

Materials and methods

Experiment 1

Angus and Angus cross beef cows (n=1546) at 8 locations from 2012 spring breeding were included in this study. All cows were given a body condition score (BCS; 1-emaciated; 9-obese) and a chute exit-gait score (1 = slow exit, walk; calm temperament; 2 = jump, trot or run; excitable temperament) at 2 to 4 weeks prior to the beginning of the breeding season. Cows were penned with Angus bulls at 1:25 to 1:30 bull to cow ratio for 85 days. Bulls (n=55) were tested to have satisfactory breeding potential and Trichomonas fetus free status. All cows were maintained on pastures and vaccinated against routine respiratory and reproductive diseases. A commercial mineral/vitamin mix was offered for ad libitum consumption throughout the breeding season. Cows' pregnancy status and fetal gestation length were determined by per-rectal palpation 35 days after the end of the breeding season. The pregnancy rate was calculated as number of cows pregnant divided by total number of cows exposed. The gestation length was determined by size of the embryonic vesicle, fetus and placentomes. Temperament scores were given by DVM students or producers once and by a clinician twice. The same clinician performed scoring in all locations. The scoring method was explained to the students and producers before the scores were given. The score given initially by clinician was used in the analysis for the determination of effect of reproductive performance. The two scores given by clinician were used to determine intra-rater agreement. The initial score given by clinician and the score given by students or producers were used to determine inter-rater agreement.

In order to determine the influence of cattle handling facilities on the temperament, there were three different types of handling facilities available - 1) Semicircular alleyway (n=2), 2) Straight, long alleyway (n=3) and 3) Wide alleyway and/or alleyway with acute turns (n=3). Animal handlers (n=24) differed between locations.

Experiment 2

Angus and Angus cross beef cows (n=1407) from 8 locations (4 locations were different from 2012 study) from 2013 spring breeding received 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), 2 to 4 weeks prior to the beginning of the breeding season. All cows were grouped with bulls (n=47; 1:25 to 1:30; with satisfactory breeding potential and free of venereal disease) during the entire 85 day breeding season. All cows were maintained on pastures and vaccinated against routine respiratory and reproductive diseases. A commercial mineral/vitamin mix was offered for ad libitum consumption throughout the breeding season. Pregnancy status was determined by per-rectal palpation at 2 and 6 months from the beginning of the breeding season to determine the pregnancy loss. The pregnancy loss rate was calculated as number of cows pregnant 2 months less number of cows observed pregnant at 6 months divided by total number of cows pregnant at 2 month.

Statistical Analysis

Experiment 1: Outcomes measured to assess reproductive performance were breeding season pregnancy rates (%) and interval from beginning of breeding season to pregnancy. Pregnancy status 35 days after the end of the breeding season was used for analysis. GLIMMIX procedure of SAS (Version 9.3, Cary NC, USA) was used to determine differences in breeding season pregnancy rates amongst temperament score groups. Variables included in the model were: temperament (calm vs. excitable), handling facility (Semicircular alleyway, Straight, long alleyway and Wide alleyway and/or alleyway with acute turns), BCS (<5 and ≥5) and two-way interactions were included in the model for the determination of pregnancy rates. Locations, natural service sires and animal handlers 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 of SAS) were used to determine the differences in the crude median days to become pregnant during breeding season between temperament score 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 cows are 'censored' when lost to follow-up, removed from the study for a reason unrelated to the event of interest, or the breeding season ends before the event of interest has occurred. This approach allows cows that are censored to contribute to the days at risk for as long as they are in the study, 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 final pregnancy examination were censored on the last day of the 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. P-values of < 0.05 were considered statistically significant.

Kappa statistics and predictive values were calculated using PROC FREQ of SAS after creating success and failures, 2 by 2 tables. For Inter rater agreement determination, student and clinician scores and intra rater agreement scores by clinician were used. Univariate analysis, PROC GNEMOD, was used to determine the proportion of excited cows in different locations.

Experiment 2: Outcomes measured to assess reproductive performance were breeding season pregnancy rates (%) at 2 and 6 months after the beginning of breeding season, and pregnancy loss rates. Pregnancy status at 2 and 6 months after the beginning of breeding season were used for analysis. GLIMMIX procedure of SAS (Version 9.3, Cary NC, USA) was used to determine differences in pregnancy loss amongst temperament score groups. Variables included in the model were: temperament (calm vs. excitable), BCS (<5 and ≥5) and two-way interactions were included in the model for the determination of pregnancy rates. Locations, natural service sires and animal handlers 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.

Results

Experiment 1

Of the study population (n=1546), a higher proportion of cows were identified as excited [excited: 58.3% (901) vs. calm: 41.7% (645)]. The proportion of excited cows varied among locations, ranging from 34.7% to 64.3% (P<0.01). The body condition score was not significantly different between calm and excited group (5.76 vs. 5.53). Handling facilities influenced the frequency of excited cows in beef operations (P<0.05). Facilities with semi-circular alleyways had a lower frequency of excited cows (12%) compared to straight, long alleyways (32%), wide alleyways and/or alleyways with acute turns (56%).

Controlling for BCS (P<0.01), handling facility (P<0.0001) and handling facility by temperament score interaction (P<0.001) the breeding season pregnancy rate was different between calm and excited cows (P<0.001; Table 1). The pregnancy rate was 94.1% vs. 88.6% for calm and excited cows respectively (Figure 1). Calm cows became pregnant earlier in the breeding season compared to excited cows [(P<0.0001; Median days to become pregnant: Calm: 35 days (31, 39) and Excited: 59 days (55, 66); Figure 2]. 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 Figure 2. Cows with BCS □5 had higher breeding season pregnancy rates compared to cows <5 BCS, 95.1% (993/1044) and 82.1% (412/502) respectively (P<0.001).

Handling facility significantly influenced breeding season pregnancy (Figure 3). Excited cows in alleyway with acute bends and turns had lower pregnancy compared to facilities with long and semicircular alleyway (P<0.05). Similarly calm cows had lower pregnancy than semicircular alleyway (P<0.05) but had similar pregnancy compared to long alleyway (P>0.05).

The inter-rater kappa (between two raters; 0.69±0.04) and intra-rater kappa (agreement between scores from same raters; 0.73±0.09) were found to be moderate to good. The predictive value for calm and pregnant was 0.84, and excited and open was 0.71.

Experiment 2

Of the study population (n=1407), a higher proportion of cows were identified as excited [excited: 53.2% (748) vs. calm: 46.8% (659)]. The proportion of excited cows varied among locations, ranging from 22.6% to 68.9% (P<0.01).

Controlling for BCS (P<0.05), the pregnancy loss was different between excited and calm cows, 5.5 (36/651) vs 3.2 (20/623), respectively (P<0.05; Table 2). The breeding season pregnancy rate at 2 months after the beginning of breeding season was different between excited and calm cows, 87.0 (651/748) vs 94.5 (623/659), respectively (P<0.0001). Similarly, the breeding season pregnancy rate at 6 months after the beginning of breeding season was different between excited and calm cows, 82.2 (615/748) vs 91.5 (603/659), respectively (P<0.0001).

Discussion

This study confirms that beef cows with calm temperament have a noticeable advantage with a higher probability of becoming pregnant early in the breeding season. Further the pregnancy loss is lower for the calm cows compared to excited cows.

In a normal physiological status, it is reasonable to expect that 2/3 of open cows should become pregnant in each 21day 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, 88.6% cows with excitable temperament compared to 94.1% of calm cows became pregnant at the end of the breeding season. Furthermore, excitable cows took longer time to become pregnant and had higher pregnancy loss in this study.

Elevated cortisol concentrations, elucidated by cow temperament, are detrimental to the reproductive function of cows (Cooke et al. 2009). Elevated blood cortisol concentrations in excited cattle inhibit gonadotropin releasing hormone and luteinizing hormone (Cooke et al. 1989; Dobson et al. 2000). This hormonal disturbance causes excitable cattle to have a delay in ovarian cyclicity after calving (Cooke et al. 1989; Dobson et al. 2000). In addition, it is possible that excitability affects follicular dynamics resulting in poor estrus expression. Even if fertilization occurs in excited cattle, reduced progesterone synthesis and increased PGF2α release may cause early embryonic death in this group. Temperament was negatively associated with BCS and nutritional status in growing cattle. Voisinet et al. (1997) observed that cattle that became agitated during handling had 14% lower body weight gain compared to calm cattle. There are two possibilities for reduced conditioning in excitable cattle. First, increased blood cortisol concentrations and other stress markers stimulate muscle and fat metabolism at a greater rate than calm cattle. Secondly, excitable cattle have more frequent meals, but overall decreased intake (Voisinet et al. 1997).

Café et al. (2011) observed that excitable cattle had decreased time spent eating, and increased activity looking for “threats” rather than consuming, resulting in body condition loss. Decreased estrus expression was observed to be lower for cows with poor body condition, possibly contributing to the observed decrease in reproductive performance in this study. So the excitement plausibly affected the follicular dynamics resulted in fertilization failure, and ovarian steroidogenesis directly via inhibiting GnRH or indirectly via depressed feed intake resulted in early embryonic death via poor maternal recognition.

The design of the facility affects handling, thereby the temperament of cattle. In this study, the frequency of excited cows differed when they were handled in different handling facility types. Further, it is conceivable that cattle temperament observed during handling expressed similar temperament during the breeding season and affected their reproductive performance.

Excited heifers had lowered A.I pregnancy compared to calm heifers (Kasimanickam et al. 2014). Cattle handling facility also influenced the proportion of heifers with excited temperament and A.I. pregnancy rates. It should be noted that there was no difference in A.I. pregnancy between temperament groups when heifers were handled in semicircular and long alleyway facility types (Kasimanickam et al. 2014). However, excitable heifers handled in facility with acute bends and turns had lower AI pregnancy compared to calm heifers (Kasimanickam et al. 2014). It is evident that facility type exerted more pronounced immediate negative effect resulted in reduced AI pregnancy in heifers.

In this study, excited cows in alleyway with acute bends and turns had lowered breeding season pregnancy compared to facilities with long and semicircular alleyway and calm cows in alleyway with acute bends and turns had lowered breeding season pregnancy than semicircular alleyway but had similar pregnancy compared to long alleyway ($P>0.05$). Cooke et al. claimed acclimation to human handling improved reproductive performance in heifers. However, acclimation was not shown to be an effective method to decrease excitability in mature cows (Cooke, 2011; Cooke et al. 2012) which explains reduced performance for excited cows during the breeding season.

The inter-rater and intra-rater agreements of modified 2-point score chute-exit and gait method were moderate to good, indicating that this method was satisfactory and a repeatable method to identify cows with excited temperaments. This scoring method observes 16% of the time a calm cow not becoming pregnant and excited cows becoming pregnant 29% of the time. It is possible that some cows scored as calm by this method could be excited in the pasture conditions. However, the predictive values are still encouraging, given several factors contributing to the success of the pregnancy. It is practical that the 2-point temperament scoring could help identify the detrimental physiologic effects of an excitable temperament. This method is practical and repeatable. However, previous studies have shown that accuracy may be reduced for novice scorers (Hearnshaw and Morris, 1984). It is very important that an experienced temperament scorer teach and evaluate novice temperament scorers.

It is arguable that the estrus synchronization protocol used in the beef heifer (Kasimanickam et al., 2014) and beef cows (Cooke et al. 2009) should circumvent the detrimental effects of excitable temperament on the physiological mechanisms associated with fertility, such as gonadotropin secretory activity, and thus impair treatment evaluation of pregnancy rates. However, increased cortisol in excited heifers plausibly failed to facilitate the initiation of physiological events needed for attainment of pubertal status in pre- and peri-pubertal heifers, and impaired synchronization success in pubertal heifers. In beef cows increased cortisol cows affected the probability of pregnancy (Cooke et al., 2009) plausibly caused by reduced synchronization success and early embryonic death.

Culling excited and open cows and utilizing bulls with high docility EPD scores offers options to reduce the number of excitable cows on a beef farm. Culling open cows alone will remove an excitable cow 13.2% of the time. However, it would be prudent to exclude excited cows from an A.I. program for economic benefits.

Conclusion

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. The modified 2-point chute exit-gait scoring method is repeatable and can be used to identify cattle with calm temperaments.

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Table 1: Explanatory variables*, body condition score, temperament score, and handling facility influencing breeding season pregnancy in Angus cross beef cows (n=1546).

Body condition score – 1, emaciated to 9, obese; Temperament score – 1, calm - slow, walking; 2, excited- jumping, trotting, or running; Natural service sires, locations and animal handlers were offered as random variables; 6;

Effect	Degrees of freedom	*F* value	*P* value
Body condition score	1	3.75	0.0083
Temperament score	1	8.54	0.0005
Handling facility	2	9.55	0.0001
Handling facility by temperament score	2	8.54	0.001

*§Co-variance parameter estimates – Natural service sire 0.1243; Location 0.32311; Animal handlers 0.00634; Residual 0.1980; Fit statistics - BIC = 1342.3; -2 Res log likelihood =1291.

Table 2: Explanatory variables*, body condition score and temperament score influencing pregnancy loss in Angus cross beef cows (n=1407).
Body condition score – 1, emaciated to 9, obese;
Temperament score – 1, calm - slow, walking; 2, excited- jumping, trotting, or running;
Natural service sires, locations and animal handlers were offered as random variables;

Effect	Degrees of freedom	*F* value	*P* value
Body condition score	1	3.55	0.05
Temperament score	1	9.16	0.0001

*§Co-variance parameter estimates – Natural service sire 0.1732; Location 0.4144; Animal handlers 0.00823; Residual 0.2032; Fit statistics - BIC = 1212.8; -2 Res log likelihood =1171.6;

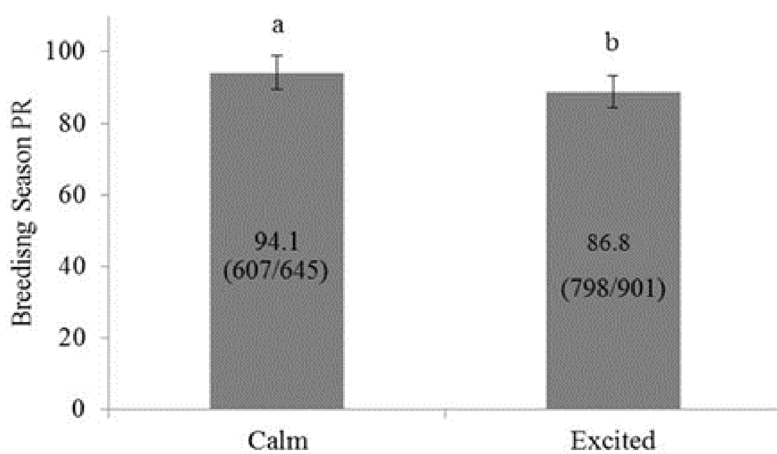
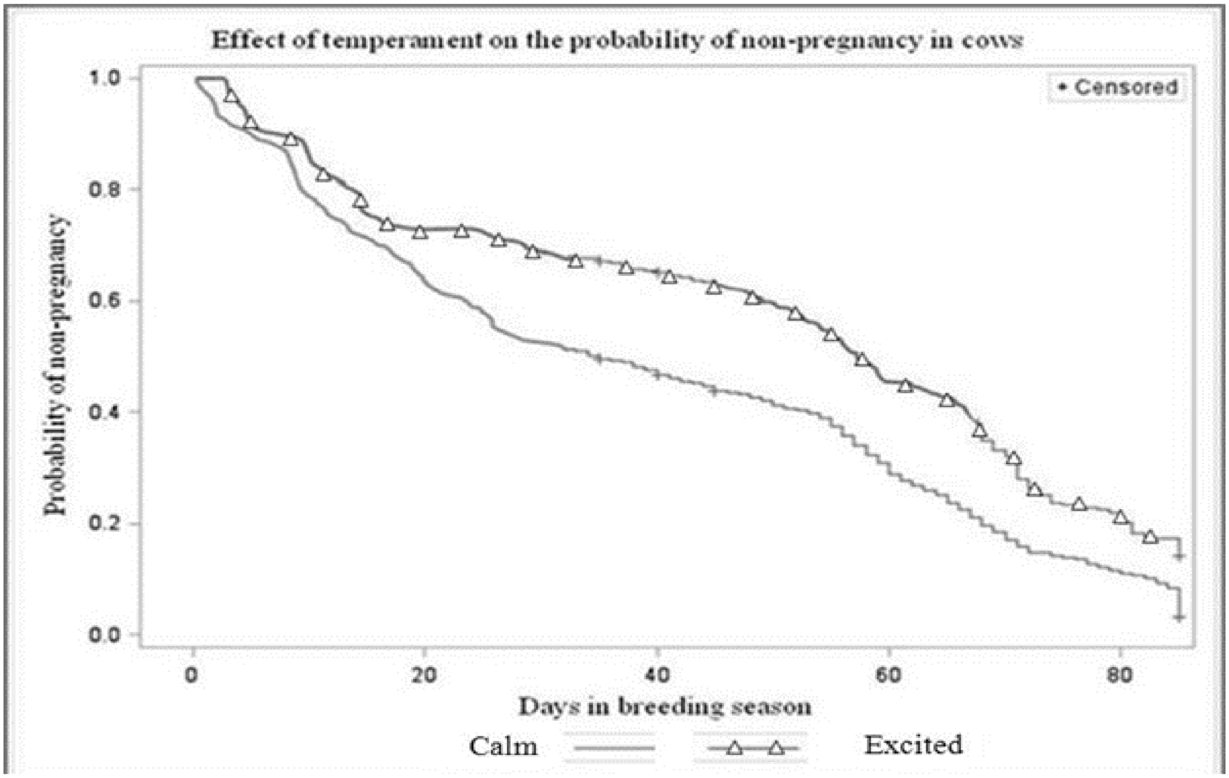


Figure 1. Breeding season pregnacy rate (PR) for calm and excited beef cows bred by natural service sires* (n=1546).
ab – Different superscripts were significantly different (P<0.05); *Bull: cow ratio – 1:25 to 1:30 cows; PR – Pregnnacy rate;



Temperament Score	% Open cows (censored)	Point Estimate	95% Confidence Interval	
			Lower	Upper
1	5.9	35.0	31.0	39.0
2	11.4	59.0	55.0	66.0

Figure 2: Survival curve for the effect of temperament on the probability of non-pregnancy* during the breeding season in beef cows (n=1546).
* Instantaneous relative risk of pregnancy on daily basis;

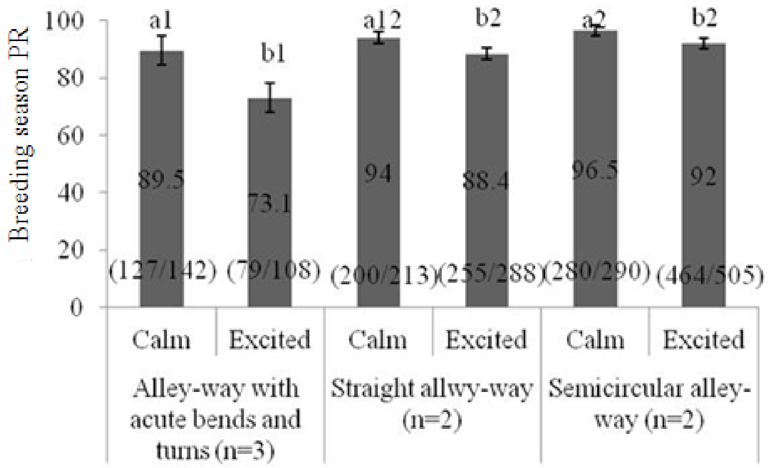


Figure 3: Effect of handling facility design[§] and temperament on breeding season pregnancy (%) in beef cows bred by natural service sires* (n=1546).

[§]Semicircular alleyway (n=2), Straight, long alleyway (n=3) and Wide alleyway and/or alleyway with acute turns (n=3); PR – Pregnnacy rate; ab – Different superscripts within facility type, between temperament groups were different (P<0.05); 12-Different numbers within temperament group, between facility types were different (P<0.05); *Bull: cow ratio – 1:25 to 1:30 cows;