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Jamee Amundson
University of Nebraska-Lincoln

Terry L. Mader
University of Nebraska-Lincoln, tmader1@unl.edu

Richard J. Rasby
University of Nebraska-Lincoln, rrasby1@unl.edu

Q. Steven Hu
University of Nebraska-Lincoln, qhu2@unl.edu

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Q. Steven Hu[1]

Summary

Ten years of records from a 150-head beef cow herd were used to determine the relationship of temperature and temperature-humidity index (THI) on pregnancy rate in beef cows. Pregnancy rate of the herd for the duration of the experiment averaged 92%. There was a linear relationship between average 30-day temperature and pregnancy rate during the first 30 days of the breeding season. Average THI greater than 65 for the first 30 days of the breeding season tended to decrease pregnancy rate in the first 30 days, but there was no effect on herd pregnancy rate. If the 60-day average THI was greater than 70, pregnancy rate for 60 days tended to decrease. Breeding season THI had no effect on pregnancy rate. High temperatures and high temperature-humidity index decrease the pregnancy rate during the first 30 days of the breeding season. Cows acclimate to environmental conditions and if the length of the breeding season is 60 days or more, pregnancy rate is not compromised.

Introduction

During the breeding season, conception, as well as embryo and fetal survival, are of concern in many cattle operations. Elevated ambient temperatures during the breeding season can decrease male and female fertility, reduce the duration of estrus, and lengthen the postpartum interval in multiparous cows. Heat stress also can delay puberty in heifers, cause anestrous in cows, depress estrus activity, induce abortions, and increase perinatal mortality. However, many studies evaluating environmental effects on conception rate are conducted using dairy cattle as the experimental unit. The reproductive response of dairy cows to heat stress may differ from that of beef cows due to differences in feed intake and genetics (Sprott et al., 2001 Prof. Anim. Scientist).

Many Nebraska cow herds are bred to calve in the spring. Consequently, breeding occurs in late spring through mid-summer when temperatures, combined with relative humidity, may reach levels that potentially affect reproductive performance. The objective of this study was to determine the effect of ambient temperature and humidity on reproductive performance of beef cows in a pasture setting.

Procedure

Ten years of calving records (1991-2000) from a spring-calving beef cow herd at the University of Nebraska Dalbey-Hallack Research Farm in Virginia, Nebraska were used to study the effects of temperature and humidity on reproductive performance. This research unit is located in southeast Nebraska. The herd consisted of about 150 commercial crossbred (1/2 Angus, 1/2 Continental) cows. All cows were managed similarly during the experimental period. Cows were bred using natural service while grazing mixed warm- and cool-season grasses. Length of the breeding season averaged 63 days for the ten years, beginning in late May and continuing through July. The bull to female ratio was maintained at 1:25.

Breeding date was estimated by subtracting 283 days from the recorded calving date. Pregnancy rate was determined by the number of cows bred during the breeding season divided by the total cows available to be bred. Pregnancy rates were totaled for the first 30 days, 60 days, and the entire breeding season and then regressed with average temperature and Temperature-Humidity Index (THI) for the corresponding time periods.

Weather data were compiled using the Great Plains Weather Archives for a station about 15 miles from the Dalbey-Hallack Farm. The weather history was downloaded in a daily format and included minimum and maximum temperature as well as average relative humidity. The average temperature and average relative humidity were used to calculate the THI for each day, using the following equation: *THI = Temperature – (.55 – (.55x (RH/100))) x (Temperature – 58).* Average temperature and THI values were calculated for the first 30 days, 60 days, and entire breeding season and then correlated with pregnancy rate for each period.

The data were divided into four sets to evaluate temperature and THI effects on reproductive performance. The first data set consisted of all years and the general effects

Table 1. Mean of all 10 years and standard deviation (SD) of temperature, relative humidity, and THI for 30-day, 60-day, and the entire breeding season.

	30-day		60-day		Breeding Season	
	Mean	SD	Mean	SD	Mean	SD
Temp (°F)	68.3	7.9	71.9	7.7	72.1	7.7
Rel. Hum. (%)	71.1	14.1	72.6	12.2	72.7	12.1
THI	66.5	6.5	70.0	6.5	69.8	6.4

Table 2. Estimated influence of temperature (Temp, °F) on predicted change in pregnancy rate (PR) and their relationship.

Item	Predicted Change in PR (% per °F)	Relationship	
		R^2	*P*-value
30-day Temp and 30-day PR	-1.08	0.382	0.057
60-day Temp and 60-day PR	-0.70	0.169	0.238
Season Temp on Season PR	-0.18	0.016	0.728

Table 3. Estimated influence of temperature-humidity index (THI) on predicted change in pregnancy rate (PR) and their relationship.

Item	Predicted Change in PR (% per unit THI)	Relationship	
		R^2	*P*-value
30-day THI and 30-day PR	-1.38	0.437	0.037
60-day THI and 60-day PR	-0.90	0.169	0.238
Season THI on Season PR	-0.21	0.013	0.754

of temperature and THI on pregnancy rate for the first 30 days, 60 days, and entire breeding season were examined. The second data set examined effects in the first 30 days of the breeding season when the average THI for the 30 days was above a threshold of 65 and used six of the ten years of data. The third data set examined effects of a 60-day THI that averaged greater than 70 and used four of the ten years of data. The fourth data set evaluated effects of THI greater than 70 on pregnancy rate for the entire breeding season and used five of the ten years of data.

Results

Table 1 reports the average temperature, relative humidity, and THI for 30 days, 60 days, and the entire breeding season. The temperature and THI values increased as the breeding season progressed from May through July. This is a typical spring/summer climate trend for southeast Nebraska.

Table 2 shows the effect of temperature on pregnancy rate using all 10 years in the data set. Average 30-day temperature was correlated (R^2 = 0.382, P = 0.057) to pregnancy rate during the first 30 days of the breeding season and pregnancy rate decreased by 1.08% for every degree increase in temperature. Average temperature did not significantly affect pregnancy rate during the 60-day period or the entire breeding season.

Table 3 illustrates the effect of THI on pregnancy rate, using all 10 years in the data set. Pregnancy rate for the first 30 days was affected (R^2 = 0.437, P =0.037) by 30-day THI. The 30-day THI decreased pregnancy rate by 1.38% per unit increase in THI. The 60-day and the entire breeding season THI model explained less than 20% of the variation in pregnancy rate. Even though the subsequent estrus occurred when THI values were greater than the previous values, the cows apparently acclimated and were able to become pregnant.

The effects of a 30-day pregnancy rate for those years in which the average 30-day THI exceeded 65 are illustrated in Table 4. During the four years in which the 30-day THI was less than 65, pregnancy rate was not affected by THI; however, during the six years in which the 30-day THI average was greater than 65, pregnancy rate tended to be reduced (P =0.078). Cows appeared to be susceptible to heat stress during the first 30 days of the breeding season, when the THI average was greater than 65 for that period and resulted in a 1.60% decrease in pregnancy rate per unit increase in THI (R^2 = 0.581). However, when the first 30 days of the breeding season had a THI greater than 65, beef cows appeared to acclimatize to the environmental conditions and became pregnant in subsequent breeding opportunities that occur later in the breeding season. This became evident when the 60-day and entire breeding season THI model only explained 15% (60-day) and less than 1% (breeding season) of the variation in pregnancy rate.

These results suggest cows have the ability to physiologically adjust to the environmental changes throughout the breeding season. If the environmental changes are extreme and rapid, the cows may not be able to adapt to the conditions and reproductive performance is impaired. Producers considering shortening the breeding season in late spring to early summer may compromise pregnancy rates during hot, humid years. Allowing cows more estrous cycles and a chance to acclimate to gradual changes in weather conditions will not likely compromise reproductive performance.

(Continued on next page)

Table 5 shows the effects of a 60-day THI greater than 70. A breeding season THI greater than 70 had no effect ($P = 0.230$) on overall pregnancy rate. The breeding season was about 3 days longer than the 60-day period; therefore, the breeding season results resemble that of the 60-day data. These data suggest that even if the THI is high during the breeding season and the breeding season is at least 63 days in length, cows will acclimate and pregnancy rates will not be reduced.

It is important to note that no other treatments were induced on the cows included in this study, and all cows were managed in a similar manner throughout 10 years, so the correlations between pregnancy rate and weather parameters were not confounded by other treatments.

Table 4. Estimated influence of 30-day temperature-humidity index (THI) > 65 on predicted change in pregnancy rate (PR) and their relationship.

Item	Predicted Change in PR (% per unit THI)	Relationship	
		R^2	*P*-value
30-day THI and 30-day PR	-1.60	0.581	0.078
60-day THI and 60-day PR[a]	-0.91	0.152	0.445
Season THI on Season PR[a]	0.25	0.014	0.824

[a]For years when previous 30-day average THI was > 65.

Table 5. Estimated influence of 60-day temperature-humidity index (THI) > 70 on predicted change in pregnancy rate (PR) and their relationship.[a]

Item	Predicted Change in PR (% per unit THI)	Relationship	
		R^2	*P*-value
60-day THI and 60-day PR	-3.15	0.843	0.082
Season THI on Season PR[b]	-0.92	0.582	0.237

[a]Effects of breeding season THI > 70 were not significant (R^2 =0.430, P =0.230).
[b]For years when previous 60-day THI was greater than 70.

Implications

Date of breeding season

Producers may consider moving the breeding season earlier in the spring so the middle of the breeding season does not occur during the months that are hot and/or humid, such as July and August. By initiating an earlier breeding season, producers may avoid the negative effects of high THI conditions during the early part of the breeding season on reproductive performance. However, when moving the breeding season, producers must consider the additional costs of increased feed requirements when starting the breeding season before spring pastures are available.

Length of breeding season

The cows in this study had a reduced pregnancy rate for the first 30 days of the breeding season when the weather was hot and humid, but pregnancy rates for 60 days or greater were not affected by THI. These results indicate beef cows can acclimate to high temperatures and humidity if given enough time with the bull. In an effort to reduce the length of the calving season, some producers will shorten the breeding season to 45 days. These data suggest a 45-day breeding season may be too short and will reduce pregnancy rates, especially where the breeding season overlaps with hot, humid weather conditions.

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[1]Jamee Amundson, graduate student; Terry Mader, professor, Animal Science, Haskell Ag Lab, Concord, Northeast Research and Extension Center; Rick Rasby, professor, Animal Science, Lincoln; Steve Hu, associate professor, Natural Resources, Lincoln.