Research Article

Haryana Vet. (June, 2018) **57 (1)**, 23-25

TEMPERATURE-HUMIDITY INDICES AS INDICATORS OF CONCEPTION RATE IN MURRAH BUFFALOES

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ABSTRACT

A retrospective study was conducted on 100 Murrah buffaloes over a period of 5 years. The data were analyzed for studying the effect of year and Temperature-Humidity Index (THI) on the conception rate of Murrah buffaloes. Logistic regression analyses were performed on data from each insemination, using pregnancy detection as the dependent variable (0 or 1), and year and temperature-humidity index as independent variables. Year and THI were considered as class variables. Five year classes were defined: 2012 to 2016. Four THI variables were defined: <60, 61–70, 71–80 and >80. Overall conception rate was observed as 42.94%. In year wise analysis, the conception rate was found to be higher during year 2016 followed by year 2012, 2013, 2015 and it was least in year 2014. Higher conception rate was observed for THI group with lowest THI i.e. <60. However, it was found that conception rate decreased as THI increased. Logistic regression analyses of conception rate with year and THI group showed that year has no significant influence on conception rate. However, THI groups showed significant association with conception rate. Based on the odds ratios, the likelihood of conception rate was higher (OR=1.61; 95% CI=1.15, 2.23) for THI<60 than THI>80 (OR=1.00). However, the conception rate for THI (71-80) was not significantly different (OR=1.01) than reference category i.e. THI>80 (OR=1.00).

Keywords: Temperature-Humidity Index, conception rate, artificial insemination, pregnancy detection

Buffalo is a premier dairy animal of India and holds the greatest promise and potential for milk, meat and draught. Recent buffalo population trend revealed that India has approximately 108 million buffaloes which are around 56.7 percent of the total world population (BAHS, 2013-14). The profitability of dairy herds greatly depends on fertility. Yet despite rapid worldwide progress in genetics and management of high producing dairy herds, reproductive efficiency has suffered a dramatic decrease since the mid-1980s (Royal *et al*., 2000).

Summer heat stress is likely to be a major factor related to low fertility in high producing dairy herds, especially in countries with warm weather. Thermal stress before insemination has been associated with decreased fertility (Putney *et al*., 1989). The intrauterine environment is also compromised in cows that suffer heat stress including alterations such as diminished uterine blood flow and an increased core body temperature (Gwazdauskas *et al.,* 1975). These changes have been linked to early embryonic loss and to unsuccessful inseminations (Rivera *et al*., 2001). The environmental temperature, radiant energy, relative humidity, and wind speed all contribute to the degree of heat stress (De Rensis and Scaramuzzi, 2003). The majority of studies on heat stress in livestock have focused mainly on temperature and relative humidity (Correa-Calderon *et al*., 2004) because data on the amount of thermal radiation received by the animal, wind speed, and rainfall are not publicly available. On the other hand, temperature and humidity records can be usually obtained from a meteorological station located nearby. The easiest way to assess the effect of increasing temperatures in livestock is the use of indexes like so called temperature–humidity index (THI), precisely because they combine data from ambient temperature (T) and relative humidity (RH) (Collier *et al*., 2007). Despite this, there has been little research into the direct effects of the THI and temperature on the conception rate of buffaloes.

The present investigation was undertaken to examine the impact of year and THI on the conception rate of Murrah buffaloes.

MATERIALS AND METHODS

The present investigation was conducted by utilising the data of 100 Murrah buffaloes for a period of five years from 1 January 2012 to 31 December 2016, maintained at the farm of Department of Livestock Production Management (LPM) of the Lala Lajpat Rai University of Veterinary and Animal Sciences (LUVAS), Hisar. Incomplete artificial insemination records resulting due to specific causes like auctions and death were excluded from the present investigation. All animals were bred by artificial insemination (AI). The buffaloes bred round the year and were inseminated by professional technicians. The voluntary waiting period was 60 days. Buffaloes were inseminated after estrus had been confirmed by examination of the genital tract. Only healthy buffaloes (with no signs of mastitis, lameness or digestive disorders) with strong uterine contractility and copious, transparent vaginal fluid were inseminated by uterine body insemination. If buffaloes returned to estrus, their status was also confirmed by per-rectal examination. Pregnancy detection was performed by veterinary technician by palpation per rectum manually at 90 days post insemination.

Climate data such as daily minimum, maximum and mean temperature, and minimum, maximum and

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Table 1

Odd ratios of variables included in binary logistic regression model for conception rate

Factor	Class	Conceived/ Inseminated	% Conception rate	Odds ratio	95% CI	P value
Year	2012	98/218	44.95	0.95	0.66-1.38	0.79
	2013	93/213	43.66	0.92	0.64-1.33	0.66
	2014	120/300	40.00	0.84	0.59-1.18	0.31
	2015	110/267	41.20	0.82	0.58-1.17	0.27
	2016	117/255	45.88	Reference		
THI Group	<60	152/306	49.67	1.61	1.15-2.23	0.01
	61-70	129/268	48.13	1.53	1.09-2.15	0.01
	71-80	145/385	37.66	1.01	0.73-1.39	0.96
	>80	112/294	38.1	Reference		

CI: Confidence Interval; Likelihood ratio test=1694. 33, P value < 0.001;

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mean relative humidity were obtained from meteorological station of Chaudhary Charan Singh Haryana Agricultural University, Hisar, located less than 2 km away from the buffalo farm. Temperature–humidity indices (THI) were calculated according to the following National Research Council formula [NRC 1971]:

$$\mathbf{THI = (1.8 \times T + 32) - (0.55 - 0.0055 \times RH) \times (1.8 \times T - 26)}$$

where: T = mean temperature (°C);

RH = mean relative humidity (%).

Statistical Analysis

Logistic regression analyses were performed on data from each insemination, using pregnancy detection as the dependent variable (0 or 1), and year and temperature-humidity index as independent variables. Year and THI were considered as class variables. Five year classes were defined: 2012, 2013, 2014, 2015 and 2016. Four THI variables were defined: <60, 61–70, 71–80 and >80.

Logistic regression analyses were conducted according to the method of Hosmer and Lemeshow (2013) by the logistic procedure in SPSS software.

RESULTS AND DISCUSSION

Odd ratios of variables included in binary logistic regression model for conception rate is given in Table 1.

Conception Rate (%): Overall conception rate was observed as 42.94%. In year wise analysis, the conception rate was found to higher during year 2016 followed by year 2012, 2013, 2015 and it was least in year 2014. The chi-square analysis was done to find any association of conception rate with years. However, it was revealed that the years did not have any significant influence on conception rate. These findings are may be due to uniform management practices at the farm throughout these years.

Temperature humidity index: Higher conception rate was observed for THI group with lowest THI i.e. <60. However, it was found that conception rate decreased as THI increased. For THI group with THI >70, conception rate was lowest. The chi-square analysis was done to find out any association of conception rate with THI and it was revealed that the THI significantly influenced the conception rate. Due to our retrospective data collection, it was however, not possible to establish whether this heat stress affected the oocytes, zygotes, or even spermatozoa. It could be that exposure of spermatozoa to elevated temperatures after AI in the uterus or oviduct of a hyperthermic female could compromise sperm survival, fertilizing capacity or both. These results are in agreement with Wiltbank *et al.* (2002), Dobson *et al.* (2003) and Hunter (2003). Armstrong (1994) identified index below 71 as comfort zone, values ranging from 72 to 79 as mild stress, 80 to 89 moderate stress, and values above 90 as severe stress. Nabenishi *et al.* (2011) reported that conception rate for THI >80 was significantly lower than other THI groups i.e. <60, 61-65, 66-70, 71-75, 76-80.

Logistic Regression Analysis: Logistic regression analyses of conception rate with year and THI group showed that year have no significant influence on conception rate. However, THI groups showed significant association with conception rate. Based on the odds ratios, the likelihood of conception rate was significantly higher (OR=1.61; 95% CI=1.15, 2.23) for THI <60 than THI >80 (OR=1.00). However, the conception rate for THI (71-80) was not significantly different (OR=1.01) than reference category i.e. THI >80 (OR=1.00). These results are in agreement with Garcia-Ispierto *et al.* (2007) who reported that conception rate increased significantly (OR=1.73; 95% CI=1.1, 2.3) for THI <70 than THI classes 71–75, 76–80, and 81–85 (OR=1.53, 1.11 and 1.30).

Overall conception rate in buffaloes was observed as 42.94%. Although, year had no significant influence on CR, the THI group was significantly and inversely associated with CR in buffaloes in this study. The CR was found to be having likelihood for low THI groups i.e. up to 70 than higher THI groups.

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