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## Temperature-humidity index values in relation to performances of dairy animals: A short note

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**Abstract**

Temperature-humidity index (THI) is an indicator used to measure the degree of heat stress on the dairy animals. Heat stress is categorized into various THI values. A high THI value negatively affects cow comfort, dry matter intake and ultimately the dairy production and reproduction in India. Based on these values, mitigation practices can be followed for recovering the animal from heat stress.

**Keywords:** Temperature-humidity index, heat stress, dry matter intake, comfort

**Introduction**

Dairy animals are particularly more susceptible to heat stress and the effects vary among individuals depending upon the breeds and production potential. Heat stress is associated with 10 to 40% reduction in milk yield in Holstein cows [6], alterations in milk composition, milk somatic cell counts and mastitis incidences, deterioration of embryo development and increased embryo loss in cattle [8]. Heat stress is influenced by air temperature, humidity, air movement, solar radiation, and precipitation. Heat stress in dairy cattle can be managed using different approaches such as housing and nutrition. Many indices have been proposed to measure the level of heat stress and is indicated that, compared to other indices, temperature humidity index (THI) is a practically useful and standard tool for many applications in animal biometeorology [6]. THI is a single value depicting the integrated effects of air temperature and humidity associated with the level of heat stress. This index has been developed as a weather safety index to control and decrease heat stress related losses [2]. The emphasis of this paper is on THI representing the influence of thermal environments on dairy animal response.

**THI and its classification:** THI is a simple combination of temperature and humidity and has been designed as a measure of animal comfort. It is extensively used in hot regions all over the world to estimate the cooling necessities of dairy animals in order to improve the efficiency of management strategies and to alleviate the negative effects of heat stress [6]. THI is calculated by numerous equations and the values obtained are classified accordingly, some of which are mentioned in Table 1.

**Table 1:** THI equations and classifications

$0.8DBT + [(RH/100) \times (DBT - 14.4)] + 46.4$ [10]		$(1.8AT + 32) - [(0.55 - 0.0055RH) \times (1.8AT - 26)]$ [7]		$0.72 (W^{\circ}C + D^{\circ}C) + 40.6$ [11]	
Classification	Values	Classification	Values	Classification	Values
No stress	< 70	Comfort	< 68	Comfortable	$\leq 70$
Mild stress	70-75	Mild discomfort	68-72	Stressful	75-78
Semi-moderate stress	76-80	Discomfort	72-75	Extreme distress	>78
Moderate stress	81-85	Alert	75-79		
Severe stress	85-90	Danger	79-84		
		Emergency	>84		

Where, DBT/D<sup>o</sup>C = Dry bulb temperature in <sup>o</sup>celsius; RH = Relative humidity; W<sup>o</sup>C = Wet bulb temperature in <sup>o</sup>celsius; AT = Air temperature

**Response of THI values in relation to dairy animal's performances:** [3] stated that milk production is affected by heat stress when THI values are higher than 72. [12] determined that milk yield declined by 0.2 kg per unit increase in THI when THI exceeded 72.

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Similarly, <sup>[9]</sup> reported that the milk yield and the dry matter intake exhibited significant declines by 1.8 and 1.4 kg, respectively for each 0.55 °C increase in rectal temperature when maximum THI reached 77. This is due to the decreased nutrient intake and decreased nutrient uptake by the portal drained viscera of the cow. Also, blood flow shifts to peripheral tissues for cooling purposes that alter nutrient metabolism and contribute to lower milk yield during hot weather <sup>[1]</sup>. Decrease in fat yield is also associated with increase in THI <sup>[6]</sup>.

On the other hand, <sup>[5]</sup> found that conception and pregnancy rates (%) were significantly decreased by 20.1 and 16.4, respectively at THI value 80-85. <sup>[4]</sup> reported increase in foetal loss, abortion and stillbirth rates (%) of Holstein cows by 7.8, 3.6 and 2.1 respectively, at THI value 80-85. Further, authors concluded that Holstein cows had a significant longer calving interval and days open by 28 and 27 days, respectively at THI value 80-85. It is considered that heat stress affects reproduction by inhibiting the synthesis of gonadotropin releasing hormone and luteinizing hormone which are essential for oestrus behaviour expression and ovulation <sup>[13]</sup>. Further, only fewer standing heats are observed during heat stress which may ultimately lead to decreased pregnancy rate.

**Conclusion:** Many indices have been proposed to measure the level of heat stress and ultimately the animal's degree of comfort but, so far, THI is considered as the most practical and standard tool to measure it. Elevated temperature and humidity as presented in THI negatively affects feed intake and alters hormone concentration which upsets the productive and reproductive performances of dairy animals which indicates that management interventions are required to ameliorate the effects of heat load on dairy animals.

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