



## TEMPERATURE HUMIDITY INDEX - AN EASY MEASURE TO IDENTIFY THE HEAT STRESS IN DAIRY CATTLE

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### ABSTRACT

Assessment of heat stress in dairy cattle had become crucial in order to adopt management strategies to optimize production. Several techniques have been evolved to measure heat stress in cattle. Among all, temperature humidity index (THI) stands as simple, cheap and best measure of heat stress in cattle. A low THI value of below 72 determines comfort zone while, a high THI indicates emergency state. THI value was also negatively correlated with milk production in animals. Further, THI could be used as early warning system and adopt management strategies under adverse environment conditions. Though, THI does not take in to the account of all the weather parameters THI is still the best technique to evaluate heat stress in dairy cattle.

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### INTRODUCTION

India is the largest milk producer in the world with a milk production of 198 million tonnes. Though, India is the largest milk producer, many factors were found to negatively affect animal health and milk production. Environment, photoperiod, geographical location, nutrition, water, disease and management are some of the factors. Among all the factors, heat stress poses a substantial menace to the existence of animals and the effects triggered by heat stress are ample harmful. Heat stress is the incapability of the animal to loose heat to the surroundings. Ambient temperature (AT), relative humidity (RH), wind and solar radiation are the climatic elements that contribute to heat stress. Under heat stress numerous behavioural and physiological responses are activated (reduced dry matter intake, increased respiratory rate, excess sweating and altered hemato-biochemical and hormonal profile) to maintain thermoregulation while compromising production behind. Research revealed a 30-40% decline in milk production in livestock due to heat stress. Several techniques have been evolved to measure the risk of heat stress in cattle which includes the use of haematological, biochemical, endocrine and molecular markers (Tej *et al.*, 2017). Unfortunately these advanced techniques involve a huge investment of money and time which cannot be

adopted by farmers to assess heat stress in animals. One of the simple and most practical technique measuring heat stress is temperature humidity index (THI).

## TEMPERATURE HUMIDITY INDEX AND ITS ROLE IN ASSESSING HEAT STRESS

Thom (1959) developed a discomfort index (DI) to measure the level of discomfort for humans based on AT and RH. Later the same has been renamed as THI to assess heat stress in animals. THI is a linear equation that takes in to account the combined effect of ambient temperature and relative humidity, the resultant value obtained after solving the equation provides a measure of heat stress (Akyuz *et al.*, 2010). A THI of < 74 indicate no heat stress, 75 to 78 indicate moderate heat stress (alert), 79 to 83 causes severe heat stress (livestock danger) and a THI of 84 and more causes very severe heat stress (livestock emergency) (Thom, 1959, LCI, 1970, Fig.1). Although THI does not take in to account the effect of solar radiation and air speed (Gaughan *et al.*, 2012) nevertheless, THI is still one of the best methods to assess heat stress in animals (Marai and haeeb, 2010). The effect of THI on livestock has been shown in Table 1 and some of the most commonly used THI formulas have been presented in Table 2.

### IMPORTANCE OF THI

- It is easy to calculate, can also be adopted by farmers
- Data loggers/HOBO loggers can be purchased by farmers for continuous recording of weather parameters
- Easy bench mark to assess heat stress in cattle
- Determines the impact of heat stress on animals
- Can be used as early warning system
- Modify the microenvironment of the animal when THI crosses 72.
- For dairy cows management strategies should be taken when THI goes above 68
- Overlook of high THI causes heavy economic loss to the farmers

### EFFECT OF THI ON MILK PRODUCTION

A unit rise in THI significantly ( $p < 0.01$ ) decreased the average daily milk production of lactating crossbred (Holstein Fresian × Indigenous local) cows inhabiting Bihar (Das, 2012). Bouraoui *et al.* (2002) reported that milk production decreases 0.41kg/cow/day when THI was above 69. Recent research showed that milk yield starts to decline at a THI of 68 (zibleman *et al.*, 2009).



Figure 1. Stressed animal

### MANAGEMENT STRATEGIES AT HIGH THI

- Feed management - providing adequate green and succulent forages during hotter part of the day and less energy diet feed
- Shelter management - by improving heat exchange mechanisms (water sprinklers, fans)
- Increase water service points and provide cool, clean and fresh water
- Avoid handling and transportation hotter part of the day

Temperature Humidity Index (THI) Chart													
Temperature Humidity Index (THI)													
		Relative Humidity											
		30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%
T	100°	84	85	86	87	88	90	91	92	93	94	95	97
E	98°	83	84	85	86	87	88	89	90	91	93	94	95
M	96°	81	82	83	85	86	87	88	89	90	91	92	93
P	94°	80	81	82	83	84	85	86	87	88	89	90	91
E	92°	79	80	81	82	83	84	85	86	87	88	89	89
R	90°	78	79	79	80	81	82	83	84	85	86	86	87
A	88°	76	77	78	79	80	81	81	82	83	84	85	86
T	86°	75	76	77	78	78	79	80	81	81	82	83	84
U	84°	74	75	75	76	77	78	78	79	80	80	81	82
R	82°	73	73	74	75	75	76	77	77	78	79	79	80
E	80°	72	72	73	73	74	75	75	76	76	77	78	78
	78°	70	71	71	72	73	73	74	74	75	75	76	76
	76°	69	70	70	71	71	72	72	73	73	74	72	75

$THI = 0.5(T - 50) + 0.55(RH - 30) + 0.45(T - 50) \times (RH - 30)$

Normal <74    Alert 75-78    Danger 79-83    Emergency >84

Figure 2. THI chart and associated livestock weather safety index categories (obtained from Thom, 1959, LCI, 1970 and modified accordingly)

**Table. 1: Effect of THI on livestock health and Production**

THI	Level of heat stress	Effect on Livestock
<74	No heat stress	<ul style="list-style-type: none"> <li>No heat related problems</li> <li>No extra energy is deviated for energy production</li> </ul>
		<ul style="list-style-type: none"> <li>Shade seeking, decreased intake of feed and increased water intake</li> </ul>
75- 78	Moderate heat stress (livestock alert)	<ul style="list-style-type: none"> <li>Behavioural and physiological responses</li> <li>Increased respiratory rate and cardiovascular changes</li> <li>Reduced feed intake</li> <li>low milk production</li> </ul>
		<ul style="list-style-type: none"> <li>Reduced weight gain, low milk production, mortality may occur</li> </ul>
79-83	Severe heat stress (livestock danger)	<ul style="list-style-type: none"> <li>Mortality of animals if further stressed by activity</li> </ul>
84	Very severe heat stress (livestock emergency)	

## CONCLUSION

THI which accounts for the collective effect of temperature and humidity, provides a measure of heat stress. Earlier studies showed a unit rise in THI from 72 caused heat stress in dairy cattle. However, recent findings revealed that dairy cattle begin to experience heat stress and reduce milk production at a THI of 68. THI also helps in determining the impact of heat stress and as a warning system. Based on THI values, micro climate around the animal can be modified and management strategies can be adopted for mitigating heat stress. One of the major advantages of using THI as a measure of heat stress is that farmers can also effectively use it to assess heat stress in animals.

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