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A Predictive Model of Equivalent Temperature Index for Dairy Cattle (ETIC)

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Abstract

Thermal stress imposed on cows adversely affects health and productivity. Various thermal indices exist in the literature that can be used to assess the level of heat stress on cattle by linking environmental conditions with physiological responses. However, many of these indices either do not incorporate all of the environmental variables or may consider only the main effects of the independent variables without considering the interaction effects. The objective of this study was to develop a thermal index for dairy cattle, referred to as *Equivalent Temperature Index for Cattle* (ETIC), which incorporates air temperature, relative humidity, air velocity and solar radiation and their interactions. Environmental and physiological data from two studies were pooled together to develop and validate the proposed index. The index (ETIC) expressed in terms of temperature units is derived from equivalent air temperature of relative humidity, air velocity and solar radiation. ETIC heat-stress level thresholds were defined according to the thresholds for temperature-humidity index (THI). The results indicate that the ETIC model predicts the measured physiological responses very well. The coefficient of correlation, R^2, for skin temperature, core-body temperature, and respiration rate were 0.79, 0.40, and 0.49, respectively. The ETIC prediction of skin temperatures, core-body temperatures, and respiration rates were better compared to that of three recently developed thermal indices (adjusted THI, heat load index, and comprehensive climate index). The proposed index could be a useful tool to assess thermal environments to ensure animal comfort.

Keywords: Thermal index, Dairy cattle, Heat stress, Environmental stressors