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Responses of high producing dairy cows to high ambient temperatures in the Netherlands

M. Zhou¹, A.J.A. Aarnink^{1*}, T.T.T. Huynh¹, P.W.G. Groot Koerkamp¹

¹ Wageningen University & Research, Farm Technology Group, The Netherlands

* Corresponding author. E-mail: andre.aarnink@wur.nl

The dairy industry in regions with moderate climates, such as Netherlands, will be increasingly challenged in the future by global warming. Heat stressed cows show increased respiration rates, sweating rates and rectal temperature. The objective of this study was to investigate the relationship between ambient climate parameters and a number of cow parameters: respiration rate (RR), rectal temperature (RT), skin temperature (ST), skin latent heat loss (LHL) and skin sensible heat loss (SHL). The study was conducted in a naturally ventilated dairy barn located in Wageningen, the Netherlands. The dataset was composed of 144 observations from 8 lactating cows under summer conditions for 33 days from July to August 2020. The climate data were collected inside and outside the barn and the average of inside Temperature Humidity Index (THI) during the experimental period was 69.4 ± 5.5 , with a maximum value of 81.7. Measurements of RR, RT, ST, LHL and SHL were conducted at 0900 and 1400 h for ± 30 min. Split-line regression of RR and RT on THI showed thresholds (above which RR and RT started to increase) of 71 and 74. During the experimental period (33 days), totally 18 days were observed with more than 4 hours a day above the THI threshold for RR. Indoor temperature showed moderate correlations with SHL ($R^2=0.29$) and LHL ($R^2=0.28$). When the indoor air temperature increased from 17 to 31°C the sensible heat transfer decreased, on average, from 200.2 to -12.8 Wm^{-2} , while the LHL by skin evaporation increased from 5.2 to 411.2 $W m^{-2}$. ST showed a moderate relationship with LHL ($R^2=0.35$), and this relationship may support the use of ST data to mitigate heat stress in dairy cows.