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“Filling gaps and removing traps
for sustainable resource management”

Modelling Heat Stress Effects on Milk Production in a Tropical Environment Using Test-Day Records and Random Regression Models

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Abstract

In the tropical environments, dairy cattle production is constrained by several factors among them being climate. The seasonal loss of milk due to heat stress is a recurring challenge for many dairy producers. The objective of this study was to detect heat stress thresholds and individual animal variations from test-day milk records using random regression models for dairy cattle in Kenya. Data were obtained from the Kenya Livestock Breeders Organisation for the years 2000 to 2017 and merged with meteorological data. After editing, the records comprised of 50743, 44899 and 35958 test-day records for first, second, and third lactations, respectively, for the four main dairy breeds: Friesian (68.1%), Ayrshire (21.0%), Jersey (7.6%) and Guernsey (3.3%). Variance components were estimated using Restricted Maximum Likelihood in ASREML software. Random regression models with heterogeneous residual variance were applied. Legendre polynomials of order 3 were fitted to the average and individual lactation curves and the reaction norms. The heat stress indicators studied were; daily average temperature (Tave), daily maximum temperature (Tmax), Temperature Humidity Index (THI) and Heat Load Index (HLI). Considering a one day lag, the estimated heat stress thresholds for the different indices were about 22°C, 69 and 81 for Tave, THI and HLI, respectively. Tmax did not adequately capture the response of milk yield to increasing temperature. On average, the milk yield loss for each unit increase in Tave from 22°C to 26°C was -0.47, -0.71 -0.98 and -1.41 kg for first lactation milk yield. The loss was -0.51, -0.78, -1.09 and -1.58 kg for second lactation, and -0.61, -0.85, -1.18 and -1.69 kg for third lactation respectively. The temperature and THI thresholds obtained in this study are important in management of dairy production systems in Kenya and in the tropics with similar climatic conditions.

Keywords: Dairy cattle, heat stress indicators, reaction norm