Preliminary studies to develop a novel, cow-centred index to monitor heat stress in dairy cows.

Tom Chamberlain[1], Noud Aldenhoven[2], Christopher Powell[2]
[1] Chalcombe Ltd, Southampton, United Kingdom
[2] Trouw Nutrition, Amersfoort, The Netherlands
drtomchamberlain@chalcombe.co.uk
Presented at Precision Dairy Conf, Vienna, August 2022

Introduction

Heat stress in dairy cows is of growing importance in many dairy producing regions of the world. Global warming is raising average summer temperatures and increasing the risk of extreme events. At the same time rising milk yields are increasing the cow's susceptibility to heat stress. Successful measurement and control of heat stress is important in reaching net-zero as it improves productive efficiency and reduces the use of fossil fuels. Current methods of assessing heat stress risk measure the environment rather than the animal's physiology and so only capture the potential risk and are only suitable for fully-housed systems. There are no suitable indices for assessing heat stress on farms that make full or partial use of grazed grass. Furthermore, none of the existing indices incorporate cow factors such as breed, milk yield, acclimatisation or the effect of genetic traits and risk thresholds are often adjusted *ad hoc* to cope with different climates and production systems. Given these deficiencies, the objective of this work was to develop a novel cow-centred index to monitor heat stress in dairy cows.

Methods

Data were collected from three commercial farms in south England (Table 1) over the summer of 2021. The patterns of calving in all three herds were such that there were high-yielding cows in the milking herd throughout the summer. All herds were fed supplementary feeds to yield in the milking parlour.

Table 1. Details of commercial farms used in trials

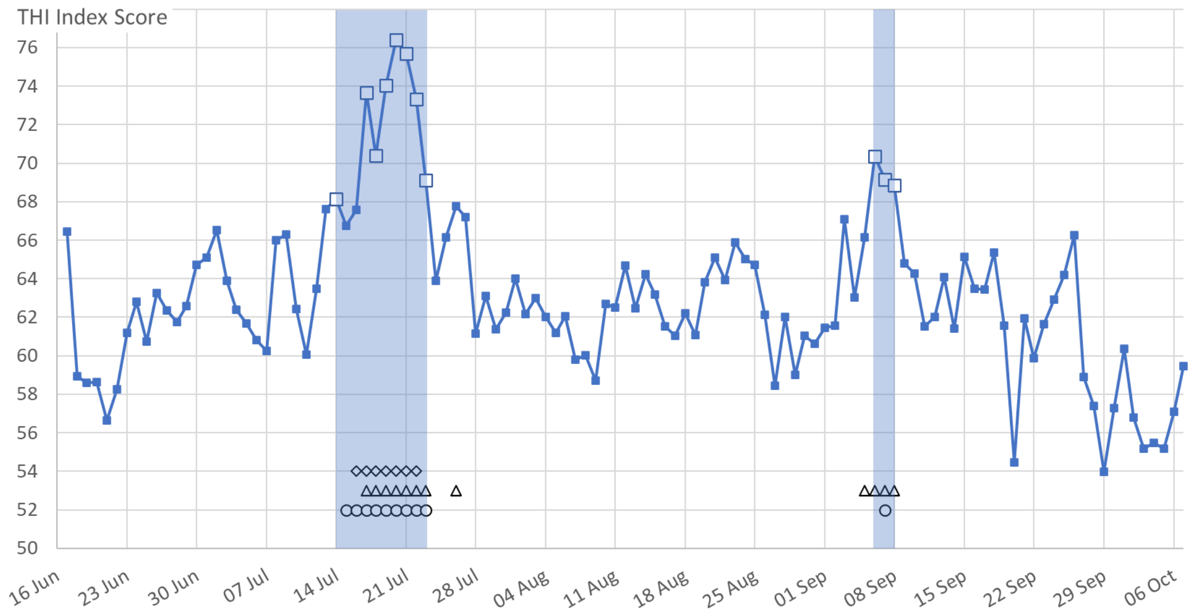
Farm	Herd size cows	Milk yield l/cow/year	Type of parlour	Summer Management
1	460	12,400	54 point rotary	Predominantly housed on TMR.
2	720	9,400	54 point rotary	Some groups housed, some grazed.
3	260	11,200	20:20 herringbone	Predominantly grazed.

From June to October 2021 temperature and humidity were recorded every 20 minutes in a stocked cattle shed on each farm and the Temperature Humidity Index (THI) was calculated (NRC, 1971). Temperature readings were collected in the milking parlour every 6 minutes during milking and temperatures excesses calculated. The temperature excesses were used to determine heat-stress risk days and, where the excess was positive, it was numerically compared to the cow-shed THI values during heat stress episodes.

Results

The THI values over the summer averaged over the three herds are shown in Figure 1. There was a major heat-stress episode (THI > 68) in mid-July and a smaller one in early September. Heat stress risk days are shown along with the temperature excess days that our index identified on each farm.

Figure 1. Daily THI index score over summer, 2021. Heat stress days (THI>68) shown as open squares and heat stress periods by shading. Heat stress risk days as identified by temperature excesses shown as diamonds (Farm 1), triangles (Farm 2) and circles (Farm 3).



The numerical values for the temperature excesses were correlated with the THI values at the time of collection (Table 2)

Table 2. Correlation between temperature excesses on heat stress days and THI value.

Farm	Correlation	95% CI		n
1	0.952	0.909	0.975	38
2	0.962	0.934	0.978	51
3	0.649	0.416	0.802	38

Discussion and Conclusions

The temperature excess index developed herein closely identified days when the THI was over 68 and, numerically, it was highly correlated with the THI values. However, THI 68 may not have been the correct threshold for each farm. The correlation was lowest for the grazing herd where THI was probably not the appropriate reference index. This study shows that our novel temperature excess index can be used to assess heat stress risks across different farm types. As the index tracks the cow’s response, rather than the environment, it is able to accommodate the animal’s acclimatisation and genetic variation and work across different climates. Furthermore, tracking the animal’s response will allow optimisation of mitigation actions with associated cost and environmental optimisation. Future work will look to collect the data in real time using Internet-of-Things (IOT) technologies to enable farmers to track and quantify heat stress risks in real time that are specific to their local environment, farm structure and cows.

Acknowledgements

This work was funded by a HealthyLife research grant from Trouw Nutrition.

References

NRC. 1971. A Guide to Environmental Research on Animals. Natl. Acad. Sci., Washington, DC, USA.