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Influence of House Climate on the Lying Behaviour of Dairy Cows

For economic reasons and dairy cow needs, predominantly non-insulated free-stall barns with roller ventilation systems are being built. In order to get information under varying climate environments, the lying behaviour of dairy cows in cubicles was recorded over a period of several months in two barns. In the thermo-neutral temperature range, no microclimate influence on the lying behaviour could be determined. At higher temperatures the cubicle occupation decreases, depending on wind speed. Further influences on the lying behaviour are the time and length of the day.

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Keywords

House climate, dairy cows, lying behaviour

Literature

[1] Deutsche Landwirtschftsgesellschaft 2004. DLG-Merkblatt 336

The optimal range of the ambient temperature for dairy cows is between +4 and +16 °C [1]. When temperatures get out of this optimal range, cattle react by physiological adaptation mechanisms and also by changed behaviour. The lying behaviour is one of the indicators, whether the physiological temperature control mechanisms of the animals are sufficient or if the missing comfort by lying can be better obtained by standing or in other place in the stable.

The aim of this study was to investigate the possible influence of the environmental parameters in the stable on the lying behaviour of dairy cows during four (pilot farm 1) and six months (pilot farm 2). Both investigated stables are 3-row loose housing stables with lying boxes for 110 dairy cows, using curtains to control openings in the sidewall. The first dairy farm lies in the Bavarian alpine upland, the second in the Rhoen low mountains..

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Measurements

Ultrasound sensors, installed above each second lying box, were used for the recording of the lying behaviour. They determine every four seconds the distance between sensor and soil and/or lying or standing animal. From the measured distance it can be concluded, whether the lying-box is empty or a cow is lying or standing in the lying box.

Temperature and humidity were recorded by combined temperature and humidity sensors placed at the stable external wall and at two central places in the stable. The wind speed and also temperature recordings were performed by 15 temperature-air stream sensors (hot wire anemometers). These sensors were installed in three measure rows along the lying box rows and the curtains. A meteorological station placed approximately 200 meters from the investigated stable noted the current weather conditions. Wind direction and wind speed were measured in 10 m height.

Results

Occupation of the lying boxes

The average occupation of the lying boxes during the entire recording period, calculated for the time interval between the morning and evening milking, was 48 % in the first dairy farm and 54 % in second farm. In both dairy farms large differences in the occupation of the individual lying boxes could be observed (farm 1: 3 to 68 %; farm 2: 8 to 67 %). Edge boxes, which are separated with a limber wall from the passages, and thus offer less lateral free spacer, or boxes placed near very highly frequented places (at the dairy farm 2 the lying boxes beside the concentrate feeder) are usually less occupied and deviate from the remaining lying boxes substantially. Differences in the occupation of the lying box can be observed also between rows. The highest occupation of the lying boxes is observed in the row aligned to feeding table (lying box row at the feeding table: farm 1: 51 % and farm 2: 59 %; remaining rows: farm 1: 47 % and farm 2: 51 %).

Influence of the temperature on the lying behaviour

Different lying behaviour was observed at low (<5 °C) and at high (> 20 °C) average daily temperatures. Thus the average occupation of the lying boxes on cold days was approx. 61 %, on warm days it was only approx. 55 %. To show the influence of the temperature on the lying behaviour, five days with high and low temperatures (*Fig. 1*) were compared. To do this the 10 minute values of the examined days were averaged; by this way the determined average temperatures during the cold days ranged between - 5 and 2° C and in the course of the warm day between 20 and 32 °C. The occupation of the lying boxes during the warm days was approx. 10 to 20 per cent points lower than during the cold days.

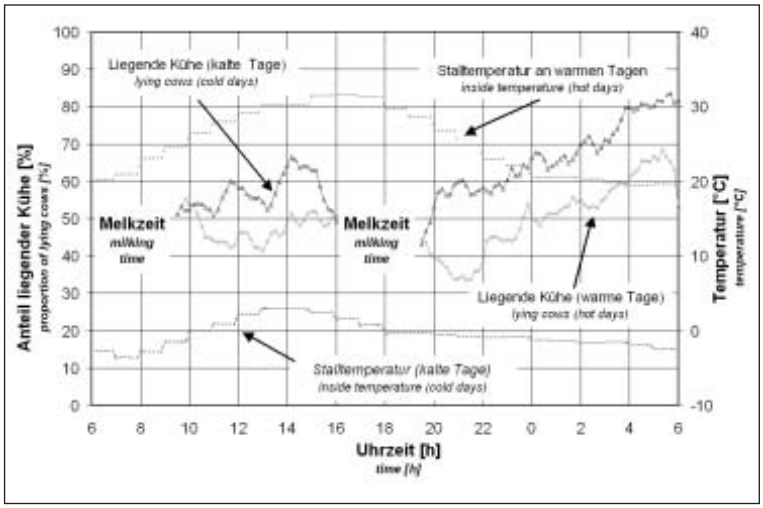

Fig. 1: Occupation of lying boxes at cold and hot days

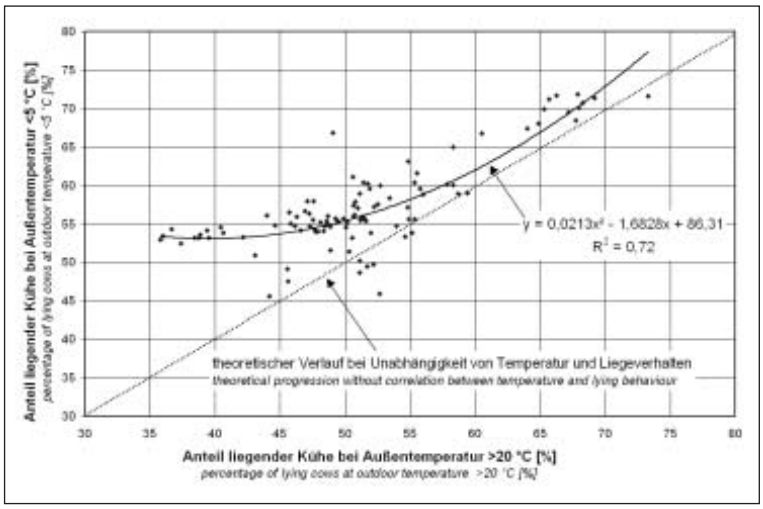

Fig. 2: Correlation between the percentage of lying cows at hot and cold days

Influence of the temperature on the lying behaviour in regard to time of day

To clarify the temperature influence regarding the times of day day on lying behaviour, i.e. to consider the natural daily rhythm of the cows, the occupation of the lying boxes was compared at the same time of day on warm and cold days. The relationship between the average occupation of the lying boxes at outside temperatures above 20 °C and below 5 °C at the same day and night time is represented in *Figure 2*. This relationship can be described with the help of a square function. It seems that the occupation of the lying boxes between 35 and 55 % at warm temperatures would at cold temperatures result in 10 to 15 percent points more cows. However, if at the warm temperatures already over 60 % of the cows are lying, then at the cold temperatures it would be not visible more. A temperature influence is then not more observed. This is a clear indicator that apart from the temperature other factors play a large role.

Influence of wind speed on the lying behaviour

The air movement in the stable depends on the region, the placement of the stable in the vicinity and the kind and size of the wall closure. The curtains installed in both farms were closed at temperatures below 6 °C. This applies likewise for wind speed over 6 m/s. With this, the measured data showed this, a large protection against outside wind movement is reached. With open curtains the average outside wind speed was 2.0 m/s at a standard deviation of 1.6 m/s. At the same time, an average air movement of 0.36 to 0.52 m/s with standard deviations of 0.24 to 0.43 could be measured at different places in the stable. Although with closed curtains the average outside wind speed with 2,65 m/s ± 2,15 m/s was clearly higher, the average air movement in the stable was only 0.23 to 0.29 m/s ± 0,10 to 0,19 m/s.

No relationship was found between the air movement in the stable and the occupation of lying boxes for the temperature range up to 23 °C. However, the occupation of the lying boxes at higher temperatures increases with increasing air movement in the stable. The correlation coefficients between wind speed and the occupation of the lying boxes was 0.30 (farm 1) resp. 0.28 (farm 2).

Conclusion

From the results of the animal behaviour and the stable environment measurements the following conclusions can be drawn:

- Large differences in the occupation of the individual lying boxes are observed in the stable. Particularly edge boxes are very less occupied.
- At the middle temperatures (5 to 20 °C) there is no clear relationship between stable environment and animal behaviour. Therefore, the control of the opening/closing of curtains can be kept very wide.
- At high temperatures, significantly less cows lie than at low temperature. This shows a decreased comfort for the animals.

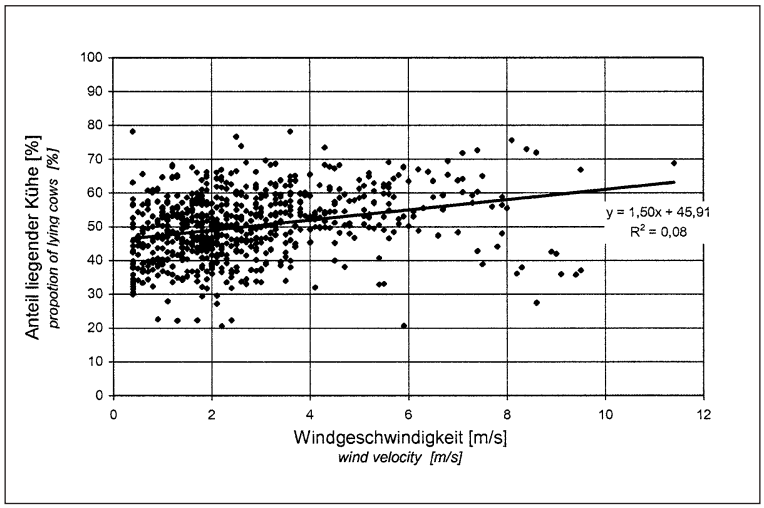

Fig. 3: Percentage of lying cows depending on wind velocity outside at temperatures > 20 °C