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EVALUATING THE EFFECT OF ENVIRONMENT IN HOLSTEIN COWS UNDER TROPICAL CONDITIONS

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ABSTRACT

In hot summer weather under tropical conditions, milking cows experience a decline in production due to the increase in both dry bulb temperature and relative humidity. Providing good shade associated with evaporative cooling help reduce the negative effects of the heat stress exposition (Bucklin et al., 1991). However under tropical weather, the normally occurring high values of relative humidity limits the use of evaporative cooling, and leaves fans or water spraying as one alternative for cooling the animals. The main disadvantage of water spraying over the cows is the excess of water that may lead to increase in the humidity inside the buildings. This research had the objective of evaluating the effect of the environment for a group of Holstein cows in a freestall system under tropical conditions. The trial had 460 Holstein milking cows and took place at a dairy farm located at an altitude of 750m, latitude of 22.14ºS and longitude of 46.74º W. The cows were selected by their milking yield and two groups were formed: the low production (LPC) for values ≤ 20 kg of milk/cow/day, and the high production cows (HPC) for values ≥.21 kg of milk/cow/day. Dry bulb temperatures and relative humidities were recorded inside the freestall buildings from October 1999 to November 2000. Data were organized in a way to statistically verify the decline of milk production as function of dry bulb temperature and relative humidity and the time of the year. It was found that for HPC the decrease in production was not significantly related to dry bulb temperature or to the relative humidity values, while the LPC presented a significant decrease in production (α=0.05) related to the increase in the dry bulb temperature inside the housing, even though it did not present significant change in milk yield due to the relative humidity. Best yields were recorded during the months of April to July, Winter season, where the milk yield increase in average was 3.4 kg/cow/day. As the use of cooling equipment tends to reduce the inside temperature, even though the less productive cows (30% of the herd, 2.0 kg/cow/day) did not show a significant response to the decrease in the environmental temperature during the cooler months, the increase in the milk yield for the most productive cows (50% of the herd, 0.4 kg/cow/day) was found. Using cooling equipments it was found for the whole herd an average increase in milk yield of 4.2kg/cow/day, that may justify an investment in cooling devices.

KEYWORDS. Milk yield, environment, cooling equipment.

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INTRODUCTION

Brazilian milk production has been transformed lately due to the new world's economic order and new technology being adopted by the producers for improving productivity. On the other hand, most Brazilian dairy cows stay on pasture and the animals are exposed to direct solar radiation and consequently are heat stressed and experience a reduction in milk production. Some producers use freestalls, however the incidence of high dry bulb and black globe temperatures lead to decreased milk production. To minimize the negative effect of the tropical environment on the milking cows it is necessary to understand the relationships between the animal exposed to high environmental temperatures and its physiological response, as well as to present solution that effectively reduces heat stress.

Milking cows usually have body temperatures around 38.5°C, heartbeats of 60 to 80 pulses/min, and respiratory frequency of 10-30 resp/min. This data change slightly during the day being higher by the end of the afternoons. It also changes during the estrus cycle and the yearly seasons (Head 1995). Nääs (1989) found the limits of 13 °C to 18 °C for the thermal comfort zone for most ruminant animals, varying from 4 °C to 24 °C for lactating cows. It is also within the limits of 7°C to 21 °C as a function of the incident relative humidity and direct solar radiation.

Milk production decrease in the tropics was found by Laloni (2001) to be associated to rain index, grazing soil temperature, and direct solar radiation. The use of fans seems to provide a good environment and is presented by Bray et al. (1994) as a good strategy for reducing heat stress during hot weather. Brazilian producers are reluctant to invest in cooling devices mainly because it is believed that the benefit would be greatest for high milk yield cows, and as these cows usually represent only a small part of the herd, the cost benefit would not justify the investment.

The objective of this research was to evaluate the effect of fans and fogging to modify the interior environment for Holstein cows lodged in a freestall barn under tropical conditions.

METHODOLOGY

The trial had 460 Holstein milking cows and took place at a commercial dairy farm located at an altitude of 750m, latitude of 22.14ºS and longitude of 46.74º W, near the Tropic of Capricorn. The cows were selected by milk yield and two groups were formed: the low production (LPC) for values ≤ 20 kg of milk/cow/day, and the high production cows (HPC) for values ≥.21 kg of milk/cow/day. They were lodged in freestall barn, as seen in Figure 1.

Figure 1. Freestall barn

The freestalls dimensions were: 4.6m of average height, 85m of length and 29m of width. The floor was cement and the roof was metal.

Maximum and minimum dry bulb temperatures as well as relative humidity were recorded inside the freestall buildings from October 1999 to November 2000. A datalogger Testo® was used for recording dry bulb temperature and relative humidity. The unit was installed at a 2.5m height in the geometric center of the building.

Data were organized in a way to statistically verify the decline of milk production as function of dry bulb temperature and relative humidity and the time of the year. The Statistics software Minitab® was used for analyzing data.

RESULTS AND DISCUSSION

Average environmental and milk production data are shown in Table 1. A T test was applied for verifying the difference between the two group and they were found to be different at $\propto$=0.05, for the distinct values of maximum dry bulb temperature throughout the year.

Table 1 shows the average environmental data as well as the yield results without the use of fans and fogging inside the freestall.

Table 1. Average environmental and milk yield data.

Month	Tmax (°C)	Tmin (°C)	RH(%)	LPC (kg/dia)	HPC (kg/dia)
Jan	32.3	22.5	75.8	16.5	24.6
Feb	33.9	22.7	73.4	16.7	23.8
Mar	32.3	21.0	74.0	19.2	24.0
April	32.2	19.6	73.1	21.3	24.6
May	32.8	16.0	71.3	16.4	24.8
Jun	29.7	14.0	70.5	20.2	25.3
Jul	30.9	14.6	65.9	18.1	26.5
Aug	32.3	15.6	60.8	17.7	26.4
Sept	32.8	16.8	62.3	17.4	25.6
Oct	32.5	20.8	64.5	14.0	25.8
Nov	35.2	21.8	68.8	17.5	24.7
Dec	34.2	22.3	74.5	16.8	24.8
Average	32.6	19.0	69.6	17.6	25.0

Figure 2 shows the milk yield for HPC and LPC as function of the time of the year without any artificial resources of reduction of heat stress. It was found that for HPC the decrease in production was not significantly related to dry bulb temperature or to relative humidity values, while the LPC presented a significant decrease in production (α=0.05) related to the increase in dry bulb temperature inside the housing, even though it did not present significant change in milk yield due to the relative humidity. Best yield were recorded during the months of April to July, Winter season with milder temperatures, where the milk yield increase in average was 2.0 kg/cow/day for the LPC group and 0.4 kg/cow/day for the HPC group. The average milk yield value for the total group (LPC+HPC) during the year was 21.36 kg/cow/day.

Profile of milk yield for two groups of milking cows

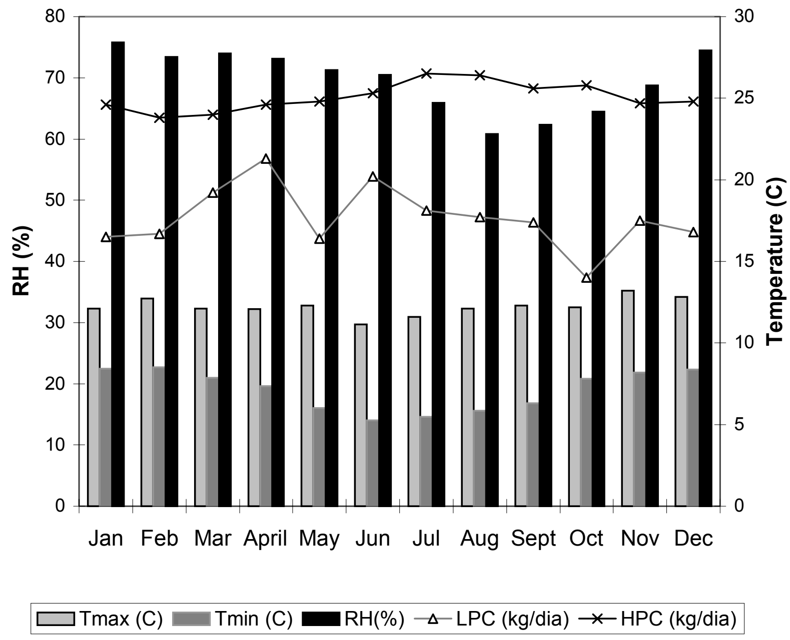
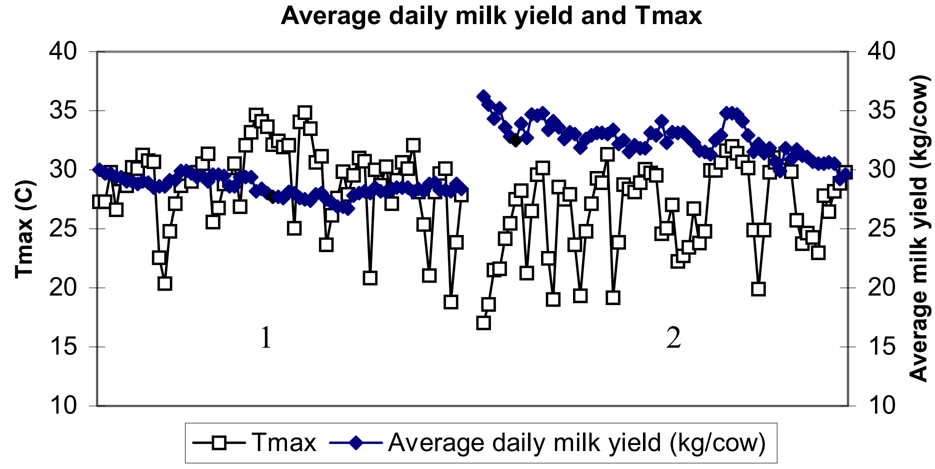


Figure 2. Profile of the milk yield for the two studied group of cows without the use of fans and fogging.

A simulation using the software Milk Plus was used. A forecast for milk yield was calculated simulating the use of fans and fogging. As the use of cooling equipment tends to reduce the inside temperature, even though the most productive cows (50% of the herd) did not show a significant response to the decrease in the environmental temperature during the cooler months, the increase in the milk yield for the less productive cows (30% of the herd) may justify an investment in cooling devices. The simulated overall increase in milk yield was of 3.4 kg/cow/day.

Afterwards 40 fans and 2 fogging lines were added to the freestall barn in order to verify and validate the simulation process. Figure 3 shows the final results comparing average milk yield and maximum dry bulb temperature for all cows in the trial.



1= without fans+fogging, 2=with fans+fogging

Figure 3. Data on average milk yield and maximum dry bulb temperature.

As it can be confirmed in Table 2, the average daily production for the whole herd increased by using fans and fogging, that improved the inside environment, as described by Bray et al. (1994) and Bucklin et al. (1991). The whole group of LPC and HPC could not be separated for the statistical analysis as they where both in the same building. The average difference in milk yield was 4.2 kg/cow/day even though the temperature did not reach the values presented by Nääs (1986).

Table 2. Data on environment and milk production (α= 0,01)

Environment	Average daily milk yield (kg/cow/day)
Natural ventilation	28.50 a
With climatization	32.65 b

This results using fans and fogging is probably due to the reduction in the inside maximum dry bulb temperature as seen in Table 3.

Table 3. Data on environment parameters

Environment	Tmax (ºC)	Tmin (ºC)	RH%
Natural ventilation	32.6	19.0	69.6
With climatization	26.5	18.5	65.9

CONCLUSION

Milk yield versus environment can be analyzed for decision making. When only natural ventilation is used for the housing system, one must also consider the seasonal changes on milk yield throughout the year, mainly during cooler months. The software Milk Plus was useful for estimating milk yield by simulating environmental changes. The prediction of milk yield was confirmed by the use of cooling devices such as fans plus fogging inside the freestall. There was a significant reduction in the dry bulb maximum average temperatures (26.5ºC<32.6ºC) that probably led to a significant improvement in the average milk yield for the whole group of housed herd of cows LPC+HPC (4.2kg/cow/day), and slightly above the predicted value (3.4kg/cow/day).

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