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COMMUNICATION

Effectiveness of different strategies to prevent from heat stress in a group of dairy farms located in the Province of Padova

Flaviana Gottardo[1], Martina Dorigo[1], Paolo Paparella[2], Cristiano Ossensi[1], Giulio Cozzi[1]

[1] Dipartimento di Scienze Animali. Università di Padova, Italy
[2] Associazione Provinciale Allevatori. Padova, Italy

Corresponding author: Dr. Flaviana Gottardo. Dipartimento di Scienze Animali. Università degli Studi di Padova. Viale dell'Università 16, 35020 Legnaro, PD, Italy – Tel. +39 049 8272662 – Fax: +39 049 8272669 – Email: flaviana.gottardo@unipd.it

ABSTRACT

Heat stress during the summer season is an important factor which can impair dairy cows physiology and productivity. A survey was carried out on a sample of 30 dairy farms of the Province of Padova to assess the effectiveness of different strategies for heat stress control. All farms used a fan cooling system but in those were a sprinkler device was also operating an increased milk yield was observed (+5.0%). Cows receiving the diet in two daily distributions (morning and evening) increased DM intake (+9.0%) and milk yield (+15.0%) in comparison to animals fed once a day. No difference, instead, were observed in farms where cows were fed once a day in the morning or in the evening. A positive milk response (+8.1%) was recorded in farms equipped with wide waterers at the exit of the milking parlour.

Key words: Dairy cow, Heat Stress, Cooling devices, Feeding management

Introduction

Heat stress is the most important factor impairing dairy cows productivity and fertility during summer months (West, 2003). A wide number of studies have been carried out with dairy cattle to select the best solutions capable to limit the detrimental effects of thermal stress. The installation of cooling devices has always been recommended and the association of fans and sprinklers has been reported to increase feed intake (+9.2%) and milk yield (+15.9%) (Turner *et al.*, 1992). The improvement of watering system is also recommended to compensate the greater water losses due to the activation of thermoregulatory mechanisms by the animals (Shalit *et al.*, 1991). Other management strategies, such as the evening administration of TMR, have be suggested in order to stimulate DMI (Aharoni *et al.*, 2004). The aim of the present study was to evaluate the effectiveness of some of these solutions in a representative sample of dairy farms of the Province of Padova during the summer season of the year 2004.

Material and methods

The study used data collected in 30 dairy farms located in the Province of Padova. All farms raised Italian Holstein cattle and the average herd size was 73 ± 36 cows. The lactating cows were housed in free stall barns in which a fan cooling system was operating during the summer season. Fan diameter was lower than 130 cm in 14 cases while in the remaining 16 it was greater than 130 cm. In addition to the fans, sprinklers were oper-

Table 1. Effect of fan sizes and presence of sprinklers on THI, feed intake, milk production, and cows physiologic parameters.

		Fan size (F) cm		Sprinklers (S)		RMSE	Significance		
		<130	>130	No	Yes		F	S	F*S
Herds	n.	14	16	20	10				
THI inside the barn		81.1	81.3	81.4	81.0	2.5	ns	ns	ns
DM intake	kg	20.8	21.6	21.1	21.4	1.6	ns	ns	ns
Milk yield	"	28.5	29.1	28.1	29.5	2.4	ns	†	ns
Milk fat	%	3.64	3.64	3.62	3.67	0.15	ns	ns	ns
Milk protein	"	3.27	3.25	3.26	3.26	0.10	ns	ns	ns
Respiratory rate	breaths/min	78.8	81.0	80.1	79.7	10.8	ns	ns	ns
Hearth rate	bits/min	81.1	83.3	81.6	82.8	6.0	ns	ns	ns
Rectal temperature	°C	38.8	38.9	38.8	38.8	0.4	ns	ns	ns

†: P < 0.10; ns: not significant

ating in 10 barns. All the herds were fed ad libitum a total mixed ration (TMR) but farms differed for the time and number of the daily distribution. The diet was delivered only once in the morning in 17 farms. A single distribution in the evening was adopted in 7 farms, while in the remaining 6 there were 2 distributions in the morning and the evening. Considering the water provision, the attention was focus on the water trough located at the exit of the milking parlour. This was absent in 5 farms, while it was <100 cm in 10 farms and >100 cm in the remaining 15. Data collection was carried out by visiting each farm twice at the end of July and August respectively. The intake of TMR and milk production per lactating cow were recorded. A representative milk sample was collected from the farm milk tank and submitted to protein and fat analysis. Rectal temperature, respiratory rate and hearth rate were measured in each farm on a random sample of 10% of the lactating cows. Environmental temperature and relative humidity were recorded at the feeding area of the barn to calculate the Temperature-Humidity Index (THI). The final data set was submitted to three different ANOVA within PROC-GLM (SAS, 1989). A first model considered the effects of fan size, presence of sprinklers and their interaction. The second model tested the effect of the time and number of TMR distribution, while the third one evaluated the effect of the waterers outside the milking parlour. All the three models included also the effects of farm and, as covariate, the herds mature cow equivalent and days in milk available at the time of the 2 visits.

The diameter of the fans operating in the barn did not affect THI as well as cows intake, physiologic parameters, and milk response (Table 1). Also the sprinklers did not improve the environmental conditions of the barn along with the values of several heat stress indicators measured on cows (Table 1). However, it must be pointed out that since the sprinklers were turned on manually in all farms, most of them were not working at the time of data collection and this could have biased the results of the environmental and physiologic variables. Consistent with Chan *et al.* (1997), this evaporative cooling system promoted instead a positive milk response as a long term effect on heat stress reduction (Table 1).

As regards to the feeding strategy (Table 2), a significant positive effect on cows DM intake was observed only in farms which adopted the double daily distribution of fresh TMR (morning and evening) during the summer season. In case of a single daily distribution, instead, there has been no difference between the morning and evening one. These results indicate that in a hot environment cows benefit from the availability of fresh

Table 2. Effect of the time and number of daily distribution of the diet on feed intake and milk production.

		Time of diet distribution			RMSE
		Morning	Evening	Morning & Evening	
Herds	Number	17	7	6	
DM intake	kg	20.6^{b}	21.6^{ab}	23.0^{a}	1.6
Milk yield	"	27.8$^{\beta}$	27.3$^{\beta}$	31.6$^{\alpha}$	2.4
Milk fat	%	3.61	3.66	3.61	0.15
Milk protein	"	3.25	3.19	3.29	0.09

Means within row with different superscript (a, b) differ at P <0.05 and (α, β) differ at P <0.10

TMR while they are less motivated to eat a diet which remains in the manger for a long time. Consistent with the highest intake, cows fed twice a day showed an increased milk production with no difference in milk composition (Table 2).

The presence of waterers longer than 100 cm at the exit of milking parlour had a positive effect on DM intake and milk yield (Table 3). On the contrary, when the size of the waterers was below 100 cm the performance of the animals were similar to those recorded in the farms without any water provision outside the milking parlour. Dairy cows behaviour could explain these results. The reduced space at the water trough as well as at the manger, can affect cattle social behaviour, increasing competition among animals. In this situation it is likely that the low ranking subjects of the herd will be penalized in their freedom to visit these areas (Syme and Syme,1979).

Considering the different strategies for the heat stress control evaluated in the present study we can conclude that the fan's size seems to have a minor influence on dairy cows physiology and productive response. It is likely that the number and location of the fans within the barn will play a more important role than their size. Cows have shown to benefit from the use of sprinklers, however the effectiveness of this cooling device could be maximized by the adoption of an automatic turn-on system capable to start the cooling device when THI inside the barn reaches the critical threshold of 75. Based on cows intake and productive response, it seems recommended to split in two distribution the daily TMR administration during the summer season, while the single evening delivery has not shown any advantage in comparison to the morning one. Finally, the survey has demonstrated the role played by the water

Table 3. Effect of presence and size of the water trough located outside the milking parlour on feed intake and milk production.

		Water trough size outside the milking parlour			RMSE
		None	< 100 cm	> 100 cm	
Herds	Number	5	10	15	
DM intake	kg	20.1$^{\beta}$	21.0$^{\alpha\beta}$	21.6$^{\alpha}$	1.6
Milk yield	"	27.2^{b}	27.4^{b}	29.5^{a}	2.3
Milk fat	%	3.56	3.67	3.63	0.14
Milk protein	"	3.32	3.24	3.25	0.10

Means within row with different superscript (a, b) differ at P <0.05 and (α, β) differ at P <0.10

provision at exit of the milking parlour. It is advisable to adopt big size waterers capable to allow the simultaneous visit of all the cows exiting together after the milking. However, in order to prevent the heat stress, the provision of drinking water outside the milking parlour must not replace the maximum availability of water in the other housing areas of the barn.

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