Italian Journal of Animal Science

ISSN: (Print) 1828-051X (Online) Journal homepage: http://www.tandfonline.com/loi/tjas20

Effect of heat stress on production in Mediterranean dairy sheep

R. Finocchiaro, J.B.C.H.M. van Kaam, M.T. Sardina & I. Misztal

To cite this article: R. Finocchiaro, J.B.C.H.M. van Kaam, M.T. Sardina & I. Misztal (2005) Effect of heat stress on production in Mediterranean dairy sheep, Italian Journal of Animal Science, 4:sup2, 70-72, DOI: 10.4081/ijas.2005.2s.70

To link to this article: http://dx.doi.org/10.4081/ijas.2005.2s.70

Effect of heat stress on production in Mediterranean dairy sheep

R. Finocchiaro[1], J.B.C.H.M. van Kaam[2], M.T. Sardina[1], I. Misztal[3]

[1] Dipartimento Scienze Entomologiche, Fitopatologiche, Microbiologiche e Zootecniche, Università di Palermo, Italy
[2] Istituto Zooprofilattico Sperimentale della Sicilia "A. Mirri", Palermo, Italy
[3] Animal and Dairy Science Department, University of Georgia, USA

Corresponding author: Raffaella Finocchiaro. Dipartimento Scienze Entomologiche, Fitopatologiche, Microbiologiche e Zootecniche, Sezione Produzioni Animali. Viale delle Scienze 13, 90128 Palermo, Italia – Tel: +39 091 7028869 – Fax. +39 091 7028873 – Email: rfino@unipa.it

RIASSUNTO – Effetto dello *stress* termico sulle produzioni quanti-qualitative di ovini da latte allevati nel Mediterraneo. *Il data-set comprende 59.661 test-days appartenenti a 6.624 lattazioni. Le variabili dipendenti sono le produzioni giornaliere di latte (g) e di grasso+proteina (g). Per la stima dei parametri genetici è stato utilizzato un repeatability test-day model. Il pedigree comprende 5.306 animali. La produzione di latte giornaliera mostra un decremento quando l'indice di temperatura-umidità (THI) raggiunge 23. Le correlazioni fenotipiche di THI≥ 23 con la produzione di latte sono state per entrambi i caratteri e i giorni considerati (stesso giorno e giorno prima del controllo) sempre negative (circa -0.3). Le correlazioni genetiche tra la produzione di latte generale e la tolleranza al caldo sono negative (circa -0.8) per entrambi i giorni e i caratteri (latte e grasso+proteina) considerati. Pertanto la produzione di latte è antagonista della tolleranza al caldo e la selezione diretta solo alla produzione di latte ridurrà la tolleranza al caldo.*

KEY WORDS: heat tolerance, temperature-humidity index (THI), dairy sheep.

INTRODUCTION – European Mediterranean countries are characterized by exposure to considerable heat between three and six months annually. High ambient temperature, solar radiation, wind speed and relative humidity, cause the effective temperature of the environment to be above the thermo-neutral zone of the animals (5 to 25ºC; McDowell, 1972) and therefore heat stress occurs (Bianca, 1962). Heat stress is one of the limiting factors in dairy production in hot climates (Johnson *et al.*, 1962) and is hard to account for by management in the extensive grazing-based farming system of Mediterranean dairy sheep where animals are rarely kept indoors. The interest of our study was to investigate if in the Mediterranean area heat stress has an effect on dairy sheep performance. Some studies (Ames *et al.*, 1971; Sevi *et al.*, 2001) on sheep heat stress investigated changes in rectal temperatures, respiration rates, volumes of air inhaled and other physiological functions. Unfortunately, such measurements are costly and not feasible on a large scale in practical farming circumstances, which leads to insufficient data quantity, especially for genetic studies. In the present paper the methodology of Ravagnolo *et al.* (2000) based on using weather station data for Holstein cattle was applied to Valle del Belice dairy sheep. The animals were investigated with the following aims: to establish the relationship between production and weather conditions using information from a weather station, and to estimate the additive genetic variances of milk production traits and heat tolerance, and therefore to investigate the possibility of future selection for increased heat tolerance.

MATERIAL AND METHODS – Data consisted of 59,661 test-day records belonging to 6,624 lactations of 4,428 lactating ewes in 17 flocks. The pedigree file consisted of 5,306 animals, i.e. besides the 4,428 animals with

records, 188 male and 690 female ancestors were included. Production information included test-day milk and fat plus protein (F+P) yield (g). The meteorological data consisted of daily maximum temperature (T) and daily average relative humidity (RH). The temperature-humidity index (THI) has been calculated as proposed by Kelly and Bond (1971). The THI is commonly used as an indicator for the degree of stress on animals caused by weather circumstances. In addition to the effects of the weather conditions of the test-day also the preceding day has been considered. Two fixed effect models have been applied, which included flock × year of test-day interaction, days in milk class × parity class (1st, 2nd and ≥3rd) interaction, and T × RH interaction or THI, respectively. In order to estimate the additive genetic (co)variances of production and heat tolerance a repeatability test-day model (Ptak and Schaeffer, 1993) has been applied as well. All lactations were used in the analysis. This increases the number of connections between flocks.

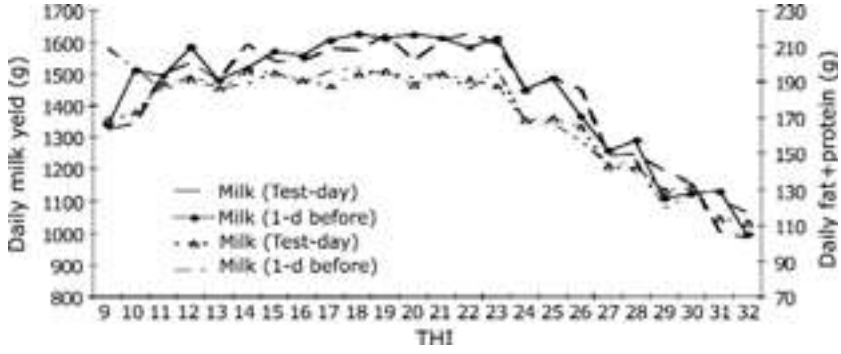
RESULTS AND CONCLUSIONS – Table 1 shows Pearson correlation coefficients between daily milk and F+P yield, the weather conditions including T, RH, and THI on the test-day and on the preceding day. Only days with heat stress (THI≥ 23) were considered. Above THI=23 production started to decline, hence THI=23 is the starting threshold for heat stress in Valle del Belice dairy sheep. Milk and F+P productions always showed negative phenotypic correlations with T and THI.

Table 1. Pearson correlation coefficients between daily milk and F+P yields and the weather conditions including T, RH and THI on two days (THI≥23).

			Test-day			1d before		
	Milk	F+P	T	RH	THI	T	RH	THI
Milk	1	0.93	-0.36	0.38	-0.30	-0.35	0.39	-0.28
F+P		1	-0.38	0.39	-0.32	-0.38	0.41	-0.31

These results indicate an effect of the weather conditions on dairy sheep performances. Further, this confirms that weather stations can be useful for the detection of heat stress in dairy sheep production. All the fixed effects in the models applied were significant. Two data sets have been used; one considered the entire data with 9≤THI≤32, and the other one a reduced data set with THI≥23. Figure 1 shows least square means for the entire data set (9≤THI≤32) for test-day milk and F+P productions with weather conditions of two days considered. All the lines show a similar shape for daily milk and F+P production; respectively, however it seems that 1d before results in a smoother line with less variability. Clear is the production decline above THI=23.

Figure 1. Relation between the daily milk and F+P yields and the THI based on maximum temperature and average relative humidity in two days (Test-day and 1d before).



The test-day presents a drop of daily milk production of -52.3 g and of -8.2 g for daily F+P production. Further 1 d before showed to have a slightly higher drop of production; it resulted, in a decrease of milk and F+P production of -55.8 g and -8.6 g respectively per unit of THI increase (THI≥23). These results indicate that Valle del Belice sheep, although originating from a hot environment, are affected by heat stress resulting in a decrease of production. In contrast, Sevi *et al.* (2001) reported heat stress for the Comisana dairy sheep breed also reared in Sicily occurred for THI≥27. The genetic correlations between both production traits and heat tolerance additive genetic effects were all negative in the two days considered at -0.77 and -0.79 for milk and F+P production on the test-day and at -0.82 and -0.86 respectively for 1 d before. These results, in agreement with Ravagnolo and Misztal (2000) for Holstein cattle, imply that production is antagonistic with heat tolerance, and therefore selection only for milk production will result, in the long term, in animals with a lower heat tolerance.

REFERENCES – **Ames,** D.R., Nellor, J.E., Adams, T., 1971. Energy balance during heat stress in sheep. J. Anim. Sci. 32:784-788. **Bianca**, W., 1962. Relative importance of dry and wet bulb temperature in causing heat stress in cattle. Nature 195:252-252. **Johnson**, H.D., Ragsdale, A.C., Berry, I.L., Shanklin, M.D. 1962. Effect of various temperature humidity combinations on milk production of Holstein cattle. Agric. Exp. Sta. Res. Bull. 791. **Kelly**, C.F., Bond, T.E., 1971. Bioclimatic factors and their measurement. In: Kelly, C.F., Bond, T.E. (Eds.) A guide to environmental research on animals. National Academy of Sciences, Washington, U.S.A., 1st ed., pp. 7-92. **McDowell**, R.E., 1972. Improvement of livestock production in warm climates. Freeman, San Francisco, pp. 410-449. **Ptak**, E., Schaeffer, L.R., 1993. Use of test day yields for genetic evaluation of dairy sires and cows. Livest. Prod. Sci. 34:23-34. **Ravagnolo**, O., Misztal, I., Hoogenboom G., 2000. Genetic component of heat stress in dairy cattle, development of heat index function. J. Dairy Sci. 83:2120-2125. **Ravagnolo**, O., Misztal, I. 2000. Genetic component of heat stress in dairy cattle, parameter estimation. J. Dairy Sci. 83:2126-2130. **Sevi**, A., Annicchiarico, G., Albezio, M., Taibi, L., Muscio, A., Dell'Aquila, S., 2001. Effects of solar radiation and feeding time on behavior, immune response and production of lactating ewes under high ambient temperature. J. Dairy Sci. 84:629-640.