Effect of weather conditions on somatic cell score in Sicilian Valle del Belice ewes

R. Finocchiaro¹, J. B. C. H. M. van Kaam², B. Portolano¹

¹ Dipartimento di Scienze Entomologiche, Microbiologiche Agrarie e Zootecniche. Università di Palermo, Italy
² Istituto Zooprofilattico Sperimentale della Sicilia “A. Mirri”. Palermo, Italy

Corresponding author: Raffaella Finocchiaro. Dipartimento di Scienze Entomologiche, Microbiologiche Agrarie e Zootecniche. Sezione Produzioni Animali, Università di Palermo. Viale delle Scienze-Parco D’Orleans, 90128 Palermo, Italy - Tel. +39-091 7028869 - Fax: +39 091 7028873 - Email: rfino@unipa.it

ABSTRACT: Mastitis susceptibility of Valle del Belice ewes from the south of Sicily to temperature, humidity, precipitation, solar radiation, sun hours, air pressure, wind-speed and wind-direction measured by a public weather station was investigated using 65,848 test-day somatic cell score (SCS) records of 5,237 ewes. All weather parameters had an effect on SCS in a regression approach. Extreme values of maximum and minimum temperature-humidity indices resulted in increased SCS. Higher precipitation, solar radiation and sun hours resulted in increased SCS, whereas higher air pressure and wind speed resulted in reduced SCS.

Key words: Dairy sheep, Mastitis, Somatic cell score, Weather effects.

INTRODUCTION – Weather conditions are known to have effects on performance and well-being of livestock animals. Few studies have been done on genetic resistance against extreme weather conditions (e.g. Ravagnolo and Misztal, 2000; Finocchiaro et al., 2005a). This is a form of genotype by environment interaction affecting the robustness of animals. Studies have often been done using detailed physiological measurements such as changes in rectal temperatures, respiration rates or volumes of air inhaled. Unfortunately, such measurements are not routinely collected, costly and not feasible on a large scale in practical farming circumstances, which leads to insufficient data quantity, especially for genetic studies. To overcome these problems, a novel approach was developed by Ravagnolo et al. (2000) where production data was combined with weather information obtained from public weather stations. The use of public weather stations instead of individual animal or farm measurements has substantial advantages: (1) Data is already collected on a regular basis for many years and is readily available without cost (2) Measurements are done with professional equipment resulting in more accurate measurements (3) Public weather stations usually measure a larger number of weather parameters compared to on-farm equipment. Research has confirmed that information from public weather stations is at least as useful as on-farm measurements (Finocchiaro et al., 2005b; Freitas et al., 2006). To assess mastitis susceptibility of Valle del Belice ewes to weather conditions, the relation between test-day somatic cell scores and several weather parameters was analyzed. These analyses are part of a study whereby later genetic effects will be included.

MATERIAL AND METHODS – Production data consisted of 65,848 test-day records belonging to 7,816 lactations of 5,237 ewes and were collected by the University of Palermo between 1998 and 2006 in 17 Valle del Belice flocks located north of Agrigento and within 60 km distance of the weather station. Individual test-day somatic cell counts (SCC) which are non-normally distributed were converted to somatic cell scores (SCS) using the Ali and Shook (1980) transformation. The daily meteorological data, collected by one weather station, consisted of maximum temperature (Tmax), minimum temperature (Tmin), average relative day humidity (DRH), average relative night humidity (NRH), precipitation, solar radiation, absolute sun hours, relative sun hours, wind speed, wind direction and air pressure. Two temperature-humidity indexes (THI) have been calculated as proposed by Kelly and Bond (1971), THI1 with Tmin and NRH and THI2 with Tmax and DRH. Based on results obtained by Finocchiaro et al. (2005a), relating to the effect of THI2 on production traits, only the effect of the day before the test-day was considered. For each of the weather parameters a fixed effect model was applied, which included a flock ? year of test-day interaction and a days in milk class ? parity class (1st, 2nd and ≥3rd) interaction.
The models can be described as:

\[ y_{ijkl} = \mu + (\text{Flock} \times \text{Year}_{\text{TD}})_{i} + (\text{DIM} \times \text{Parity})_{j} + \text{Weather Parameter}_{k} + e_{ijkl} \]

Statistical analyses were performed using SAS PROC GLM (SAS Institute Inc., 2000).

**RESULTS AND CONCLUSIONS** – The results of the regression approach indicated effects of all weather parameters on the SCS patterns. All models were significant and showed a coefficient of determination around 0.11. Figure 1 shows the least square means for SCS using either THI1 or THI2 in the model. Extreme values of both parameters show higher SCS values. With \( \text{THI2} \geq 25 \) the SCS is increasing. THI1 and THI2 show a similar pattern because cold days come usually with cold nights and hot days with hot nights. The range in SCS on the y-axis for THI1 is equivalent to a SCC of \( 23 \times 10^3 \) cells/ml and for THI2 the range is equivalent to a SCC of \( 49 \times 10^3 \) cells/ml. Hence both heat and cold lead to increased occurrence of mastitis.

Figure 1. The effect of temperature-humidity indexes using minimum temperature with night relative humidity (THI1) and maximum temperature with day relative humidity (THI2) recorded the day before on somatic cell score (SCS).

![Figure 1](image.png)

Using the precipitation parameter in the model (Figure 2), it can be calculated that the differences in SCS correspond to a range in SCC of \( 31 \times 10^3 \) cells/ml.

Figure 2. The effect of precipitation classes recorded the day before on somatic cell score (SCS) level.

![Figure 2](image.png)

The decrease in SCS on the y-axis is equivalent to a drop in SCC of \( 9 \times 10^3 \) cells/ml.
Figure 3. The effect of wind speed classes recorded the day before on somatic cell score (SCS) level.

In general in all models higher solar radiation, sun hours and precipitation resulted in increased SCS, whereas higher air pressure and wind speed resulted in reduced SCS. These preliminary results suggest that it is important to include weather information in genetic evaluation models for mastitis resistance.

REFERENCES – Ali, A.K.A., Shook, G.E., 1980. An optimum transformation for somatic cell concentration in milk. J. Dairy Sci. 63:487-490. Finocchiaro, R., van Kaam, J.B.C.H.M., Portolano, B., Misztal, I., 2005a. Effect of heat stress on production of Mediterranean dairy sheep. J. Dairy Sci. 88:1855-1864. Finocchiaro, R., Di Grigoli, A., van Kaam J.B.C.H.M., Bonanno, A., Portolano, B., 2005b. Evaluation of in-farm versus weather station data as heat stress indicator in Mediterranean dairy sheep. Book of Abstracts of the 56th Annual Meeting of the European Association for Animal Production (EAAP), 5-8 June 2005, Uppsala, Sweden, p. 266. Freitas, M.S., Misztal, I., Bohmanova, J., West J., 2006. Utility of on- and off-farm weather records for studies in genetics of heat tolerance. Livest. Sci. 105:223-228. 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. Ravagnolo, O., Misztal, I., 2000. Genetic component of heat stress in dairy cattle, parameter estimation. J. Dairy Sci. 83:2126-2130. 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. SAS Institute Inc., 2000. User's Guide, Version 8. Cary, NC, USA.