INFLUENCE OF VARIOUS CLIMATIC FACTORS ON MILK PRODUCTION IN CATTLE IN TANZANIA

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SUMMARY

Milk records of individual cows and meteorological data for each day over a period of 24 years were extracted from the files at the Livestock Production Research Institute at Mpwapwa in Central Tanzania. The herd was composed of various crosses between Bos indicus and Bos taurus cattle, and carried on average about 20% taurus inheritance. Milk yields were accumulated for successive periods of 28 days from calving to end of lactation, and related to average temperatures and total rainfall in the same period (and/or in the preceding period). The relationship was studied by multiple regression analysis.

The proportion of total variation in milk yield accounted for by the climatic parameters considered, was in the range of 5 to 10 per cent. The variation which could be ascribed to individual weather variables was small, partly because of the close correlation between most of the variables.

High morning (09.00 h) temperatures had a consistently negative influence on concurrent milk yield. In contrast high minimum temperatures, and high afternoon (15.00 h) temperatures on the wet bulb thermometer, had a significant positive effect. Milk yield was also positively influenced by high rainfall both concurrently and in the preceding period.

The apparently positive effect of high wet bulb temperature in the afternoon might be explained by the inverse relationship between humidity and solar radiation, a climatic factor which was not recorded in this set of data.

INTRODUCTION

Adverse climate is supposed to be one of the major constraints on livestock production in the tropics. The seasonal pattern of rainfall results in large fluctuations in availability and quality of pasture over the year. High ambient temperatures, often combined with high humidity and/or intense solar radiation, lead to heat stress, discomfort and reduced feed intake which again depresses production. Many animal health problems are also aggravated by a tropical climate.

Most of the studies on the effect of climate on livestock production have been carried out in climatic chambers where temperature and other climatic factors can be controlled (e.g. Johnson, 1965; Bayer et al., 1980). The animals used have mostly been Holstein-Friesian or other temperate breeds. The same breeds have also been studied in a number of investigations based on field data (Dragowich, 1979; Sharma et al., 1983; Rodriguez et al., 1985). The objective of the present study was to examine the influence of various climatic factors on milk yield in tropical cattle.

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MATERIAL AND METHODS

The data used for this study were collected at the Livestock Production Research Institute (LPRI), Mpwapwa, central Tanzania, from 1964 to 1989. The institute is located at 6°20' S, 36°30' E, about 1,100 m above sea level. The climate is semi-arid with average annual rainfall of about 660 mm, most of it falling from December to May. However, the amount and distribution vary widely from year to year. Average maximum and minimum temperatures have been reported to be 26-5° and 15-5°C respectively.

The herd of cattle at the institute is composed of the Mpwapwa breed and various crosses of this breed. Mpwapwa is a synthetic dual-purpose (meat and milk) breed developed at this institute. The breed has received about 60% of its inheritance from improved dairy breeds originating in the Indian subcontinent (Sahiwal and Red Sindhi), about 30% from African zebu breeds (Boran and Tanzanian shorthorn zebu) and the remaining 10% from European dairy breeds (mainly Ayrshire).

Since 1968 a part of the Mpwapwa herd has been used for an experiment in which females were mated with Friesian, Ayrshire or Jersey bulls. The offspring from these matings were termed crosslines. Female offspring were then mated to Mpwapwa bulls to form a backcross. The theoretical proportion of Bos taurus inheritance is thus 55% in the crosslines and 32-5% in the backcross. A historical account of the breeding programme at Mpwapwa was given by Getz et al. (1986).

The cows at the institute depend mainly on natural and improved pasture for their feed. Supplementary feeding is limited to small amounts of concentrates offered at milking. The cows are milked twice a day, usually by machine. Average milk yield per day of lactation during the period of data collection ranged from about 5 kg in Mpwapwa and backcrosses to nearly 7 kg in Friesian crosses.

The climatic data collected routinely at the institute include ambient temperatures recorded on a dry bulb and a wet bulb thermometer in the morning (09.00 h) and in the afternoon (15.00 h), maximum and minimum temperatures, and rainfall. All these parameters were recorded daily. Milk yields were recorded for each cow at each milking and added to daily and weekly totals. The weekly totals were later combined in sets of 4 to cover successive periods of 28 days from calving. These yields were then related to the average temperatures and total rainfall for the same period (or the preceding period).

RESULTS

Coefficients of correlation between various weather variables are shown in Table I.

All weather variables were positively correlated. The highest correlation was found between a.m. and p.m. temperatures. Dry and wet bulb temperatures at the same time of the day were also closely correlated. Minimum temperature showed only low correlation with all other weather variables, and rainfall was closely correlated with wet bulb temperatures only.

The influence of various weather variables on 28-day milk yield was examined by multiple regression analysis. In the first analysis the regression procedure with backward elimination was used and retention of independent variables was set at the $P < 0.10$ level of probability. The records for each stage of lactation were analysed separately. Table II shows the partial regression coefficients of milk yield on the variables retained in the model.

Wet bulb p.m. temperature and minimum temperature were retained in the model.