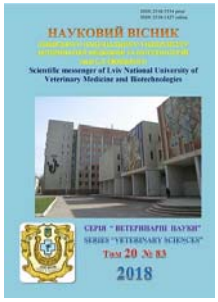

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Influence of high temperature on dairy productivity of Ukrainian Schwyz

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In monitoring studies of recent years, global warming is reported. This is a significant problem for dairy farming in much of Europe, especially in the central and southern regions, as reported by numerous studies. Dairy cattle highly productive are extremely sensitive to hot temperatures; their consequence is health problems, a significant reduction in milk yield and milk quality. Unfortunately, heat stress remains an unrecognized problem for domestic cattle breeding, although the financial losses from its harmful influence in European are quite substantial. The aim of our work was to study the effect of high temperatures on milk yield of cows of Ukrainian Schwitz on one of the complexes of high-tech milk production. At the beginning of the research, we decided to test the hypothesis of increasing hot air temperatures in the warm period of the year compared with the long-term data. Then we studied how the milk of Schwitz breed varies during the hot season, depending on the magnitude of the maximum temperature values. According to the results of the study, it can be noted that the air temperature during the warm period of 2017 tended to increase (+0.6 °C) in comparison with the long-term data. In August, the air temperature significantly exceeded the long-term data by +3 °C (td = 2.89, P < 0.05). The relationship between the temperature and milk yield of cows is revealed by an average degree of reliability (r = -0.45, P < 0.05). Compared with the most favorable external conditions in May, the cows' milk yield decreased in June by 3.0%, the yield of milk fat by 5.2%, the milk protein content by 3.4% (P < 0.001). In July and August, the cows' milk yield decreased by 4.6 and 5.5% (P < 0.001), the yield of milk fat decreased by 3.1 and 7.3% (P < 0.01–0.001), the yield of milk protein 3.4 and 5.7% (P < 0.001). Thus, high temperatures during the summer period contributed to a decrease in milk yield and the main components of milk of the Ukrainian Schwitz, which can lead to tangible financial losses.

Key words: *global warming, hot temperatures, cows, Schwitz breed, milk yield, yield of milk fat and protein.*

Introduction

Ensuring of health and comfort for milky cows in conditions of in industrial technologies remains a problem question – from solution of this problem depends opportunity of animals realise their genetic potential and receiving of quality milk (Milostiviy et al., 2017). Complicated situation with contenting animals all of the year in premises of a light construction, where cows directly are subject of a factors external environment.

In monitoring studies of recent years, global warming is reported. This is a significant problem for dairy farming in much of Europe, especially in the central and southern regions, as reported by numerous studies. According to experts (Pyron and Malynyn, 2015), for the EU countries the problem of heat stress is quite relevant. In the summer, losses in the dairy sector can be about 3 kg of milk per cow per day. In the southern regions of Europe (Spain, Italy and southern France) cattle are exposed to heat stress for most of the day (13–18 hours), losing up to 5.5 kg of milk per cow per day. And even in the northern regions of Europe (Switzerland, Czech Republic and Poland), dairy cows can be exposed to heat stress from 6 to 10 hours a day. A sharp increase in the temperature of the environment in Eastern Europe leads to an increase in cases of abnormal heat during the summer time (the duration of the stress period may be 30 to 60 days), which leads to a deterioration in the conditions of animals and financial losses in dairy cattle. Dairy cattle highly productive are extremely sensitive to hot temperatures; their consequence is health problems (Das et al., 2016; Fournel et al., 2017), a significant reduction in milk yield and milk

quality (Liu et al., 2017). Unfortunately, heat stress remains an unrecognized problem for domestic cattle breeding, although the financial losses from its harmful influence in European countries are estimated at an average of more than 400 euro per cow per year (Pyron and Malynyn, 2015). Previous studies (Milostivyj et al., 2017) indicate a high probability of occurrence of thermal stress in cows in the conditions of high temperatures in the central part of Ukraine and significant economic losses in dairy cattle breeding (Vasilenko et al., 2018).

The aim of this work was to study the influence of high temperatures in summer on the productivity of cow's of the Schwitz, in conditions of keeping in stalls all year round with a paddocks in the large dairy complex.

Materials and methods

Long-term data, as well as the dynamics of air temperatures in the warm period of 2017 (from May to September inclusive) at the location of the dairy complex (where the animals are kept in light barns) were taken into account by analyzing the materials of the weather report archive (www.accuweather.com). The yield of cows was assessed using the herd management system «Dairy Comp 305». The average amount of milk received per day, the yield of milk fat and protein per herd of cows was taken into account throughout the study period. To process the data obtained and to evaluate the reliability of the indicators, the software Statistica 10 was used.

Results and discussion

It was found that the average temperature during the warm period of the year from May to September 2017 (26.4 °C), slightly increased (0.6 °C), compared with the long-term data, but did not have significant differences (td = 1.07; P > 0.05). However, in August this year was hotter than the long-term data. The air temperature exceeded the average values by 3.0 °C (td = 2.89, P < 0.001), and in certain periods of this month the excess of the multi-year maximum was 8.0 °C. Unusually hot was September, the difference between long-term data and temperature in certain periods this month was 10–13 °C, at the highest temperatures up to 35 °C, which is not very typical for this time of year (Figure 1).

Analysis of the state of the air environment and the level of productivity of animals in the hot period indicates a significant dependence of the daily milk yield on the temperature of the air, between which the average degree of negative correlation (r = -0.45; P < 0.05) was detected. As can be seen from the data (Figure 2), periods of growth of external temperatures were accompanied by a significant decrease in the daily milk yield in cows.

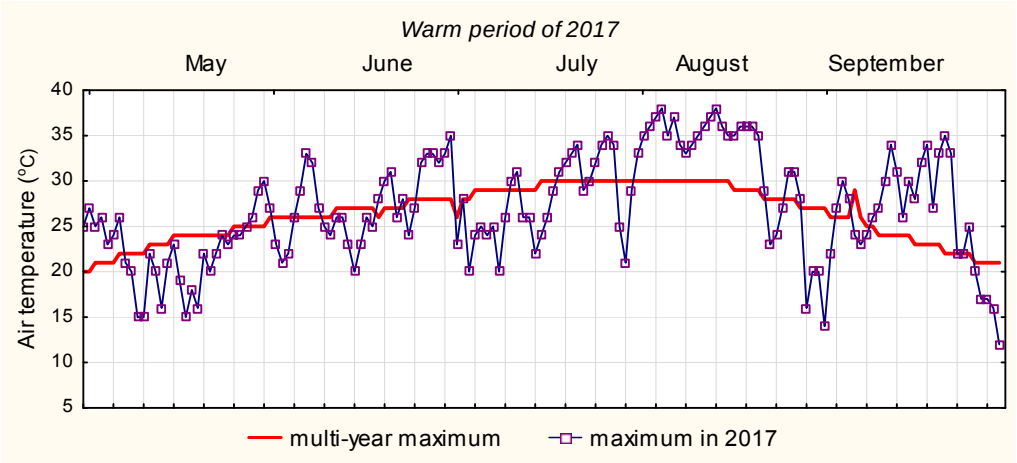

Figure 1. Dynamics of maximum temperatures during the period from May to September

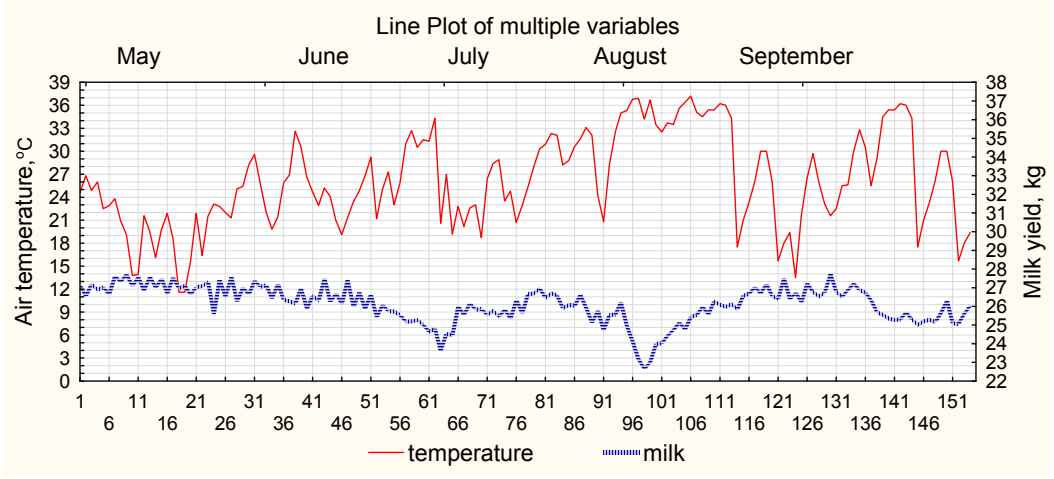

Figure 2. Dependence of daily milk yield on external temperatures during the hot season

We found that the most favorable temperature conditions for the manifestation of milk productivity in cows were in May. This month, with an average air temperature of 14.7 °C, the average yield of milk in a herd of cows averaged 27.1 kg per day. We compared how high temperatures in the summer affected this figure in the future. In June, the average air temperature increased by 5 °C and amounted to 19.7 °C. This resulted in a decrease in milk yield of cows by 3.0% ($P < 0.001$). The yield of milk fat decreased by 5.2% ($P < 0.001$). The rise in temperature was also reflected in the yield of milk protein, the amount of which decreased by 3.4% ($P < 0.001$). Thus, the content of these indicators in June decreased by 850; 50 and 30 g respectively (Figure 3).

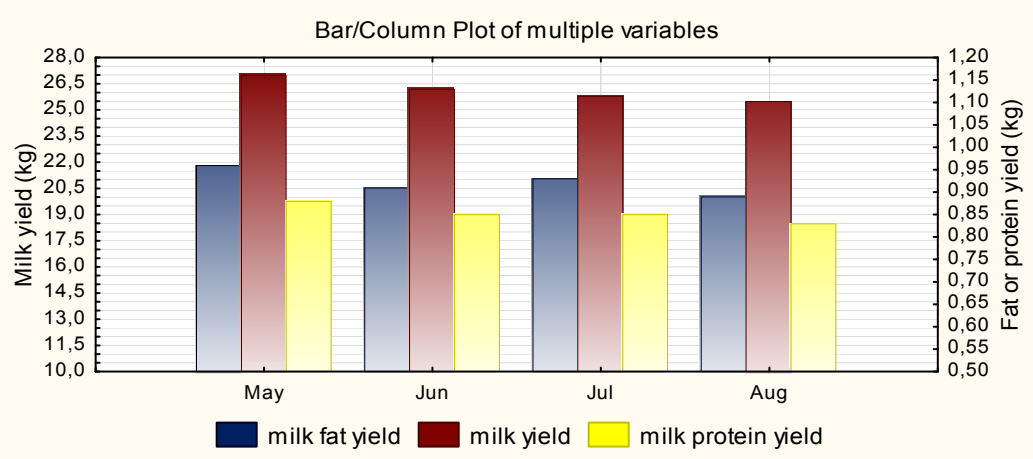

Figure 3. Dynamics of milk production productivity in the heat of the year 2017

In July, the average air temperature was 20.7 °C, that is, it increased by 6.0 °C compared to May. This led to a decrease in milk yield by 4.6% ($P < 0.001$), milk fat yield by 3.1 ($P < 0.01$) and milk protein yield by 3.4 ($P < 0.001$), or by 1390; 30 and 30 g respectively.

August was the hottest month of summer. The average temperature was at 23.4 °C. Its increase of 9.2 °C compared to May, led to a decrease in milk yield of cows by 5.5% ($P < 0.001$), milk fat yield by 7.3% ($P < 0.001$) and protein yield by 5.7% ($P < 0.001$) or 1540; 70 and 50 g respectively. It should be noted that the monthly fluctuations in fat and protein content in milk (%) were not reliable.

Hot temperatures and, in particular, heat stress, affect the health of animals through direct or indirect effects on physiology, metabolism, hormonal and immune system (Do Amaral et al., 2011; Rashid et al., 2013; López-Gatius and Hunter, 2017). The decline in productivity in dairy cows is associated, first of all, with a decrease in food intake and changes in the digestive tract (Baumgard and Rhoads, 2013; Bravo and Wall, 2016).

The materials obtained about the decrease in the yield of milk and its components in cows under the influence of high temperatures are consonant with the results of other researchers. It is reported (Bouraoui et al., 2002) on the reduction of dry matter intake of feed (by 9.6%) and decrease in milk yield (by 21%) with a rise in temperature-humidity index (THI) from 68 to 78. The increase in THI per unit over 69 was the reason reduction of milk yield in cows by 0.41 kg (Spiers et al., 2004). It is enough four hours of finding cows in conditions of moderate heat stress for the loss of 1 kg of milk per day (Burjakov et al., 2016). High temperature and humidity not only caused the decrease in milk yield in cows, but also helped to reduce the yield of fat and milk protein by 39.7 and 16.9% (López-Gatius and Hunter, 2017).

Modification of the air environment of premises in hot weather usually consists of keeping dairy cows under shady canopies with ventilation-turbine blowing and spraying. In the results published in 1988 (Wolfenson et al., 1988), it was shown that the combination of wetting and forced ventilation can reduce the daily increase in rectal temperature by 0.3 °C and increase the milk yield of cows by 3.6 kg per day. It is reported (Vysokos et al., 2015) that the contents of cows in stalls throughout the year, the parameters of the air environment in the «cold» barn of the frame type were approximated as much as possible to the conditions of the environment. An increase in the external temperature from 19.6 to 33.0 °C, led to an increase in the indoors temperature from 20.4 to 28.5 °C. At the same time (Milostivyj et al., 2016) the use of the active ventilation and spraying system in the barn during the heat, prevented the rectal temperature increase in the cows by 0.4 °C and promoted a decrease in respiration rate by 8 times / min.

To prevent the effects of high temperatures in the barns of the complex, active ventilation is used by means of the longitudinal arrangement of powerful fans. However, their independent use (without air humidification) proved to be insufficiently effective. As a result, for the period from June to September 2017 inclusive, losses per cow per herd were about 146 kg of milk.

Therefore, it is much more effective to combine active ventilation with air humidification (Pugach et al., 2016). The advantages of using fog-type systems on farms include automatic maintenance of an optimal microclimate (humidity / temperature), elimination of dust and pathogenic bacteria, neutralization of unpleasant odors and neutralization of volatile compounds (ammonia, methane, carbon dioxide, etc.). During evaporation, excessive air humidification does not occur, so the litter remains dry, unlike less efficient systems. There is also the possibility

of using a set of equipment for disinfection of large-sized premises of an industrial complex (Vysokos et al., 2017).

Conclusions

Thus, high temperatures of outdoor air in the warm period of the year in the breeds of cows cause a decrease in the yield of milk and its main components. Therefore, to prevent the harmful effects of high temperatures on animals in conditions of year-round maintenance in barns of lightweight construction, it is advisable to use active ventilation systems with air humidification.

Prospects for further research. The obtained experimental data will be used to predict the influence of high temperatures on the milk productivity of cows by constructing a regression model.

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