Thoughts and insights on some factors that can affect the effectiveness of heat stress mitigation in dairy farms

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Dr. Flamenbaum started working with dairy cows in the late sixties, as an herd man and then, in charge of the 150 dairy cows herd in Kibbutz Misgav Am, in the north of Israel. Then he joined the State of Israel, Ministry of agriculture, Extension services in 1977.Since 1977 until 2008 - Serving in different positions, starting as a dairy cattle regional extension officer, head of cattle department and lately, as the director of the division of Animal Husbandry. In April 2008, he retired and dedicated professional activity time as private consultant in Israel and worldwide.

In a survey that we carried out recently in Israel, we found a great variation between farms, in terms of the number of hours along the day the cows are in "heat stress" condition (body temperature above normal). This variation is correlated with cow's milk yield and breeding performance during summer months. As time in a day, cows face heat stress is longer, the drop in milk production and conception rate in the summer (as compared to winter levels) is greater.

In this article, I intend to touch on some factors which may significantly contribute to the effectiveness of cooling treatment in reducing summer negative impact on cow's and farm profitability. The topics that I will discuss in this article include the direct and indirect solar radiation negative impact on the cows, the availability and the quality of drinking water as well as the quality and intensity of wetting and forced ventilation impact on the effectiveness of the cooling process.

A. Prevention of exposure to solar radiation

Heat generation by dairy cows is very high, due to intensive metabolism. A high-yielding cow generates about 2,000 watts of heat (20 times more than a man), and needs to dissipate it to the environment. This cow is not able to dissipate this amount of heat in summer months, and even forced ventilation cannot do it alone. More intensive cooling treatment is needed and can be done by evaporating water from cow's surface (direct cooling) or roam the air (indirect cooling). Intensive cooling of the cows allows cows to dissipate their body heat in the condition that these cows are not exposed to direct or indirect solar radiation.

Exposing cows to direct solar radiation will raise the "amount of heat" the cow needs to dissipate to the environment by 1,600 watts more (nearly doubling the metabolic heat production), making the cow's ability to dissipate heat impossible.

Where in the farm's facilities cows can suffer from being exposed to solar radiation? This depends of course on the farm type of housing. In full confinement system, cows may be exposed to solar radiation while walking to the milking parlor (especially in large-scale farms), where cows have to walk for hundreds of meters to the milking parlor and back, 2 – 3 times per day (pictures 1 and 2). Solar radiation can penetrate indirectly, in certain hours of the day into the cow's barn, depending on the setting of farm buildings, as can be seen in the following pictures. Simple and cheap shading means, such as plastic nets and curtains, can be installed over walkways and along the sides of waiting yards (pictures 3 and 4), feed alleys (picture 5), and resting areas. (incidentally, the curtains installed in waiting yard sides may also help to block side cross winds that may impair the forced ventilation intensity of the fans placed in these sites.

B. Drinking water

Drinking water is considered to be the "most important feed ingredient" in cow’s diet. Cows consume about 4.5 liters of water per liter of milk produced. In summer, water consumption increases by 50% or more, compared to the consumption in the winter, with the aim to use it as a cooling mean. In order to allow optimal food consumption in the summer, water temperature must range between 15 to 20 degrees Celsius. Water in higher temperatures will suppress

food intake and increase cow body temperature. To allow maximum water consumption in the summer, it is recommended to install at least two water troughs per group of cows (this will prevent a dominant cow from suppressing water drinking of weaker cows). In warm regions, it is recommended to provide space of at least 15 cm of trough per cow, so that at any moment, water troughs will be available for 20% of cows in the group.

Water troughs should be placed in the shade, and not at a distance of more than 20 meters from the cows. The water trough depth will allow frequent cleaning and rapid water flow, which will keep it fresh and cool. I have seen many cases where the pipeline supplying the water troughs is exposed to the sun and, if this pipeline is too long, cows will meet hot water in the water trough, and will drink and perform less. Making sure that pipelines supplying water to the water troughs are well buried in the ground, or being well isolated, is highly recommended.

C. Wetting and ventilation requirements

In one of my recent articles entitled "water, wind, time and wow, that's all it requires for summer cooling", I referred to the importance of optimizing wetting and forced ventilation, as well as the amount of time for cooling the cows during the day, required to reach fully dissipation of cow's heat load. In order to obtain good wetting, large droplets sprinklers must be used, which, together with proper line pressure and for suitable wetting time, will allow water to penetrate cow's fur and be in contact with cow's skin. Only when this happens and water touching skin is evaporated, cows are properly cooled. In the attached picture, you can see in picture 6, a cow that was properly wetted and in picture 7, the tiny water droplets that stay on cow's fur ends (poor wetting), so direct contact with cow's skin do not take place. Since the "wetting quality" is influenced by different conditions varying from farm to farm, it is not possible to give an overall recommendation of the wetting time required, and this should be determined empirically in each farm and for each group of cows. My recommendation is that for an optimal wetting duration, the farmer should watch for cows when wetting takes place and determine wetting duration from time wetting begins until water runoff begins. In dairy farms with computerized control of cooling system operation (mainly in the waiting/cooling yards), it is recommended to extend the first wetting cycle (to around two minutes), which may allow complete soaking the cow, while the rest of water applications being shorter, as above recommended.

As far as ventilation is concerned, a wind speed on a cow’s back of 3 meters/second is recommended, when it comes to ventilation, as part of the cooling process, which combines also wetting. A wind speed of 2 meters/second, is recommended when it comes to ventilation of cows in rest areas, provided without wetting. When setting fan distances, it is advisable to use an anemometer, measuring wind speed on the cow’s back level, and take into account possible side cross winds effect that may affect the real wind speed produced by the fans over the cows.

Regarding the total duration of the cooling treatment along the day, and the frequency of cooling treatments, I would like to bring here the results of an experiment carried out by Israeli researchers (Honig et al, 2012), published in the Journal of Dairy Science. The research compared cooling the cows, combining wetting and forced ventilation in two durations and frequencies along the day. One group of cows was cooled for five, 45 minutes cooling sessions, and a total of 3.5 cumulative hours per day. The other group of cows was cooled 8 times per day, and for 6.0 cumulative hours per day. The cows that have been cooled for a longer time and for more times per day consumed more food and produced significantly more milk. These cows had lower body temperature and despite the obligation to stand longer due to being cooled for longer time during the day, these cows rested and ruminated for longer time. Based on these experiment findings and the experience gained in "successful farms" in Israel (high summer to winter performance ratio), my recommendation is to cool the cows by combining short water applications with forced ventilation, for 45-60 minutes in each cooling session and provided every 4 hours during the day. This treatment will allow high yielding cows to maintain normal body temperature in the summer, significantly improve their summer performance and increase farm profitability.