Cattle Grazing Time is Related to Temperature and Humidity

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Highlight

Temperature and humidity are recognized to affect the physiology of animals and thus influence their activities including grazing. The temperature-humidity index (T.H.I.) discussed here is an accurate expression for relating these climatic factors to grazing time of beef cattle.

Investigators have known for some time that cattle, like people, restrict their activities on uncomfortably hot days. But attempts to predict how much time cattle will spend grazing on hot days have been few and none has taken humidity into account. In a recent study we used a formula that accurately predicts beef-cattle grazing time. It depends on a temperature-humidity index (T.H.I.) that was devised to measure human comfort.

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Methods

In the spring of 1962, twelve 500-lb. heifers were selected for uniformity in size and weight from a herd grazing an area of glade prairies, old fields, and woods on the Mark Twain National Forest in the Missouri Ozarks. Large letters were painted on the sides of the study animals with a cattle-marking dye. The cows were then allowed to disperse over the area with the rest of the herd. At 2-week intervals throughout the 6-month grazing season one of the marked animals, selected at random, was followed and observed for 24 hours. Temperature, humidity, and wind direction and velocity were recorded hourly.

Results

In general, the higher the average daytime temperature (5:00 AM to 8:00 PM) the less time the animals spent grazing. The formula we used to express this relation is similar to Dwyer's (1961) used in Oklahoma.

But, like Dwyer, we observed that humidity as well as temperature affected grazing time. For example, one day when the temperature was 75 F the cattle grazed 8.8 hours while another day when the temperature was 85 F they grazed 8.9 hours. According to our regression equation, using temperature and grazing time, they should have grazed less on the hot day. Both days were calm and aside from temperature the only apparent difference between the two days was the relative humidity. On the cooler day the average relative humidity was 76% while on the warmer day it was only 57%.

In our attempt to define the relation between grazing time and weather more accurately, we used a system similar to the one used by Johnson et al. (1962) for dairy cattle. That is, when we found that we could not correlate grazing time and humidity alone, we used a T.H.I.—the one developed by the American Society of Heating and Air-Conditioning Engineers (Anon. 1957) and used by the U.S. Weather Bureau to express relative human comfort. This index is obtained by the equation:

$$\text{T.H.I.} = 0.4\,[T_d + T_w] + 15$$

where T.H.I. = Temperature-humidity index

T_d = dry-bulb temperature

T_w = wet-bulb temperature

This expression is more closely related to time spent grazing than air temperature alone. A nonlinear regression equation gave a highly significant multiple correlation of 0.968 between the T.H.I. and time spent grazing (Fig. 1). This curvilinear regression is significantly different from and more logical than a linear regression.

The T.H.I. reported here is similar to the one Johnson et al. (1962) used to study animal comfort by measuring physiological reactions of dairy cattle in controlled-environment chambers. They found that body functions changed little with slight changes in either temperature or

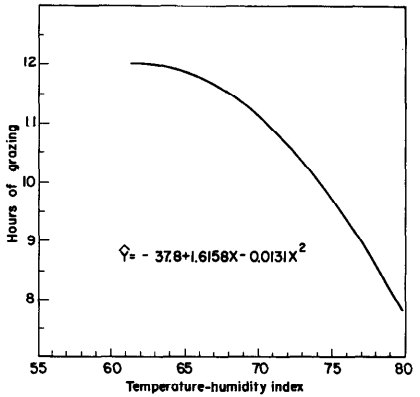

FIGURE 1. Grazing time per cow-day versus average temperature-humidity index (calculated from average 5:00 a.m. to 8:00 p.m. temperature and humidity). (Correlation coefficient ($R = 0.968$) is significant at the 0.01 level.)

humidity in a range of T.H.I. from 60 to 70. However, relatively large changes in body functions occurred with slight changes in temperature or humidity in a T.H.I. range from 73 to 80. Assuming grazing time is related to animal comfort, our curve of time spent grazing and T.H.I. is in general agreement with their work. An increase in T.H.I. from 65 to 67 would result in about 0.25 hours less grazing while a change in T.H.I. from 73 to 75 would result in a change of about 0.84 hours grazing.

We also found, as expected, that grazing time increased when windspeed increased on hot, humid days. For example, one afternoon when the T.H.I. was 82, cattle that had been resting in the shade began grazing when a 7-mile-per-hour breeze occurred. The increase in windspeed must have made it possible for the animals to transfer more body heat, by conduction and skin vaporization of moisture, to the air. Since deep body tissues rapidly lose efficiency and express discomfort when their temperature rises only slightly, small changes in air conditions can be significant. The guide for heating, ventilating, and air-conditioning engineers takes wind as well as wet- and dry-bulb temperatures into account. So on the particular day in question the increase in windspeed lowered the T.H.I.

This engineering index was prepared for humans and because of differences in body structures the relation between atmospheric conditions and comfort may not be exactly the same for cattle. Still, the index was more closely related to the time beef cattle spend grazing than any of the indices prepared specifically for cattle.

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