HOARD'S DAIRYMAN

THESE SOLAR PANELS harness energy while also serving as an option for shading pastured cows.

Making money in the shade

Some solar panels can capture the sun's energy while providing shade for cattle — a win-win for farmers.

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THE agricultural industry relies on fossil-fuel in the production of food, feed, fiber, and energy. Electricity cools milk; fuel is burned in combines and tractors in grain fields; trucks bring goods to market; and nitrogen fertilizer nourishes plants.

That makes agriculture captive to large and constant supplies of a wide range of fossil energy. Agriculture's dependence and thirst for fossil-fuel carries significant economic, environmental, and social risks for the nation and world.

Utilizing the sun

Agrivoltaics is one way producers might be able to become less dependent on fossil fuels. These dual-use solar installations could lower production costs, enhance land efficiency, improve forages and crops for use by dairy cattle, and bolster milk production and health in dairy cows. Using a ground-mounted photovoltaic (PV) system in a dairy setting could give shade to dairy cows during extreme heat events and provide farmers with an alternative means of income.

The University of Minnesota West Central Research and Outreach Center (WCROC) in Morris, Minn., has a dairy operation that milks 275 cows twice daily and is representative of a mid-sized Minnesota dairy farm. The cows are split almost evenly between a conventional and a certified organic grazing herd. Through past investments and institutional experience in renewable energy and dairy production research, our team has a globally unique opportunity to lead a new green revolution — a revolution that creates energy currently consumed within the agricultural industry.

No previous research investigated the use of a ground-mounted solar system to provide shade for dairy cows and to determine the effects on dairy cows. Therefore, our team wanted to investigate the effects of shade from solar photovoltaic panels on the production, health, and behavior of pastured dairy cows.

During the summer of 2018, a 30-kilowatt ground-mounted solar system was installed in a pasture at the WCROC (see photo). The panels were mounted at 35 degrees south and 8 to 10 feet from the ground so that cows could not reach the panels.

The solar panels were Heliene panels using Solar Edge inverters and optimizers. They were installed by Zenergy. The extra cost for mounting the panels above the cows was minimal, and the total expense was about $90,000.

The pastured dairy cow study was conducted from June 2019 through September 2019. Twenty-four crossbred dairy cows were assigned to one of two treatments: shade from solar PV or no shade. The no-shade cows did not have access to any shade on pasture.

All cows had a CowManager ear tag sensor to record ruminating, eating, not active, and active behaviors for all cows. Also, a SmaXtec bolus was placed in the reticulum of the cow to record internal body temperature, as well as activity and drinking bouts of the cows. Daytime ambient high temperatures during the study ranged from 81°F to 93°F.

Keeping cows cooler

The shade and no-shade cows were similar for behavioral measurements, and fly numbers on cows were also similar. The shaded cows had less overall high activity than did no-shade cows because they were standing underneath the solar panels during the hot hours of the day. Daily drinking bouts were similar for all cows. Respiration rates for shade and no-shade cows were consistent during the morning hours, but in the afternoon, shaded cows had lower respiration rates (66 breaths per minute) than no-shade cows (78 breaths per minute).

Surprisingly, milk, fat, and protein production were not different for cows whether they had shade or no shade. Quite possibly, no difference was observed for production because cows were only under the shade for 28 days of the 175 days the cows grazed during the summer. Long-term effects of milk production may have been observed had cows been under the shade for the entire summer.

Hourly body temperature results show that no-shade cows had greater internal body temperatures (more than 1°F) than shade cows from 1 p.m. to 12 a.m. (see figure) Between milking times (10 a.m. to 8 p.m.), the shade cows had lower internal body temperatures than no-shade cows. All cows had similar body temperatures during the nighttime hours.

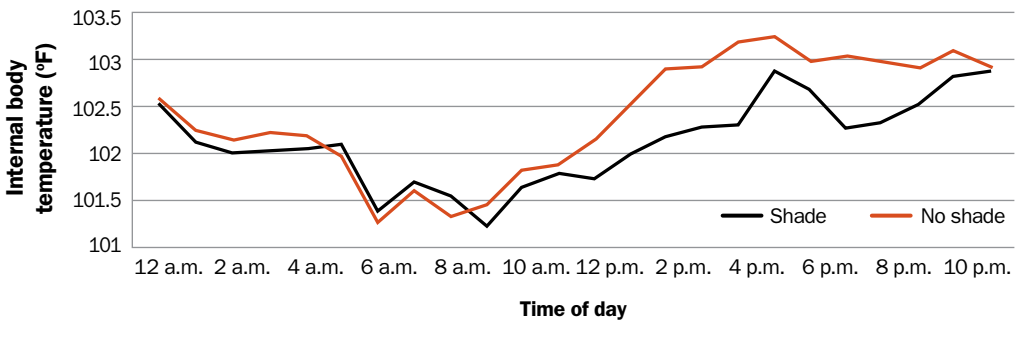
Based on the results of this study, cows may have sacrificed grazing time to stand in the protection of the shade. Future research with our solar panel will investigate the reproductive performance of the cows, plus long-term effects on milk, fat, and protein production, body weight, body condition, and animal health and well-being.

A smaller footprint

Our study indicates that agrivoltaics may provide an acceptable method of heat abatement to pastured dairy cows, as well as generating electrical energy for farmers. This would reduce the carbon footprint of the dairy operation.

In the future, we will explore tracking systems for solar power on livestock farms, using solar panels as windbreaks for cattle, and evaluating crops and forages that will grow best under solar systems. Economic impacts of the agrivoltaic system and land productivity from solar farms will drive the adoption of solar photovoltaic systems on farm.

Average body temperatures of cows in the study



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