

Influence of agrivoltaic systems on thermal comfort of dairy cows in a tropical climate

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BACKGROUND

Silvopastoral Systems

- Pasture-based systems integrated with trees
- Improve thermal comfort
- Allow expression of natural behaviors

Heat Stress

- High solar radiation increases heat load
- Impairs welfare, behavior and productivity

What do we already know?

- Natural shade (trees) improves thermal environment
- Photovoltaic (PV) panels can modify heat load



Figure 1. Scheme comparing: open pasture x tree shade x PV panel.

Research Gap

- No studies evaluating photovoltaic panels

The aim of this study was to evaluate the influence of an agrivoltaic system on the thermal comfort of dairy heifers in a tropical climate.

METHOD



Study Area

- July–August 2025
- Southeast Brazil
- 12 consecutive days of evaluation

Two pasture systems:

- OPS – Open Pasture System
- AGV – Agrivoltaic System
- AGV: 36 photovoltaic panels
- 3 paddocks
- 12 panels per paddock

Figure 2. Positioning of the photovoltaic panel in the pasture.



Measured variables:

- Air Temperature (AT)
- Relative Humidity (RH)
- Black Globe Temperature (BGT)
- Wind Speed (WS)

Calculated indices:

- Black Globe Humidity Index (BGHI)
- Radiant Thermal Load (RTL)

All data were analyzed in R using a mixed model with days and hours as random effects.

Figure 3. Equipment used in data collection.

RESULTS & DISCUSSION

All microclimate variables were lower ($p < 0.001$) in the AGV when compared with OPS.

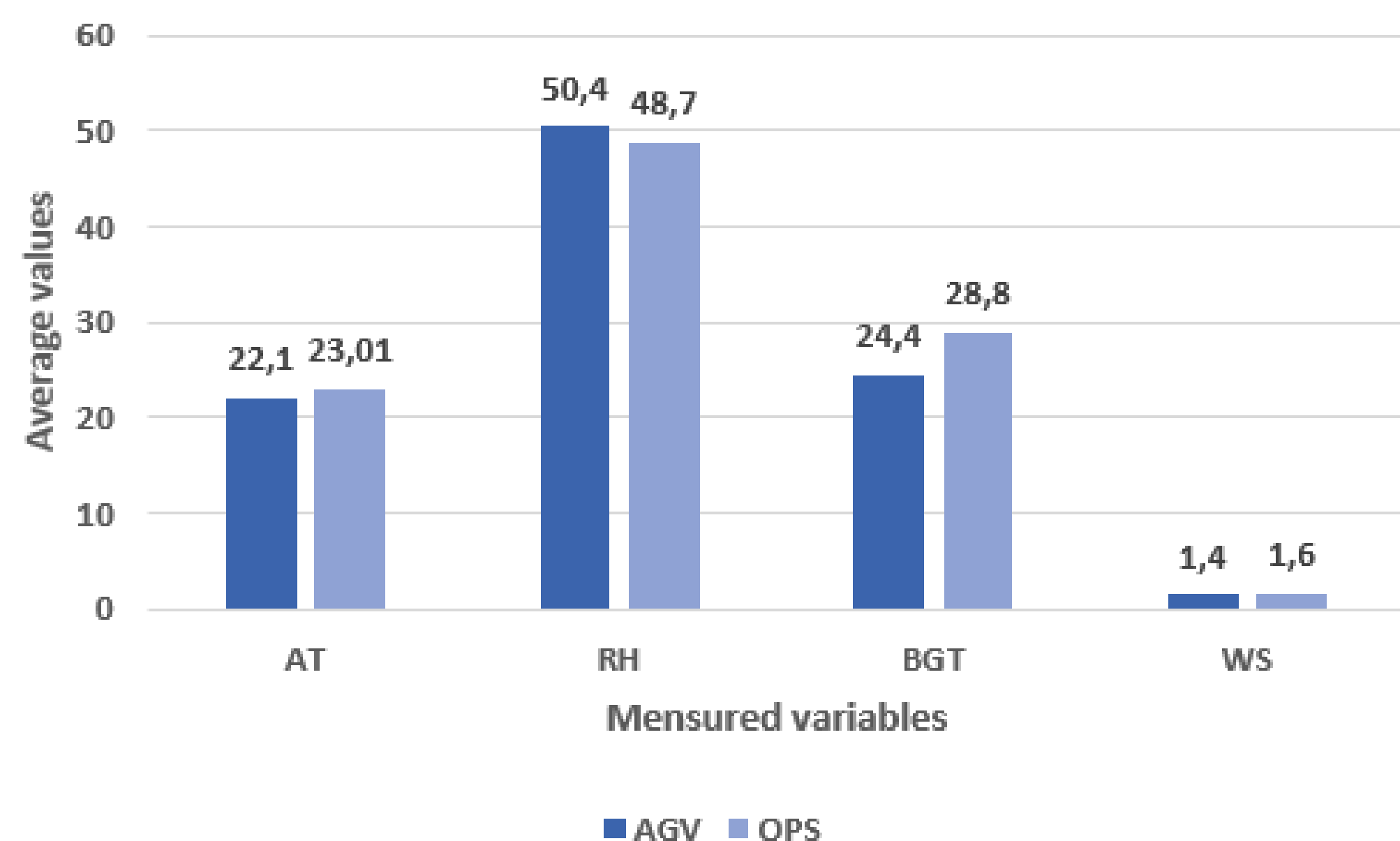


Figure 4. Comparison of the average values of AT, RH, BGT and WS of the two pasture systems: AGV x OPS.

The lowest average (\pm SE) values of bioclimatic indicators were observed in the AGV (BGHI: 70.1 ± 0.8 and RTL: 487.2 ± 7.4), than OPS (BGHI: 74.6 ± 0.9 and RTL: 574.2 ± 8.1). In OPS, BGHI was above the threshold (>74 units) for heat stress for bovines during 62% of the measurements, promoting a challenging thermal environment.

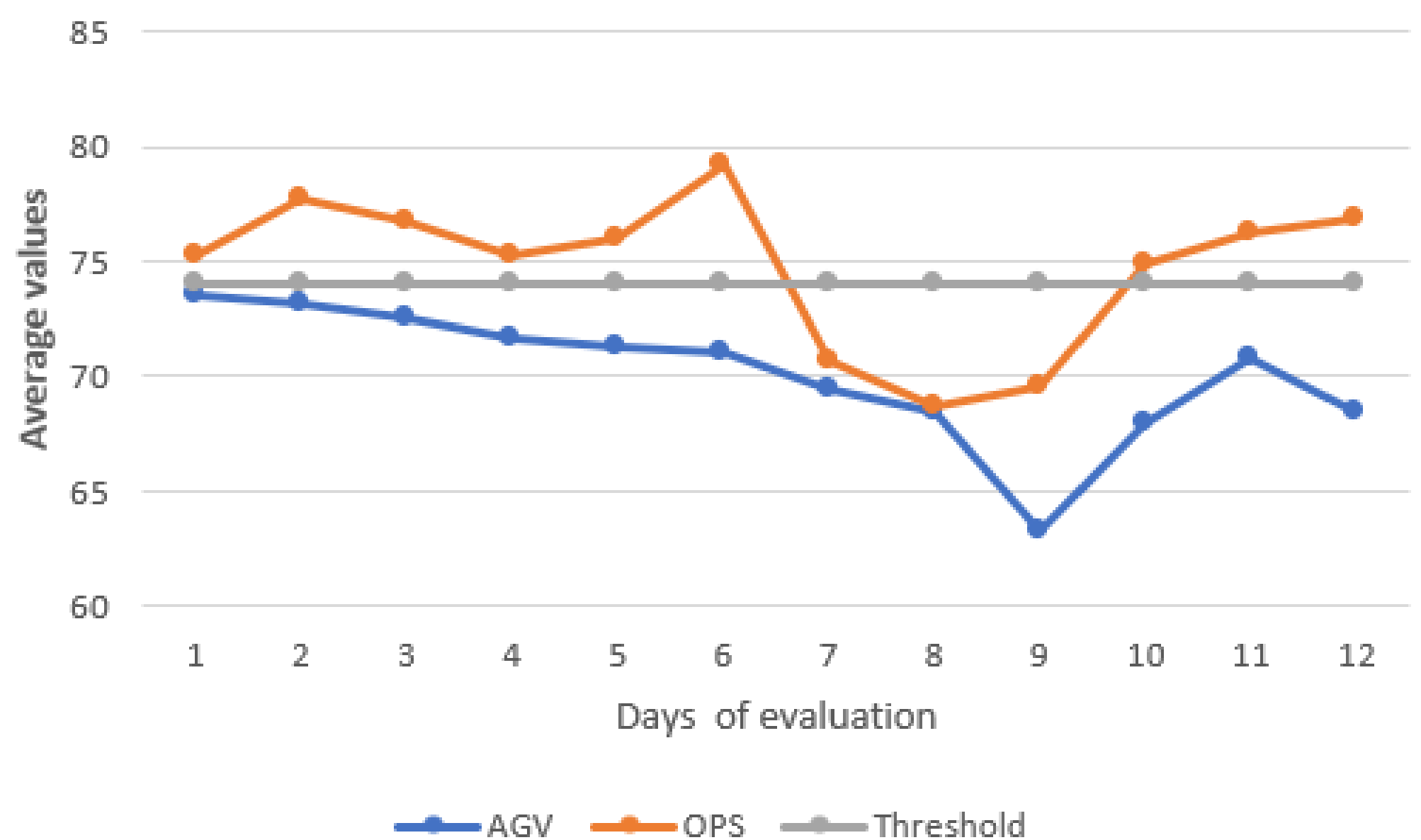


Figure 5. Mean values of BGHI values between the two pasture systems, with presentation of the 74-unit threshold.

CONCLUSION

In conclusion, the AGV provided a better thermal environment for pasture-based systems when compared to OPS, indicating that it can mitigate the effects of heat in a tropical climate.

ACKNOWLEDGEMENTS