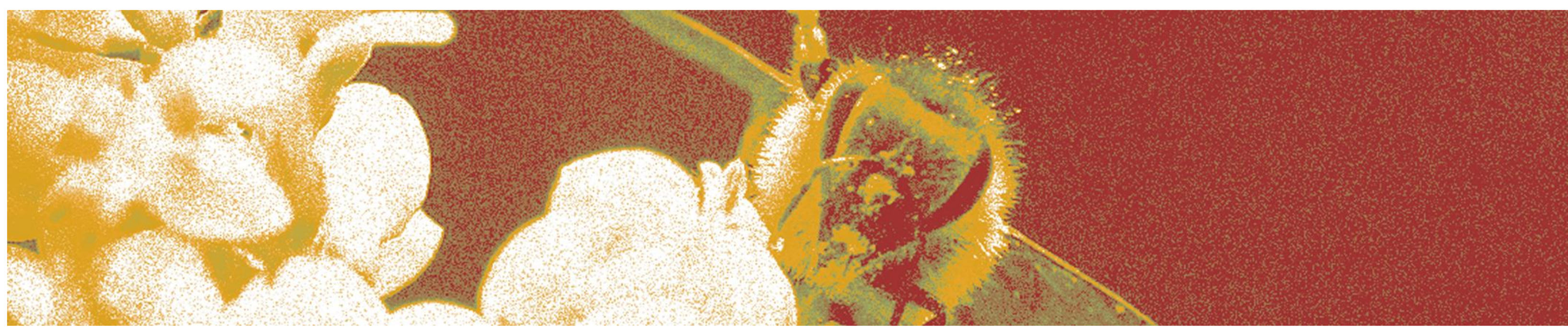


New insights in the thermal properties of the Dadant bee hives to make them less sensitive to weather conditions

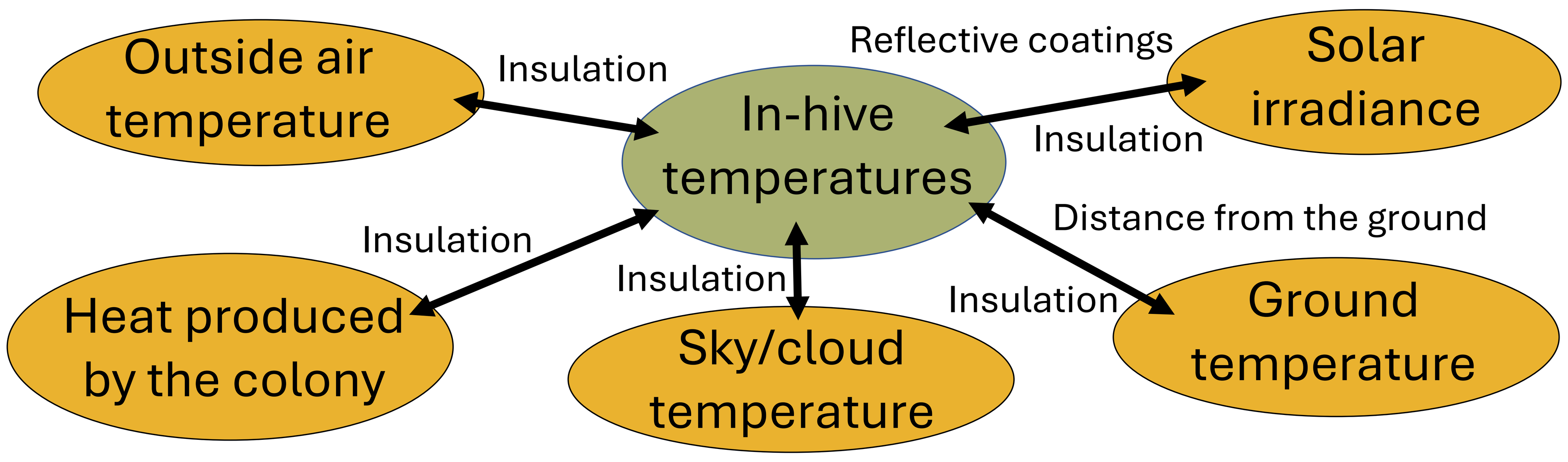
Anne Lavalette[1], Anna Dupleix[1], Emmanuel Ruffio[1], Dirk De Graaf [2]

[1] Alt-RD CoActions company, Bègles, France, *anne.lavalette@alt-rd.com*

[2] Ghent University, Ghent, Belgium

Context

Context: Hive temperature is one factor influencing bees behavior, health and the beekeeper's productivity. Several parameters related to the hive and the environment impact in-hive temperatures:



—> **Interviews of beekeepers** in their apiaries, throughout Europe provide information on their initiatives to modify the hives for the health of their bees (varroa control, mitigation of climate change).

—> To what extent changes made to the beehive affect hive temperature ? **Scientific instrumentation work** quantify the effects of their initiatives. As this study focuses on environmental factors, **only empty hives are instrumented** to assess their thermal properties.

Methodology: Cross-disciplinary approach designed to ensure that the knowledge acquired is meaningful for beekeeping

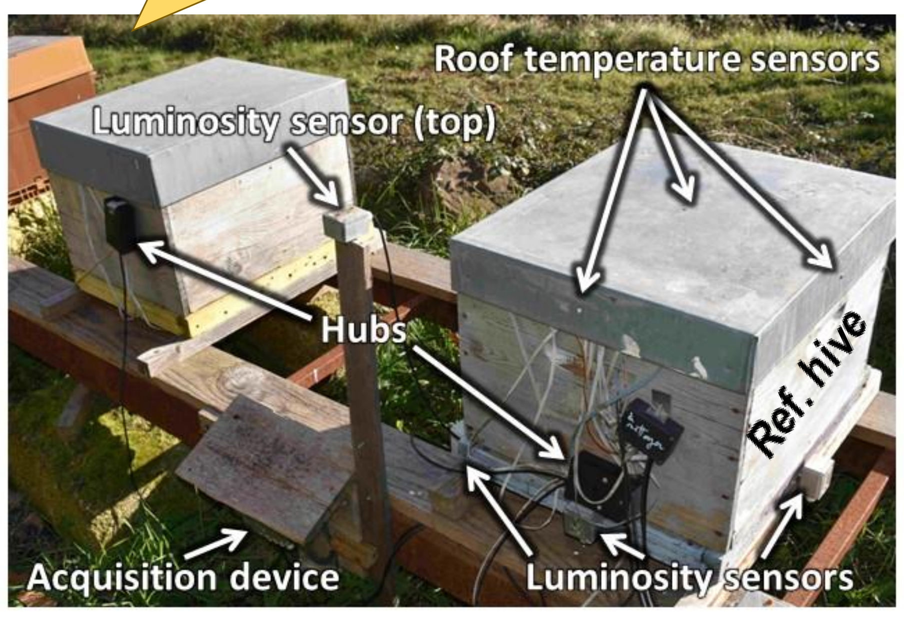
Tool 1: Interviews of professionals in Europe (beekeepers, sellers, manufacturers)

Interview guide sections:

1) Beekeeper sociography/background/education/network
2) Beekeeper goals and ideals in terms of beehive
3) Thermal regulation practices
4) Wood protection practices
5) Interest in participatory research

Data = Beekeepers innovations knowledge

Tool 2 : Measures, models, simulations



(1)

Experimental apiary - Two Dadant hives(Fig.1) equipped with 8 T°C sensors (Fig.2). Solar irradiance is measured on each of the 6 sides. A weather station measures air T°C and wind speed.

(2)

One hive is kept unchanged during the experiments (Reference hive) and the other hive (Test hive) undergoes successive modifications

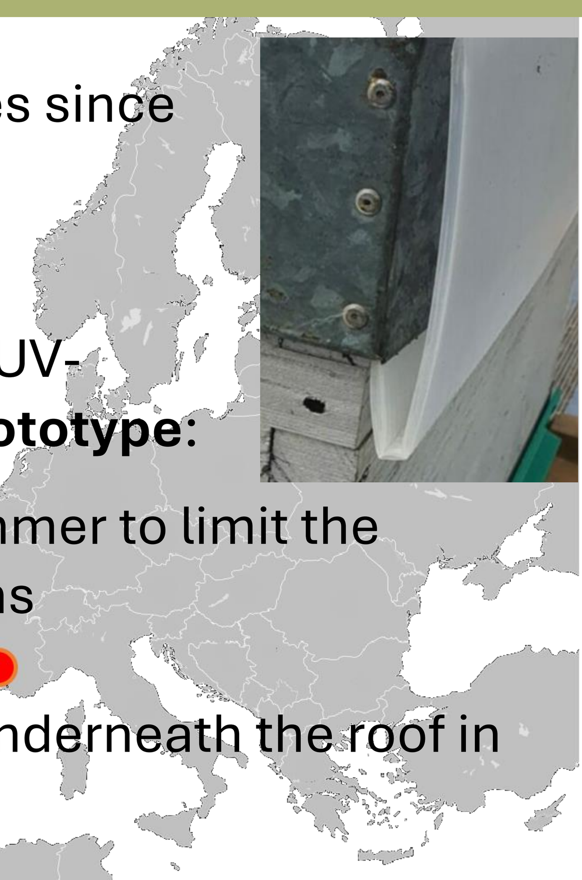
Data = Quantitative results on temperature measurements

Example: white cap prototype interview and test on experimental apiary

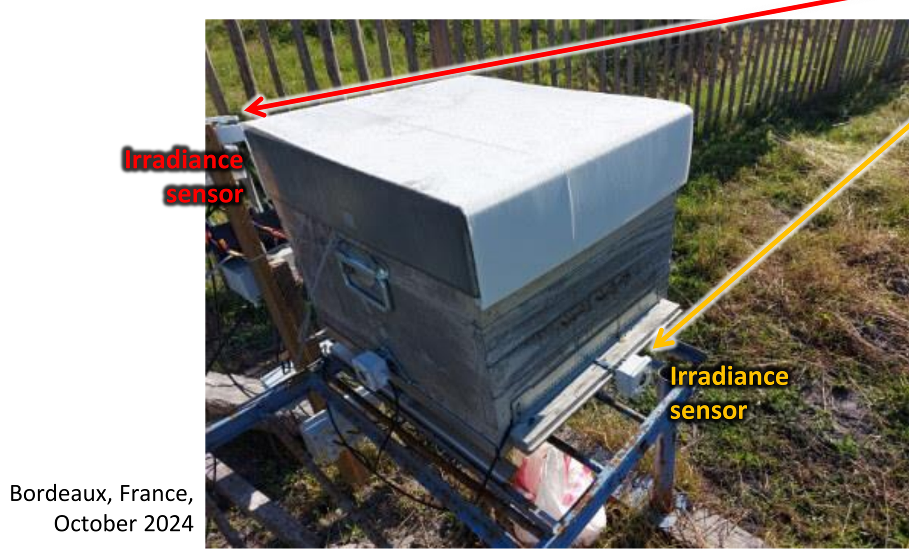
David B., 50 y old. 150 beehives since 2009. Former Building & Civil Engineering material seller.

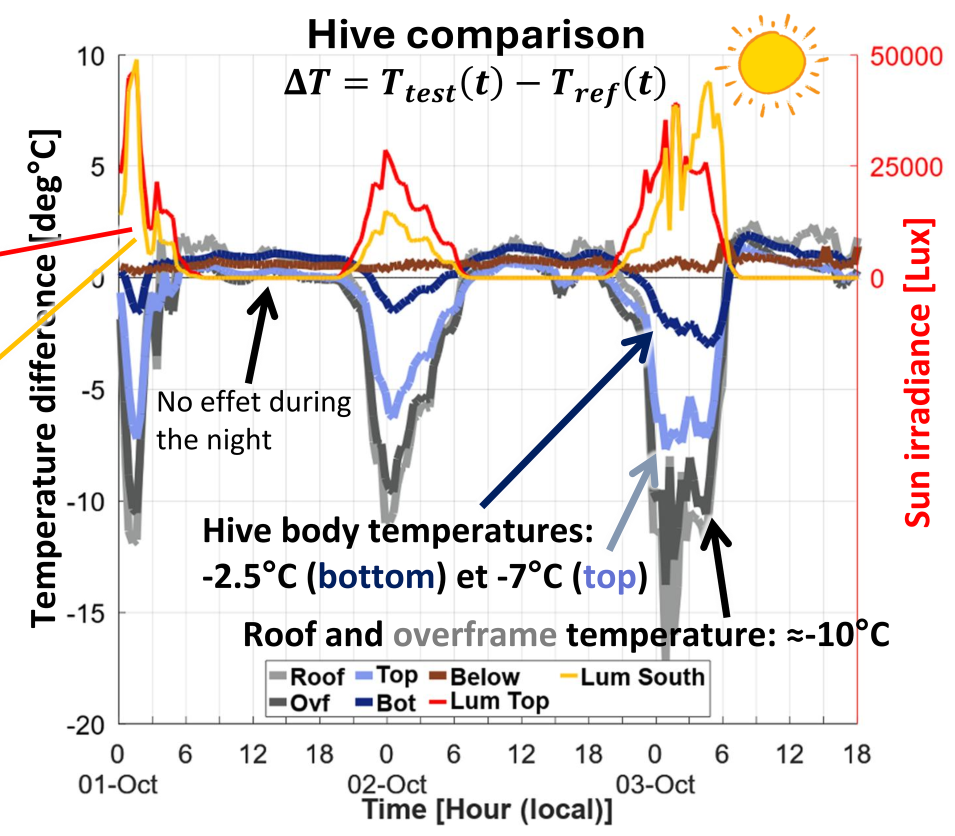
Innovation: Lightweigt white, UV-resistant polypropylen **cap prototype**:

- acting as a white roof in summer to limit the absorption of solar radiations
- acting as insulation board underneath the roof in winter



Reference hive temperature (T_{ref}) is substracted to test hive temperature (T_{test}) to better visualize the effect of the polypropylen white cap

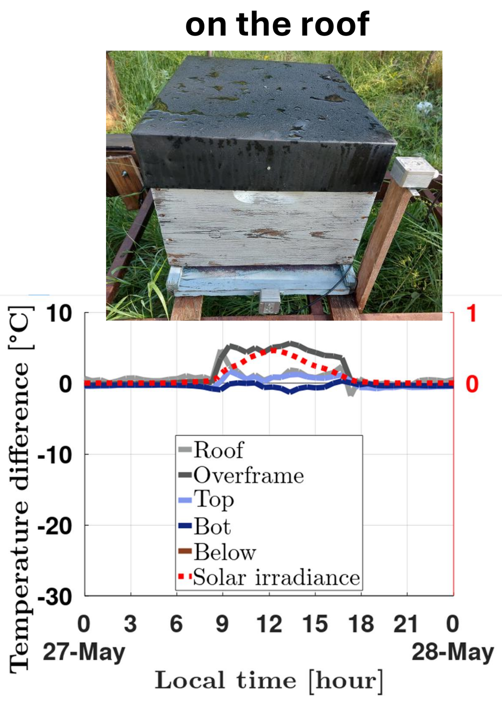




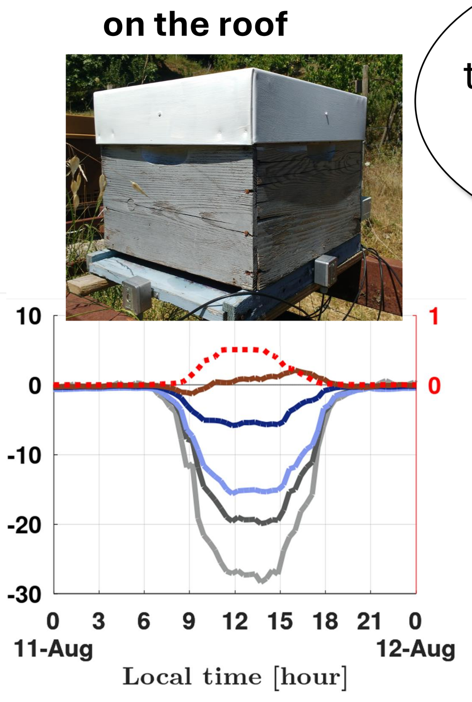
Conclusion

Conclusion: The working method used (transdisciplinary study) allows us to measure the effect of beekeepers' innovations on hive thermal properties.

Effect of black paint on the roof



Effect of white paint on the roof



White paint on the roof or a white cap reduces the temperature

Compared to galvanized steel roof, black paint has no significant effect

Coatings reduce or increase the amount of heat absorbed

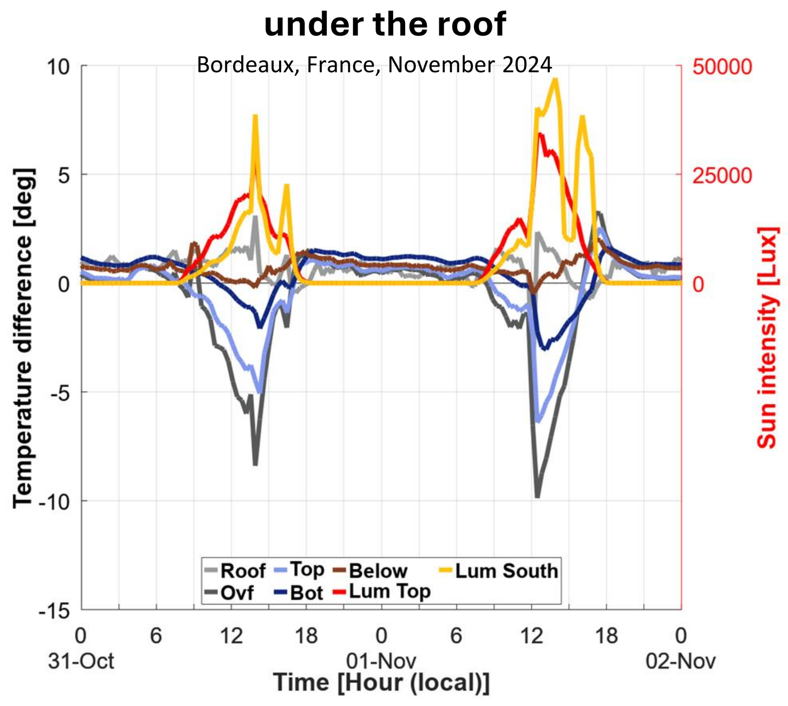
Ground can modulate the heat received by the hive

Shading reduces the amount of heat received

Paint on walls: no noticeable effect on temperature

Air gap under the roof insulates the hive (especially in summer)

Effect of air gap under the roof



Perspectives

Perspectives: Depending on materials, paints, structure, the sensitivity of a hive to weather conditions can be made higher or lower depending on the beekeeper and colonies needs. These results could be used in different ways: to stabilize/increase/decrease hive temperatures, to prevent thermal stresses, to move towards sustainable beekeeping through greater care for the bees, helping them to adapt to climate change.

WEBSITE
www.better-b.eu
info@better-b.eu

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