Mapping a Sweeter Future for HONEY Production

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*Combining data-driven technology with traditional beekeeping, the **BEE-OPTECH4Honey** project aims to elevate honey quality in Malta and Türkiye. **THINK** meets with researchers **Arthur Lamoliere** and **Prof. David Mifsud** to discuss the potential benefits and groundbreaking use of modern technologies to enhance honey production.*

In a world increasingly dominated by digital solutions, the BEE-OPTECH4Honey project stands out with its unique fusion of technology and tradition. This initiative, a collaborative effort between Malta and Türkiye, leverages Geographic Information Systems (GIS) and advanced data-processing techniques to optimise beekeeping practices. The aim is straightforward yet ambitious: to enhance the quality and sustainability of honey production by pinpointing ideal nectar sites and optimising beekeeper routes. With this innovative approach, BEE-OPTECH4Honey not only supports beekeepers but also works to secure a more resilient future for honeybees in an evolving ecosystem.

At the heart of this research are Prof. David Mifsud and affiliate researcher Arthur Lamoliere, both members of the Biodiversity and Ecology Research Group (BERG) at UM. Mifsud, a professor of entomology and an apiculture expert, brings more than three decades of dedication to honeybee studies. Lamoliere, an ecologist specialising in GIS, complements this expertise with cutting-edge spatial data analysis, enabling the project to bring a scientific edge to traditional beekeeping practices.

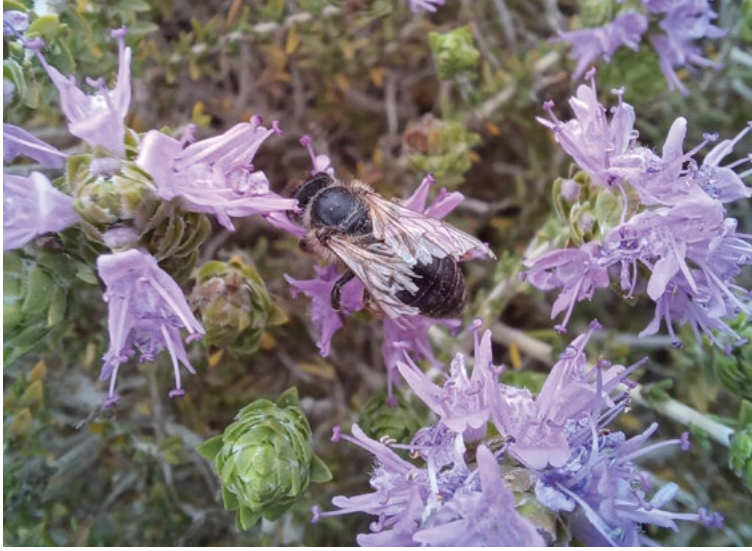
In Türkiye, Dr Şahin Aydın is the founder and principal researcher of INTALA LAB (Intelligent Agriculture and Livestock Applications Laboratory) at Işık University, Istanbul. He coordinates the project and works alongside Dr Gülsüm Çiğdem Çavdaroğlu Akkoç (assistant professor in GIS and researcher), as well as Hüseyin Deniz and Hasan Kıvrakdal, research students at Işık University. Their expertise lies in IT and includes the development of optimisation models for assignment and routing problems. They are also responsible for the design, development, and testing of an integrated information system for apiculture product management. The team also collaborate with Gökhan Akdeniz, Samet Okuyan, and Serhat Solmaz from the Apiculture Research Institute of Türkiye, who bring expertise in beekeeping, coordination with beekeepers across Türkiye, and honey analysis.

According to Lamoliere, 'The project aims to improve the efficiency, quality, and marketability of wild thyme honey, bridging tradition with innovation. We aim to optimise honey production quality by identifying the most suitable areas for beekeepers to place their hives.' This thoughtful intersection of technology and tradition is a reflection of the wider goals of this project. The focus is on collaboration, whether it means working with local farmers,

Photos courtesy of Melvin Bugeja

Experimental apiary in the Denizli Province, Türkiye

Photo courtesy of Arthur Lamoliere



A Maltese honey bee foraging on wild thyme flowers

Photo courtesy of Arthur Lamoliere

conservation groups, or researchers from other institutions, and the aim is to advance ecological knowledge while creating real-world solutions for pressing environmental challenges.

FROM INSPIRATION TO REALISATION

The BEE-OPTECH4Honey project emerged from Mifsud's desire to develop and properly market a monofloral honey – honey produced from the nectar of a single plant species – in this case, wild thyme. Wild thyme honey has a unique flavour profile. Lamoliere's expertise in GIS provided the missing piece to Mifsud's vision, allowing the project to scale up traditional practices through digital tools and spatial analysis. By working together, they have crafted a strategy to both refine the quality of wild thyme honey and improve the efficiency of honey production as a whole.

The process uses models that combine multispectral images (layers of images with specific wavelength bands) captured by drones and satellites to locate areas rich in wild thyme. Machine learning then analyses these images, helping to identify prime spots for beekeepers to position their hives. Additionally, the model considers environmental conditions in order to select the most favourable locations for honeybee foraging. This method effectively guides beekeepers to the most resource-abundant flower areas for better honey production.

BREAKING DOWN THE GOALS OF BEE-OPTECH4HONEY

BEE-OPTECH4Honey operates through a clear set of objectives designed to support both novice and seasoned beekeepers. These goals encompass a range of activities, from honey characterisation to the use of AI-driven imaging for land assessment.

1. **Honey Characterisation**: The first aim of the project is to characterise monofloral honey. By examining honey samples from different regions, researchers hope to pinpoint their floral origin and understand how environmental factors influence honey quality. This research could potentially help establish protected status for Malta's locally-produced wild thyme honey. 'The ultimate goal is to develop standards for achieving Protected Geographical Indication status for monofloral honey in Malta,' confirms Lamoliere. Such a designation would officially recognise the quality of Maltese honey, benefiting local beekeepers and adding marketing value to the product.
2. **Mapping Nectar Sites with GIS and AI**: Utilising satellite and drone imagery as well as machine learning, the team can identify the most productive areas for beekeeping practices in Malta. These assessments focus on floral availability, environmental conditions, and other factors critical to honey quality. By providing beekeepers with clear, data-driven recommendations, the project hopes to improve the productivity of each hive while ensuring that honey maintains its desired quality.
3. **Optimising Beekeeper Routes**: In Türkiye, migratory beekeeping, which involves moving beehives to better sites according to the changing seasons, is a well-established practice. Mapping and optimising these routes allows beekeepers to avoid overpopulated areas and pollution, reducing costs and protecting the health of bee colonies. Ultimately, it is about finding the best paths for bees and beekeepers alike. The research analysis will provide a reliable way to move beehives so that they

Drone mapping setup in the wild thyme garrigue of northern Malta

Photo courtesy of Arthur Lamoliere

are always where they need to be for the highest yield. Locally, the emphasis would rely more on finding suitable, fixed locations rather than routes.

4. **Creating a Digital Toolkit**: The project's final objective is to develop an accessible, integrated system where beekeepers can find essential information about nectar availability, site quality, and optimal migration paths. This toolkit would include user-friendly digital resources that streamline the beekeeping process, offering insights into seasonal changes, floral density, and more.

SELECTING SUITABLE NECTAR SITES: A PRECISION-DRIVEN PROCESS

A core focus of BEE-OPTECH4Honey is identifying optimal locations for beehives to ensure maximum honey quality. Lamoliere details the factors that determine a site's suitability. Specifically in Malta, 'to be considered suitable, a site must have plenty of wild thyme, as it's essential for our monofloral honey. The area should also be free from pollution and be accessible to beekeepers.'

Using high-resolution multispectral imagery and AI-driven data analysis, the team maps areas abundant in wild thyme that are free from pollutants. These models examine environmental variables and floral density, to recommend locations where bees can thrive. Maximising both the productivity of each hive and the health of each colony is key. Such technology not only benefits the beekeepers but also protects the delicate ecosystems that support honeybees.

For migratory beekeepers, this is a game-changer. Instead of relying on historical knowledge alone, one can now predict optimal routes based on real-time data. This reduces operational costs and helps prevent hive overcrowding. 'Optimising these routes improves honey production,' says Lamoliere, 'and reduces operational costs while also promoting the health of the bee colonies.'

A BUZZING COLLABORATION WITH A BRIGHT FUTURE

Looking ahead, BEE-OPTECH4Honey is redefining how we think about honey production and environmental stewardship. The significance of the project goes beyond honey. At its core, the project represents a holistic approach to sustainable agriculture that respects traditional methods while embracing the possibilities of modern technology.

By enhancing nectar sites and migratory routes, this research preserves valuable beekeeping traditions while addressing the realities of climate change and urban expansion.

Working with a passionate group of individuals makes the effort even more worthwhile. Reflecting on their progress, Lamoliere notes, 'It is a very exciting project, and I love to work on it with such a nice team.' It is evident that the technology being implemented is making a tangible difference in a time-honoured craft – while safeguarding that legacy for forthcoming generations. With the collaboration between Malta and Türkiye, BEE-OPTECH4Honey is poised to set new standards in honey production, ensuring that beekeepers – and their bees – thrive for years to come.

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