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PP-572 [Pollination and Bee Flora]

هيئة أبوظبي للزراعة والسلامة الغذائية
ABU DHABI AGRICULTURE AND FOOD SAFETY AUTHORITY

Enhancement of Floral Resources for Honey Bees in the United Arab Emirates

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Introduction

Beekeeping in the United Arab Emirates (UAE) faces significant challenges due to the country's harsh arid climate and sparse bee forage. Honey production is concentrated during two main periods, and overreliance on two nectar flows—primarily from Sidr (Ziziphus spina-christi) in autumn and Samar (Vachellia tortilis) trees in late spring. Outside these seasons, some limited forage is available for bees to utilize, but forage scarcity is a major issue for bee management and can compromise colony strength and sustainability. Although nearly 200 flowering plant species in the UAE have been identified as potential forage sources, mostly remain underutilized by beekeepers.

Key Bee Forage Resources in the UAE

Tree	Season	Nectar/Pollen	Importance
Sidr	Oct–Nov	Nectar	Premium honey source
Samar	Apr–Jun	Nectar + Pollen	High-quality honey
Ghaf	Mar–May, Oct	Nectar + Pollen	Pre-Samar buildup
Damas	Nov–Dec	Pollen	Post-Sidr recovery
Mangrove	Apr–Jul	Nectar	Coastal forage
Date Palm	Feb–Apr	Pollen	Spring colony growth

Yearly Floral Map for Honey Bees in Lowland Areas of Abu Dhabi

The following projects are currently being undertaken by the Abu Dhabi Agriculture and Food Safety Authority (ADAFSA) to address bee forage scarcity in the UAE.

Project (1) Title: Enhancement Strategies for Improved Bee Forage in the UAE

Objectives:
To catalogue native and cultivated bee forage plants in the UAE.
To assess temporal availability of nectar and pollen resources.
To develop strategies that enhance year-round floral availability for honey bees

Project Components and Results:

1. Diversification of Bee Forage and Floral Gap Bridging

- Introduce drought-tolerant, nectar/pollen-rich species such as Acacia implexa.
- Supporting year-round bee forage and promote cultivation of native plants with extended flowering periods
- Prioritize species attractive to bees and adapted to arid climates

2. Strategic Plantation and Distribution

- Propagate and distribute suitable bee forage plants through ADAFSA nurseries: over 20,000 plants distributed (2021–2023)
- Develop floral corridors in agricultural zones and forest belts
- Integrate flowering species into urban and roadside landscaping.

Shortlist of prioritized flowering plants with high potential for enhancing honey bee nutrition:

Common Name (English)	Common Name (Arabic)	Scientific Name	Family	Flowering Period
Sweet Acacia	Anbar, Futnah	Vachellia farnesiana	Fabaceae	Mar-May
Gum Arabic Tree	Babul	Vachellia nilotica	Fabaceae	Mar-Nov
Salam	Salam	Vachellia flava	Fabaceae	Feb-Apr
Red River Gum	Cafor	Eucalyptus camaldulensis	Myrtaceae	Apr-Jun
Hickory Wattle	-	Acacia implexa	Fabaceae	Jan-Feb
Drum-stick Tree	Alban, Yasar	Moringa peregrina	Moringaceae	Feb-Jun
Rohida, Desert Teak	Ferfar	Tecomella undulata	Bignoniaceae	Jan-Apr
Rhanterium	Arfaj	Rhanterium epapposum	Asteraceae	Jan-May
Toothbrush Tree	Arak	Salvadora persica	Salvadoraceae	Mar-Jul
Hureim, Bean Caper	Harm	Zygophyllum, spp.	Zygophyllaceae	Mar-Jun
Caltrop	Zaher	Tribulus omanense	Zygophyllaceae	All year
Mesquite	Ghwief	Prosopis juliflora	Fabaceae	Oct-Jan, Mar-May

Project (2): Forest Mapping and Ecological Zoning project (2024–2026)

- A multi-phase initiative to digitize and analyse forest ecosystems for optimal hive placement and capacity estimation optimizing floral resource planning.
- Collaborative initiative: Dendra| SANAD | ADAFSA | DMT
- Ecological Mapping & AI-Enabled Forest Assessment
- Identify optimal apiary zones based on floral composition and capacity
- Regulate hive density in accordance with forage potential
- Build predictive honey capacity models using ecological and remote sensing data

Project Component Details

- Forests survey.
- Remote sensing technology: Ultra-High-Resolution (UHR) RGB (0.6 cm GSD), Multispectral (4.8 cm GSD for vegetation health), LiDAR (≥10 pts/m²) to assess canopy structure.
- Taxa modelled Sidr, Samar, Ghaf, Damas, and other species that look morphologically similar to the 4 species of interest (e.g. Gwaif).
- AI Capabilities Tree detection and segmentation, crown size, species ID, canopy height, health filtering.
- Outputs Hive capacity maps, honey yield models, ecological zoning

Methodology Summary

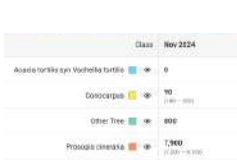
1. Field & Image Data Collection
- Tree tagging via GPS and species-level ID
- Ground-truthing: height, crown diameter, health condition
- Remote sensing imagery was collected using drones
- More than 100,000 taxa were identified on UHR imagery for training and validation of the AI models

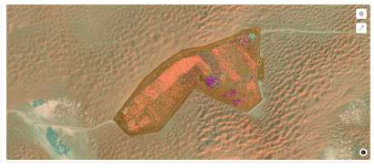
2. AI Development Pipeline
- Deep learning models for tree detection and crown segmentation
- Photogrammetry for 3D height estimation
- Binary classifiers paired with random forest for species detection (e.g., Sidr, Ghaf)
- Filtering non-productive/stressed trees from hive models

3. Hive Capacity & Yield Modeling
- Trees per hive and expected yield per species (based on expert inputs)
- Alternative model based on nectar sugar content per flower
- Adaptive rule-based modelling for "other" tree species
- Current Floral Resources & Underutilized Plants

Outcomes and Results

- 27 forests across Abu Dhabi were surveyed using a combination of remote sensing technology.
- AI algorithms successfully detected trees, segmented crowns, identified species (Sidr, Samar, Ghaf, Damas, etc.), and assessed canopy health.
- Based on tree species composition and density, forests were categorized according to their suitability for honey production for each honey flow.
- Developed hive capacity maps by correlating tree density, species composition, and nectar potential.
- All forest data are available through an interactive geospatial platform (Dendra Platform) enabling stakeholders to:
  - View species distributions.
  - Identify high-yield zones.





Conclusion

These projects integrated approach to address bee forage scarcity in the UAE merges cutting-edge technology with ecological fieldwork, and native plant enhancement. Critically, it also strengthens the sustainability and productivity of beekeeping, offering a replicable model for dryland regions worldwide.

Prosopis cineraria

Ziziphus spina-christi

Moringa peregrina

Vachellia tortilis

Acacia implexa

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Floral resources for honey bees in the UAE and how they can be enhanced

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Beekeeping in the United Arab Emirates (UAE) presents unique challenges due to the harsh arid climate, characterized by extremely high temperatures, low annual rainfall, and vast desert landscapes, and free-standing water is scarce. The availability of bee forage is a significant constraint, as natural vegetation is sparse and highly dependent on irrigation. Beekeepers in the UAE primarily operate in two environments: mountainous regions, which offer slightly better forage conditions, and desert areas, where sustaining bee colonies is particularly difficult. Honey production in the UAE is concentrated during the winter-summer and summer-winter transition periods, when flowering plants provide sufficient nectar and pollen. However, outside these periods, beekeepers struggle to maintain colonies due to limited forage availability. Although nearly 200 flowering plant species in the UAE have potential as honey bee forage, most beekeepers rely heavily on Samar (Acacia tortilis) and Sidr (Ziziphus spina-christi), overlooking other valuable native and cultivated plant species. The natural vegetation of the UAE is adapted to local climatic, soil and biotic conditions. As such, it is dominated by arid zone species. Except for mangroves, most of this vegetation grows in wadis and only flowers after rain, which is infrequent and unpredictable. Nonetheless, native vegetation still provides a valuable source of forage for honey bees. This study highlights the most important native bee forage plants across different ecological zones, including coastal shorelines, desert regions, and mountainous areas. It emphasizes the need for a more sustainable beekeeping approach that prioritizes year-round forage availability. By integrating diverse forage sources and adopting sustainable management practices, beekeepers can enhance colony survival, improve honey yields, and contribute to the conservation of honey bee populations in the UAE.