APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-025 [Bee Health]

BeePal

Kofinanziert von der Europäischen Union

Diese Maßnahme wird mitfinanziert durch Steuermittel auf der Grundlage des vom Sächsischen Landtag beschlossenen Haushaltes.

#0312

An automated AI-based diagnostic method for assessing Varroa destructor-infestation in honeybee colonies – First results and findings

Introduction

- Varroosis, classified as a Category C, D, and E disease under EU Regulation 2018/1882, is a primary cause of winter losses in beekeeping.
- The parasite, **„Varroa destructor"**, directly weakens affected colonies as a brood parasite and serves as a vector for various viruses[4].
- Traditional diagnostic methods include „wash tests, the "powdered sugar method" and counting mites dropping onto a bottom board.
- This study aims to validate an automated, AI-based method for determining within-colony mite fall.

Methods

The **automated diagnostic device "BeePal ONE"** was validated to manual counting of mites in the debris and compared with the results from the standard **"wash-test"**.

- The error-quota between manual debris analysis vs AI –analysis were determined
  - all the debris-pictures taken and analyzed by the **BeePal ONE** sytem where validated manually, the rate of false positives and false negatives was calculated.

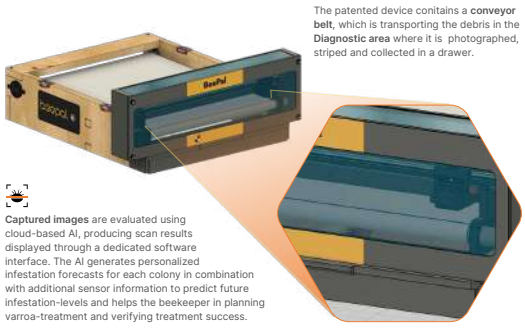
The wash test method

- aprx. 300 bees (30-50g) are taken from brood-combs and killed with ice-spray.
- They are put in 500ml water with dishwashing detergent, shook and let go for 15 min. The water is filtered and the mites are counted.

- **BeePal ONE** utilizes "debris diagnosis" at the bottom board combined with AI-driven image recognition.
  - The debris is transported on a **conveyor belt** into a diagnostic area where it is photographed, stripped, and collected in a drawer. **Captured** images are evaluated using cloud-based AI, producing scan results displayed through a dedicated software interface.

- The number of bees in the hive were calculated using the „modified Liebefeld Method"[3].

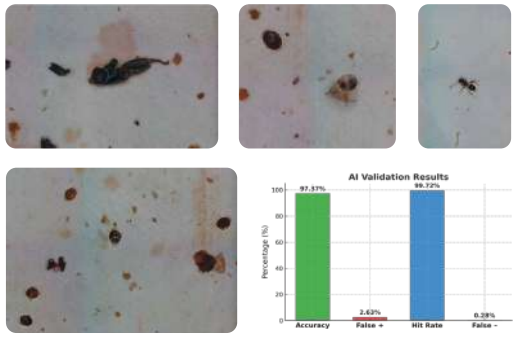
The BeePal ONE & how it works



The patented device conitains a **conveyor belt**, which is transporting the debris in the **Diagnostic area** where it is photographed, striped and collected in a drawer.

Captured images are evaluated using cloud-based AI, producing scan results displayed through a dedicated software interface. The AI generates personalized infestation forecasts for each colony in combination with additional sensor information to predict future infestation-levels and helps the beekeeper in planning varroa-treatment and verifying treatment success.

BeePal AI vs. Human Eyes



Results & conclusion

Infestation forecasts differed strongly depending on the diagnostic method. The „BeePal ONE" debris counting is very accurate and removes subjectivity of manual counting and offers solid scientific data gathering with less effort.

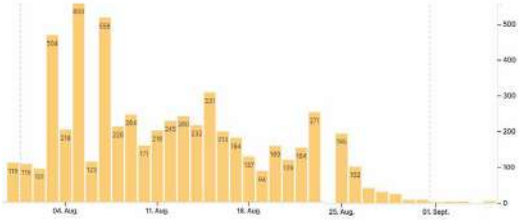
All results based on 20,000 bees in one hive:
Wash samples (n=2): 2.5–2.8% infestation → approx. 500–560 mites.
Debris diagnosis (AI-based): 50–119 mites/day (mean: 74.6).
Estimation according to Boecking et al.[2]: ≈ 11,190 mites (≈ 55.9%). (Rule of thumb: daily mite fall × 120 = total infestation.)

To further investigate these results, the colony was treated with 60% formic acid after sampling. The effectiveness of mite control with 60% formic acid is well documented and reported to be 75–95% (Bachert et al. 2022)[1].
Mite drop was analyzed using the **BeePal ONE**.

The Assumption of mite infestation in the colony based on
Wash sample: ≈ 560 mites
Debris count: ≈ 11,190 mites

Post-treatment mite drop: 5,754 mites

Amount of mites



02.08.2024 – Start of the treatment

The chart out of the Usercockpit of BeePal shows the increase of the mitecount starting 03/08/2024.
Until 23/08/2024 **5310** mites are counted.

05.09.2024 – Treatment success

The mite count decreases continiously to 5 mites
Total amount of mites counted till 05.9.2024: 5754

Error discussion

General: Just one hive observed with **BeePal ONE** prototype

Debris diagnostics: Detected only dead or groomed-off mites. High counts may also indicate good hygienic behavior. Accuracy depends on colony and requires repeated observations across multiple colonies under identical conditions. Ant activity can remove mites and bias results; frequent automated scanning would help reduce this effect.

Wash sample: About 400 bees from a brood comb are tested. Result assumes even mite distribution within the colony.
Colony strength determination: Strongly observer-dependent; assessments may vary despite identical conditions.

Bigl, G. */ Hardt, M.**
* BeePal UG, Leipzig, www.beepal.ai /
** State Institute of Health and Veterinary Affairs of Saxony

1) Bachert, A., Scheiner, R., Brandt, A. & Büchler, R. (2022). Wirksamkeit und Nebenwirkungen einer Varroabehandlung von Honigbienen mit 60%iger Ameisensäure in verschiedenen Verdunstersystemen. DOAJ (DOAJ: Directory Of Open Access Journals). https://doi.org/10.2376/1439-0299-2022-6
2) Boecking, O., Kubersky, U. (2008) Leitfaden Varroabekämpfung in Öko-Imkereien. S. 11. Niedersächsisches Landesamt für Verbraucherschutz und Lebensmittelsicherheit
3) Imdorf, A., Buehlmann, G., Gerig, L., Kilchenmann, V. & Wille, H. (1987). ÜBERPRÜFUNG DER SCHÄTZMETHODE ZUR ERMITTLUNG DER BRUTFLÄCHE UND DER ANZAHL ARBEITERINNEN IN FREIFLIEGENDEN BIENENVÖLKERN. Apidologie, 18(2), 137–146. https://doi.org/10.1051/apido:19870204
4) Traynor, K., Mondet, F., De Miranda, J., Techer, M., Kowallik, V., Oddie, M. A., Chantawannakul, P. & Mcafee, A. (2020). Varroa destructor: A Complex Parasite, Crippling Honey Bees Worldwide. Trends in Parasitology, 36(7), 592–606. https://doi.org/10.1016/j.pt.2020.04.004

PP-025 [Bee Health]
An Automated AI-Based Diagnostic Method for Assessing Varroa destructor Infestation in Honeybee Colonies-First results and findings

Gunther Bigl[1], Michael Hardt[2]
[1]BeePal UG Leipzig
[2]Landesuntersuchungsanstalt Sachsen: Dresden, DE

Varroosis, classified as a Category C, D, and E disease under EU Regulation 2018/1882, is a primary cause of winter losses in beekeeping. The parasite, Varroa destructor, directly weakens affected colonies as a brood parasite and serves as a vector for various viruses. Traditional diagnostic methods include wash tests, the "powdered sugar method" and counting mites dropping onto a bottom board. This study aims to validate an automated, AI-based method for determining within-colony mite fall. The BeePal Varroa-Detector utilizes "debris diagnosis" at the bottom board combined with AI-driven image recognition. Unlike conventional practices that conduct periodic mite fall assessments for a limited duration, this system analyzes debris continuously. The debris is transported on a conveyor belt into a diagnostic area where it is photographed, stripped, and collected in a drawer. Captured images are evaluated using cloud-based AI, producing scan results displayed through a dedicated software interface. The AI generates personalized infestation forecasts for each colony in combination with additional sensor information to predict future infestation-levels and helps the beekeeper in planning varroa-treatment and verifying treatment success. Various technical challenges associated with automation have been addressed. Validation was achieved by counting mites in high-resolution scans over a complete month. The AI detection accuracy stands at approximately 95%, distinguishing between false positives (FP), where objects are incorrectly identified as mites, and false negatives (FN), where mites are missed by the AI. Results derived from the AI analysis were compared with findings from a wash test conducted on the same colony, with colony strength initially determined using the Liebefeld estimation method. The mite counts identified through AI detection were significantly higher than those anticipated from the wash method, indicating potential underestimation by traditional techniques. Further investigation is warranted to explore these findings in depth; the implications of the results will also be discussed.