Verification of a new electronic bee-counting device using video analysis and manipulative trials

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Bee counting devices promise new findings in bee research. Since accuracy of existing bee counters is unsatisfactory, the Beecheck was developed. This new device ensures the separation of single bees by small passageways and operates with capacitive sensors providing quantitative information of the object passing the sensor. The sensor readings are transformed to bee exit and entry counts based on an algorithm. Due to variability in bee behaviour, misinterpretation by the algorithm happens occasionally.

In this study, the device counts are verified by empirical methods, enabling the improvement of the algorithm. Videos of the operating device were recorded at varying times of the day and under different meteorological conditions. Subsequently every bee was counted watching the video in the slow-motion mode. In semi-field trials, the counting device was placed in front of bee forage resulting in equal numbers of incoming and outgoing bees. Data from both experiments was compared to the records of the Beecheck.

The capacitance-based sensors accurately detected changes in their electrical field. First results suggest that the behaviour of bees differs according to time of the day and meteorological conditions. Yet, the algorithm has some structural errors leading to the misinterpretation of common situations. However, it is difficult to generalize the sensor readings in a way that the device always correctly decides whether a bee went in or out or turned. The methods described in this study can be used to validate bee-counting devices accuracy so that it can be used in scientific research and risk assessment.