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Breeding for Hygienic Behavior in Honey Bees

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Abstract : The Western honey (Apis mellifera) is threatened by a number of parasites, especially the devastating Varroa mite (Varroa destructor) is responsible for a high level of mortality over winter, e.g., in Europe and USA. While the use of synthetic pesticides or organic acids has been preferred so far to control this parasite, breeding strategies for less susceptible honey bees are in early stages. Hygienic behavior can be an important tool for controlling Varroa destructor. Worker bees with a high level of this behavior are able to detect infested brood in the cells under the wax lid during pupation and remove them out of the hive. The underlying processes of this behavior are only partly investigated, but it is for sure that hygienic behavior is heritable and therefore, can be integrated into commercial breeding lines. In a first step, breeding lines with a high level of phenotypic hygienic behavior have been identified by using a bioassay for accurate assessment of this trait in a long-term national breeding program in Luxembourg since 2015. Based on the artificial infestation of nucleus colonies with 150 phoretic Varroa destructor mites, the level of phenotypic hygienic behavior was detected by counting the number of mites in all stages, twelve days after infestation. A nucleus with a high level of hygienic behavior was overwintered and used for breeding activities in the following years. Artificial insemination was used to combine different breeding lines. Buckfast lines, as well as Carnica lines, were used. While Carnica lines offered only a low increase of hygienic behavior up to maximum 62.5%, Buckfast lines performed much better with mean levels of more than 87.5%. Some mating ends up with a level of 100%. But even with a level of 82.5% Varroa mites are not able to reproduce in the colony anymore. In a final step, a nucleus with a high level of hygienic behavior were build up to full colonies and located at two places in Luxembourg to build up a drone congregation area. Local beekeepers can bring their nucleus to this location for mating the queens with drones offering a high level of hygienic behavior.

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