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A scientific note on hygienic behavior in *Apis mellifera lamarckii* and *A. m. carnica* in Egypt

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Apis mellifera lamarckii / *Apis mellifera carnica* / hygienic behavior / Egypt

Hygienic behavior in the honey bee, *Apis mellifera* L., is highly variable among and within populations and subspecies (Spivak and Gilliam, 1998a, b). The complex of behaviors that result in hygienic bees has been implicated in resistance to various bee diseases, including American foulbrood (*Paenibacillus larvae*), chalkbrood (*Ascosphaera apis*), and the parasitic mite, *Varroa destructor* (Woodrow and Holst, 1942; Rothenbuhler and Thompson, 1956; Spivak and Gilliam, 1998a, b; Boecking and Spivak, 1999).

The purpose of the present study was to compare the hygienic behavior of two populations of *A. mellifera* commonly used in Egyptian apiculture. *A. m. lamarckii* Cockerell is the endemic bee of Egypt, and is well adapted to the local conditions and pests of the region. However, *A. m. lamarckii* is considered by some beekeepers to exhibit high levels of defensive behavior and to be an inferior honey producer. Consequently, a large population of honey bees descended from *A. m. carnica* Pollmann is maintained commercially in Egypt. Descended primarily from *A. m. carnica* imported over a 30 year period (ending in 1962), these “Egyptian *carnica*” bees are reported to have apicultural traits (mild defensive behavior, calmness on the comb, and high honey yield) preferred by some beekeepers (Kamel, 1991).

In May 2000, an apiary was established at Suez Canal University in Ismailia, Egypt, containing two bee stocks, Egyptian *carnica* (n = 12) and *A. m. lamarckii* (n = 7). The Egyptian *carnica* queens originated from the Egyptian Ministry of Agriculture breeding program (New Valley). The *A. m. lamarckii* colonies were collected from mud tube hives in the Assiut region in 1999 and transferred to wooden moveable frame equipment. Subspecies assignment of the Assiut colonies was based on computer assisted morphometric analysis (Ruttner et al., 1978; unpublished data). At the time of assay,

colonies were approximately equal in strength and contained three to four frames of brood housed in a single Langstroth hive body. Neither group had previously been selected for hygienic behavior. Both lines were managed to optimize colony populations for honey production.

A freeze killed brood assay (Spivak and Gilliam, 1998b) was conducted by removing a 5 cm by 8 cm square sections of comb containing approximately 100 cells of capped brood from each colony. The sections were placed in a freezer for approximately 18 hours, and then the brood was thawed and placed back into the frame from which it was removed. The number of cleaned cells was observed and recorded at 4, 24, and 48 hours. A “cleaned” cell contained no visible trace of brood. Colonies that removed all of the dead brood within 48 hours of the replacement of the frozen comb were considered to exhibit hygienic behavior.

The proportion of cleaned cells was determined by dividing the number of cleaned cells by the total number of cells capped at the initiation of the experiment. Proportional data were transformed with an arcsine transformation and the data were analyzed with repeated measures ANOVA (GLM-Repeated Measures, SPSS 8.0, 1997). Differences were considered significant at the $P < 0.05$ level.

We found significant differences between the two lines of *A. mellifera* in the percentage of cells uncapped at 24, and 48 hours and the percentage of colonies considered to exhibit hygienic behavior. At both sampling times, the *A. m. lamarckii* colonies had a significantly higher level of hygienic behavior than did the Egyptian *carnica* colonies.

A range of hygienic behavior was observed in both *A. m. lamarckii* and Egyptian *carnica* colonies. However, in the *A. m. lamarckii* colonies 42.9% (3/7) of colonies had removed all of the dead brood at 24 hours, whereas none (0/12) of the Egyptian *carnica* colonies had completely removed the dead

brood in the same time period. At 48 hours, 71.4% (5/7) of the *A. m. lamarckii* colonies had removed all of the freeze killed brood, while in the same time period 8.3% (1/12) of the Egyptian *carnica* colonies completely cleaned the section of killed brood. These results suggest that the natural occurrence of hygienic behavior is higher in *A. m. lamarckii* than in Egyptian *carnica*.

In both populations of bees, uncapping and brood removal began within 4 hours of comb reintroduction into the colony. Egyptian *carnica* colonies removed 9.6% (s.d. = 8.9) and *A. m. lamarckii* removed 21.8% (s.d. = 17.8) of the dead brood at 4 hours. This difference in brood removal in the first 4 hours following comb reintroduction was not significant ($P = 0.095$; $F = 3.11$). However, *A. m. lamarckii* exhibited significantly higher levels of hygienic behavior at the later sampling times. At 24 hours *A. m. lamarckii* colonies had removed an average of 72.5% (s.d. = 34.8) of the dead brood and the Egyptian *carnica* had removed an average of 35.6% (s.d. = 20.3) ($P = 0.022$; $F = 6.31$). At 48 hours, *A. m. lamarckii* colonies had removed an average of 90.5% (s.d. = 21.0) of the dead brood and the Egyptian *carnica* had removed an average of 59.4% (s.d. = 29.3) ($P = 0.014$; $F = 7.44$). While the difference in dead brood removal was not significantly different at the 4 hour observation, it appears that *A. m. lamarckii* more quickly determines the status of damaged brood, more quickly begins to remove brood once damage is detected, or devotes more resources to brood removal than does Egyptian *carnica*.

Clearly any conclusions drawn from these results must be considered in view of the limited sample sizes and duration of the study. However, if the preliminary observations are verified, then the prospect for selection of bee stocks for hygienic behavior in Egypt is very good. Selection protocols could be developed to increase the frequency of other desirable traits in *A. m. lamarckii* while maintaining the naturally high level of hygienic behavior in the population. Crosses of *A. m. lamarckii* with extant Egyptian *carnica* could decrease the time needed to select for desirable apicultural traits. Finally, it would be interesting to investigate

whether the relatively high frequency of hygienic behavior in the native *A. m. lamarckii* population (71.4%) versus the introduced and more intensively managed Egyptian *carnica* (8.3%) is a result of subspecies differences in hygienic behavior or the effects of selection by beekeepers. Surveys of other native populations may reveal a reservoir of hygienic bees to be used in future breeding programs.

Note scientifique sur le comportement hygiénique en Égypte d'*Apis mellifera lamarckii* et de l'abeille carnoise, *A. m. carnica*.

Wissenschaftliche Notiz über das hygienische Verhalten von *Apis mellifera lamarckii* und von der ägyptischen Carnica-Biene, *A. m. carnica*.

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