The removal response of *Apis mellifera* L. colonies to brood in wax and plastic cells after artificial and natural infestation with *Varroa jacobsoni* Oud. and to freeze-killed brood

O. Boecking and W. Drescher

*Institut für Landwirtschaftliche Zoologie und Bienenkunde, Bonn, Germany*

ABSTRACT


Like *Apis cerana* colonies, *A. mellifera* colonies also show removal response to *Varroa*-infested brood cells. Infested worker brood cells of artificially and naturally infested combs were detected by the worker bees to various degrees in all types of comb-material used.

The bees uncap brood cells and remove larvae or pupae infested with one or two mites. The removal response of worker bees was stronger towards brood cells containing two mites than cells with one mite.

The specific signals which cause the removal of brood cells infested with *Varroa* mites are unknown. Removal response to *Varroa*-infested brood cells in plastic comb-material ("Jenter"- and ANP-comb) was significantly higher than to brood in wax combs. Up to now we do not know to what extent this tolerance mechanism is influenced by genetic and environmental factors.

Our experiments comparing the removal of freeze-killed brood with the removal of brood infested with *Varroa* mites demonstrate positive correlations. Considering the time-consuming method of the artificial infestation with living mites, the hygienic behaviour – including the removal of brood cells infested with mites – of large series of colonies can be tested using freeze-killed brood.

INTRODUCTION

The ectoparasitic mite *Varroa jacobsoni* Oud. has been spread nearly all over the world and has become one of the most dangerous pests of the honey bee *Apis mellifera* L.
The original host of the Varroa mite, the Asian honey bee *Apis cerana* Fabr., achieves low mite infestation levels because the bee developed tolerance to this mite (Woyke, 1976; Koeniger, 1987; Peng et al., 1987; Rath and Drescher 1990). So far only some reports indicate the occurrence of tolerance to the Varroa mite in European and Africanized honey bees (Ritter and De Jong, 1984; Ruttner et al., 1984; Engels et al., 1986; Ritter, 1990).

For the breeding of a Varroa-tolerant stock of the European honey bee *A. mellifera* the identification of possible tolerance mechanisms is necessary. Most investigations have concentrated on differential reproduction of the mite, brood attractiveness, and the duration of the postcapping stage (Ritter and De Jong, 1984; Ruttner et al., 1984; Moritz, 1985; Schousboe, 1986; Büchler, 1990).

More recently, Boecking and Drescher (1990, 1991) published investigations concerning the removal response of *A. mellifera* bees to brood cells infested with Varroa mites as a possible additional tolerance mechanism. Specialy constructed test combs seemed to influence the extent of the removal rate. So far the removal response in wax combs has not been investigated.

Here we report the results of investigations regarding the response of *A. mellifera* bees to brood cells of different comb materials infested with Varroa mites. Further we compared the removal response of worker bees towards freeze-killed brood and brood infested with Varroa mites to test whether the degrees of removal are correlated.

MATERIALS AND METHODS

The response of *A. mellifera* bees to worker brood cells of wax and "Jenter"-combs artificially infested with Varroa mites

The response of *A. mellifera* bees to worker brood cells infested with Varroa mites has been tested in a selection and breeding project in Bonn (June 1991) using "Jenter"- and wax combs. The specially constructed comb of the "Jenter"-queen-breeding system consists of one cell layer only and provides 90 cells (among 465) with movable cell bottoms (Fig. 1). Alienated from its purpose to get eggs for queen-breeding, we use "Jenter"-combs to infest worker brood cells after their capping. Before using them in our tests the plastic foundations were covered with a layer of wax cells by the bees. The "Jenter"-combs permitted the artificial infestation of maximal 90 brood cells with Varroa mites after cell capping. As the cell bottoms had little plugs, it was guaranteed that the structure of the cell capping remained undamaged in the process of infestation. Shortly (∼0–6 h) after capping, these brood cells were marked on a transparent plastic sheet (Ifantidis, 1983; De Ruijter, 1987). For successive controls this sheet could be placed in the same position on the comb. About one third of the cells of one "Jenter"-comb were infested with one Varroa mite, and one third with two Varroa mites, which were collected from infested