SPECIFITY OF THE SEX PHEROMONE IN *VARROA DESTRUCTOR*

Bettina Ziegelmann[1], Anne Lindenmayer[1], Johannes Steidle[2], Peter Rosenkranz[1]

1) Apicultural State Institute, University of Hohenheim, D-70593, Stuttgart
2) Institute for Animal Ecology, University of Hohenheim, D-70593, Stuttgart

Introduction

The lifecycle of *Varroa* females is divided in a phoretic phase on adult bees and a reproductive phase within the sealed brood. Reproductive females enter brood cells prior to capping. Oviposition starts 60 to 70 hours after capping with a haploid male egg. Up to 5 diploid female eggs follow in regular 30 hour intervals. The developmental time from egg to the adult molt takes about 5.8 and 6.6 days for females and males, respectively (Donzé and Guerin, 1994; Ifantidis, 1990). Mating usually takes place at the faecal accumulation site between adult males and virgin daughter mites. The mating process is a cascade of sequent behaviors of the male, including palpation of the female opisthosoma, ascending the female and descending to the solenostomes on the ventral side of the female (Lindenmayer, 2006, Fig. 1). Finally, the spermatophore is transferred by means of the chelicerae. In a choice test young freshly moulted females were significantly more attractive than older mites; female deutochrysalis were not attractive at all. Thus the mate choice occurs not by chance. In could be shown that the mating behavior is elicited by a sex pheromone released by young female mites (Ziegelmann et al., 2008). In this study the volatility and the gender specifity of the pheromone are examined.

Fig. 1: Male palpating the female genital region between coxa 3 and 4

Material & methods

Fig. 2: Ether extracts were applied to filter paper which is offered to male together with a deutochrysalis

Extracts – Ether-extracts were prepared from young females (which were proved to be attractive within the bioassay) and adult males. After an extraction time of 48h, the extracts were evaporated and filled up with pentane to a concentration of 2 individuals per 10µl in order to avoid a repellent effect of ether in the bioassay.

Bioassays – The activity of the extracts was tested by applying amounts of two individuals (=10µl) to a filter paper (15mm x 1mm). The treated filter paper was then fitted in a queen cell cup (Fig. 2) and a female deutochrysalis as an unattractive dummy was placed at the bottom. Therefore, we could prove whether volatiles from the treated filter paper have the ability to elicit the copulation behavior toward the dummy. The following parameter of the male's copulation behavior were recorded over a 5 minutes period: walking around the female, mounting the female‘s dorsum and ascending to the ventral side, assuming the copulatory position. In the control tests only solvent was applied to the filter paper.

Results

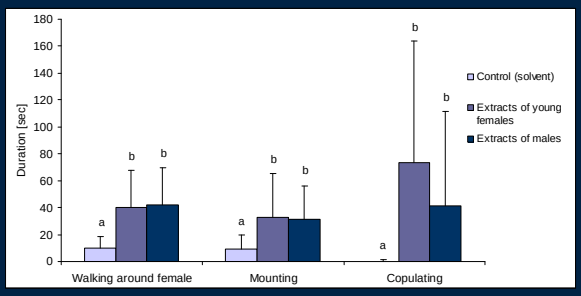

Fig. 3: Male responses to solvent, extracts of males and young females. Significant differences were determined by ANOVA test, p <0,05 (n=30)

The solvent alone did not elicit any copulation attempts of the male mite (Fig. 3, control). After the application of a female extract, however, the male's behavior changed significantly and the typical cascade of the copulation behavior was observed (Fig. 3, light blue). Surprisingly, extracts of male mites had nearly the same effect (Fig. 3, blue-black). Responses to male extracts were somewhat lower, but not significant different from the female's extracts. Therefore, both male and female extracts contain the active compounds to elicit the specific mating behavior (Fig. 4).

Fig. 4: Male trying to copulate with deutochrysalis after extract application

Discussion

With our new bioassay we are able to test and quantify the copulation behavior of *Varroa* males towards extracts and specific compounds. The here presented results evince that the *Varroa* sex pheromone is volatile and can be detected by the male from a distance of several millimeters. Although males themselves aren‘t attractive to other males, extracts of both, females and males could elicit the specific mating behavior. This suggests that the active compound(s) of the sex pheromone are synthesized in both sexes. But obviously, the pheromone is available on the body surface only in young females. We suppose that the pheromone is released to the body surface through the female solenostomes immediately after the female is molted. In the male, however, the compounds are only present within the body but can be released through the soft integument by long term extraction. The lack of the “sex-specifity” indicates that the active compound(s) are products of the general metabolism rather than products of specific glands. The fact that we are able to trigger significantly the mating behavior of male *Varroa* mites by volatile compounds under laboratory conditions provides for the first time the possibility for a biological control.

References

Donzé, G., Guerin, P.M., 1994. Behavioral attributes and parental care of Varroa mites parasitizing honeybee brood. Behav. Ecol. Sociobiol. 34, 305–319.

Ifantidis, M.D., 1990. Re-examination of some parameters concerning reproduction of the mite Varroa jacobsoni Oud. ln: Proceedings of the International Symposium on Recent Research on Bee Pathology, Gent, Belgium, pp. 20–26.

Lindenmayer, A., 2006. Chemotaktische Orientierung bei der Partnerfindung und Details des Kopulationsverhaltens der Bienenmilbe Varroa destructor. Zulassungsarbeit Fakultät für Biologie, Universität Tübingen.

Ziegelmann, B., Steidle, H., Lindenmayer, A., Rosenkranz, P., 2008. Sex pheromones trigger the mating behaviour of Varroa destructor. Apidologie 39, 598.