Some aspects of the behaviour of the queen and workers in colonies of *Melipona favosa* (F.) (Hym., Apidae): Individual behaviour of workers involved in brood cell construction and provisioning

BY

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Résumé

Quelques aspects du comportement de la reine et des ouvrières dans la colonie de Melipona favosa *(F.) (Hym., Apidae): comportement individuel des ouvrières impliquées dans la construction et le remplissage des cellules à couvain.*

On a étudié le comportement des ouvrières qui étaient impliquées dans la construction des cellules à couvain et la procédure de l'oviposition. Seule un nombre limité d'ouvrières est impliqué dans la construction d'une cellule à couvain, en moyenne 17 ouvrières.

Le nombre d'ouvrières qui est impliqué dans l'approvisionnement de cellules est encore plus bas. Les insertions corporelles avec contraction de l'abdomen (en moyenne 11) sont exécutées par 6 ouvrières en moyenne. Les ouvrières qui se *« déchargent »* sont aussi les plus actives comme abeilles constructrices. Pendant l'approvisionnement d'une cellule il y a, dans la série d'ouvrières, quelques ouvrières qui reviennent plusieurs fois et montrent des contractions subséquentes. Après avoir déchargé, ces abeilles s'éloignent le plus souvent vite de la cellule.

Nous avons étudié dans les environs de la cellule les échanges trophallactiques des ouvrières pendant la procédure d'approvisionnement. Il parut qu'entre les déchargements subséquents les ouvrières mendient de temps en temps de la nourriture chez d'autres ouvrières et ceci étant récompensé très souvent.

Nous nous demandons si on pourra appeler l'éloignement assez rapide de la cellule, comme on a parmi les abeilles les plus actives de *M. favosa* le *« post discharge escape »* (SAKAGAMI et al., 1977). Peut-être nous pourrons comprendre ce comportement en supposant que les ouvrières en question sont motivées à apporter assez vite plus de nourriture dans la cellule. Le grand engagement avec la cellule de ce groupe limité d'ouvrières, étant évident de leur participation à la construction et l'approvisionnement, montre une grande similarité avec la biologie des abeilles solitaires.

Introduction

The distribution of the stingless bees (Meliponini) is restricted to the tropical regions of the world (MICHENER, 1974). The behaviour of these social bees inside the nest is studied by several authors. Since 1963 SAKAGAMI has published in collaboration with ZUCCHI and others a series of articles on the oviposition behaviour of a number of species.

Stingless bee colonies are perennial and may contain a large number of individuals. The queen is obviously specialized for egg laying. In many species, however, workers are able to oviposit in the presence of the queen (SAKAGAMI et al., 1973). Worker eggs laid under queenright conditions often represent a nutritional source for the queen (*«trophic eggs»*). BEIG (1972) demonstrated that in *Scaptotrigona postica* most of the males are produced through the production of worker eggs. In most species the queen feeds herself mainly on the larval food that has been discharged into the brood cell by the workers.

The characteristic mass provisioning of all stingless bees implies that the brood cells shortly after being constructed are filled with a liquid larval food. This cell provisioning and the successive oviposition by the queen generally takes place within only a few minutes or less. It is characteristic that the provisioning, the oviposition and operculation are performed in one undisrupted behavioural sequence. This is called the *«Provisioning and Oviposition Process (P.O.P.)»* (SAKAGAMI et al., 1965). The general activity of queen and participating workers during a *P.O.P.* is distinctly higher than between oviposition bouts.

While the brood cells in certain species are built one by one and provisioned as soon as they are ready, other species do construct a certain number of cells synchronously and provision and oviposit in them in a batch.

In the course of a *P.O.P.* frequent interactions can be observed between queen and workers. However, it appears that in several species this *P.O.P.* can take place in absence of the queen. Workers which oviposit under these circumstances are found to be important in preceding phases of the concerning *P.O.P.* also (SAKAGAMI & ZUCCHI, 1974; VELTHUIS, 1976; SOMMEIJER & VELTHUIS, 1977).

Our finding that under queenless conditions the laying workers play a prevailing role in the first phases of the *P.O.P.* (e.g. in the discharge phase) gave rise to the question whether such individual differences among workers participating in a *P.O.P.* also occur under queenright conditions. This contribution gives a first answer to that question.

Method

Colonies of *M. favosa* were kept under controlled conditions in our laboratory. The colonies originated from Surinam. They were housed in observation hives as described by SAKAGAMI (1966). All workers were marked individually. In addition to observations on laboratory colonies we have also studied the worker behaviour in colonies under natural conditions in Trinidad (West-Indies).

Results

In *Melipona favosa* only a restricted number of workers is involved in the construction of a single cell. In a series of observations on two colonies (300-400 individuals) there were on the average only 17 bees involved in the construction of each cell. An average of 11 body insertions with abdominal contraction was carried out by an average of 6 workers. We found that these «discharging» bees had been active also in the construction of the same cell. In fact they constitued the group of the most active builders. In the sequence of workers engaged in the provisioning of one cell some individuals return several times for subsequent contractions. This was most obvious in the first discharging bees. Generally, the workers leave the cell quickly after having discharged.

We obtained some indications supporting the hypothesis that the subsequent body insertions with abdominal contraction of the same individual really represent subsequent discharges. Firstly, we observed that these bees only gradually lost the swollen appearance of the abdomen. Some bees have after returning at the cell for another discharge a swollen abdomen again. In relation to this it appeared that workers who performed subsequent discharges were soliciting food from other workers in between their own subsequent discharges. This food soliciting behaviour was often rewarded.

Discussion

The quick disappearance of a worker from the cell just after having discharged was observed by SAKAGAMI and collaborators in several other species. This behaviour has been described in these species as the *«post discharge escape»* (SAKAGAMI et al., 1977). They propose to consider the behaviour of the discharging bee as being governed by three behavioural systems (*«drives»*): *«attack on the queen»*, *«flee away the queen»* and *«food discharge»*, resp. Before the discharge, the first and third *«drive»* should determine the shape of the «escape reaction».

In our colonies of *M. favosa*, with individually marked workers, we have noted that this escape reaction is intensely performed by those workers who are greatly involved in the construction and provisioning process of that cell. We also observed that these workers execute subsequent food discharges. Furthermore, we observed the successful soliciting of food from other workers during the provisioning phase by these workers. These observations seem to be in contrast to the hypothesis of SAKAGAMI et al. (1977). Instead of being an escape reaction this behaviour in *M. favosa* may be related to a motivation of the respective workers to bring quickly more food into the cell. The great involvement of a limited number of workers bees with the construction as well as the provisioning of the same cell draws our attention to resemblances with the biology of solitary bees.

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