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BEHAVIOUR OF WORKERS ON WASTE DUMPS IN THE NESTS OF *Melipona favosa* (APIDAE, MELIPONINI)

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RESUME

Le comportement des ouvrières envers le "waste dump" dans le nid de *Melipona favosa (Meliponini,Apidae)*

Une analyse du comportement des ouvrières de nettoyage révèle l'existence d'un polyéthisme ontogénétique, et d'une rythmique quotidienne de ces comportements.

SUMMARY

The behaviour of workers on specific waste dumps is described. A sequence analysis on the behaviour of individual workers has been carried out. There is a strong relation between certain behavioural elements. An age-dependent polyethism and a daily rhythm was found. The phenomenon of waste dumps in the nests of *Melipona* is discussed.

INTRODUCTION

A division of labour within colonies that consist of two generations of females is a major characteristic of eusocial insect colonies. This division of labour, therefore, has been a subject of many behavioural studies on social bees. Comparison of the behaviour of Stingless Bees (*Meliponinae*) with that of the Honeybee (*Apis mellifera*) reveals striking similarities in the behavioural organisation, which are interesting, since both groups presumably independently attained a highly social level .

There are, however, major differences. The specific system for broodcell-construction and rearing of new workers was studied in different species by Sakagami (1982) and in *Melipona favosa* by Sommeijer et

al. (1982,1984). Now, we would like to deal with the fact that the nests of Stingless Bees are characterised by the presence of an area where workers defecate. Such an area, which we will call "waste dump" from now on, is not found inside *Apis*-hives, since Honeybee-workers fly out in order to defecate.

The brood compartment of a *Melipona favosa* nest is separated from the storage compartment. The waste dump or dumps are generally found in between these two compartments. In this paper we will first describe the behaviour of workers on the waste dump in *M. favosa* and next, we will analyse some relations between these behaviours.

MATERIALS AND METHODS

For this study we used colonies of *M. favosa* , originating from Surinam and Trinidad, West Indies. The colonies were kept under controlled conditions in observationhives (cf. Sakagami,1966) . From these hives bees are unable to fly out. They are being fed with syrup and pollen. All workers were age-marked individually.

Observations were done directly and with the aid of video-equipment, both under red light. Two distinct observation methods were used. First, all behaviour on one of the waste dumps was registered continuously for a period of 10 minutes and subsequently observations shifted to another dump. Second, a focal-animal-sampling method was used, with observations on individuals starting at the approach to the dump and ending with the withdrawal. Duration and sequence of behavioural elements were registered and analysed.

RESULTS

a/ Ethogram

On and near waste dumps of *M. favosa* a number of behavioural traits can be distinguished. Some of these are behaviours also found elsewhere in the hive, others are entirely restricted to the waste dump itself. We discriminated between 10 different behavioural elements which in our opinion are connected with the processing of waste materials.

"Legcleaning" (LCL). This behaviour can be seen everywhere inside the hive but it is especially frequent on waste dumps. The abdomen is raised, and the distal parts of the hind legs are rubbed together. At close

examination, small particles can be seen falling from the legs.

"Grooming" (GRO). This also is a behaviour not merely restricted to the waste dump. The worker rubs her body with front-, middle- or hindlegs.

"Carrying bee" (CAB). A worker walks with a dead bee,or part of it , in her mandibles.

"Carrying miscellaneous objects" (CAM). A worker is carrying parts of used broodcells, waste pollen or resin or other objects or materials.

"Defecating". Workers of *Melipona* almost always defecate on a waste dump. This is in contrast to the defecating behaviour of the queen. We distinguished three types of defecating, according to the constitution of the feces: feces can be very watery (DEW), can be firm and deposited as a clump (DEC) or can be viscous, leaving a thread not easily separated from the body (DET). All kinds of defecating, but especially the latter type, are frequently followed by shaking the abdomen vigorously.

"Gathering" (GAT) can be seen in various places but especially in the vicinity of the waste dumps. Moving slowly in this area around the dump, workers collect small particles, using their mandibles and holding the antennae in continuous contact with the surface, more or less resembling the act of vacuum cleaning.

"Depositing" (DEP) is exclusively seen on the waste dump. This behaviour is responsible for the formation of the dumps. All kinds of particles, held between the mandibles, are deposited on the waste dump. Sometimes several objects are deposited in one sequence. By moving her head up and down, the worker can then bring several particles from her mouthparts.

The term "Mandibular Dump Contact" (MDC) is somewhat misleading as several of the previous behaviours include a contact between dump and mouthparts. This behavioural element is characterised by a curved position of the abdomen and by the slow backward movements of the worker's body. The head moves up and down while the worker separates a small part from the dump. This part of dumpmaterial is moulded into a pellet.

b/ Age dependence of the behaviour

Waste dump behaviour was conducted by workers of 0 to 53 days old. One of us reported this for other colonies as

well (Sommeijer, 1984). At that time we suggested that this could possibly be due to our not distinguishing between different elements. This proved to be only partly true. Of the 10 aforementioned behavioural elements, only two (namely GRO and LCL) were regularly performed at all ages. Three also started at an age of 0 days but stopped between 19 and 38 days. The other five behaviours were not performed in bees younger than 3-5 days old. Out of 10 behavioural elements, 8 distinctly peaked in bees of 10- 20 days old. As a result, the graph for all elements together also shows a peak at that age interval (figure 1).

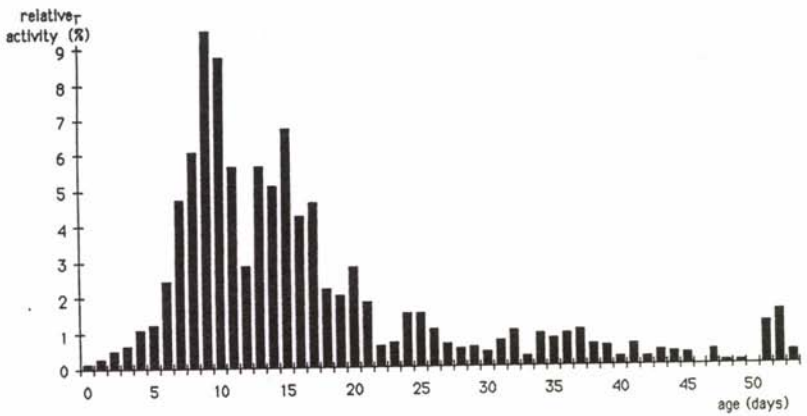

figure 1 Age dependence of waste dump behaviour. *Comportement au "waste dump", dépendant de l'age.*

It is striking that in all of these 8 elements, there was a distinct dip in activity at an age of about 12 days. This is approximately the age at which building and provisioning of broodcells is highest , as we reported earlier (Sommeijer, 1984). Of a number of 42 workers observed to discharge larval food during the present observations, only four exhibited one or two of these dump-behaviours. Moreover, these behaviours only were Defecating, GRO and LCL. In a free flying colony, we found that carrying waste outside the hive, started at an age of about 18 days, peaked at 32 days and was last performed by workers of 50 days old. This fits into

the pattern of this study of colonies in captivity. Thus we may conclude that carrying waste outside succeeds waste processing ontogenetically.

c/ Daily activity pattern

All 10 behaviours showed a clear diurnal rhythm with a relatively low activity between 6 pm and 6 am, and a higher activity in the remaining period (figure 2).

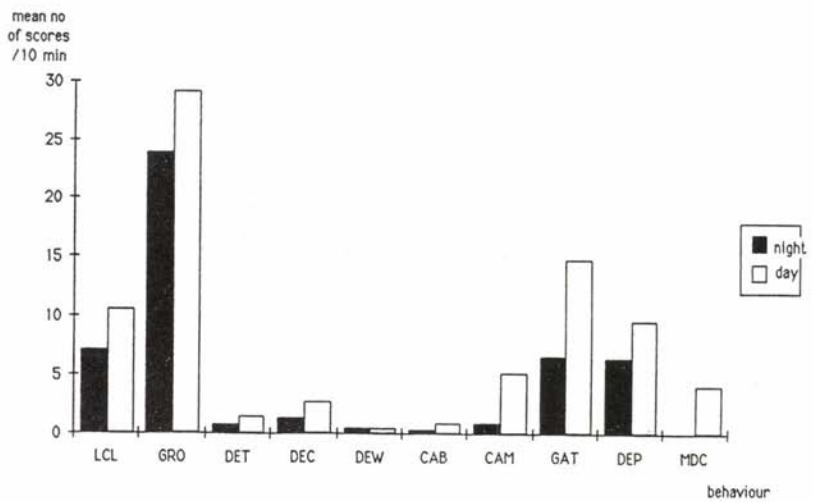

figure 2 Waste dump activity during day and night.
L'activité au "waste dump" pendant le jour et la nuit.

This is of interest, because for our captive bees, there were no visual clues to determine the time of the day; they could not forage outside the hive. Earlier we found that building and provisioning of brood-cells, egg-laying and also other behaviours did not exhibit a daily rhythm, neither in laboratory nor in natural conditions (Sommeijer, Beuvens & Verbeek, 1982; obs. in Trinidad). From this we conclude that the decrease in waste processing activity during night time is not caused by a lower temperature or a general decrease in activity. It suggests that these bees use an internal clock for this

behaviour and concentrate waste processing behaviour in periods in which it is normally possible to fly out with some of the waste. This is probably best illustrated by the behaviour MDC, which could be described as pellet making behaviour, and is always seen just before carrying waste outside. This behaviour was never seen at night time.

DISCUSSION

The sequence analysis of behavioural elements revealed a distinct separation of three groups of elements. The first group is composed of CAB and DEP. The second group contains GAT, DEP , MDC and CAM. Thirdly, a group is formed by the three kinds of defecating plus GRO and LCL. From these results we conclude that waste dumps are used for at least three purposes. First, dead bees are temporarily stored before being carried outside. Second, other waste material is carried to the dumps, stored and removed. And third, the waste dumps are the spots where workers defecate. The development of waste dumps is very dynamic and the extend and appearance of the dumps can change from day to day, due to massive dumping or removal of dumpmaterial.

The occurrence of waste dumps in colonies of *Melipona spp.* is very interesting, especially when we consider the risk of diseases finding a substratum on these dumps. To answer the questions concerning the function of this phenomenon we now concentrate on the constitution of the waste dumps. Possibly, they may compose a source of vital material for the proper functioning of a Stingless Bee colony.

REFERENCES

Sakagami S.F., 1966.- Techniques for the observation of behaviour and social organisation of stingless bees by using a special hive. *Pap. Avuls. Depto. Zool. Secret. Agric. S. Paulo,* 19, 151-162

Sakagami S.F.,1982.-Stingless Bees. *In : Social insects III (H.R.Hermann, ed.), New York, Academic press,* 361-423

Sommeijer M.J., Beuvens F.T., Verbeek H.J., 1982.- Distribution of labour among workers of *Melipona favosa*

F.. Construction and oviposition of brood cells. *Insectes Sociaux*, 29(2), 222-237.

Sommeijer M.J.,1984.-Distribution of labour among workers of *Melipona favosa* F.. Age-polyethism and worker oviposition. *Insectes Sociaux*, 31(2), 171-184.

Sommeijer M.J., Bruijn L.L.M. de, 1984.- Social behaviour of Stingless Bees:"bee-dances" by workers of the royal court and the rhythmicity of broodcell provisioning and oviposition behaviour. *Insectes Sociaux*, 29(2), 222-237.