Journal of Insect Behavior, Vol. 7, No. 1, 1994

Short Communication

Communication Among *Melipona* Workers (Hymenoptera: Apidae)

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Accepted October 26, 1992; revised August 26, 1993

KEY WORDS: stingless bees; bee communication; *Melipona* species.

INTRODUCTION

Some preliminary data on communication about the food source by trail-marking workers of *Melipona compressipes* and *M. rufiventris* have been published (Kerr and Rocha, 1988). This system is known to occur also in four other genera, namely, *Scaptotrigona*, *Trigona* (including the subgenus *Geotrigona*), *Oxytrigona*, and *Cephalotrigona*, of which *Scaptotrigona* contains the species most studied (Lindauer and Kerr, 1960).

Three experiments with *M. quadrifasciata* indicated that *Melipona* bees communicate by sound (that is heard as pipings) and get oriented in the first 5 to 20 m after leaving the hive entrance by following scout bees (Lindauer and Kerr, 1960; Kerr *et al.*, 1963). *Melipona* bees produce a sound of 300 to 600 vibrations/s when delivering nectar. The duration of these pipings was correlated with the distance to the food source in the two species studied: *M. quadrifasciata* and *M. seminigra* (Esch *et al.*, 1965; Kerr and Esch, 1965). Destruction of the mud and resin structures of the nest entrance of *M. compressipes* disrupts the newly recruited bee's ability to follow the informer correctly (Kerr, 1987). The informer bee also opens the valves of its deposits of mandibular gland products, generating an odor corridor (or odor tunnel) in the air from hive to food source that helps to maintain the correct directional orientation of recruits over short distances. Evidently the odor dissipates in the air so this is a poor method under windy conditions. The odor left by *Trigona spinipes* can be detected by a human observer about 1 m from a bee (Kerr *et al.*, 1981). Therefore, the recruited *Melipona* bee leaves the nest for the food source with information on distance (given by sounds) and direction (given by the entrance configuration, sight of

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0892-7553/94/0100-0123$07.00/0

the informer bee flying to the field, and odor tunnel left by the informer bee), and when near the food source it finds two or three spots that have been marked with scent, the last one being on the food source proper.

More information is needed on this mechanism, especially because of the many differences found among species. For instance, *M. compressipes* scent marks in two locations—at the food source and at another site 1 to 8 m from it—and usually defecates when marking (Kerr and Rocha, 1988). *M. rufiventris* workers scent mark intensely on two or three sites: *Scaptotrigona postica* puts a mark each meter from the food source 400 m away to a point 10–15 m from the colony.

MATERIALS AND METHODS

The present paper concerns three species hitherto not studied: *M. scutellaris*, *M. bicolor*, and *M. quadrifasciata*. *M. scutellaris* is one of the three semidomesticated species of meliponids. *M. bicolor* is usually found with two to five queens. In order to obtain comparative information, colonies of *M. rufiventris* were included in the study.

Twenty-three hives were maintained in a covered space at the Apiary of the Federal University of Uberlândia (18°56'S, 48°18'W): 13 *M. scutellaris*, 6 *M. rufiventris*, and 4 *M. quadrifasciata*. On the afternoon of August 12, 1988, bees from all hives were trained to a feeding station (FS) 20 m away, where a liter of a solution of 40% sucrose, scented with 2 drops of linalol, was offered. There were four shrubs (1, 2, 3, and 4) in the line between the hives and the FS.

Shrub 1 was 1.35 m tall and 1.5 m from the FS.

Shrub 2 was 1.0 m tall and 2.6 m from the FS.

Shrub 3 was 1.8 m tall and 4 m from the FS.

Shrub 4 was 1.1 m tall and 7.5 m from FS.

On August 13, 1988, from 1630 until 1715 h, the bees were stimulated by placing in the hive entrance 0.2 ml of the same syrup as used the day before.

The observations of *M. bicolor* were made with six colonies in the live collection of the Universidade Federal de Viçosa (20°45'S, 42°53'W) on January 3 and 4, 1989. The bees were trained by pouring in their interior 1 ml of 40% sugar syrup scented with eucalyptol. Petri dishes with the same syrup were placed 15 m from these hives. The following morning 10 bees visited the dishes.

Observations on flowers were also made. *M. quadrifasciata* was observed collecting nectar in a daisy bush [*Montanoa bipinnatifida* (Asteraceae)] on June 15, 1993; these bushes produce nectar varying from 18 to 44% total solids. *Scaptotrigona postica* was observed collecting pollen in *Myrciaria cauliflora* (Myrtaceae) on July 19, 1993.

Twice a week, the bees of the apiary are fed in a kind of feeding station, where many of these observations are confirmed.

RESULTS

Three minutes after they were stimulated, *M. scutellaris* and *M. rufiventris* workers began arriving at the feeding place and also began scent marking. For 20 min the bees were observed marking leaves and stems of four shrubs (1, 2, 3, and 4) and were counted. In these 20 min the total frequencies of scent-marking bees were as follows:

Shrub 1, 11 *rufiventris* and 17 *scutellaris*;
Shrub 2, 4 *rufiventris* and 19 *scutellaris*;
Shrub 3, 2 *rufiventris* and 16 *scutellaris*; and
Shrub 4, 1 *rufiventris* and 5 *scutellaris*.
Total: 18 *rufiventris* and 57 *scutellaris*.

A marking bee rapidly walks 2 to 10 cm on a leaf (Figs. 1 and 2), stem, or trunk, but preferably on the edge of a leaf. Each marking operation lasts from 3 to 15 s. Workers of both species fly less than 1 m from the ground, contrary to *M. compressipes*, which flies above 3 m.

Two *M. bicolor* workers began marking at 0950 h. In 1 h of observation four markings were observed: the shortest lasted 3 s and the longest 17 s. In no case was a third mark observed in this species.

Observations were made on *Myrciaria cauliflora* Berg flowers. (July 19, 1993); each flower opens for 5 h and the total honey flow lasts 3 days. The flowers, which in this species cover all trunks and all branches, were open on the first day with a great intensity and releasing a very agreeable odor from 0700 to 1400 h. At 0810 h, a *Scaptotrigona postica* worker discovered the bush and begun collecting pollen. On the second trip this worker behaved exactly as described previously (Lindauer and Kerr, 1960; Kerr *et al.*, 1968), and at 0835 h more than 150 workers were attracted to those flowers. At 0900 h the whole bush was full of these bees and many bees also marked. In the last 4 years this plant flowered 16 times but this was the first time that *Scaptotrigona* discovered this tree. On June 15, 1993, at 0700 h, a *M. quadrifasciata* worker began working on flowers of a bush of *Montanoa bipinnatifida*. It made five trips before beginning to mark as described above; four workers arrived within 30 min. On the following day I deposited 1 drop per flower of an inodorous syrup. When the bee found the drop, she marked and eight bees arrived in less than 10 min.

It is very common to observe *M. scutellaris* and *M. quadrifasciata* males arriving at the feeding station in the last 30 min of this operation. Also, males are seen the following morning aggregating in leaves of plants 50 to 180 cm from the feeding places. It is also very common, at the end of the feeding

Fig. 1. *Melipona scutellaris* worker marking a *Pouteria caimito* leaf 4 m from the food source and 8 m from the hive.

operation, to see one (or sometimes two) virgin queen (Kerr *et al.*, 1992). Since we made several observations of males feeding on flowers (Kerr, 1987) and others of virgin queens on flowers, it may be inferred that males and queens follow the communication provided by the workers for mating purposes.

Fig. 2. *Melipona quadrifasciata* worker scent marking in the same tree, 4 m from the food source and 20 m from the hive.

DISCUSSION

M. rufiventris usually has a nest entrance with a diameter large enough for only one bee at a time. Therefore, when a food source is productive and foraging is intense, delivery of food from field bees to receivers and dehydrators at the nest takes place outside of the hive, within a radius of 5 to 18 cm from the entrance; dehydrators begin their work at the outside of the nest. This behavior releases the scent of the artificial nectar in the air and attracts *M. quadrifasciata* workers. It may also be that some *M. quadrifasciata* bees came to their hives perfumed with the *M. rufiventris* odor that many workers of the latter left as their first mark (that is, on the FS proper); these two causes are likely what causes other *M. quadrifasciata* workers to look for food around the hive entrance of *M. rufiventris* where field bees are releasing the same smells (nectar and glandular). This also induces *M. rufiventris* workers from weaker hives to move to more populous ones. These same mechanisms allow and induce "robbing of information": Training a bee in an apiary usually trains bees in its colony and their odor releases attract many others. Hives of *M. compressipes* and *M. scutellaris* may be placed near others, with their entrances only 35 cm apart. Nest

entrances must be farther apart in *M. rufiventris*, likely due to this behavior. *Scaptotrigona postica* and *S. xanthotricha* also mutually rob information if their scent trails cross in a field (Kerr *et al.*, 1963).

M. bicolor workers trained to a FS 20 m away made one or two marks each on the edges of leaves. Since there were no evident differences between the communication behavior of these bees and that of *M. quadrifasciata* workers, no more observations were made.

Taking into account the frequency of marks in a given time and the efficiency of this system of communication in attracting newcomers, the five species already studied can be listed as follows: first (most efficient), *M. rufiventris* and *M. scutellaris*; second, *M. compressipes*; and third (least efficient), *M. bicolor* and *M. quadrifasciata*.

ACKNOWLEDGMENTS

This work is supported by CNPq (Brazilian Research Council) and FAPEMIG (Fundaçâo de Amparo à Pesquisa do Estado de Minas Gerais). Dr. R. E. Page, Jr., and Dr. C. D. Michener helped with the English. Dr. L. A. O. Campos allowed the use of *M. bicolor* hives from his laboratory. The observations of anonymous referees delayed publication but increased the quality of this communication.

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