

## Morphological and Biochemical Differences in the Abdominal Glands of *Pheidole pallidula* (*Myrmicinae*)

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Different degrees of polymorphism exist in the widespread *Pheidole* genus. Extensive research has been conducted on glands producing pheromones or defensive compounds in dimorphic New World species, showing not only differences between neutral castes but also between species. Our study of the strictly dimorphic European species, *Pheidole pallidula*, contributes to the present knowledge of biochemical polymorphism in the genus *Pheidole*. By use of biometric, histological, chemical and ethological techniques, we have studied the abdominal glands (pygidial, Dufour's and poison glands) in the minors and the majors of *P. pallidula*.

### MATERIAL AND METHODS

Abdomens of *P. pallidula* were fixed in gluteraldehyde osmium, imbedded in Spurr's resin and pygidial glands were observed on 2  $\mu$ m sections. Measurements were taken on freshly dissected glands. For chemical analysis, Dufour's and poison glands were dissected and extracted in *n*-pentane. Pentane glandular extracts were analysed by capillary gas chromatography and (Z,E)- $\alpha$ -farnesene identified by its <sup>1</sup>H N.M.R. spectrum.

Circular artificial trails with glandular extracts were used as bioassay for trail pheromone. Other pheromonal functions were investigated through preliminary experiments. All the abdominal glands were presented in random order on a slip of heavy paper (5 x 5 mm) laid 15 cm from the nest entrance. Reactions like threats, alarm runs, short bites to other workers, bites to paper and self-cleanings were recorded and counted within a circle (2cm diameter) centred on the paper, as well as the number of ants entering the circle.

### RESULTS AND DISCUSSION

Pygidial glands are moderately developed in *P. pallidula* and the differences between minors and majors are small. The glandular reservoir is somewhat larger in the majors in which more gland cells were observed. This contrasts with the extreme development of this organ in *P. biconstricta* (Kugler, 1979).

Contrary to some New World *Pheidole* species (e.g. Wilson and Hölldobler, 1985; Law et al, 1985), the size's increase of the poison gland's reservoir between the two neutral castes is very moderate (volume ratio major/minor = 1.9 (n=61)) and skatole could not be detected in the chromatograms of majors' poison gland secretions. A marked trail-following behaviour is induced by circular trails drawn with the minors' poison gland and in a much lesser extent with the majors' poison gland extracts. The production of trail pheromone by the minors is consistent with their essential role in exploration and in the initiation of food and defensive recruitments.

Size dimorphism of the Dufour's gland in the two subcastes is remarkable (volume ratio major/minor = 11.2 (n=50)) and proportionally even more marked than the well known dimorphism of the head capsule (volume ratio major/minor = 7.6 (n=20)). This hypertrophy of the Dufour's gland in the majors is associated with a clear biochemical specialisation of the major's gland in the production of (Z,E)- $\alpha$ -farnesene, representing about 94 % of the compounds detected by GC. The farnesene is also present in the Dufour's gland of the minors but constitutes only 17 % of the compounds detected by GC. We estimate that the majors produce about 80 times more (Z,E)- $\alpha$ -farnesene than the minors. The biological meaning of this biochemical specialisation is not yet understood. The Dufour's gland of other myrmicine species is also specialised in the production of one or several farnesene derivatives but no biological function has been assigned to these compounds (e.g., Cavill et al, 1967; Cammaerts et al, 1981).

Our bioassays indicate that poison gland secretion of the minors attracts and alarms the ants. This reaction is probably caused by the trail pheromone. The Dufour's gland secretions of majors and especially of minors induce alarm runs and aggressive behaviours like threats and bites to other workers. Only weak reactions were observed in the presence of crushed pygidial glands of the minors but those of the majors induce bites to paper and threats as well as numerous self-cleanings. These preliminary results suggest that both Dufour's glands and pygidial glands could be involved in the defence-alarm reaction of the society but more information is needed before concluding that they are actually released during defence.

### REFERENCES

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