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PHYSIOLOGY OF REPRODUCTION IN THE PHARAOH'S ANT (*MONOMORIUM PHARAONIS* L.) 1. PHEROMONE MEDIATED CYCLIC PRODUCTION OF SEXUALS

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The synanthropic pharaoh's ant *Monomorium pharaonis* L. (*Hymenoptera, Myrmicidae*) is an insect pest of growing importance. Contrary to many other hygienic pests like bedbugs, filth flies etc. distribution of the pharaoh's ant is promoted by the modern way of life. Therefore eradication of this insect from infested buildings like hospitals is very difficult and time consuming.

Improvement of the conventional insecticides and the search for new means of control on the basis of a better understanding of the biology of this pest is essential. As long as the precise conditions of nesting were unknown the biology of the pharaoh's ant was a subject of speculation. Peacock et al., were the first to rear this insect, and recent improvement of rearing methods has afforded experimental access to many unsolved problems. The pharaoh's ant is characterised by the following special features:

1. The colonies are polygynic.
2. Nuptial flight is abandoned in favour of copulation in the nest, probably in adaptation to life under nontropic conditions.
3. Their dissemination is effected by sociotomy.
4. The individuals of different strains are sociable with each other.
5. Fertility of workers does not occur.
6. In queenless colonies production of new sexuals takes place.

The mechanism of regulation of production of sexuals (determination of castes) is little known in the pharaoh's ant. Buschinger et al. suggested (1973) a hypothesis on the basis of the theory of Bier (1956). Bier postulated a so-called profertile substance and suggest, that competition between queens and larvae for the profertile substance is the primary mechanism for the determination of castes in certain ants. Buschinger et al. pointed out that the pharaoh's ant queens receive different food,

dependent on age from the workers. Older queens receive food from the crop and younger ones — a special gland food. It is, however, doubtful whether the experiments mentioned were carried out under physiological conditions, as some of the parameters differ strongly from our own observations of large field populations. Under field conditions the approximate age of queens in one year, whereas Buschinger et al. indicate an age of only three to five months. In our laboratory colonies queens at the age of four months were at their highest egg-laying capacity. Further the cited authors stated that the cycle of sexual production lasts approximately four months. Our observation on field and laboratory colonies indicated a duration of one year. Shorter periods indicated abnormal conditions in the societies.

We were given the opportunity of controlling large colonies in the Berlin Tierpark (GDR) throughout the year. Furthermore we were able to produce laboratory colonies on a large scale. During our five-year-study the induction of new sexuals was always observed to take place in the same season. In the rest of the year we never found winged queens or males.

Based on our investigations we postulate, in contrast to Buschinger et al. (1973), as the primary mechanism for the induction of the rearing of new sexuals, the presence of an "Inhibitory Pheromone". The pharaoh's ant queen secretes a queen suppressive pheromone, the origin of which is still unknown. This pheromone formes a thin layer on the surface of the whole body. It is licked from the queen's body by the workers and distributed via the social food chain. The substance mentioned is soluble in organic solvents.

First of all it was to be proved that the primary mechanism is not competition for food between queen and larvae. For this purpose we carried out the following experiment with laboratory colonies: At the age of two to four months normal queens were introduced to intact societies (700-2000 workers, equal numbers of larvae, pupae und praepupae). The queens were laboratory-reared according to Kretzschmar (1971), and Berndt (1974), respectively. The queens were dipped into acetone for 15 seconds daily. Afterwards they were not placed directly into the nest, but on the cover of the nest cell. Mortality of the queens so treated was low. Dead queens were replaced by living ones. Queenless colonies and such with untreated females, served as a control. Whereas the colonies with normal queens developed without production of sexuals the queenless colonies soon produced males and females. Colonies of queens treated with acetone also reared giant larvae which moulted into normal female and male pupae and adults several days later than the queenless colonies.

These results can be interpreted as follows: the sex-suppressing-pheromone was washed off the surface of the queen's body, by the daily dipping in acetone. The queens are obviously not able to secrete sufficient amounts of the pheromone to prevent the formation of new sexuals. If the factor would be a nutritive one the acetone treatment would not induce the rearing of new sexuals, as the extracted queens showed a normal behaviour (social behaviour, feeding, egg-production etc.).

According to these finding we interpret the yearly production of sexuals in field conditions in the following way: With growing age the queens secrete progressively less "Inhibitory Pheromone". This condition is caused by an exhaustion of the supply or by a degeneration of the pheromone-producing gland. The colony is physiologically queenless, as the pheromone is absent. Because the queens still produce eggs, such a colony is in far less danger than in the case of the death of all queens.

If one takes such a queen from large field colonies shortly before the growth of new sexuals take place it is also possible to produce new females and males under laboratory conditions with normal brood and workers. In the presence of the new queens the old ones also live in the colony for up to another three months.

If the Inhibitory Pheromone is introduced into the colonies by bait via the food chain no effect will result. If one adds freshly — killed queens to the food daily production of sexuals is not significantly delayed. The daily introduction of freshly-killed queens has only a minor effect.

The new Theory explained above, indicates a new possibility of control of the pharaoh's ant. If it is possible to introduce this inhibitory pheromone into colonies of the pharaoh's ant shortly before the rearing of new sexuals, the development of new queens and males would be suppressed and after the death of the old queens these colonies would no longer be viable. The new possibility of control is, as yet, far from being put into practice and depends on a variety of factors. Further details on the origin and effect of this inhibitory pheromone will be published elsewhere.

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FIZJOLOGIA ROZRODU MRÓWKI FARAONA (*MONOMORIUM PHARAONIS* L. — *HYMENOPTERA, FORMICIDAE*). 1. CYKLICZNA PRODUKCJA OSOBNIKÓW PŁCIOWYCH Z UDZIAŁEM FEROMONÓW

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Badając w ciągu ostatnich 5 lat biologię mrówki faraona w warunkach terenowych i laboratoryjnych, zwrócono uwagę na sezonową rytmikę pojawu nowego pokolenia płciowego. Autor tłumaczy obserwowane fakty obecnością u młodych samic „feromonu supresyjnego", nie występującego u starszych. Pochodzenie tego feromonu nie zostało jeszcze zbadane, wiadomo tylko, że pokrywa on cienką warstwą ciało młodych królowych. Zazwyczaj pokolenie płciowe pojawia się raz do roku. Jeżeli jednak młode samice codziennie kąpać w acetonie, dochodzi wkrótce do produkcji nowego pokolenia płciowego. A więc mechanizm indukujący hodowlę w kierunku uzyskania pokolenia płciowego pierwotnie nie jest zależny od czynnika pokarmowego. Oczywiście w dalszym rozwoju osobniczym czynnika tego pominąć nie można.

W oparciu o hipotezę udziału „feromonu supresyjnego" proponuje się nową metodę zwalczania mrówek faraona.