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THERMOREGULATION IN THE NEST OF FORMICA PRATENSIS RETZ. (HYMENOPTERA: FORMICIDAE)

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The first data on the thermoregulative function of ant nests were published by HUBER (1820), and then on the *Formica* species, by STEINER (1926), KATO (1939), SCHERBA (1962), and KNEITZ (1969a, b). Apart from a datum of KNEITZ (1969b), no literature reference is known to the nests of *Formica pratensis*.

The investigation of the nests of *Formica pratensis* was carried out in the clearings of a lowland wood of sandy soil. The biotop is of an extreme microclimate. The thermoregulation of the nests is therefore absolutely necessary in the active season for the survival of the *Formica pratensis*, which has a comparatively limited ecological amplitude.

Methods

The temperature of the nests built of vegetal parts was measured at a depth of five cm. At the same time, the soil temperature and the air temperature at grass level were also observed. The site of investigation: the ant nests in the *Astragalo-Festucetum sulcatae* and *Festucetum vaginatae* spots of the Emlékerdő at Ásotthalom (in the vicinity of Szeged). Date: **1966** (the complete season), **1971** (July), and **1972** (from March until June). Material of the investigation: seven nests in **1966**, twelve nests in **1971—72**.

Results and Discussion

1. Seasonal changes in the nest temperature

The thermoregulation of the nests is manifested in a temperature which as a rule, considerably exceeds those of the soil and the air. Similarly to the results of STEINER (1926) and SCHERBA (1962), in the cold winter months was observed no thermoregulation. However, neither was observed the Winter temperature inversion described by SCHERBA (1962). In early spring, the average nest temperature relating 2 °C was 8 °C. In the course of the subsequent rise in spring temperature the difference between nest and soil temperatures increased rapidly. The higher spring temperature and the large humus content compared with that of the adjecent sandy soil result in a vegetation that is very vigorous and much higher than that of the enviroment round the nests. As a result of the shading effect of this developed plant wreath, the temperature of a large part of the mound does not exceed 30–35 °C even on warm summer days. At the same time, the temperature of the central part, exposed to the direct radiation of the sun, may approach 50 °C (e.g. July 1966). Under such circumstances, both the workers and the sexed ants stay at the depths of the nest, or at the cooler, shady parts of the mound.

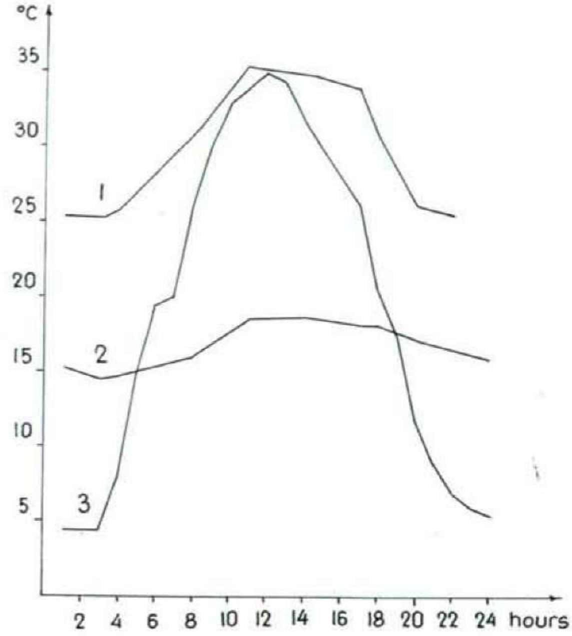

Fig. 1. Diurnal change in the temperatures of nests (1), soil (2), and air (3), 31 May 1972.

2. Diurnal changes in the nest temperature

Between 29 May and 1 June 1972 the daily changes in the temperature, its fluctuations and night minima were recorded. The temperature values observed for a clear day of adequate radiation (31 May) are given in Fig. 1. It is characteristic of the nest temperatures that they are considerable more staedy than the those of the air but more extreme than the temperature profile of the soil. On the clear, precipitation-free days of observation, the nest temperature did not fall below 25 °C and the maximum observed was 35.4 °C, meaning a fluctuation of not more than about ± 5 °C round the 28–30 °C that is optimum of the ants.

The average nest temperature, 29.75 °C is considerably higher than the daily mean temperatures of the soil (16.43 °C) and of the grass level (19.17 °C), the latter approaching the nest temperature at noon.

3. Relation between the temperatures of the nests and the environment

The thermoreguletion ensures the relative independence of the nests from the environmental factors, as well as the most appropriate milieu oecus for the ants but, at the same time, the nest temperature to a certain extent follows

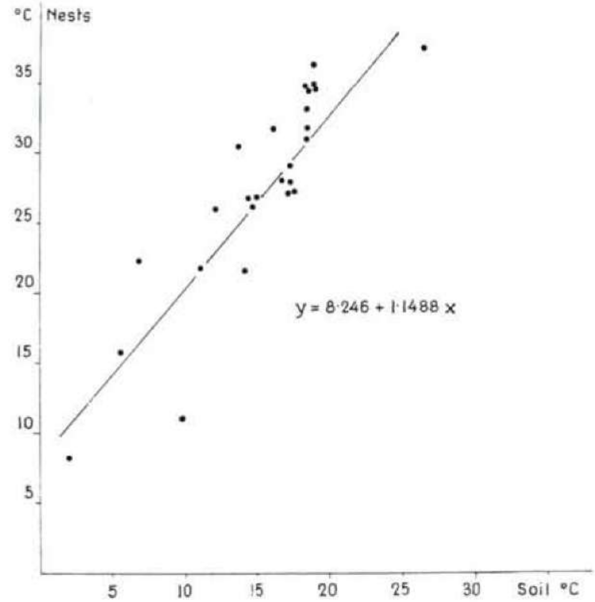

Fig. 2. Relation of the nest temperature with that of the soil.

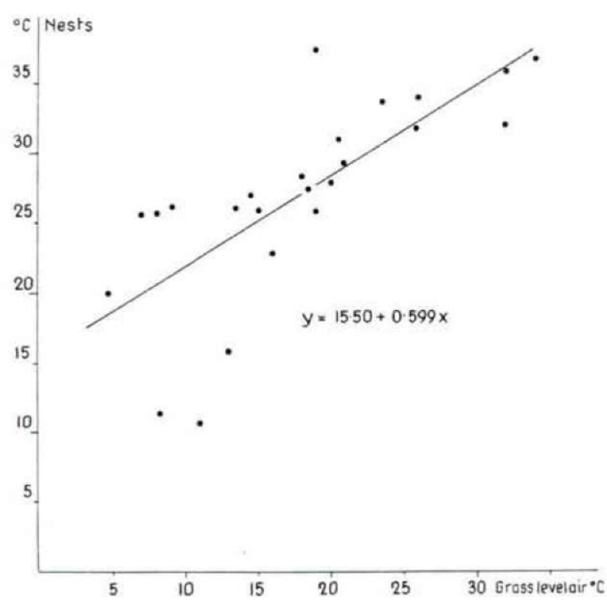

Fig. 3. Relation between the temperatures of nests and grass level.

the changes in the environmental temperature. The changes in the nest temperature are correlated to the temperatures of soil ($r = 0.6725$) and air ($r = 0.6811$) (Figs. 2 and 3).

The thermoregulative mechanism can be explained in that the insolation rays are absorved more by the surface of a loose nest made of vegetal parts than by the solid soil. This explanation is also supported by the fact that in rainy, cloudy weather the thermoregulation is smaller. In the case of Formica pratensis, the ant activity has no role in the development of a favourable temperature other than the building of the nest.

Summary

1. The temperature of the nest of *Formica pratensis* RETZ. exceeds the temperature of the environment in the active season, in this way ensuring optimum conditions for the ants.

2. Thermoregulation is ensured by a particular nest building.

3. The excessive warming up of part of the nest is impeded by the „ant-bush" developed round the nest.

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