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THE EFFECTS OF VARIOUS TEMPERATURES AND RELATIVE HUMIDITIES ON THE SURVIVAL OF WORKERS AND SOLDIERS IN *ODONTOTERMES MICRODENTATUS* ROONWAL AND SEN-SARMA (ISOPTERA : TERMITIDAE)†

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(With 4 Text-figures)

INTRODUCTION

The influence of abiotic factors such as temperature and relative humidity on poikilothermic organisms has a great bearing on their survival (Bachmetjew 1907, Uvarov 1931, Buxton 1932, Bélchrádek, 1935). Herter (1953) and Precht *et al.* (1955) have summarized the information on the effect of temperature on insects and other animals. In termites, such studies have been reported in *Reticulitermes* (Williams 1934, Strickland 1950, Gösswald 1955, Ernst 1957), Kalotermes (Gösswald 1941, Becker 1942, Pence 1956, Ernst 1957, Klee 1960, Sen-Sarma 1964), *Zootermopsis* (Ernst 1957) and *Nasutitermes* (Ernst 1957). In Indian termites, the effect of different relative humidity on the survival of workers at constant temperature has been investigated by Sen-Sarma and Chatterjee (1966) in *Microcerotermes beesoni* and Sen-Sarma (1969) in *Heterotermes indicola*. Temperature and humidity behaviour of any species of a fungus growing termites is not known at all. This work was taken up with a view to fill the existing gap.

MATERIAL AND TECHNIQUE

The test termites (workers and soldiers) were collected from New Forest, Dehra Dun, as and when required and were sorted out for experimental purpose at a constant temperature 27°C±1°C in an underground cellar. Only healthy termites were selected.

Different temperatures of 15°C, 20°C, 30°C and 35°C were maintained in a "Sew B. O. D. Incubator selecta 8". Different relative humidities were maintained by means of saturated solutions of the following salts K_2SO_4, KCl, NaCl, $Ca(NO_3)_2$, $4H_2O$ and $CaCl_2$, $6H_2O$ in distilled

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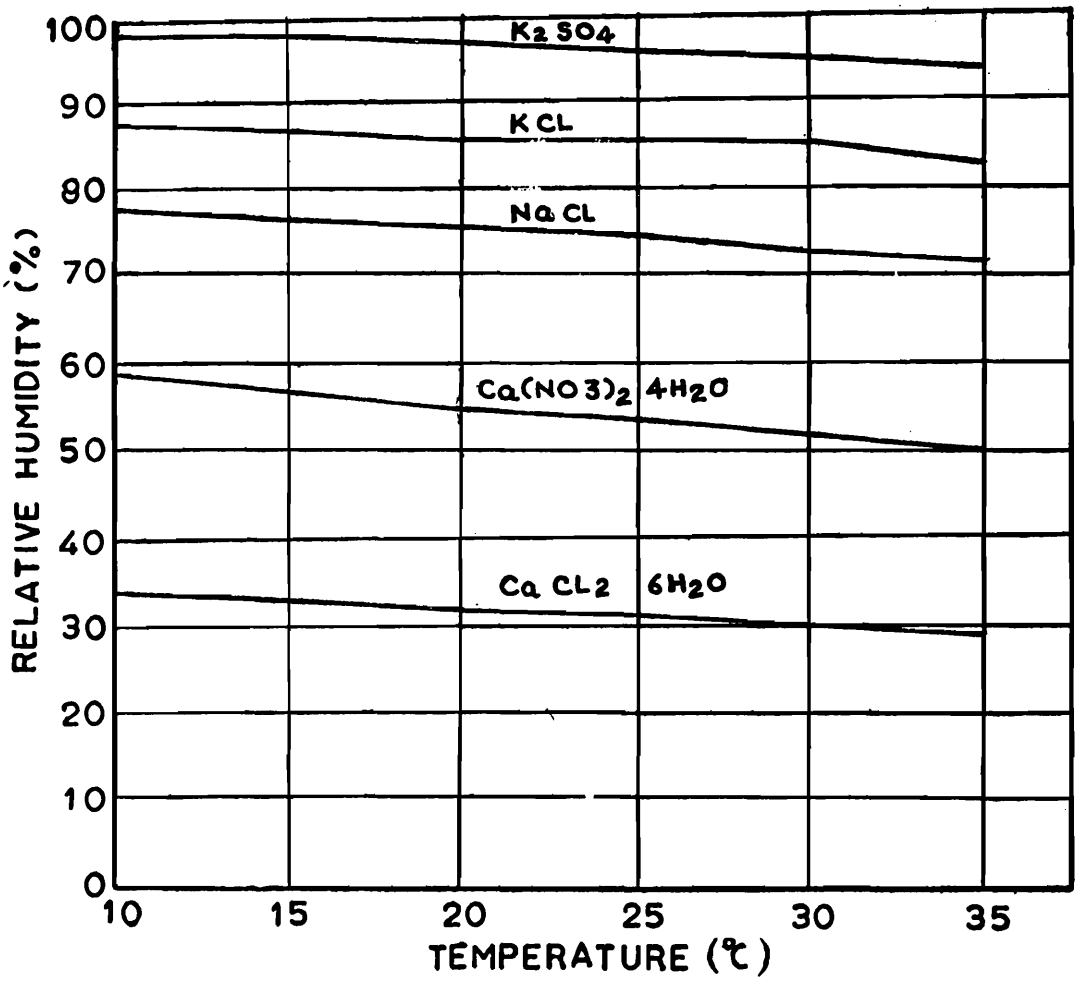
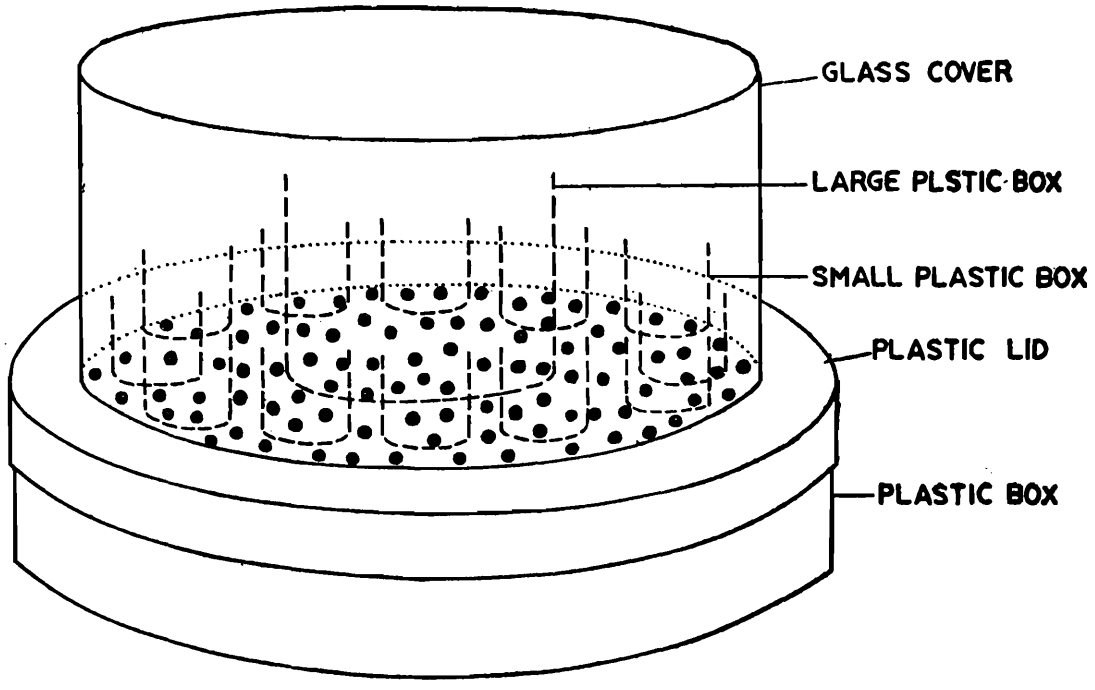


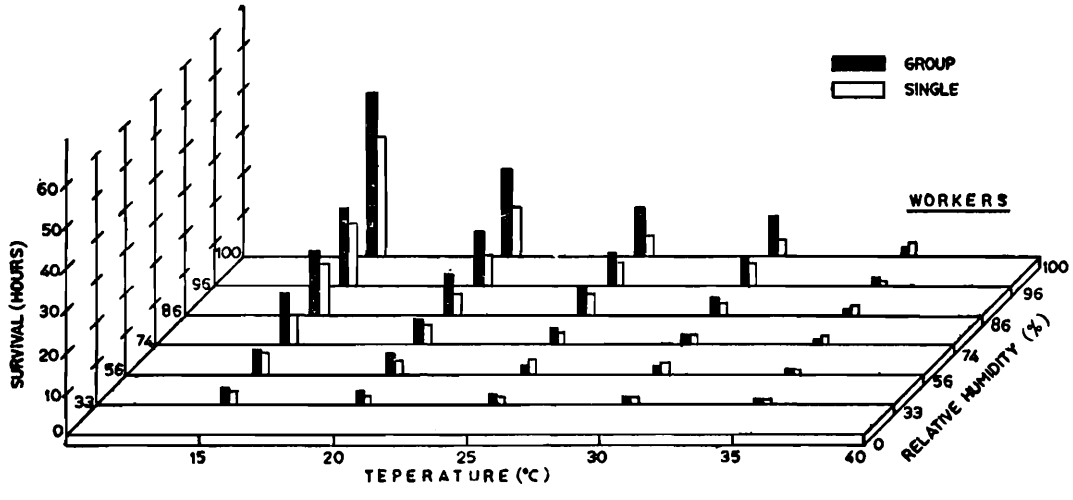
Text-fig. 1. Relative humidity obtained by means of saturated solutions of various salts at different temperatures.



Text-fig. 2. The schematic diagram of the apparatus used,

water (*vide* Sen-Sarma 1964) (Text-fig. 1). Hundred per cent relative humidity was observed by distilled water. The variation in the relative humidity did not exceed ± 2 per cent. The experimental appraratus was designed as follows (i) A glass dish was kept at the bottom of a round plastic trough to act the receptacle for the saturated aqueous solution of the inorganic salt (ii) A perforated lid was put on the plastic trough. (iii) A round glass cover of lesser diameter than the plastic trough was put inverted over the perforated plastic lid (Text-fig. 2). The saturated aqueous solution of the appropriate inorganic salt was kept in the bottom glass dish.

Ten experimental termites were used either singly or in groups for each experiment, and each experiment was replicated six times. No food was supplied to the termites during the experiment. Termites in groups were periodically examined after death under stereoscopic binocular microscope in order to detect mutilation of any body part due to cannibalism.



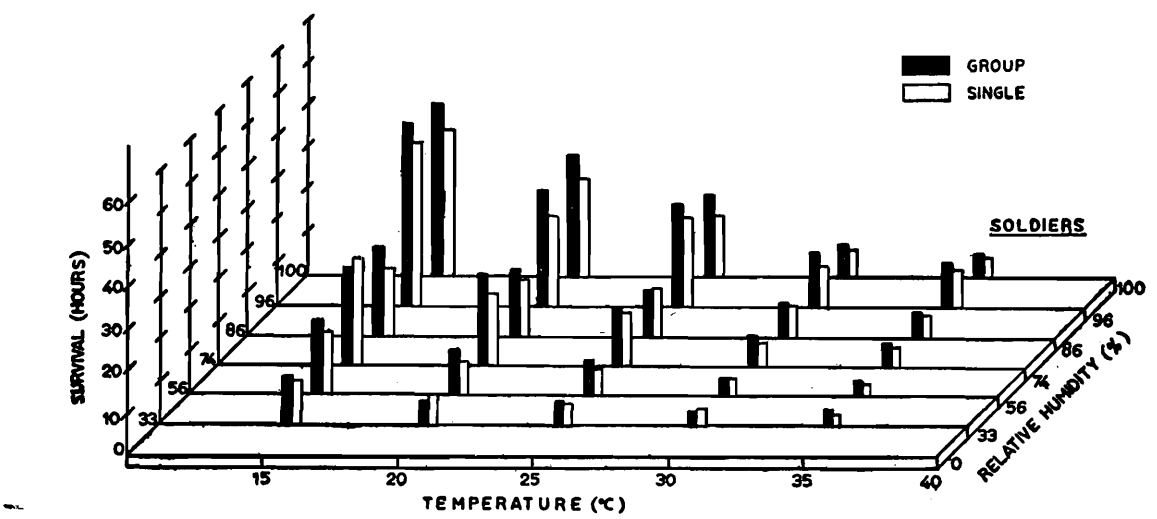
Text-fig. 3. Survival period of workers of *Odontotermes microdentatus* (in hours) at the temperatures 15°C, 20°C, 25°C, 30°C and 35°C and at different relative humidities in isolated individuals and in groups.

RESULTS

Workers : The average survival period of workers as isolated single individuals and in groups is shown in Text-fig. 3. The maximum average period of survival of experimental termites is 39.6 hours in groups and 29.1 hours in isolated individuals at a temperature of 15°C and 100 per cent R. H., the lowest is 1.3 hours (in both categories) at 35°C and 33 per cent R.H. The abdomen of workers has shrunk obviously due to loss of water. In general, the survival period is higher in groups than in isolated individuals.

Soldiers : Fig. 4 depicts the average survival period of soldier caste. The experimental termites survive for the maximum average period

of 40.8 hours in groups and 34.0 hours as isolated individuals at a temperature of 15°C and 100 per cent R.H., the lowest is 4.1 hours in groups and 3.4 hours as isolated individuals at 35°C and 33 per cent R.H. In general, the survival period is higher in groups than in isolated individuals. This may probably be due to lower rate of water loss from the body surface in soldiers on account of stronger chitinization.



Text-fig. 4. Survival period of soldiers of *Odontotermes microdentatus* (in hours) at the temperatures 15°C, 20°C, 25°C, 30°C and 35°C and at different relative humidities in isolated individuals and in groups.

Discussion

The survival period of both workers and soldiers is higher in groups than in isolated individuals and the difference is marked at lower temperatures and higher humidities than at the higher temperatures and lower humidities. The higher survival period of nueter caste in groups than in isolated individuals has been noted earlier by Grassé and Chauvin (1944), Ernst (1957), Sen-Sarma (1964) and Sen-Sarma and Chatterjee (1966). For a given relative humidity, the survival period decreased correspondingly with the increase of temperature and for a given temperature, the survival period decreased correspondingly with the reduction in the percentage of relative humidity. Accordingly to Ernst (1957), the weight of termites decreases in a continuous and linear fashion with the reduction in humidity, and the weight loss is caused primarily due to loss of water content of the body, the weight of fat content and dry substances remaining almost constant. The shrunken abdomen of experimental termites at lower humidities also explain the same. The higher survival of grouped termites has been explained by Grassé (1946) as resulting from "Group effect". Grassé and Chauvin (1944) were of the opinion that duration of life

in groups increased as a rusult of tactile stimulation. Using radioactive tracer techniques, Alibert (1959), Göswald and Kloft (1963), Sen-Sarma and Kloft (1965) explained group effect in terms of trophallaxis. As the soldiers can not feed themselves, factors other than trophallaxis seems to be involved in higher survival period in groups than in isolated individuals. It seems possible that 'huddling' or 'clustering' of termites, as explained by Pence (1956), might be responsible for higher survival period of grouped soldiers.

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SUMMARY

The individuals in group and ten isolated individuals of *Odontotermes microdentatus* were used for each experiment. The maximum survival period in groups as well as in isolated individuals in both workers and soldiers was observed at a temperature of 15°C and 100 per cent R.H. and the minimum survival period was noted at 35°C and 33 percent R.H. The survival period in both workers and soldiers in groups was, in general, higher than in isolated individuals in all combinations of temperatures and relative humidities. The difference in the survival period was more marked at lower temperatures and higher humidities than at higher temperatures and lower humidities. The survival period of soldiers was higher than that of workers.

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