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HUMIDITY AND TEMPERATURE EFFECTS ON RESPIRATORY PATTERN IN THE WORKER CASTE OF THE TERMITE *HODOTERMES MOSSAMBICUS* (HAGEN)

Isabelle Maxine Inder

Abstract

The evolutionary genesis and the current adaptive significance of the use of the discontinuous gas exchange cycle (DGC) for respiration by insects is the subject of intense debate. Most current research centers on three adaptive hypotheses and one non-adaptive hypothesis; these are the hygric hypothesis, the chthonic hypothesis, the oxidative-damage hypothesis and the emergent-property hypothesis respectively. Workers of the harvester termite, *Hodotermes mossambicus* were selected as a model to test three of these hypotheses. The respiratory patterns of workers, investigated using flow-through respirometry, were obtained at 0 % relative humidity (RH), 100 % RH, at 100 % O_2 and under varying temperature to evaluate the assumptions of the various hypotheses. A change in ambient humidity had no impact on metabolic rate (VCO_2), coefficient of variation (CV) or the pattern of gas exchange but only influenced the amount of water loss experienced by workers. Major workers exposed to hyperoxia (100 % O_2) responded by increasing spiracular control and constriction through the use of cyclic gas exchange thereby protecting their interior against the toxic effects of O_2. As VCO_2 increased in response to increasing temperature, the gas exchange pattern displayed by workers transitioned from a modified DGC through cyclic to continuous gas exchange. A true DGC, defined as showing all three phases and a CV value close to 2, was not expressed under any of the experimental conditions. The results of this study support the oxidative-damage and emergent-property hypotheses but not the hygric hypothesis. The workers of *H. mossambicus* spend only brief periods above ground before returning to the refuge of their underground nests and as such there is probably little selective advantage to the DGC for limiting respiratory water loss. The conclusion drawn from the study of termite workers is that changes in respiratory patterns are most likely an emergent property of the insects' nervous and respiratory systems and spiracular control also serves to limit oxidative damage.