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Intraspecific Response of the Ciliate Tetrahymena thermophila to Copper and Thermal Stress

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Abstract : Heavy metals present in large quantities in ecosystems can alter biological and cellular functions and disrupt trophic functions. However, their toxicity can change according to thermal conditions, as toxicity depends on their bioavailability and thermal optimum of organisms. Organisms can develop different tolerance strategies to maintain themselves in a stressful environment, but these strategies are often studied in a single-stressor context. This study evaluates the responses of the ciliate Tetrahymena thermophila to copper, high temperature, and their interaction. Six genotypes were exposed to a gradient of copper concentrations ranging from 0 to 350mg/L in synthetic media at three temperatures: 15°C, 23°C, and 31°C. Cell density, cell shape and size (and their variance), swimming speed and trajectory, and copper uptake rate were measured. Depending on the genotype, swimming speed, trajectory, and cell size were highly affected by stress gradients. One gets bigger, while two genotypes get smaller and the other remain unchanged. Some genotypes swam less rapidly, while others speed up as copper and temperature increased. Concerning copper uptake, the two genotypes accumulating the best and the worst, whatever the copper concentration or temperature, were also those that had the highest densities. Finally, very few temperature x copper interactions were observed on phenotypic parameters. The diversity of phenotypic responses revealed in this study reflects the existence of divergent strategies adopted by Tetrahymena thermophila to resist to copper and thermal stress, which suggests an important role of intraspecific variability in biodiversity response to environmental stress. One general and the surprising pattern was a global absence of interactive effects between copper and high temperature exposure on the observed phenotypic responses.

Keywords : ciliate, copper, intraspecific variability, phenotype, temperature, tolerance, multiple stressors
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