Eco-Evolutionary responses to global change in a clonal population: role of epigenetics and non-genetic inheritance

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Abstract

Organisms experience high biotic and abiotic stresses. We thus need to understand how species cope with environmental stress. Evidence is accruing that organismal responses to stress often affect organisms in a way that is transmitted across generations. Still, the role of adaptive epigenetically inherited variation, its importance relative to genetic heritability and its stability when stress ceases remains largely unexplored. Here, we explored this still unchartered domain with experimental evolution in clonal aphid lineages under predation and heat waves stresses. Unwinged aphids often plastically respond to stresses by asexually producing winged epi-mutants. We thus recorded the % of winged aphids at each generation and measured intraclonal (nongenetic) and interclonal (genetic) heritability of the winged phenotype before and after experimental evolution. We found that the % of winged aphids increases in response to predation whereas it decreases with heat waves showing that this phenotypic trait can evolve in a purely clonal lineage in response to environmental stressors. Interestingly, after 15 generations of experimental evolution, changes in phenotype frequency remain stable for at least four generations in absence of stresses. Finally, the non-genetic heritability of the winged phenotype was more important at the end than at the start of the experimental evolution revealing that environmental stresses and evolution can increase the non-genetic heritability of traits in a clonal population. Overall, our results indicate that non-genetic heredity is quite significant relative to genetic heredity and could play an important role in evolutionary responses to environmental changes.

Keywords: Nongenetic inheritance, epigenetics, phenotypic plasticity, global change, predation, temperature, aphids, evolution

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