Experimental evolution of zinc tolerance and hyperaccumulation in Noccaea caerulescens

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Abstract

In plants, adaptation to metal-polluted environments requires the development of metal tolerance capabilities and, in rare cases, of metal hyperaccumulation. Currently, many studies are conducted to understand the genetic mechanisms underlying metal tolerance and hyperaccumulation. However, few studies have experimentally analyzed the relationship between colonization of metal-polluted soils and evolution of tolerance and hyperaccumulation capabilities. In this context, an experimental evolution project was initiated to mimic the colonization of a zinc-polluted soil by individuals from a non-polluted soil, and study the evolution of metal tolerance and hyperaccumulation over several generations. For this purpose, several non-metallicolous populations of the pseudometallophyte *Noccaea caerulescens* were sampled. Four experimental populations were constructed, all based on descendants from the same maternal plants (Ancestral populations or AP). In outdoor conditions, each AP was cultivated on a given zinc treatment (0, 500, 1000 or 2000 mg/kg of zinc). At the end of their lifecycle, plants and their seeds were harvested and measured. In proportion to the relative fitness estimation of each individual, a new generation (Derived populations or DP) was created for each AP. In greenhouse conditions, representants of the AP and the four DPs were cultivated on 500 mg/kg of zinc. Several tolerance estimations (including growth assays, biomarker dosages and comet assays) and a zinc dosage were performed on these plants. A comparison between DPs and AP showed that differential selection due to the effect of zinc was possible after a generation at high selective pressures (1000 and 2000 mg/kg of zinc), especially on zinc hyperaccumulation.

Keywords: Pseudometallophytes, Noccaea caerulescens, hyperaccumulation, Tolerance, Experimental evolution

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