

Polyploidization is a key mechanism of rapid speciation, with many phenotypic consequences which extent, however, is poorly understood. A deeper understanding of the evolutionary implications of genome duplication is limited due to lack of knowledge of the links between changes in genome, the phenotype of the individual and environmental constraints. Natural lineages closely related to model species represent the ideal systems for addressing such questions. The thesis is thus focuses on highly promising yet overlooked di-polyploid system within *Arabidopsis* genus. In the western Carpathians morphologically distinct populations of diploid and tetraploid plants of *Arabidopsis arenosa* grow along a marked altitudinal gradient. Using high-throughput DNA sequencing, measuring morphological characteristics and collecting ecological data of high alpine and foothill populations I try to reveal main trends of genetic and morphological variability of these populations. Additionally, using morphometrics of natural and experimentally planted populations we want to test the hypothesis whether morphological divergence of alpine and foothill populations has a genetic basis or is driven by phenotypic plasticity. The presented thesis is an important multidisciplinary combination of genetic research on natural related of model organism and field measurements. Close relationship *Arabidopsis arenosa* to model organism *Arabidopsis thaliana* allows to interpret the results in a broader framework.