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MODERN THEORETICAL AND TECHNICAL APPROACHES IN PLANT MORPHOLOGY

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Morphology is deeply rooted in organismal biology, which in recent years has gone through a steady decline in interest both at research institutions and funding agencies. In parallel with this development, morphology as a discipline has been marginalized and nowadays many think of it as just a classical and largely obsolete field of research. However, this is far from the truth. Thanks to modern theoretical concepts and novel technical applications, plant morphology has much to contribute to modern botanical and evolutionary research.

In our presentation, we will first outline the application of High Resolution X-Ray Computed Tomography (HRXCT) to the study of plant structure. The ideal way to describe the morphological phenotype of a given organism is to build a three dimensional (3D) model, which may then be interpreted with respect to other types of data, e.g., metabolite content or functional groups of pollinators. We have developed simple but efficient lab protocols using contrasting agents such as phosphotungstate and bismuth tartrate that allow for the streamlined acquisition of high resolution phenotypic data and 3D-representations even of soft plant tissues such as floral organs, ovules, and meristematic tissues. To illustrate this, we will outline selected ongoing studies in comparative plant science that make use of high resolution tomography.

In the second part of our talk, we will present a project on the floral morphospace. A striking feature of morphological variation is that due to developmental, functional, and phylogenetic constraints, not all theoretically possible architectures have been explored during evolution. A modern approach to studying the evolution of realized forms among possible ones is to construct morphospaces, i.e. theoretical, mathematical spaces describing and relating organismal phenotypes. Although widely applied in zoology, morphospace analyses and related approaches have so far been largely disregarded in botany, with notable exceptions in the field of pollination biology. Here, we use a morphospace approach to describe and quantify the morphological diversity (disparity) of flowers in the asterid order Ericales. To do so, we have built a dataset containing 37 floral characters for more than 380 species (275 genera) representative of the entire order. We have used non-parametric representations and statistics methods based on distance matrices to build and analyze a morphospace, in which we compare the relative positions of the different ericalean families. We quantify and interpret the disparity among these groups in the light of their taxonomic diversity, their evolutionary history, and their ecology. In addition, we analyze patterns of disparity between sterile, male, and female floral organs.