Plant traits are defined as the morphological, anatomical, physiological, biochemical, and phenological characteristics of plants and their organelles. Comprehensive trait data bases are already at hand, providing averaged values of plant species functional traits. However, the variability in functional traits (FT) in response to environmental conditions is still poorly studied. Here we use an extremophile plant as a model organism to infer intraspecific variability in functional traits and the degree of adaptive plasticity as a key point to understand plant strategies for adaptations to extreme environments in the course of changes under human impact. Our main question is: how does *Salicornia europaea* traits that show high small- or large-scale variability are controlled by epigenetic factors? The main aim of our research is to find out how are the salt-responses of functional traits of Salicornia europaea populations belonging to different maternal salt environments in terms of morpho-anatomy, cell wall biopolymers, nanomechanical properties and gene expression with salinity as a driver, we are intended to integrate these dependent variables to build a mathematical predictive model of salt adapted species. The novelty of our research regards in the incorporation of cellular and ultrastructural traits as they are directly linked to functional adaptation. The stiffness of cell walls plays a vital role as a FT in the whole plant resistance. Contemporary models see a specific role of a particular tissue in plant adaptation. But, this cannot be confirmed without a direct measurement of cell polymeric organization and mechanical properties of internal cell walls at a nanometric scale.

We hypothesize that i) *S. europaea* growing up under different maternal saline environments, overcome saline stress differently by developing diverse biochemical, nanomechanical properties and genetic response variables that modify their biological traits, specifically cellular architecture (i.e. shape and size of cells and vacuoles, stomata index among others), concentration of structural polymers (cellulose-hemicellulose, lignin and pectin) of CW, these responses consequently could induce changes in the CW stiffness, ii) different saline levels impose different cell wall stiffness in order to facilitate a specific maintenance of hydric and ionic homeostasis in population developing under saline stress. iii) we expect variability in the amount of gene transcripts among the populations belonging to different salinity gradient iv) through the tested salinity-response variables, we expect a mathematic function able to describe the resistance to salinity regimes in terms of plant salt maternity (Poland and Germany).

We aim to develop a mathematical predictive model of plant salt adaptation to allow the use of non-destructive functional traits (macrostructural parameters by image analysis) able to predict salinity-response traits. We propose inland *S. europaea* as the halophyte model species because is similar to glycophytes. Moreover, inland populations of this species are isolated, which allow us to look for population variability shaped by the local environment. We will investigate this species under controlled environmental conditions - at lower and higher salt levels for halophytes. We will perform also soil analysis for in situ samples of each population to confirm already known differences. The plants will be monitored during 2 months. Novel methods for trait assessments will be applied. Morphological and anatomical will be described by image analysis, cell structures and biopolymeric compounds by chemical and fluorescence techniques and nano-mechanical cell wall stiffness by atomic force microscopy (AFM), all these complemented with gene expression analysis. Correlation between investigated FT will be assessed by statistical and principal component analysis. Results will be used to build a mathematical predictive model of halophyte FT under salinity stress. Then, the existing halophyte data bases can be updated with the new functional traits found at a nanometric level which can be useful for scientific groups working with salt tolerant plants. As the amount of salt-affected land increases this model can be adapted in the future to different plants to select the most suitable ones for harsh environments.