



Trait variation and phenotypic plasticity in *Phragmites australis*: a case study in contrasting environmental conditions

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Genotypes with higher phenotypic plasticity express a greater ability to cope with altered environmental conditions [1,2,3]. *Phragmites australis*, a perennial emergent macrophyte, occurs in a wide range of environments, from pristine wetlands to highly disturbed ecosystems, and is characterized by high trait plasticity and genetic variability, with more than 30 haplotypes identified [4,5]. This study aims to assess the degree of phenotypic plasticity among haplotypes as an adaptive response to climatic constraints, accounting for their genetic similarity.

Rhizomes were collected from natural populations in Tuscany and subsequently propagated clonally. Three haplotypes (M, L and K) and one intravariant of M (CO) were identified. In 2023, 18 rhizome fragments per haplotype were selected and transplanted across two experimental sites located in Florence and Mount Amiata.

The evaluation of vegetative development was performed by measuring culm diameter, height, number, and relative growth rates. Chlorophyll and flavonoid content were determined using a chlorophyll meter, photosynthetic efficiency was evaluated with Handy PEA fluorimeter through Fv/Fm and Performance Index (PI) measurements.

A linear mixed-effects model was applied to test differences in culm length [6], whereas generalized linear mixed-effects models were used to evaluate total biomass production, photosynthetic efficiency, and growth over time [7], in all cases considering haplotypes, sites and their interaction as fixed effects.

Haplotype was the main driver of variation in structural traits and physiological parameters, while site mainly affected growth dynamics and chlorophyll content. CO and M haplotypes showed the highest culm production, and biomass traits were consistently haplotype-dependent. Photosynthetic responses varied, with mixed effects of haplotype and site depending on the parameter. Relative growth rates were influenced only by site. Overall, genetic variation primarily shaped plant performance, whereas environmental conditions modulated growth and physiological traits.

References

1 Valladares et al., 2014; 2 Meyerson et al., 2016; 3 Münzbergová et al., 2017; 4 Mozdzer and Zieman, 2010; 5 Saltonstall, 2002; 6 Kuznetsova et al. 2017; 7 Bates et al. 2015