Understanding *Carpobrotus* sp.pl. (L.) N.E. Invasions: Stress Tolerance and Genetic Diversity Insights

Sara González-Orenga*[1,2,3], Luis González[2] & Adela M. Sánchez-Moreiras[2,3]

[1] *Universitat Politècnica de València, Instituto de Conservación y Mejora de la Agrodiversidad Valenciana, Camino de Vera 14, 46022 Valencia, Spain*

[2]*Universidade de Vigo, Departamento de Bioloxía Vexetal e Ciencias do Solo, Facultade de Bioloxía, Campus Lagoas-Marcosende s/n, 36310 Vigo, Spain*

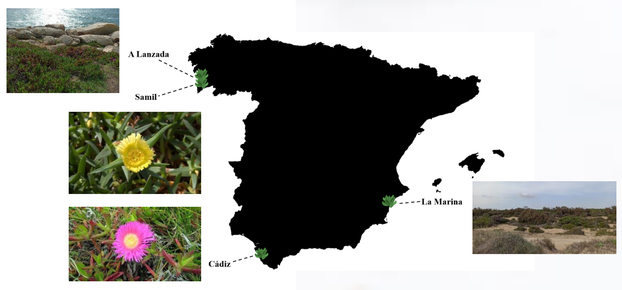
[3]*Universidade de Vigo, Instituto de Agroecoloxía e Alimentación (IAA), Campus Auga, 32004 Ourense, Spain*

***Corresponding author, e-mail:** sagonor@doctor.upv.es*

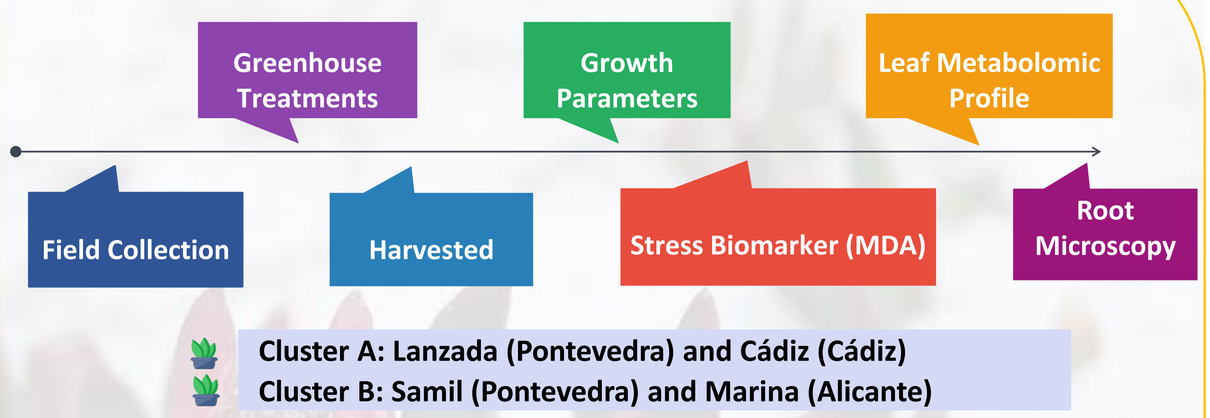
INTRODUCTION

Conservation priorities for the coastal flora and habitats throughout the Iberian Peninsula require understanding the threats posed by invasive species. One of the most dangerous invasive species worldwide is *Carpobrotus* sp.pl. (L.) N.E. Br., an invasive clonal succulent plant native to South Africa. Its prostrate growth form enables rapid expansion and colonisation of coastal dunes, rocky coastlines, and sea cliffs. Introduced as an ornamental plant and for soil stabilisation, *Carpobrotus* exhibits fast growth and low resource requirements. Its competitive ability is also based on its **tolerance to stress factors such as salinity and drought**. The plant interferes with the germination and survival of native species, alters soil conditions, and modifies ecosystem processes. Understanding the mechanisms of its invasion and ecological impacts is crucial for developing effective conservation strategies.

In this study, two genetic clusters **- Cluster A, from A Lanzada (Pontevedra) and Cádiz (Cádiz) and Cluster B, from Samil (Pontevedra) and La Marina (Alicante)** - composed of two populations each from different climatic areas (Atlantic and Mediterranean), were included.



MATERIAL & METHODS



50 days of treatment

Control (0 mM NaCl, irrigated every week)

4 NaCl Concentrations (0, 250, 500 and 800 mM)

4 levels of Drought (1; 1 and 7; 1, 7 and 15 of 50 days and every week)

Combination of all levels of **Drought** and **Salinity:**

16 Treatments in 4 Populations

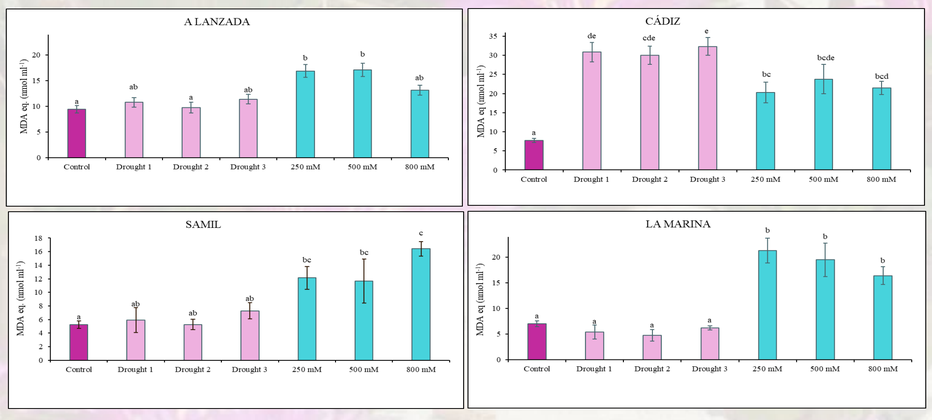
RESULTS AND DISCUSSION

The experimental results demonstrated that all tested populations exhibited relative **resistance to drought and salinity**, as evidenced by their survival over a 50-day period of stressful treatments. However, both stressors adversely affected the growth of all populations to varying degrees.

Growth Parameters

Growth inhibition was evident through **reduced fresh aerial weight**, **water content and length**, **particularly under high salinity conditions**. Notably, **Cluster B**, Samil, and La Marina populations displayed significant and similar growth inhibition, suggesting a **genetic basis for stress acclimatisation**. In contrast, the responses of **Cluster A populations** (A Lanzada and Cádiz) to stress conditions differed according to growth parameters, indicating that **genetic factors may not play such a significant role**

Malondialdehyde (MDA)

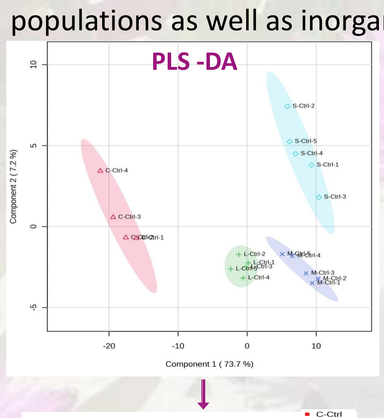


Across all populations, a **strong correlation was observed between malondialdehyde**, a marker of lipid peroxidation, **and growth parameters**, indicating the presence of **oxidative stress** under stressful conditions but with distinct patterns.

Cluster B accumulated more MDA under drought conditions than under salt stress in comparison with Cluster A. While in Cluster A there are differences between populations. In A Lanzada, MDA levels were similar for hydric and saline stress, while in Cádiz, hydric stress caused the greatest oxidative stress.

Metabolomic Profile (Control)

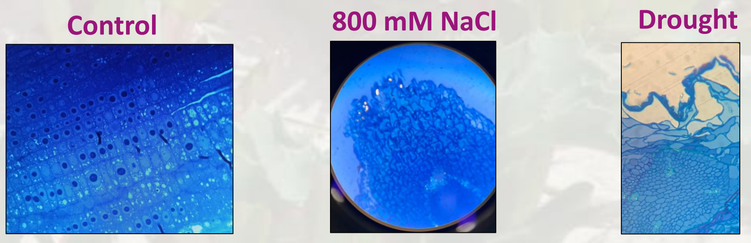
The metabolomic assays revealed a **distinct separation of the plant metabolome among the four populations**, with a notable trend higher in Cádiz. Individuals from Samil accumulate more organic acids than the other populations as well as inorganic phosphate.



Component 1 (73.7%)

Component 2 (7.2%)

Root Microscopy



CONCLUSIONS

- All tested populations were relatively **resistant to drought and salinity,** the plants survived 50 days of stressful treatments.
- **Growth was inhibited**, as evidenced by reduced fresh weight, water content and length of the aerial part and roots, particularly under high salinity conditions.
- There was a significant correlation between MDA, and growth parameters, suggesting a substantial presence of **oxidative stress.**
- **The four control populations are clearly separated** been the differences more notable between the populations of Cluster A than between Cluster B, demonstrating the **influence of genetics and the environment** on the metabolomic profile of *Carpobrotus* sp.pl.
- **Metabolomics simplify future analysis** in *Carpobrotus* sp.pl., focusing on the compounds that have significant results between populations and between treatments.
- **Genetic variation** and **plasticity** must be considered in managing invasive species.

Acknowledgements:
S.G-O acknowledges the 'Margarita Salas' grant from Universitat Politècnica de València and Ministerio de Universidades, Spain, funded by the European Union-Next Generation EU.

Funded by the European Union NextGenerationEU