Water use efficiency variation among Pinus pinaster populations

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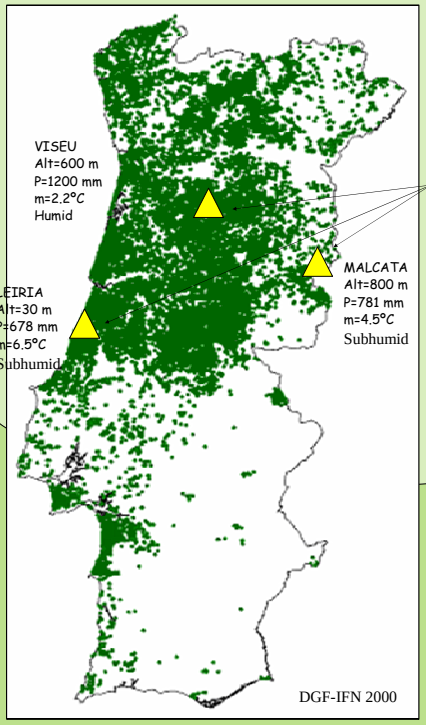
1 INTRODUCTION

We aimed at investigating the phenotypic plasticity of *Pinus pinaster* Ait. response to drought, exploiting its genetic variability at the provenance level, through the study of morphological, physiological and molecular traits.

In addition to growth, differences in response to drought may be expressed by bud burst phenology and polycyclism as well as by the carbon isotope composition ($d^{13}C$), which represents an integrated measure of water use efficiency (WUE) and therefore to stomatal control of photosynthesis and transpiration. It is associated to different drought adaptability of *P. pinaster* provenances.



Maritime pine distribution in Portugal showing three sites of the provenance test (Alt = altitude; P = annual cumulative precipitation ; m = mean of minimal temperatures for the coldest month; Humid, Subhumid: Emberger rain-temperature coefficient).

Sampling under Random Complete Block (RCB) design of forestry tests and use of appropriate statistical methodology allow separation between environmental and provenance effects.

2 OBJECTIVES

(i) to understand the relationship between isotopic composition of leaf tissue ($d^{13}C$) and adaptive traits among populations growing in contrasting sites to establish geographical drought adaptation patterns

(ii) to know which physiological mechanisms are associated with drought-stress responses under controlled-environment conditions

(iii) to understand how this adaptive variation is reflected in the allelic variation in candidate genes for drought-stress response

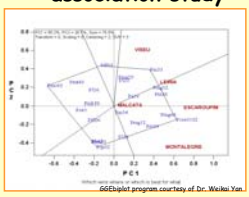
(iv) to integrate results and use the information for application in afforestation, breeding and conservation, taking into account plausible scenarios of climate change.

3 MATERIALS AND METHODS

Phenotypic traits (growth, survival, polycyclism, bud burst phenology) and $d^{13}C$ (integrated measure of WUE) will be evaluated under field conditions in 30 populations growing in three sites of a provenance test.

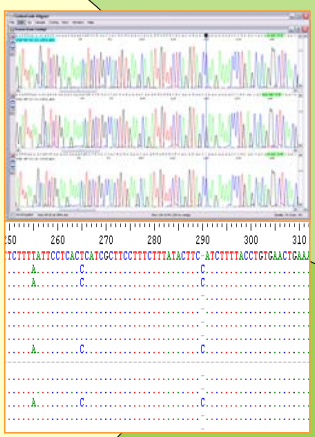
Seedlings from contrasting populations will also be grown in controlled environment conditions to investigate physiological processes (biomass allocation to roots and shoots, ontogenetic development, physiological parameters) associated with drought-stress responses in the field.

Drought-stress response association study



Genotype x Environment interaction for all traits will be evaluated using quantitative genetics tools (mixed model and biplot analysis).

Results of these complementary approaches will be integrated to help understand how they interact to determine phenotypic plasticity.



Populations will be sampled under the RCB design of the provenance test. They will be characterized by neutral molecular markers (Single Sequence Repeats, SSR) and screened for patterns of nucleotide diversity (Single-Nucleotide Polimorphisms, SNP) in candidate genes for drought-stress response.

4

Results will contribute to develop marker assisted selection (MAS) and certification of forest reproductive material. They will also enable selection of forest reproductive material better adapted for forest plantations (e. g. burned forest areas), for conservation measures and for improvement, taking into account climate change tendencies and filling a gap of the ongoing Portuguese genetic improvement program of *P. pinaster*.

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