Tree breeding and mycorrhizal symbiosis as important tools in forestation processes

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Introduction

It is currently known that to establish good quality and productive plantations the genetics of the planting material needs to be taken into consideration. Maritime pine (*Pinus pinaster* Ait.) covers a large area of Southwest Europe and is one of the most economically important forest species Portugal. This led to the start of a breeding program in the early 1980s which is presently in its second generation. Tree genetic diversity may have an impact in the flux of nutrients and consequently influence the interaction of the plant with soil microorganisms. Ectomycorrhizal (ECM) fungi are known to form symbiotic relations with *P. pinaster* and are an integrant part of forest ecosystems. Although it is possible that the biometric traits exhibited by *P. pinaster* trees that are bred are an intrinsic characteristic of the genetic selection, we have risen the possibility that the improved *P. pinaster* genotypes have a superior capability of mycorrhizal establishment and that the morphological traits used as selection criteria are a reflection of such symbiosis.

Objectives

❖The aim of this work was to assess whether tree breeding influences mycorrhizal establishment and determine its effect on plant development in a forest nursery greenhouse.

Materials and Methods

❖Selected and wild seedlings of *P. pinaster* were inoculated with compatible ectomycorrhizal fungi: *Suillus bovinus*, *Pisolithus tinctorius* or *Rhizopogon roseolus*, and grown in individual cells containing forest soil, in a commercial forest nursery;

❖Growth and nutritional traits were determined; colonisation parameters were assessed;

❖The fungal community established was determined by *Denaturing Gradient Gel* Electrophoresis (DGGE).

Results

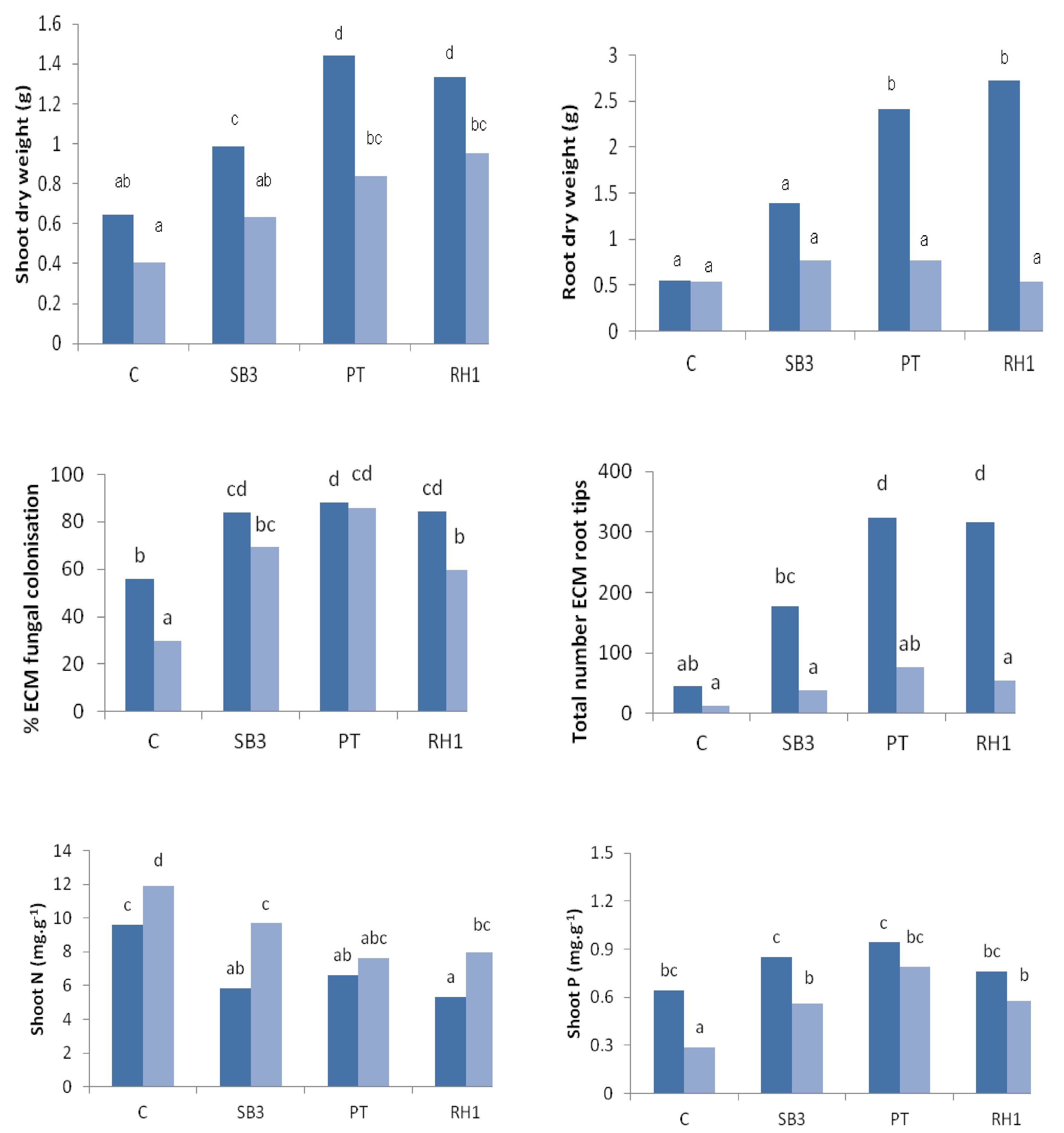

Fig. 1 – Biometric, mycorrhizal and nutritional traits of selected (dark bars) and wild (light bars) *Pinus pinaster* seedlings inoculated with *Suillus bovinus* (SB3), *Pisolithus tinctorius* (PT), *Rhizopogon roseolus* (RH1) and non-inoculated control (C). Columns marked with different letters differed significantly according to Duncan's Multiple Range test at $P < 0.05$. ECM, ectomycorrhizal.

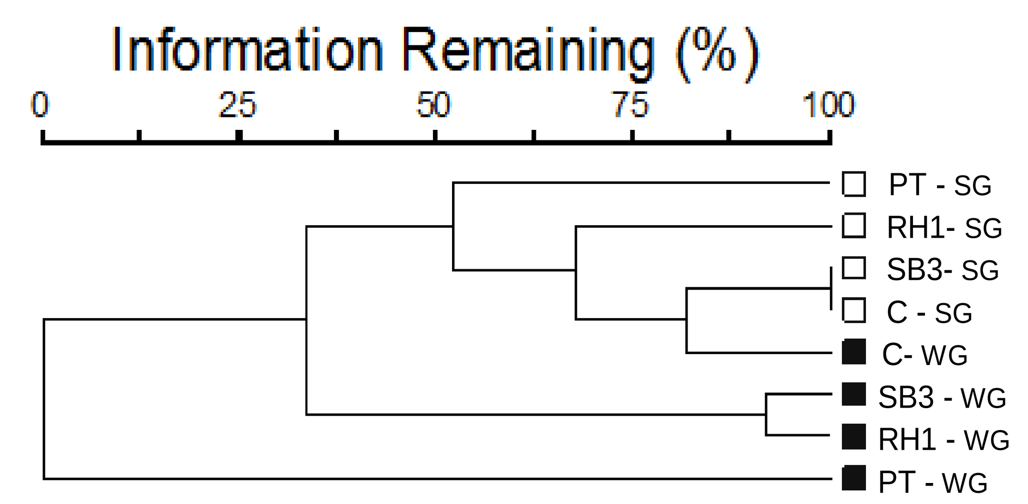

Figure 2 - Cluster analysis of DGGE patterns of selected and wild *Pinus pinaster* seedlings. Legend: ■ WG- wild genotype;□ SG - selected genotype; C - non-inoculated seedlings; SB3 – seedlings inoculated with *Suillus bovinus*; PT - seedlings inoculated with *Pisolithus tinctorius*; RH1 - seedlings inoculated with *Rhizopogon roseolus*. Similarities were calculated using Sorensen (Bray-Curtis) measure distance.

Figure 3 – Example of a pine tree classified as plus.

Figure 4 – Seedlings growing in containers in the forest nursery greenhouse in Northern Portugal.

Figure 5 – Mycorrhizal roots of inoculated *P. pinaster* seedling.

❖*R. roseolus* and *P. tinctorius* were the most efficient isolates in promoting plant development;

❖Inoculated selected saplings had an overall superior development than their wild counterparts, with up to a 4.9-fold in root dry weight and a 13.6-fold increase in the total number of ectomycorrhizal root tips;

❖ECM fungal inoculation overall influenced the fungal community establishment and the response varied amongst genotypes.

Conclusions

❖The results from this study suggest that the selected genotype establishes a more efficient symbiosis with ECM fungi, leading to a superior development of nursery-containerised saplings, even at an early stage. From the isolates tested *R. roseolus* and *P. tinctorius* have proven to be superior to *S. bovinus* emphasising the importance of an appropriate selection of ECM inoculants.

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