Effect of nitrogen and boron fertilisation on juvenile stone pine growth - A pot experiment

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Objetives

The primary aim of this study was to assess the impact of nitrogen (N) and boron (B) applications on the development of the stone pine plant in a controlled environment during its initial three-year growth period.

Materials and Methods

Experimental Design:

The study was conducted as a pot experiment under greenhouse conditions, using 6.9 dm^3 *Kickbrauckman* pots. The trial was carried out on 1-year-old *Pinus pinea* L. seedlings in a randomised complete block design with a 2 x 5 factorial arrangement and three replications.

The experimental treatments were as follows:

T1 - N_0 B_0 (without N and B)	
T2 - N_0 B_1	T6 - N_1 B_1
T3 - N_0 B_2	T7 - N_1 B_2
T4 - N_0 B_3	T8 - N_1 B_3
T5 - N_0 B_4	T9 - N_1 B_4

B levels correspond to: N_0=0; N_1=0.25; N_2=0.5; N_3=0.75 and N_4=1 mg B/kg of soil per year. Experimental treatments with N (N1) correspond to 872mg N/pot/year.

Soil characteristics:

Haplic Podzol (PZ): sandy texture; pH-H_2O = 5,7; MO=0.88 %; P_2O_5 =7.7 mg kg^{-1}; K_2O=14 mg kg^{-1}; CEC=2.21 cmol(+)kg^{-1}); BS=50.2 % ; B =0.04 mg kg^{-1}.

Statistical analysis:

- Two-way analysis of variance (ANOVA II)
- Duncan's multiple range test (p=0.05)
- Correlations between aerial and root biomass production and growth parameters

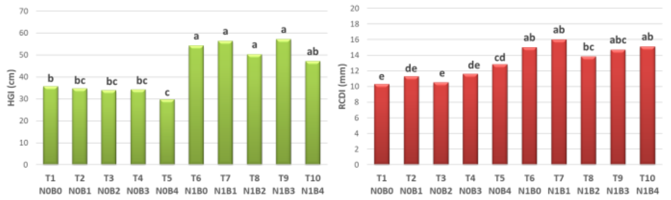
Conclusions:

- The application of nitrogen at a juvenile stage of stone pine stands will allow a better vegetative development of the plants and may constitute an important reserve of this nutrient to be used at later stages of their development, especially in soils of low fertility;
- Regarding B, further research is needed to clarify the importance of this nutrient in the early growth stages of stone pine;
- The calculation of the sum of branch lengths is a good estimate of the total biomass production of young pine trees.

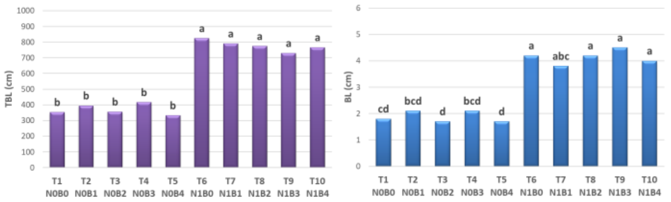
Results

Growth measurement:

The presence or absence of N had a highly significant effect ($p<0.001$) on all the considered morphological characteristics.



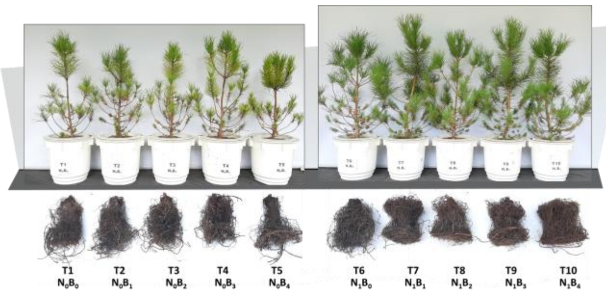
Figures 1 and 2 - Response of *height growth increment* (HGI) and *collar diameter increment* (RCDI) to the application of increasing levels of B in the absence (T1 to T5) and in the presence (T6 to T10) of N (different letters indicate significant differences, p=0.05).



Figures 3 and 4 - Response of *total branches length* (TBL) and *terminal buds length* (BL) to the application of increasing levels of B in the absence (T1 to T5) and in the presence (T6 to T10) of N (different letters indicate significant differences, p=0.05).

Biomass production:

A highly significant effect ($p<0.001$) was also observed on leaves, branches, trunk and roots weight, due to the presence or absence of N. In fact, the total biomass production due to N fertilisation was up to twice higher than the non-N supplied plants.



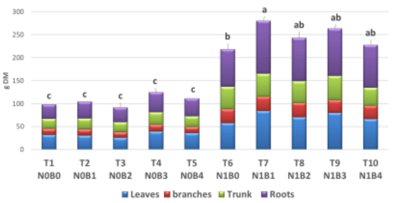


Figure 5 - Response of total produced dry matter (DM) biomass (leaves, branches, trunk and roots) to the application of increasing levels of B in the absence (T1 to T5) and in the presence (T6 to T10) of N (different letters indicate significant differences p=0.05).

Highly significant and positive correlations ($p\leq0.001$) were found between aerial and root biomass production and root collar diameter (RCD), height (HG) and sum of branch length (SBL).

The highest correlation coefficient between biomass production and growth measurements was found for total biomass (TBio) with the sum of branch length (SBL) (r=0.902***), suggesting that this parameter can gives a good estimate of the expected total biomass production.

Table 1 - Correlation matrix showing interrelations between biomass production and growth measurements (r values)

Parameters	LB	BB	TB	RB	TBio	RCD	HG
LB							
BB	0.893***						
TB	0.890***	0.867***					
RB	0.909***	0.847***	0.871***				
TBio	0.969***	0.919***	0.937***	0.974***			
RCD	0.801***	0.872***	0.839***	0.779***	0.840***		
HG	0.779***	0.769***	0.937***	0.825***	0.860***	0.748***	
SBL	0.875***	0.976***	0.875***	0.826***	0.902***	0.867***	0.796***

LB-leaves biomass, **BB**-branches biomass, **TB**-trunk biomass, **RB** - roots biomass, **TBio**-total biomass, **RCD**-root colar diameter, **HG**-height growth, **SBL**-Sum of branch length; **r**- correlation coefficient

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