# Effect of temperature on germination behaviour and early growth of *Pinus halepensis* M. seeds.

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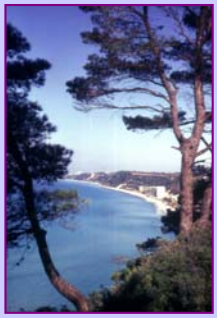
## Introduction

The intense human pressure, the adverse climatic conditions, the repeated fires and also the overgrazing of the *P.halepensis* forests, make difficult the natural regeneration of this species. The ecological, landscape, recreational and soil conservation uses of *Pinus halepensis*, and its aesthetic value, make this species important for landscape planning and multipurpose forestry.



For these reasons, in many cases, the artificial regeneration is obligatory in order to make the ecosystems restoration faster.

Although *P. halepensis* seeds is characterized by high germination capacity and the constant temperature of 20ºC is considered as the optimal for both rate and final percentage germination (ISTA 1996), no research has dealt with the germination behaviour and early growth of newly seedlings under alternative temperature conditions similar to those dominating outdoors.

## The aim

The study aimed at the comparison of the germination behavior of *Pinus halepensis* seeds between laboratory natural alternative conditions and growth chamber conditions with constant temperature 20ºC, which is considered as optimal temperature according to the previous studies.

The specific aim was:

a) to obtain the seed quality data of *P. halepensis* seeds

b) to determine the percentage of abnormal early seedlings, empty seeds, viable seeds that didn't germinate and infected seeds.

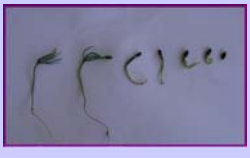
c) to evaluate germination percentage, maximum germination rate and total length of the early seedlings in the two temperature conditions(chamber and laboratory environment).

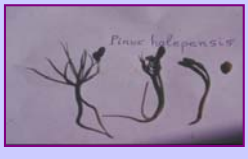
## Materials and Methods

Before the germination tests, the seeds were examined for their quality, according the ISTA rules. The tests included the precision of authenticity and purity analysis, the weight of 1000 seeds and their number per kilo and the moisture content.

In order to study the effect of temperature conditions on seed germination two treatments were applied: The first treatment took place in the growth chamber and the second one in the laboratory environment, with the same conditions except the temperature. In the growth chamber, germination behaviour was tested under constant temperature 20ºC with photoperiod 12-h light/ 12-h dark. While in the laboratory conditions, germination behaviour was tested during March, under alternative temperature and the same photoperiod. Germination tests were performed using (8) eight replicates-for each treatment, each containing 100 seeds, per Petri dish (diameter 9 cm).

The criterion of germination was that seeds have germinated when their radicle showed positive geotropism and their shoot exhibited normal growth and morphology. In this experiment the majority of the normal seedlings were removed at the interim counts, but the assessment of many of the doubtful and abnormal seedlings had been left until the end to ensure that slower growing, but otherwise normal seedlings, are not incorrectly removed. At the end of the experiment period, all remaining ungerminated seeds had been cut and examined visible, and the number of fresh, firm and possibly viable seeds recorded .





## Results

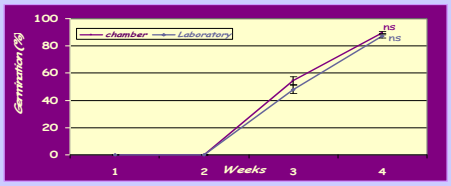
**Table 1.** Examination of purity, weight of 1000 seeds and number per kg and moisture content, according the ISTA rules. Sample size 2500 seeds.

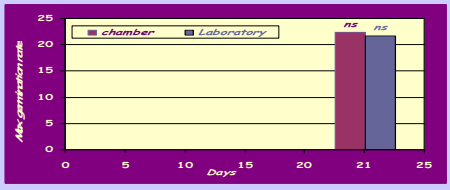
| Purity (%) | Weight of 1000 seeds (gr) | Number of pure seeds per kg | Moisture content (%) |
|---|---|---|---|
| 98,83 | 18,94 | 52.798 | 7,9 |

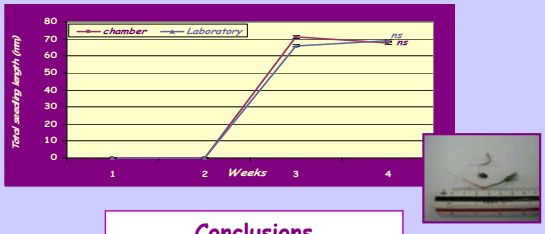
**Table 2.** Means of abnormal seedlings, empty seeds, infected seeds, viable seeds that didn't germinate and their standard error. (Values are average from 8 replicates of 100 seeds of each treatment).

| Treatment | Abnormal Seedlings (%) | Empty seeds (%) | Viable seeds that didn't Germinate (%) | Infected seeds (%) |
|---|---|---|---|---|
| **Treatment A** (Chamber) | **0,25 (0,16)** | **1 (0,33)** | **4,75* (0,75)** | **4,25* (0,90)** |
| **Treatment B** (Lab) | **0,00 (0,00)** | **0,88 (0,40)** | **8,88* (1,29)** | **2,25* (0,48)** |

*: significant differences ($p<0.05$, t-test).




## Conclusions

The results show that:

✓ No significant differences were found considering abnormal seedlings and empty seeds between the two growth conditions (chamber and laboratory environment)

✓ The percentage of viable seeds that didn't germinate was significantly lower in growth chamber's conditions, which means that the constant temperature enhanced the earlier germination of viable seeds.

✓ However, the average percentage of infected seeds was found significantly higher in growth chamber.

✓ Total germination didn't show significant differences between the two growth conditions.

✓ The maximum germination rate was observed on 21th day and there were no significant differences between the two environments (chamber and laboratory).

✓ Also, no significant differences observed between growth chamber and laboratory environment concerning the total seedling length of the newly seedlings.

Thus, based on this study, it's concluded that there is no need to test the germination capacity of *P. halepensis* seeds in a controlled environment of growth chamber because the laboratory conditions provide the similar results.