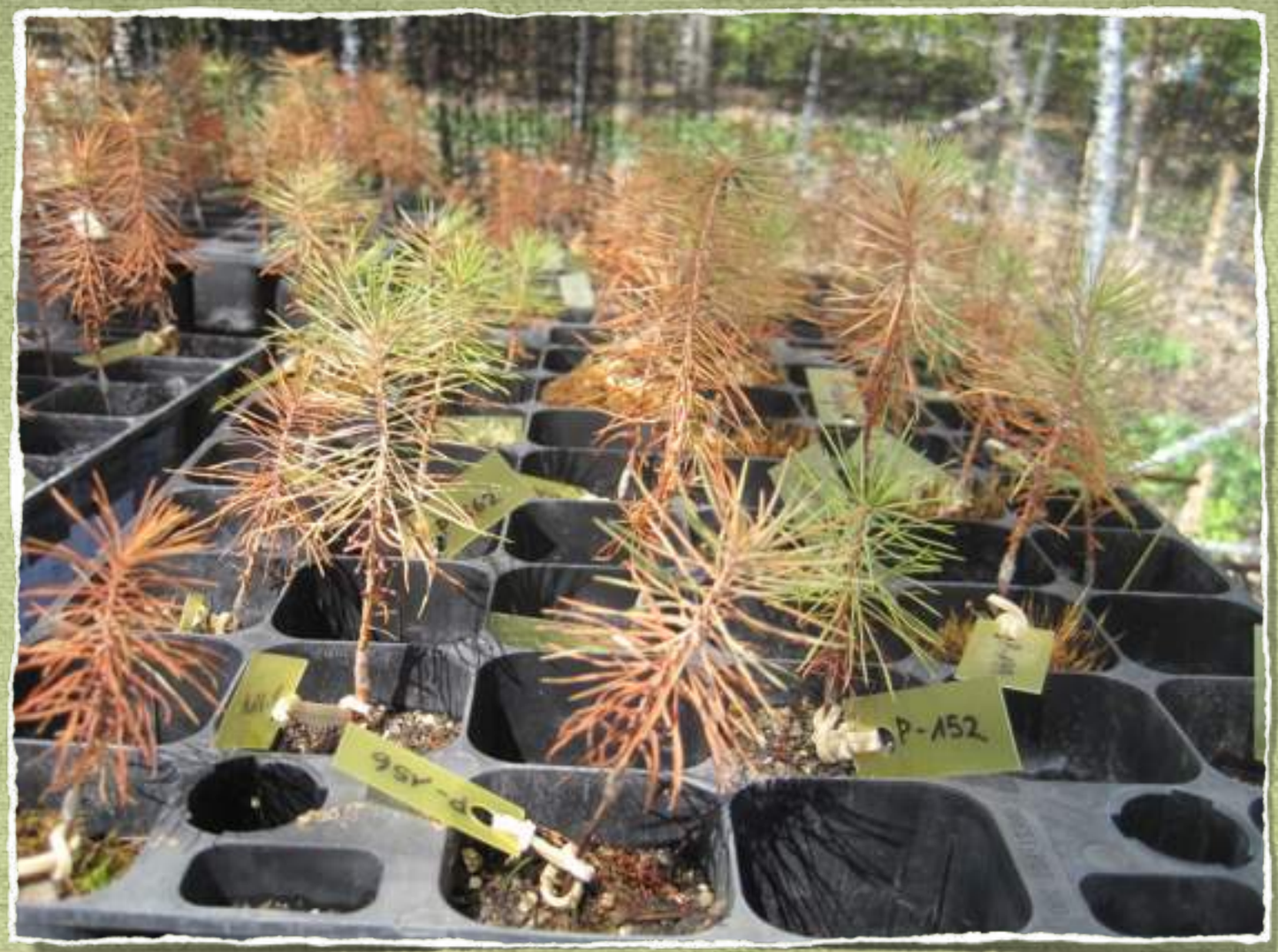


Aleppo pine provenances vary in susceptibility and secondary chemical response to *Gremmeniella abietina* infection

Carmen Romeralo, Johanna Witzell, Julio Javier Diez

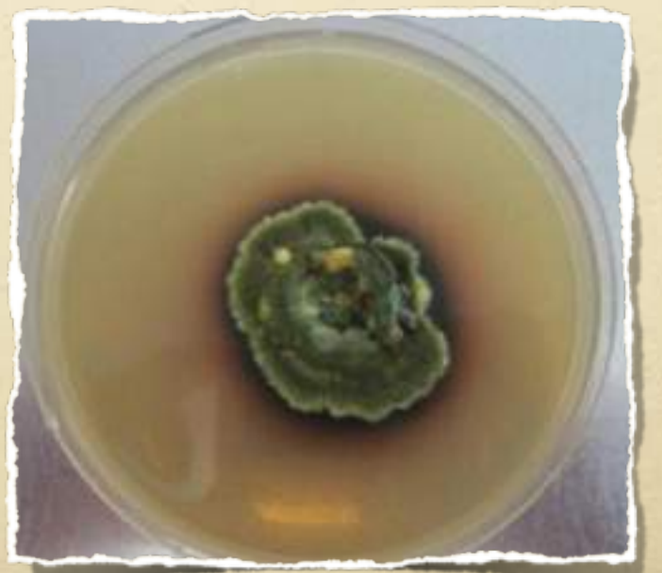
Gremmeniella abietina (Lagerberg) Morelet

50ha area of afected *Pinus sylvestris* in Sweden
(J. Witzell)

Gremmeniella abietina (Lagerberg) Morelet

In Spain:

- Asexual stage
- No epidemic
- Defoliation
- Twig distortion
- Aleppo pine

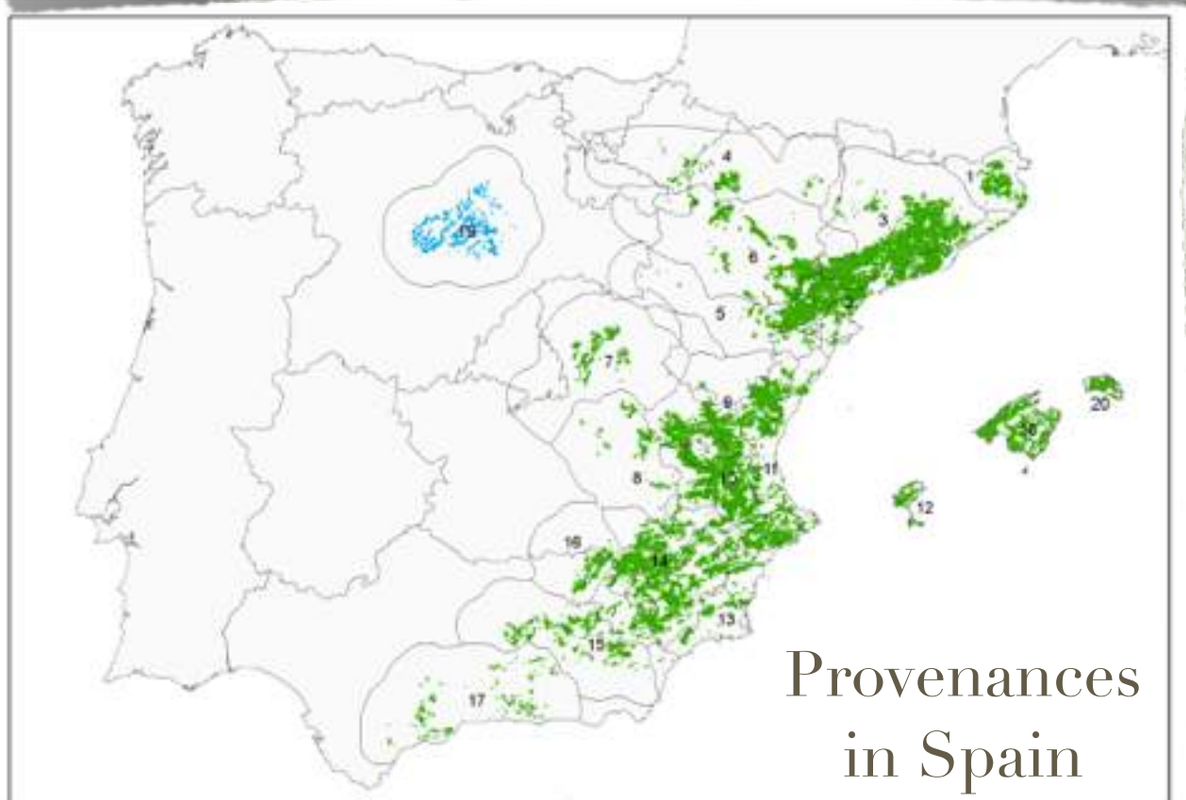


Aleppo pine (*Pinus halepensis* Mill.)

- **Natural distribution**: throughout the coast and in the central parts of the country.

- High **heat** and **drought** tolerance. Reforestation.

- **Higher risk** of infection when the tree species or provenances are growing outside its optimal habitat.

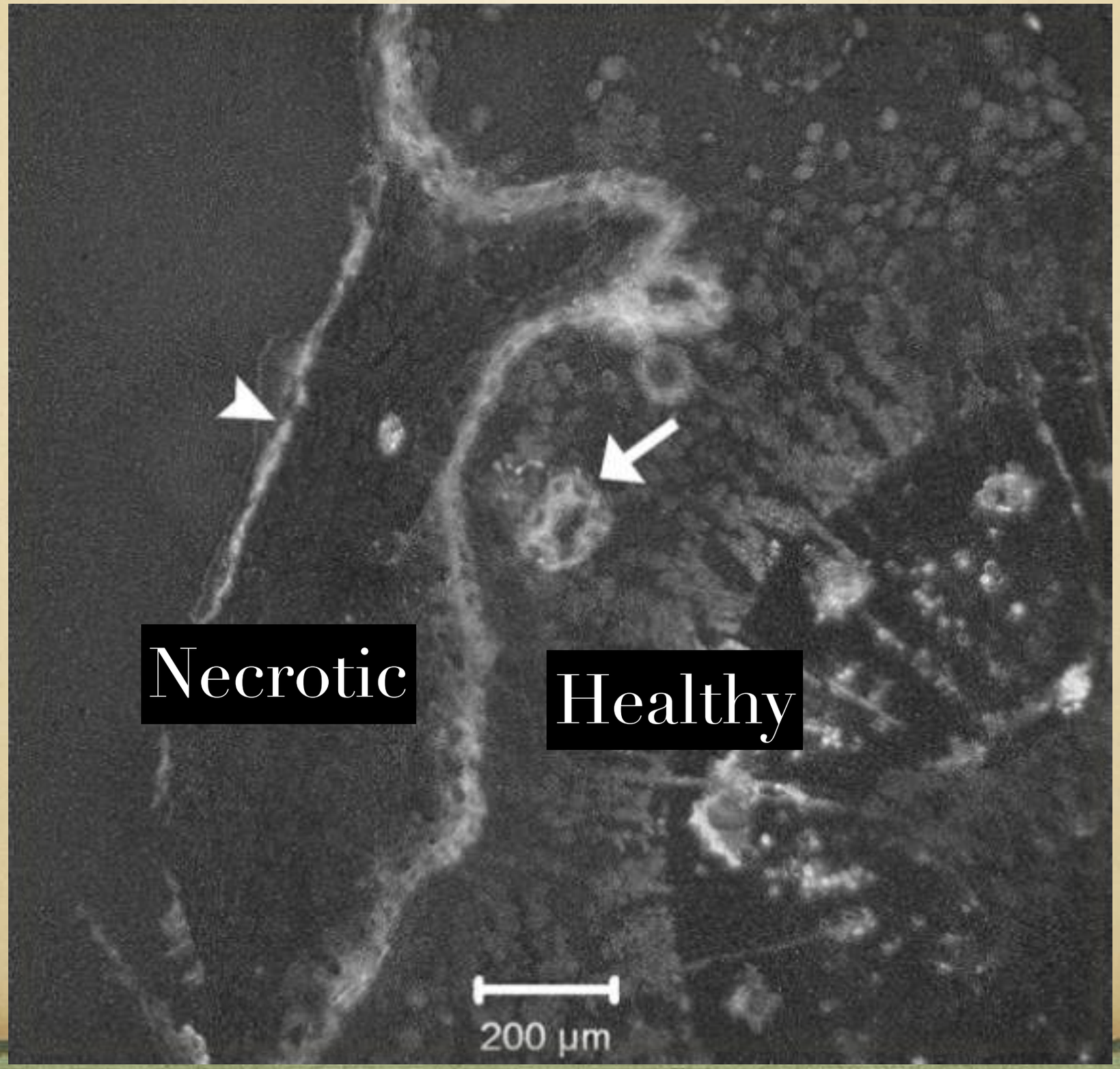


Provenances in Spain

Responses to *G. abietina* infections

- Both **physical and chemical reactions** in inoculated trees have been reported.
- Host's resistance to the *G. abietina* infection is likely to be related to:
  - (i) production of ligno-suberized tissues that help the tree compartmentalize the invaded tissues.
  - (ii) secretion of molecules such as phenolic compounds capable of degrading or altering the extracellular sheath of the pathogen.

Bernhold A, Hansson P, Rioux D, Simard M, Laflamme G, 2009. Resistance to *Gremmeniella abietina* (European race, large tree type) in introduced *Pinus contorta* and native *Pinus sylvestris* in Sweden. Canadian Journal of Forest Research 39, 89–96.



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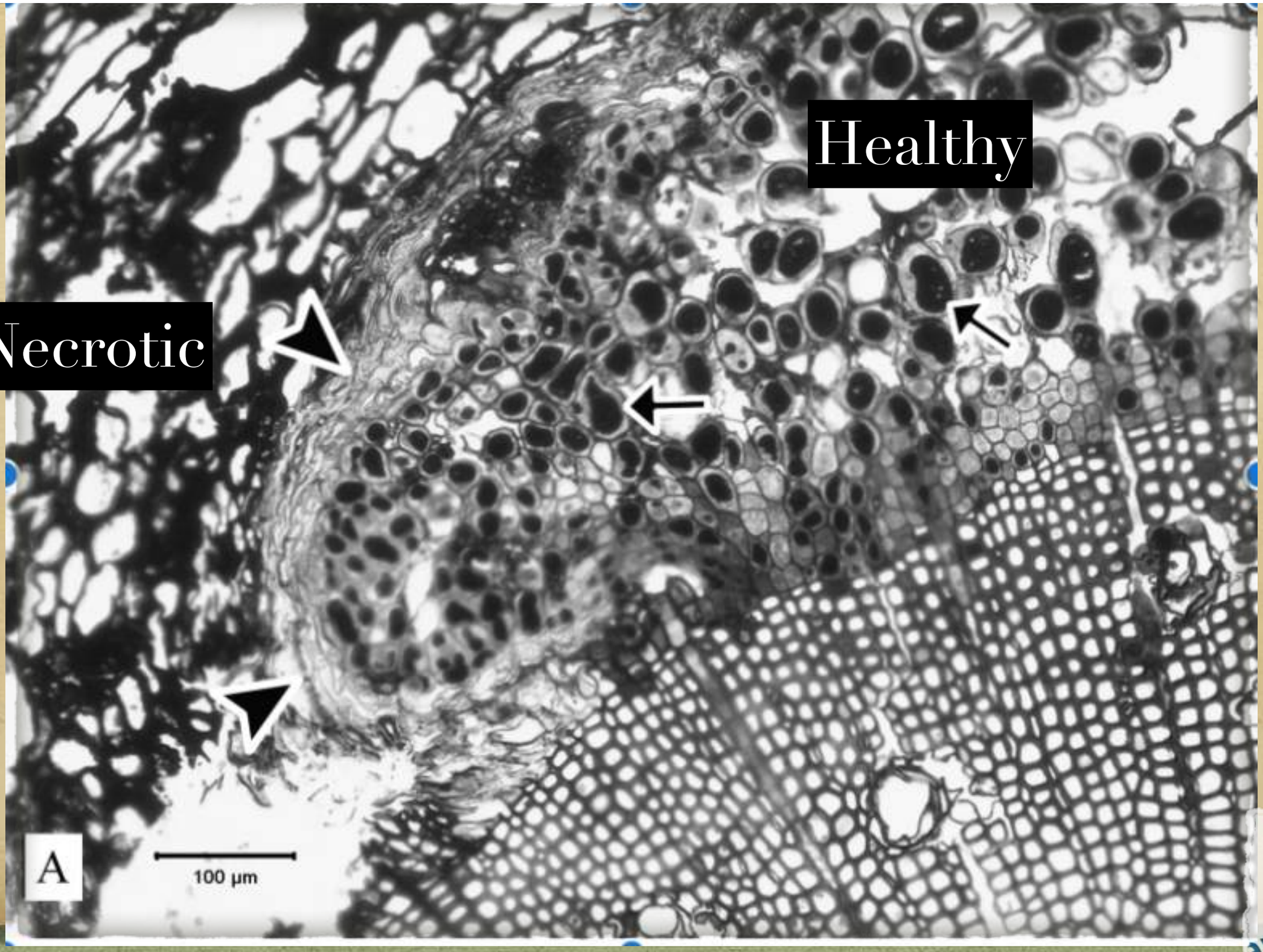


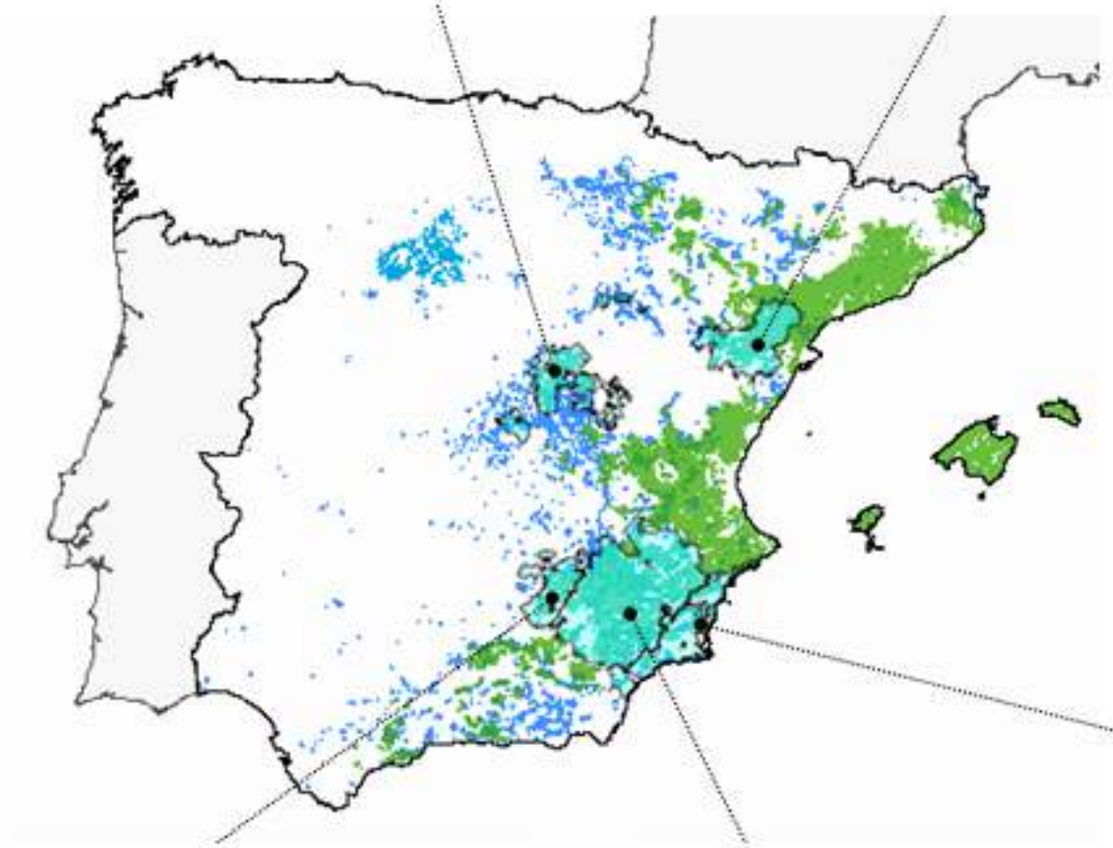
Aims of the study

- To explore the response of the provenances to the disease.
- Susceptibility of the provenances was quantified by measuring:

  (i) The **necrosis** produced by the progression of the pathogen.

  (ii) The **concentration of some UV-absorbing compounds** in the seedlings produced in response to the infection.

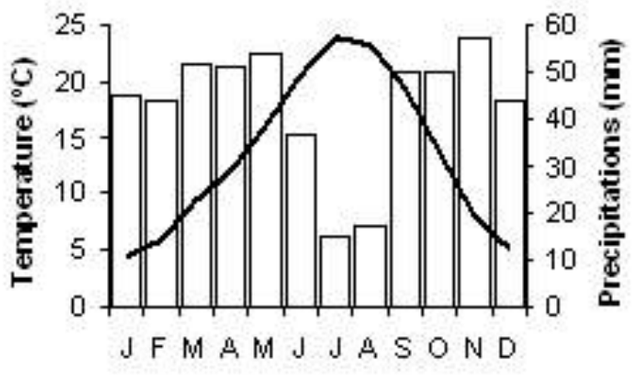
Materials & Methods



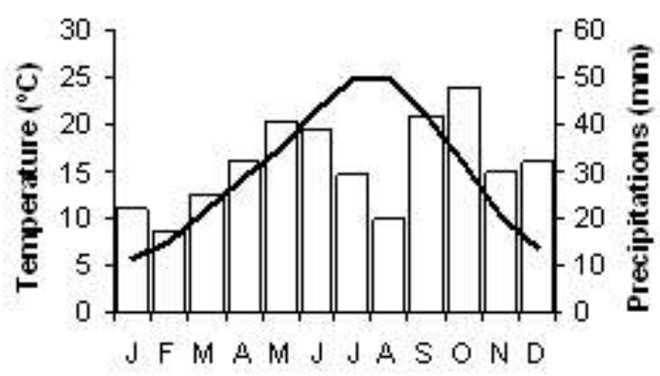
Leyend

- Natural stands of *P. halepensis*
- Selected provenance regions
- Artificial reforestations of *P. halepensis*

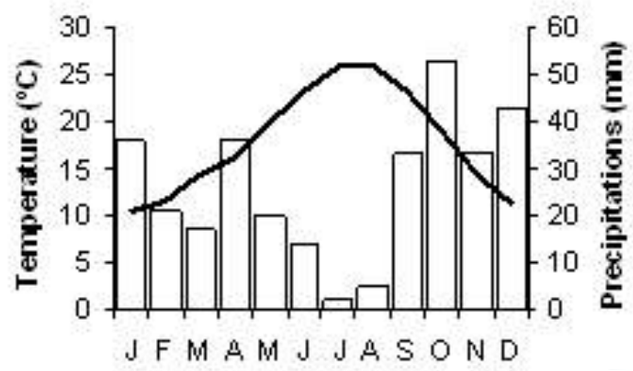
P2-Alcarria



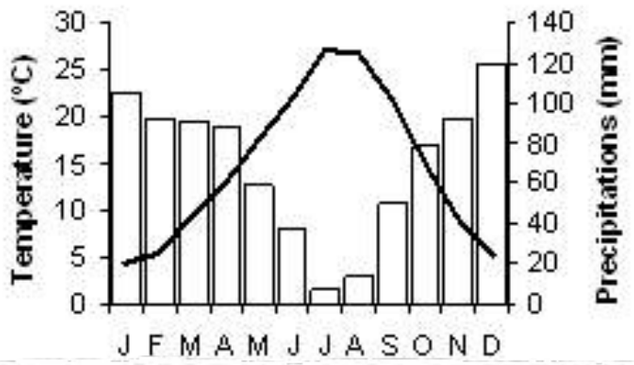
P1- Ibérico



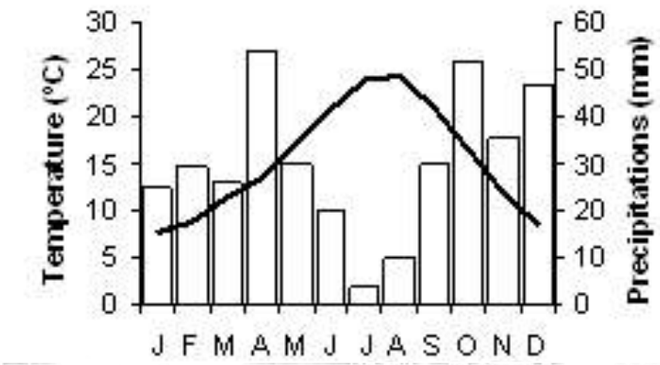
P3-Sudeste



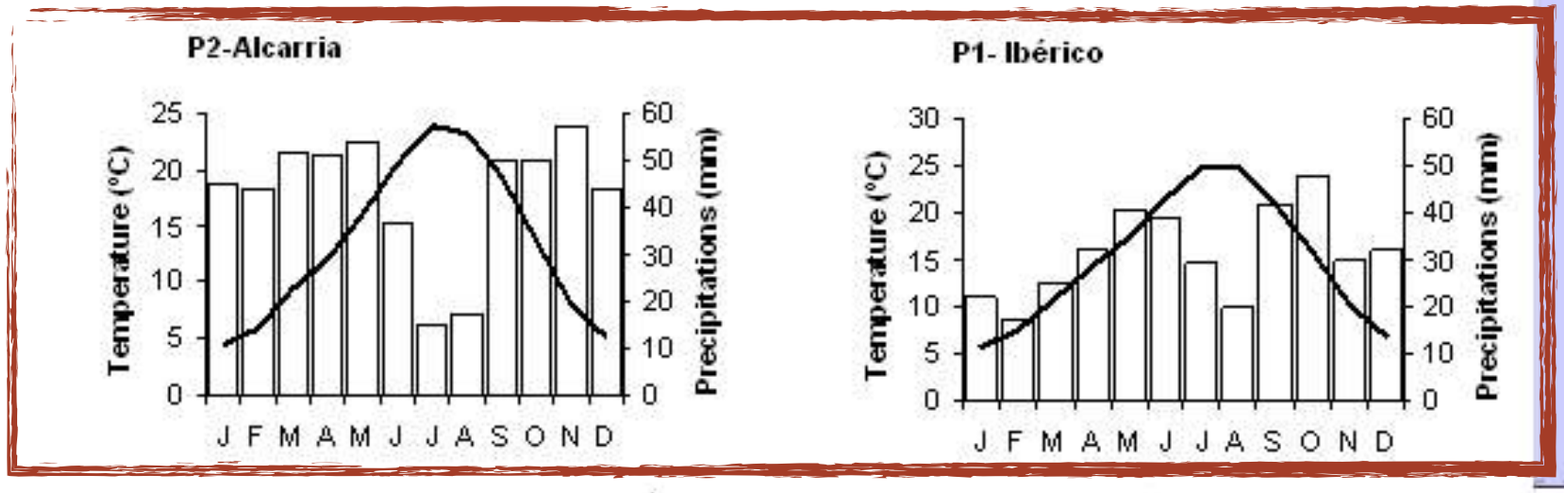
P5- Cazorla

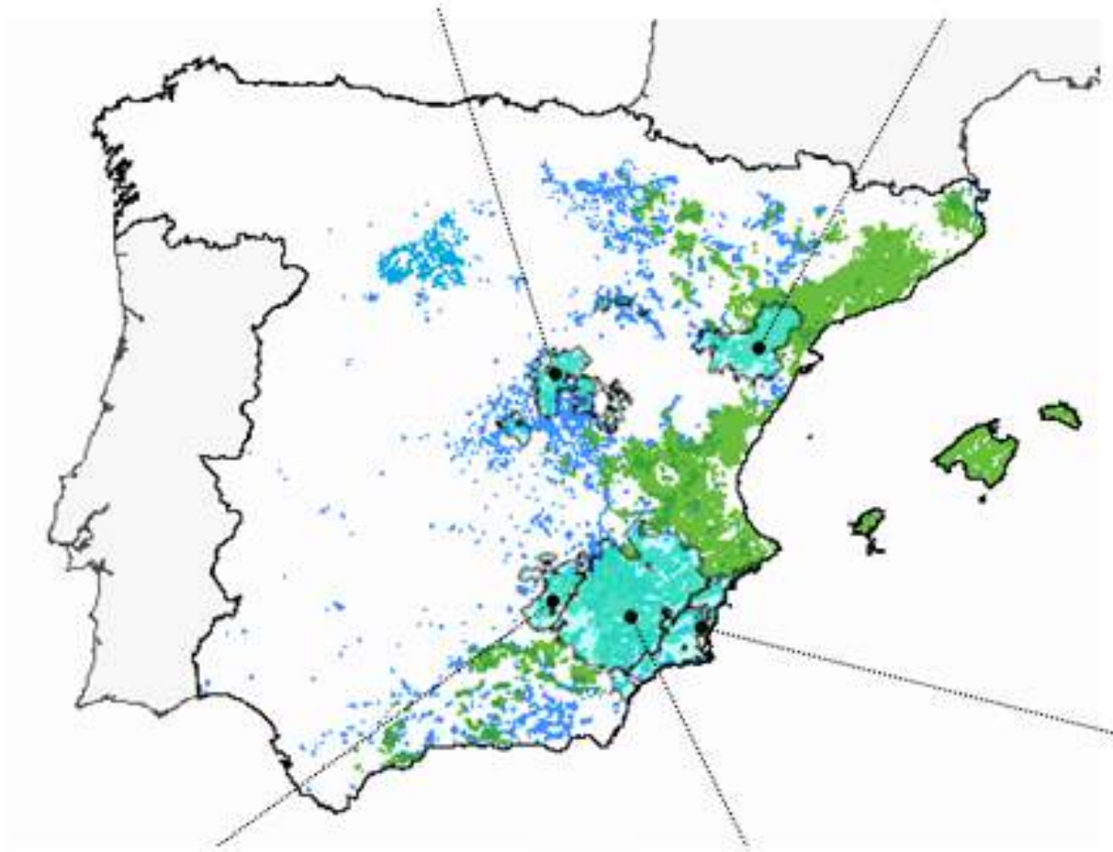


P4- Bética Sur



evoltree





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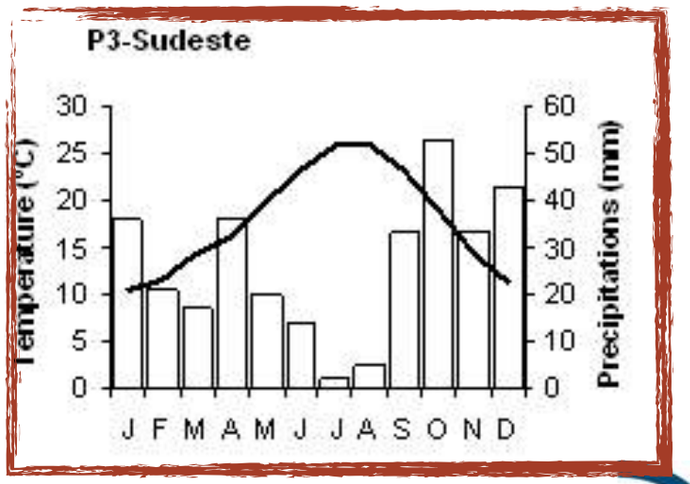
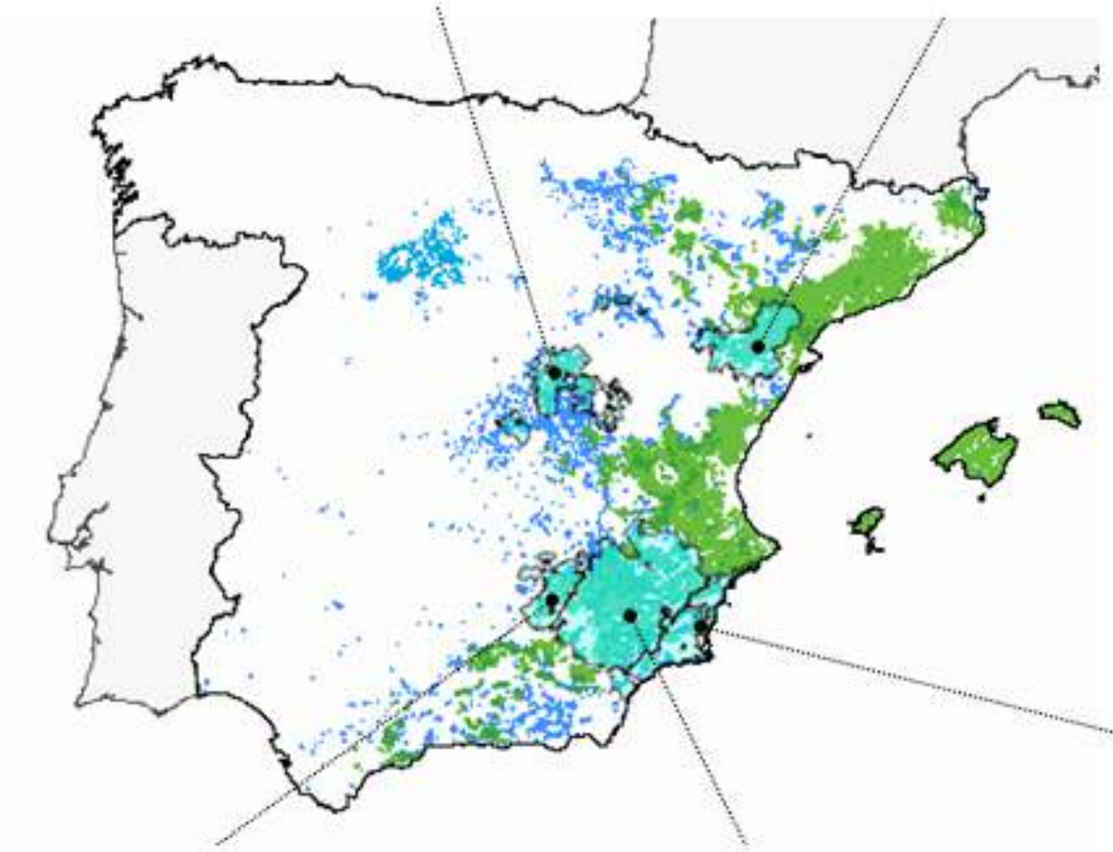
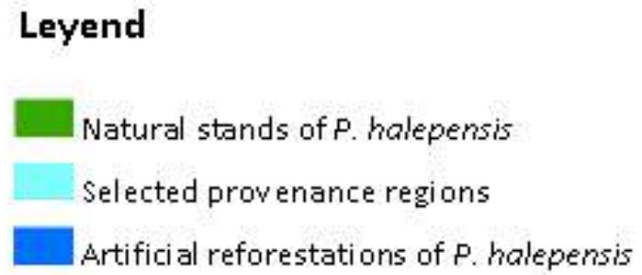


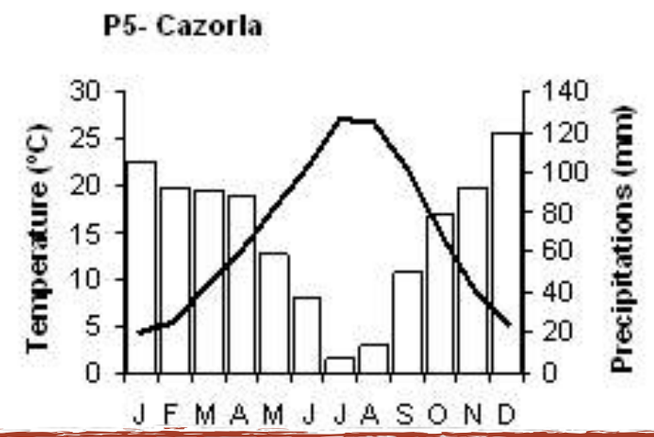
Continental climate

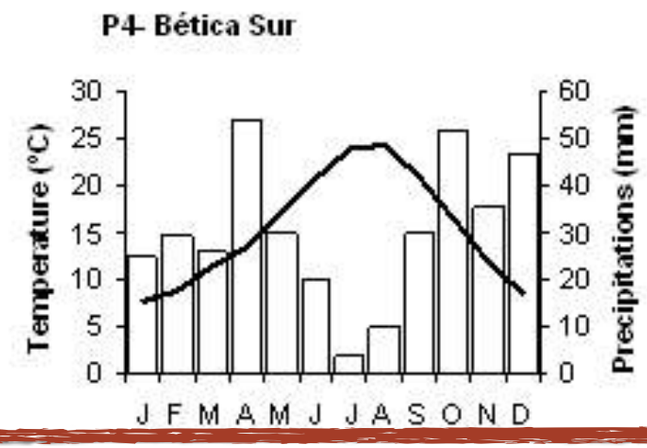
evoltree

Extreme continental climate









evoltree

Provenances

Pinus halepensis, Aleppo Pine seeds

Photo © Cándido Gálvez Ramírez & Rafael Mª Navarro Cerrillo

Pinus halepensis, Aleppo Pine seedlings

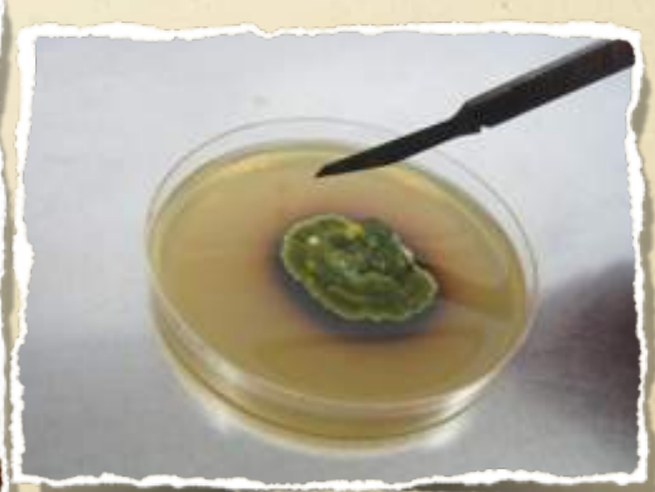
Photo © Cándido Gálvez Ramírez & Rafael Mª Navarro Cerrillo

18 months

Inoculations

- Made in **January** to mimic natural infection.
- **Eight** *G. abietina* isolates were used. Control seedlings: **agar**.
- **Mycelia** was used: no success with conidial suspensions.
- 3 weeks later: the experiment was repeated. Total: **630 seedlings**.






Visual severity: scale

0-Symptomless

1-Chlorosis

2-Advanced chlorosis

3-Dieback

4-Necrotic

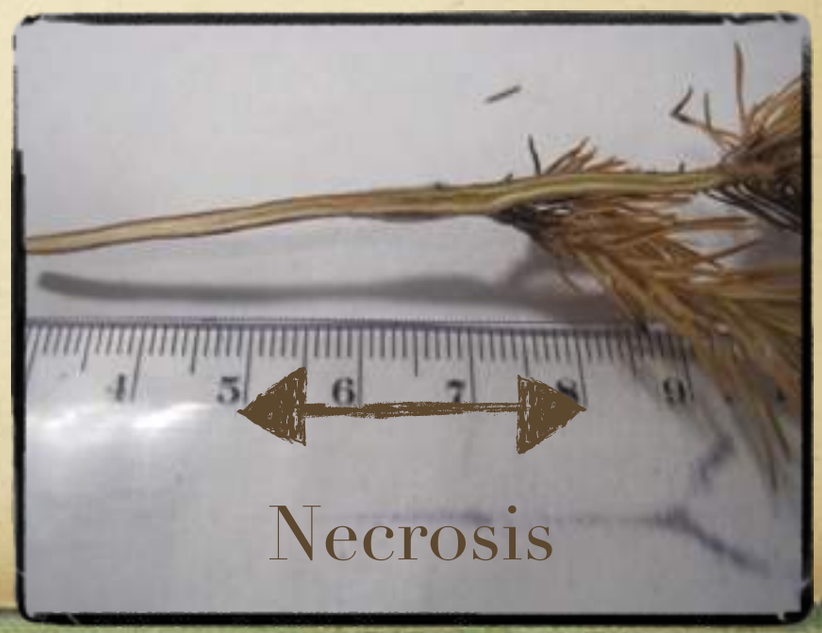
5-Dead

Relative necrosis length

Total length of the plant

Cut lengthwise

$$RNL = \frac{\text{Necrosis}}{\text{Total length of the plant}}$$



Necrosis

High-performance liquid chromatography (HPLC) analysis

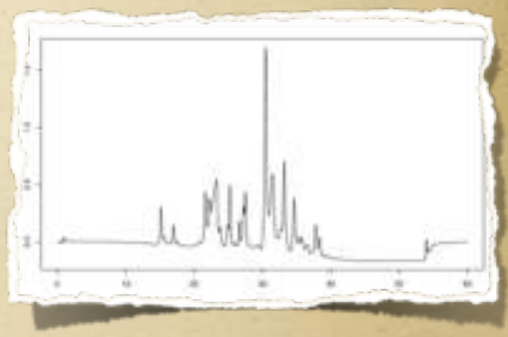
(1) 10cm-piece

(2) Freeze-dry 24h

(3) Grind until powder

(4) Extract with methanol

(5) HPLC



Two peaks: eriodictyol and naringenin dominated the HPLC profile at 280 nm.

Statistics

- Relative necrosis length: **Mixed Model.**

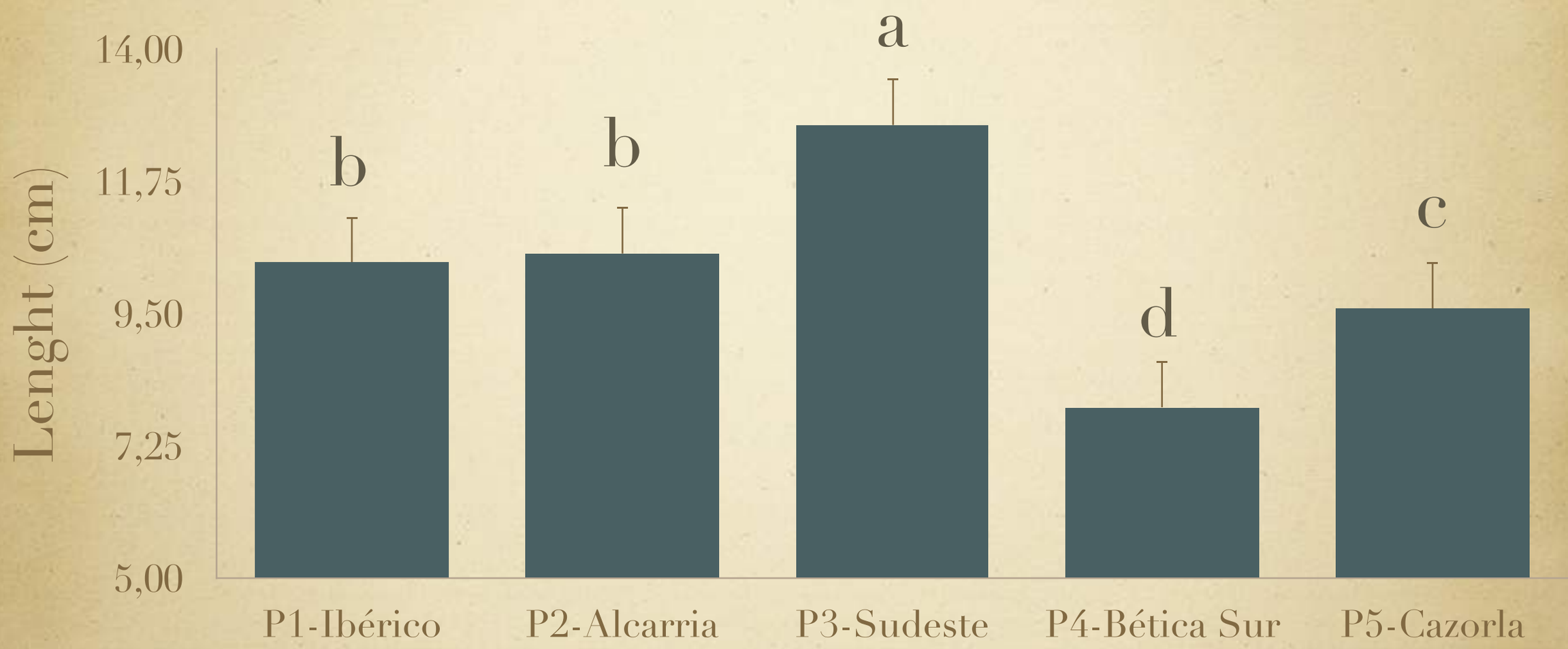
  (*high heterogeneity of the variance of the data*)

- Content of phenols: erioctydiol and naringenin: **non parametric** Kruskal-Wallis test.

- Relationships among variables: non parametric **Spearman correlation** matrix.

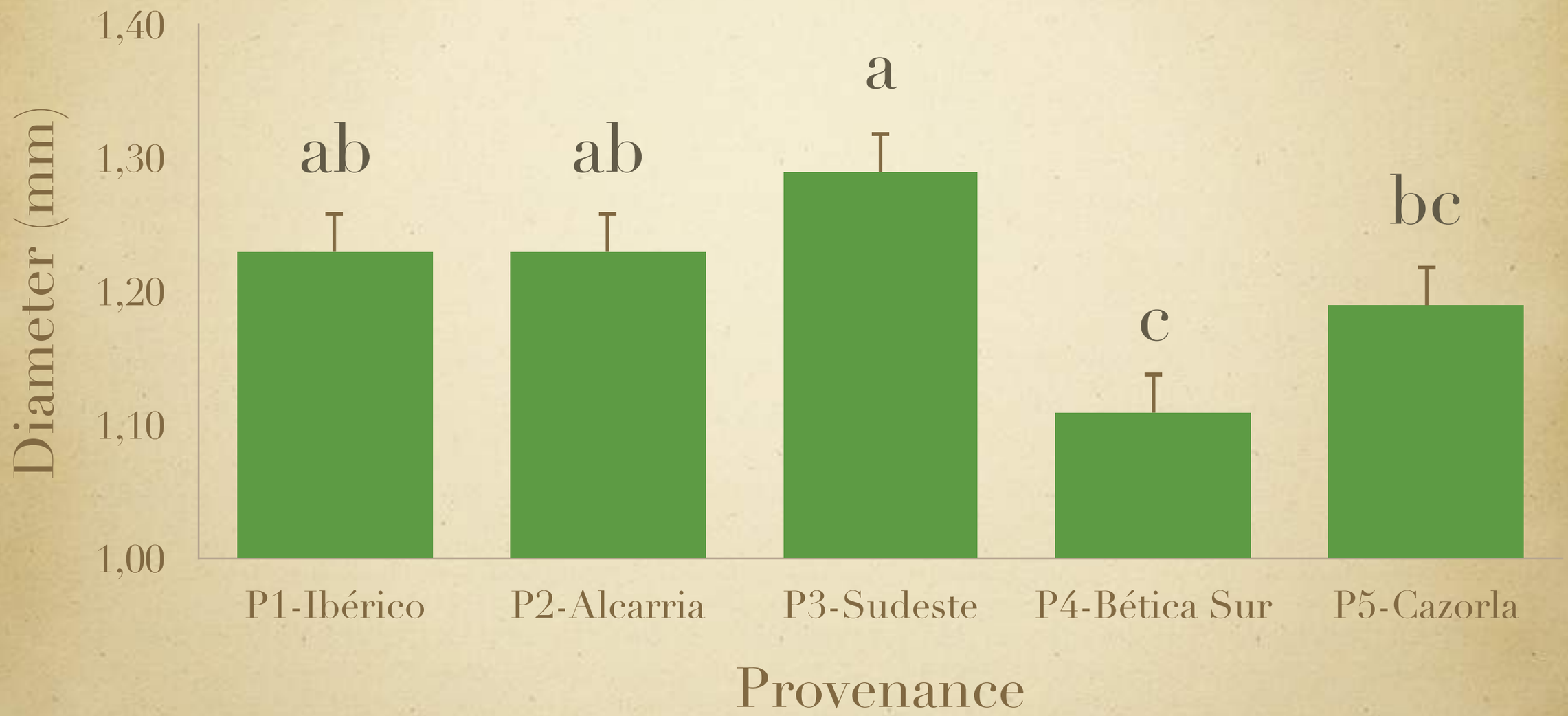
Results

Length of the seedlings



* Means without a common letter in the same column show values significantly different from $p<0.05$ (ANOVA Tukey's HSD Test).

Diameter of the seedlings



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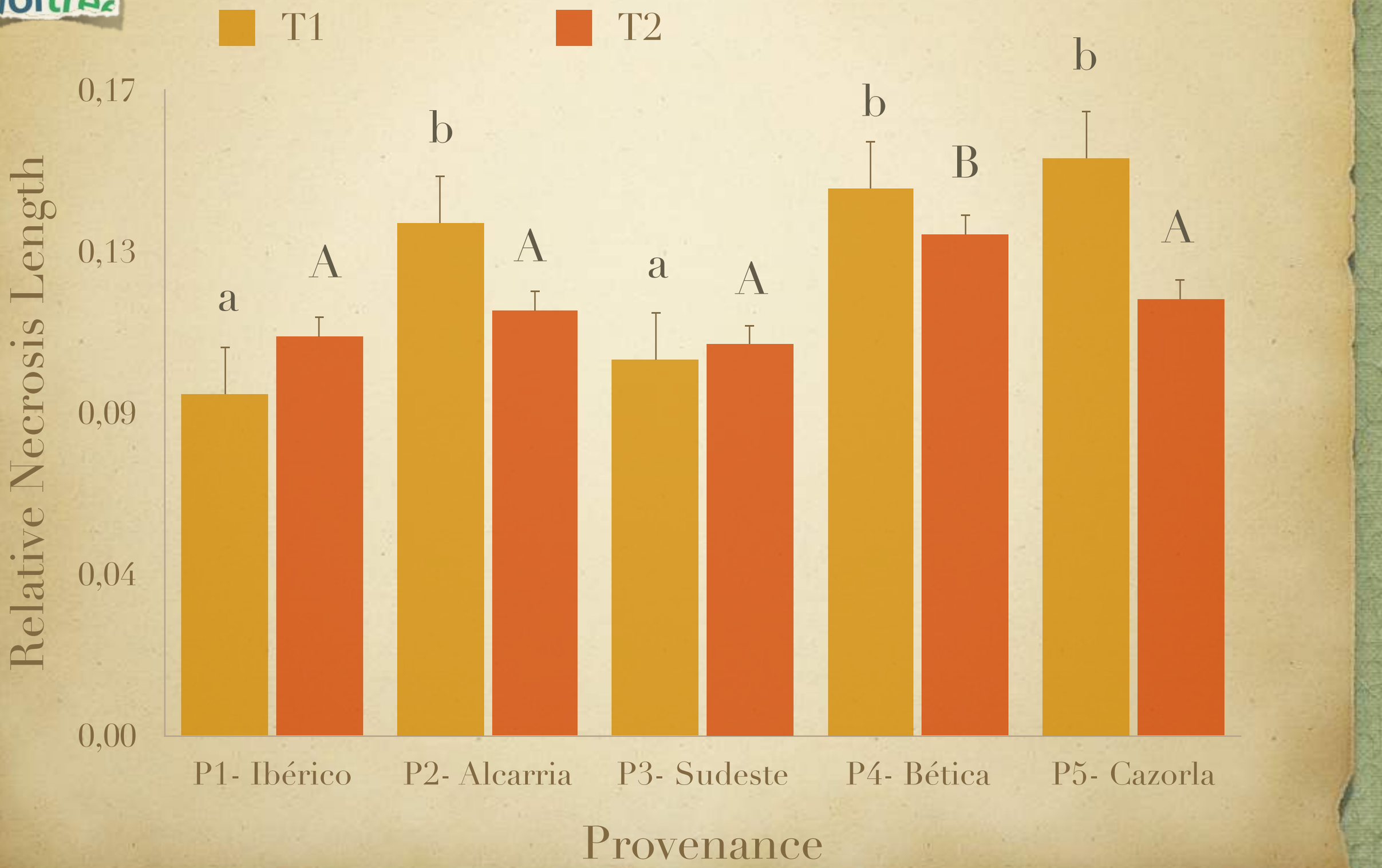
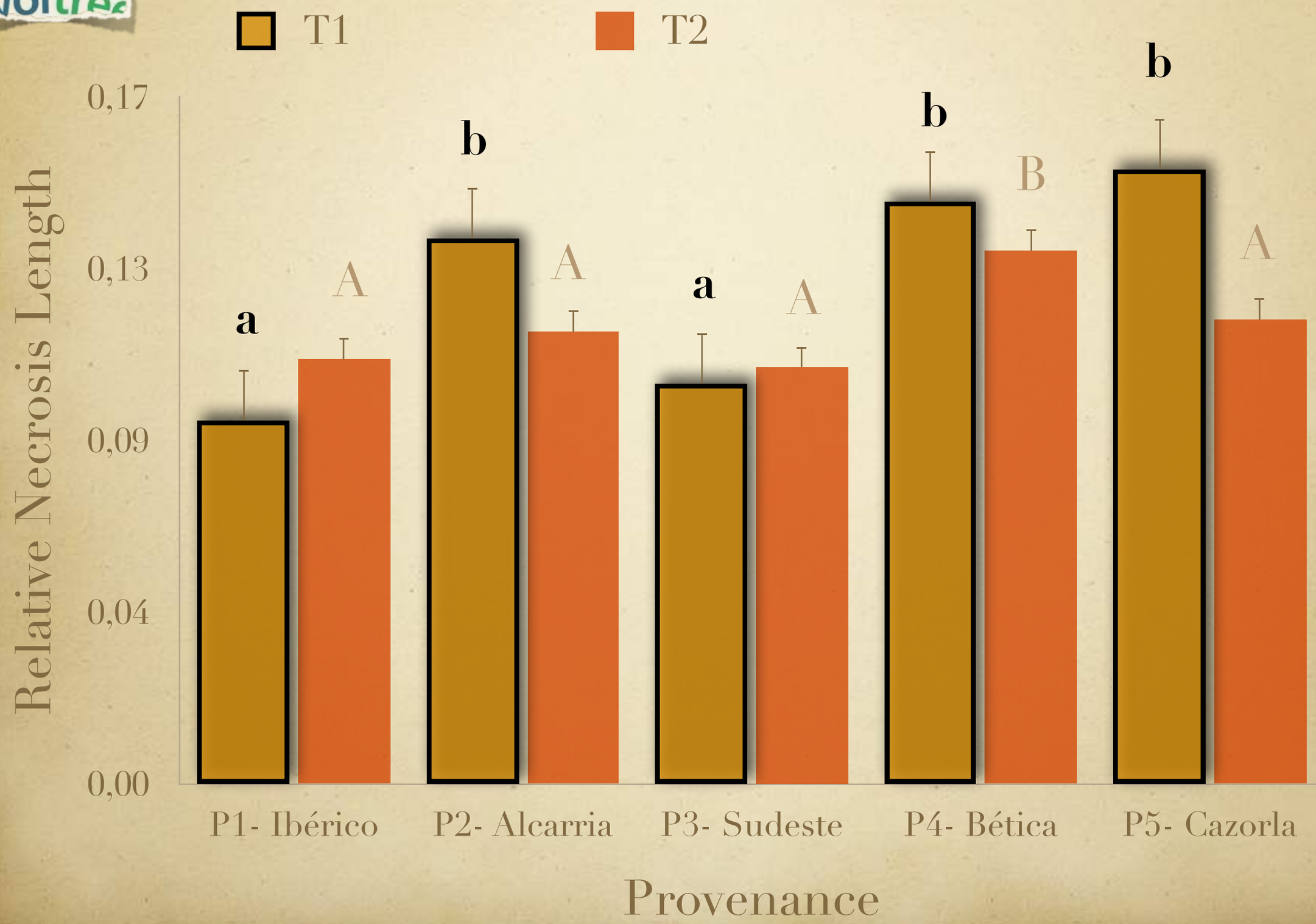
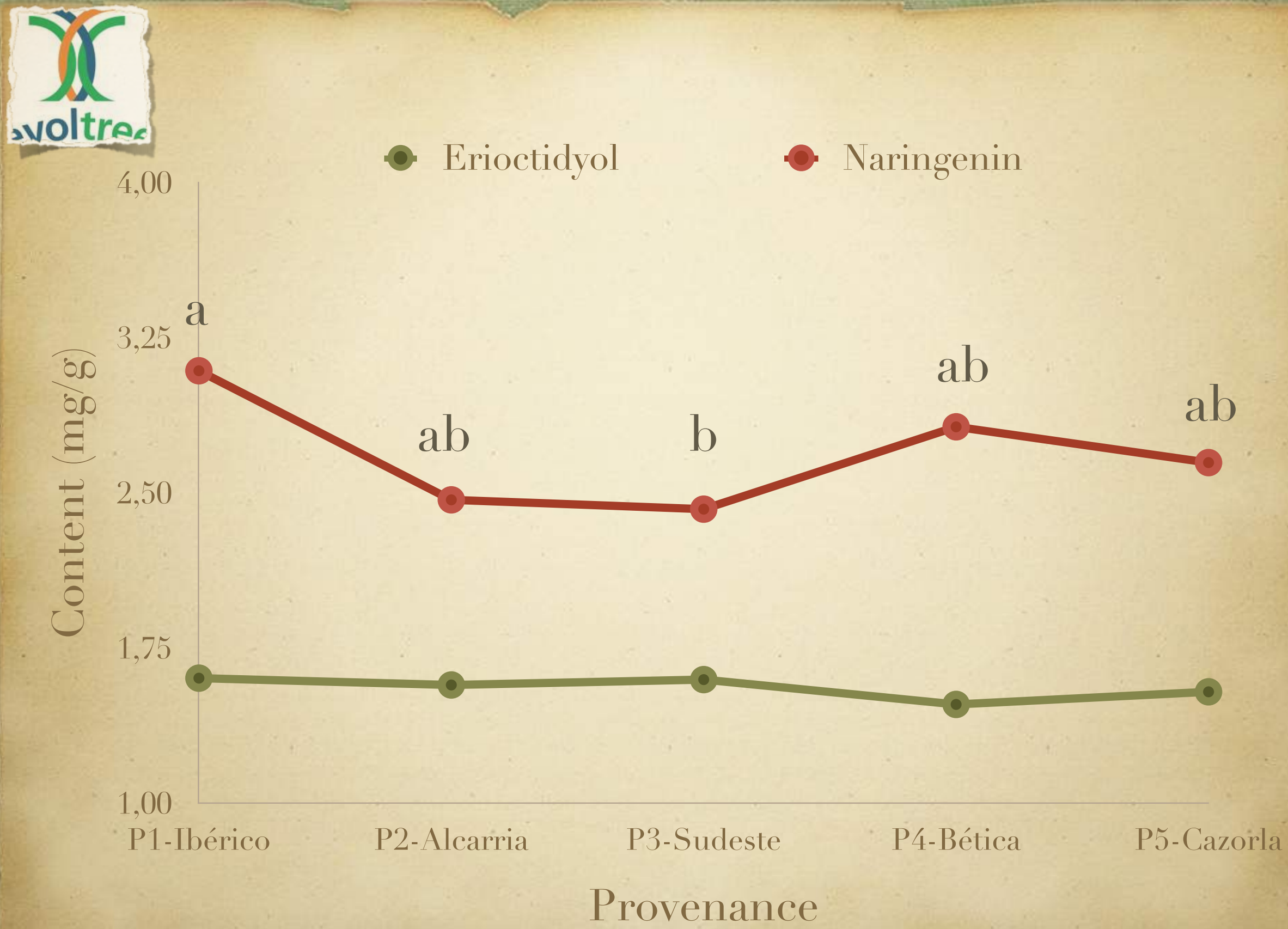
Relative Necrosis Length



Relative Necrosis Length




Erioctidyol
Naringenin
4,00
3,25
2,50
1,75
1,00
Content (mg/g)
a
ab
b
ab
ab
P1-Ibérico
P2-Alcarria
P3-Sudeste
P4-Bética
P5-Cazorla
Provenance

Correlation Matrix

	RNL	Altitude	XUTM	YUTM	Precp.	Eriodictyol	Naringenin	T°	Severity
RNL	1	0.20	-0.18	-0.20	0.12	*n.s.*	*n.s.*	*n.s.*	*n.s.*
Altitude		1	-0.73	-0.09	0.38	*n.s.*	*n.s.*	-0.73	*n.s.*
XUTM			1	0.18	-0.71	*n.s.*	0.15	0.57	*n.s.*
YUTM				1	-0.05	*n.s.*	*n.s.*	-0.57	*n.s.*
Precp.					1	*n.s.*	*n.s.*	-0.50	-0.11
Eriodictyol						1	0.30	*n.s.*	*n.s.*
Naringenin							1	*n.s.*	*n.s.*
T°								1	*n.s.*
Severity									1

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Tº								1	*n.s.*
Severity									1

Conclusions

1. The provenances of Aleppo pine showed a different response to the *G. abietina* infection in terms of relative necrosis length.

2. Higher elevation and precipitation, lower resistance to disease.

3. Increasing damage as the latitude of origin decreases.

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Conclusions

4. The observed difference in resistance may be explained by the fact that these high- and low-altitude provenances presented significant differentiation in adaptive traits mediated by maternal effects.

5. The concentration of naringenin was different between provenances, suggesting further studies to see if it may be involved in resistance.

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Acknowledgements:

EVOLTREE for their economic support

El serranillo nursery

COST action FA1103

Thanks for your attention

Merci pour votre attention!