Forest ecosystem genomics and adaptation

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POPULATION VARIATION FOR FROST TOLERANCE IN MARITIME PINE (*Pinus pinaster* AITON.)

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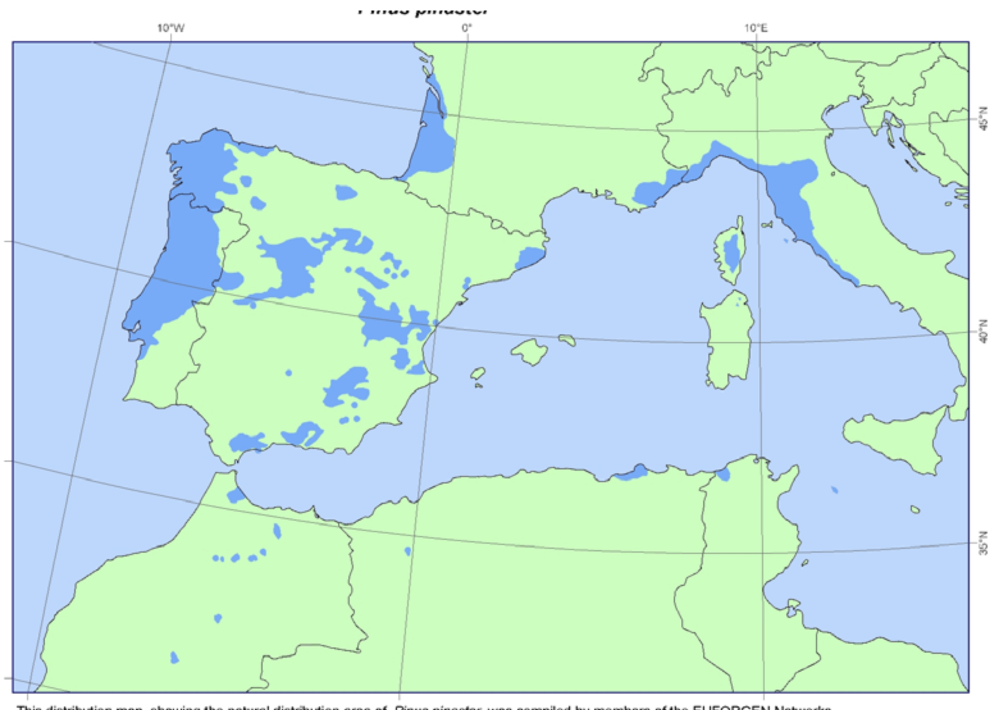
Grupo Tragsa

Introduction

Maritime pine is a paradigm of high ecotypic differentiation for a number of molecular and phenotypic traits.

Highly contrasted climatic conditions across its range of distribution and different population histories (González-Martínez 2002).

In the Iberian peninsula, large areas together with many scattered smaller populations



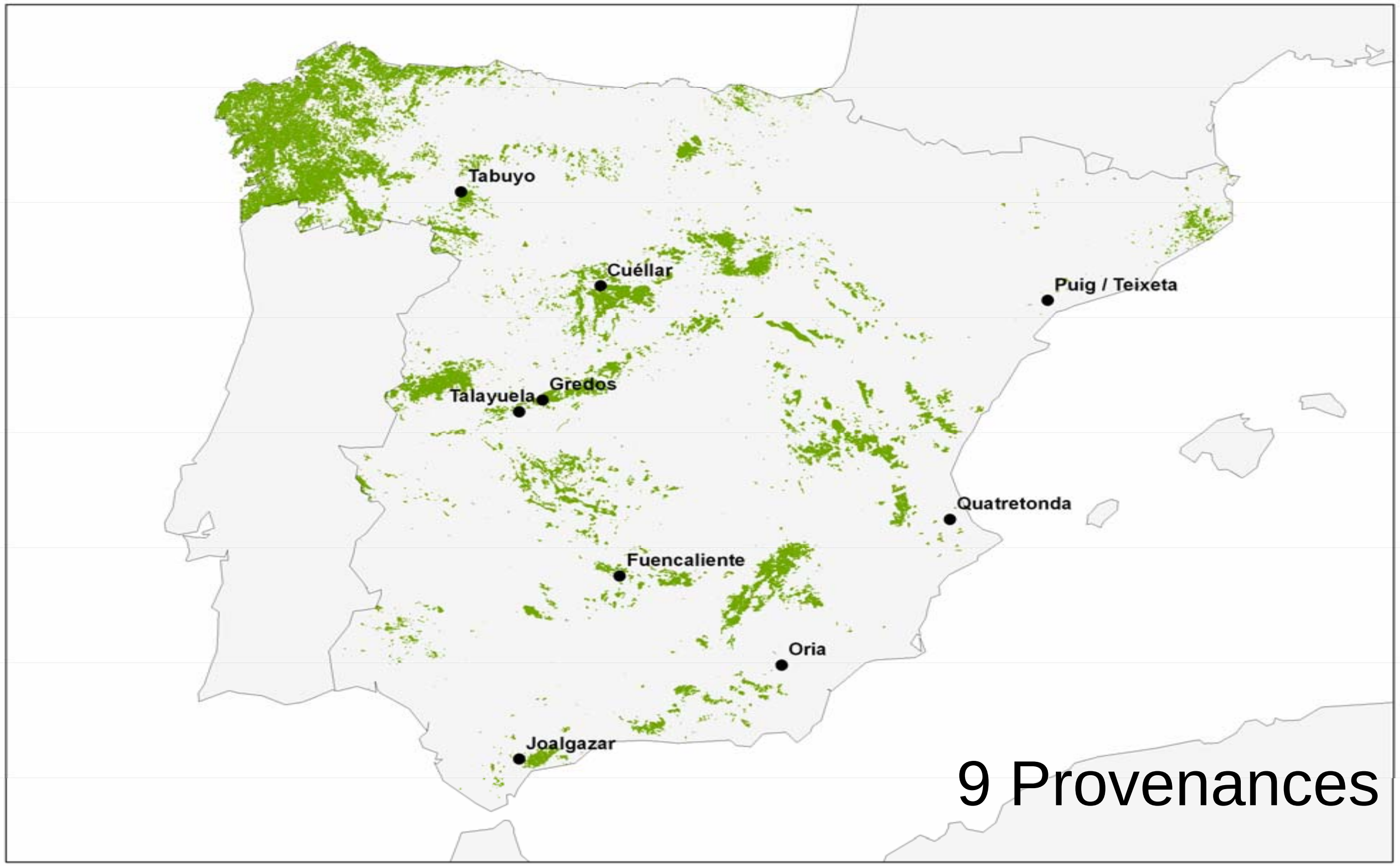
Introduction: ecotypic variation in Maritime pine

- Growth, survival, form (Alia et al. 1997, Sierra de Grado et al. 1997 and others)
- WUE and allocation (Guehl al. et, 1997Sánchez-Gómez et al. 2010 and others)
- Life-history traits (Tapias et al. 2004, Climent, in this meeting)

Introduction: frost tolerance

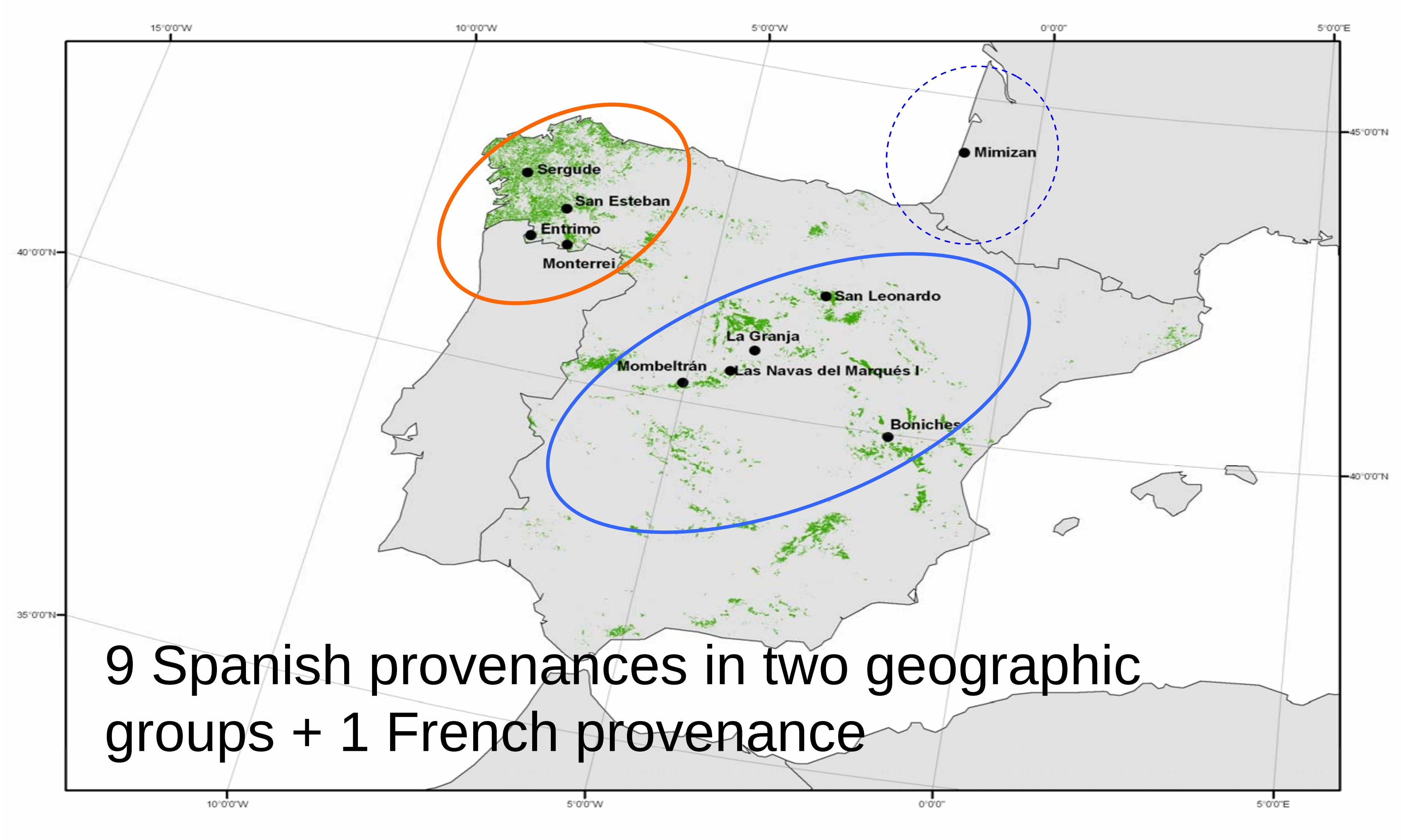
- Information on ecotypic variation for cold tolerance in Maritime pine is very scarce.
- Severe frost damage was observed in France in introduced Iberian materials
- UE imposed restrictions for importing FRMs from Iberian provenances.

Preliminary test



All provenances equally frost tolerant, even southernmost ones

Material and Methods



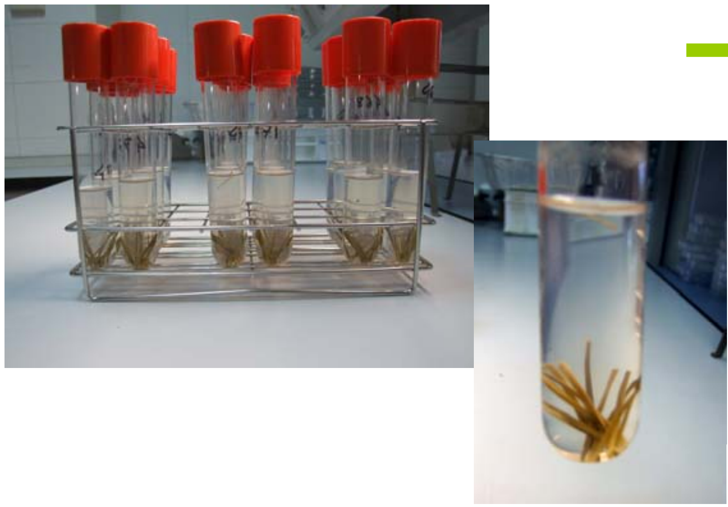
9 Spanish provenances in two geographic groups + 1 French provenance

Artificial frost test

Tests were repeated from the beginning of autumn to the end of spring (totaling 10 tests) in a controlled freezing chamber.

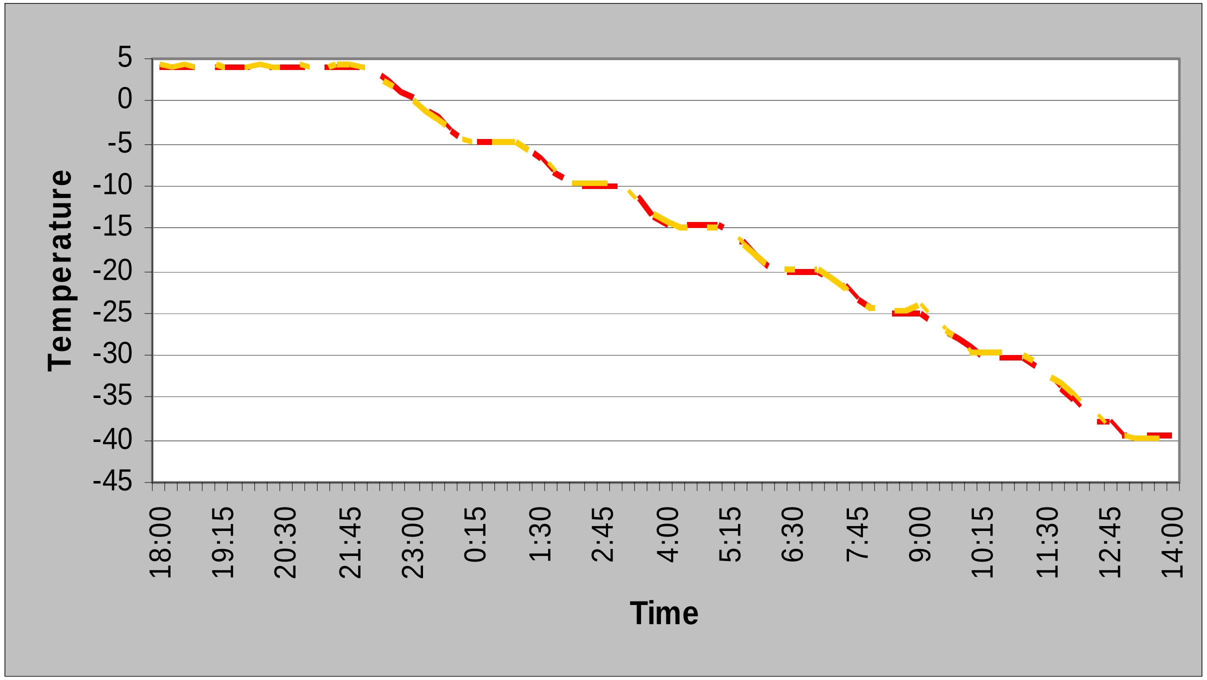
Using:

- 2 cm adult (secondary) needle fragments from last year’s growth
- in test tubes



Artificial frost test

Temperatures were slowly lowered step by step and the samples for each target temperature were removed from the chamber after 1 hour exposure.
Frost damage was evaluated by electrolyte leakage and an injury index was calculated following Flint (1969).

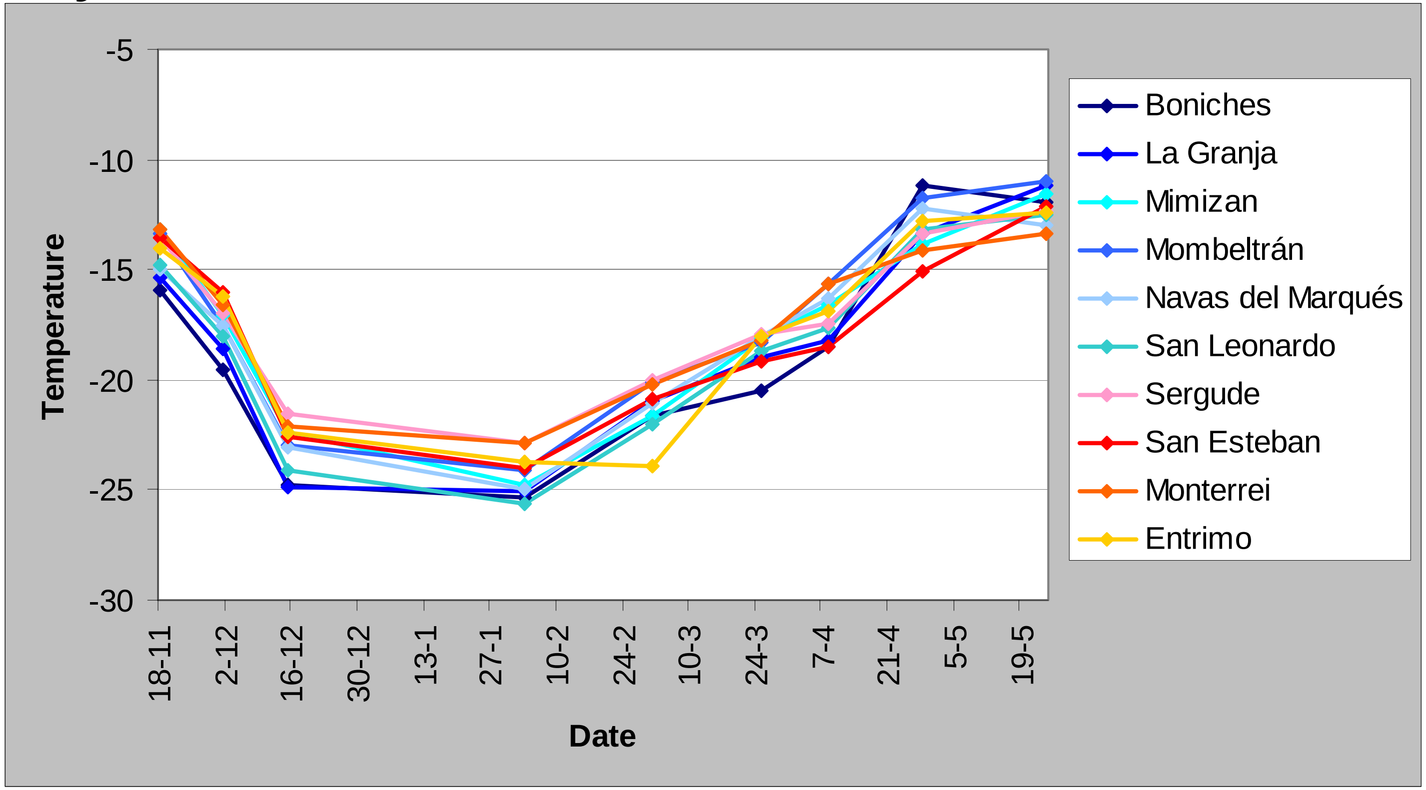


Statistical Analysis

- LT_{50} values were determined by adjusting logistic models to the frost damage index values.
- In the early January test, target temperatures were not sufficiently low (-36ºC) to adjust the model. This test was not considered in the analysis.
- Differences among provenances were evaluated by a generalized linear model approach, using the *logit* link function.

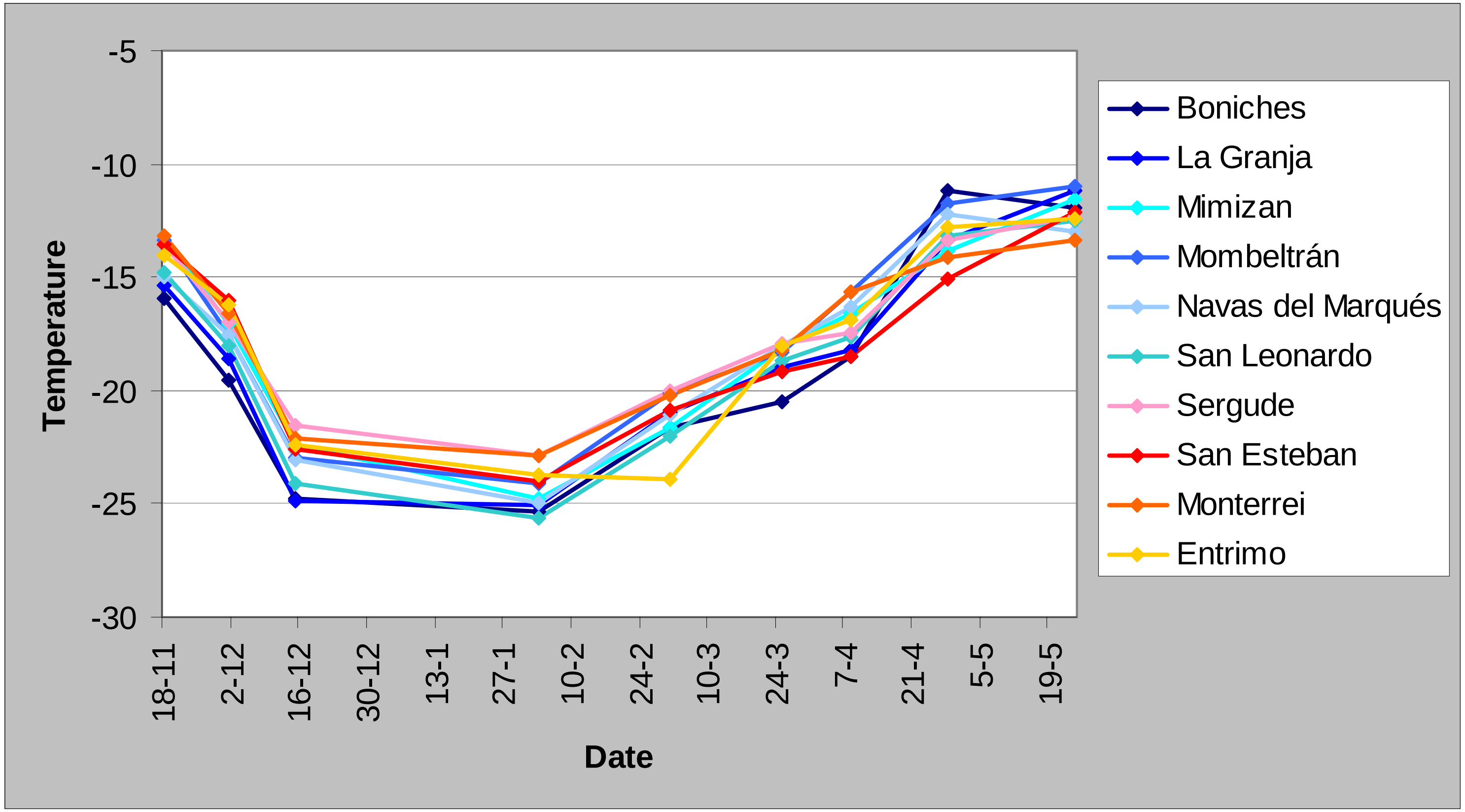
Results

As expected, when plants were exposed to progressively lower night-time temperatures during autumn and winter, LT_{50} declined significantly in all populations, reaching very low values (between -23 and -25º C) in December and January.



Results

All provenances followed very similar hardening-dehardening rhythms, despite the contrasted altitudes and climatic conditions of origin



Results

Genetic differences among populations were only significant just before the beginning of the spring de-hardening period (Feb), and in early spring (end of March) .

More damage

February 3	March 28
San Leonardo	San Esteban
Mombeltrán	Entrimo
Boniches	La Granja
Navas del Marqués	Boniches
La Granja	Monterrei
Mimizan	Mombeltrán
San Esteban	San Leonardo
Sergude	Mimizan
Entrimo	Navas del Marqués
Monterrei	Sergude

In February, provenances from the “warm” group were significantly less damaged than continental ones.

Conclusions

- Differences between populations of Maritime pine for frost damage in needles were much lower than expected.
- All provenances followed very similar hardening-dehardening rhythms, and attained high levels of tolerance in winter.
- We will now evaluate frost tolerance of twigs and buds.

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Thank you!!!!