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Genetic architecture of water use efficiency and related traits in maritime pine

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Introduction:

✓ Water use efficiency (WUE), a trait related to plant water economy, could be important in water-scarce environments since it allows maximizing growth with regard to the amount of water available.

✓ However, the adaptive value of WUE in maritime pine is still a matter of debate as no clear correlation of this trait with biomass production or environmental conditions has been determined [1,2].

$$WUE = \frac{\text{Carbon assimilated}}{\text{Water lost}}$$

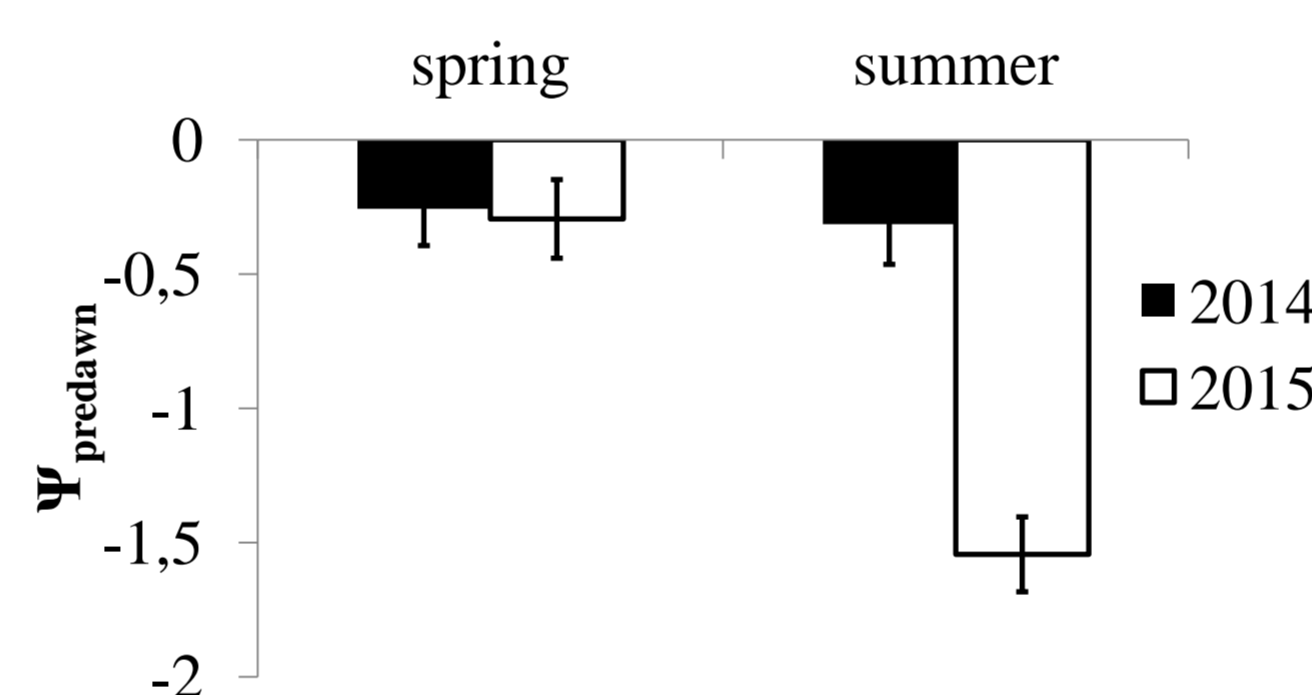
Objectives:

- Study the relationship between WUE and photosynthesis related traits
- Disentangle the genetic architecture of these complex functional traits.

- ✓ across different years
- ✓ at different levels of water availability

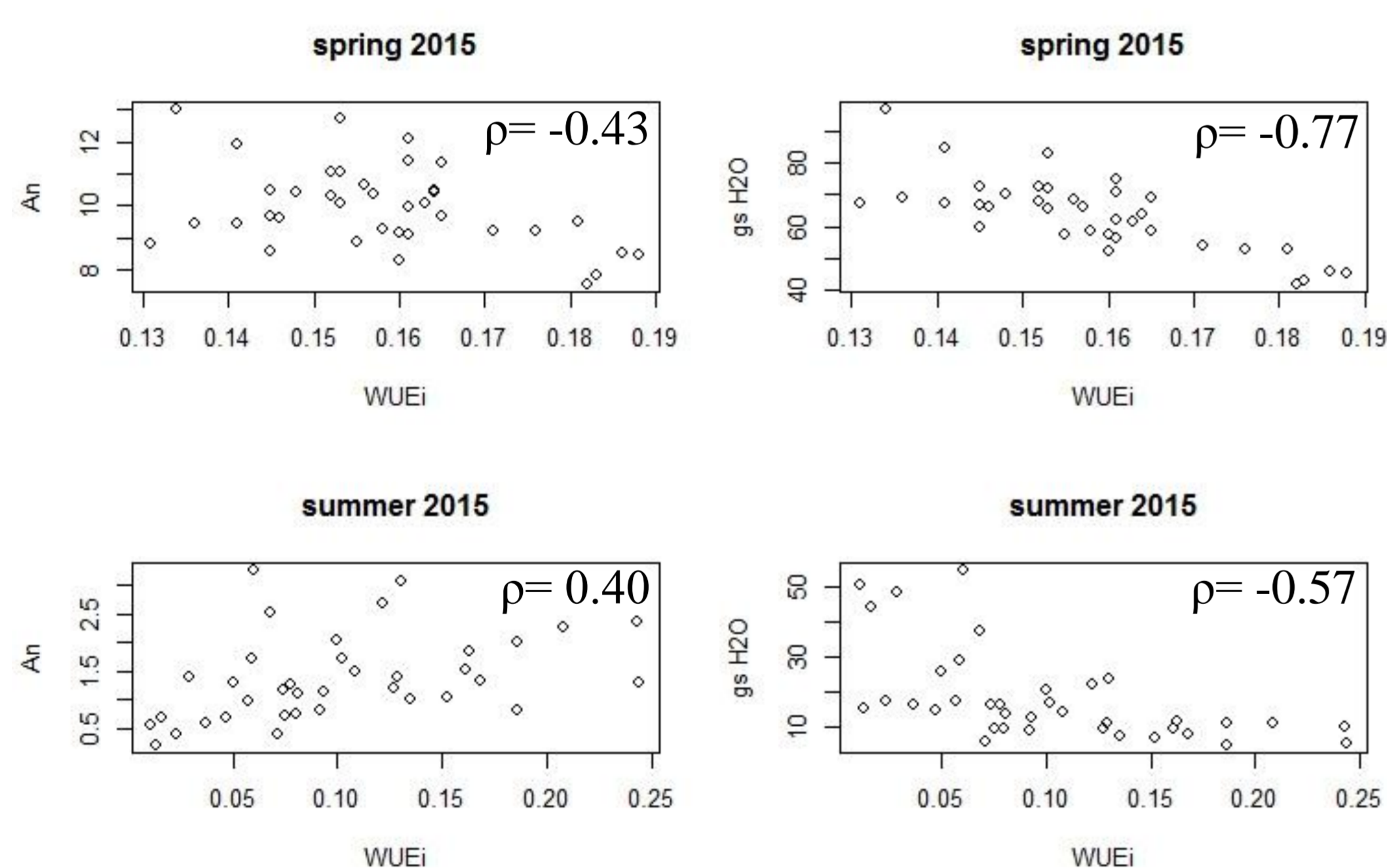
Materials and Methods:

- ✓ 108 F₁ full-sibs from a controlled cross between two contrasted provenances **Morocco x Landes**
- ✓ Experimental plot established in 2007 in Aquitaine (France).
- ✓ Chlorophyll fluorescence and gas exchange measurements in spring and summer of 2014 and 2015.
- ✓ High density SNP genotyping [3].
- ✓ Environmental characterization.



2015 dry summer

Results:



Higher correlation of WUE_i with g_{sH2O} than with A_n

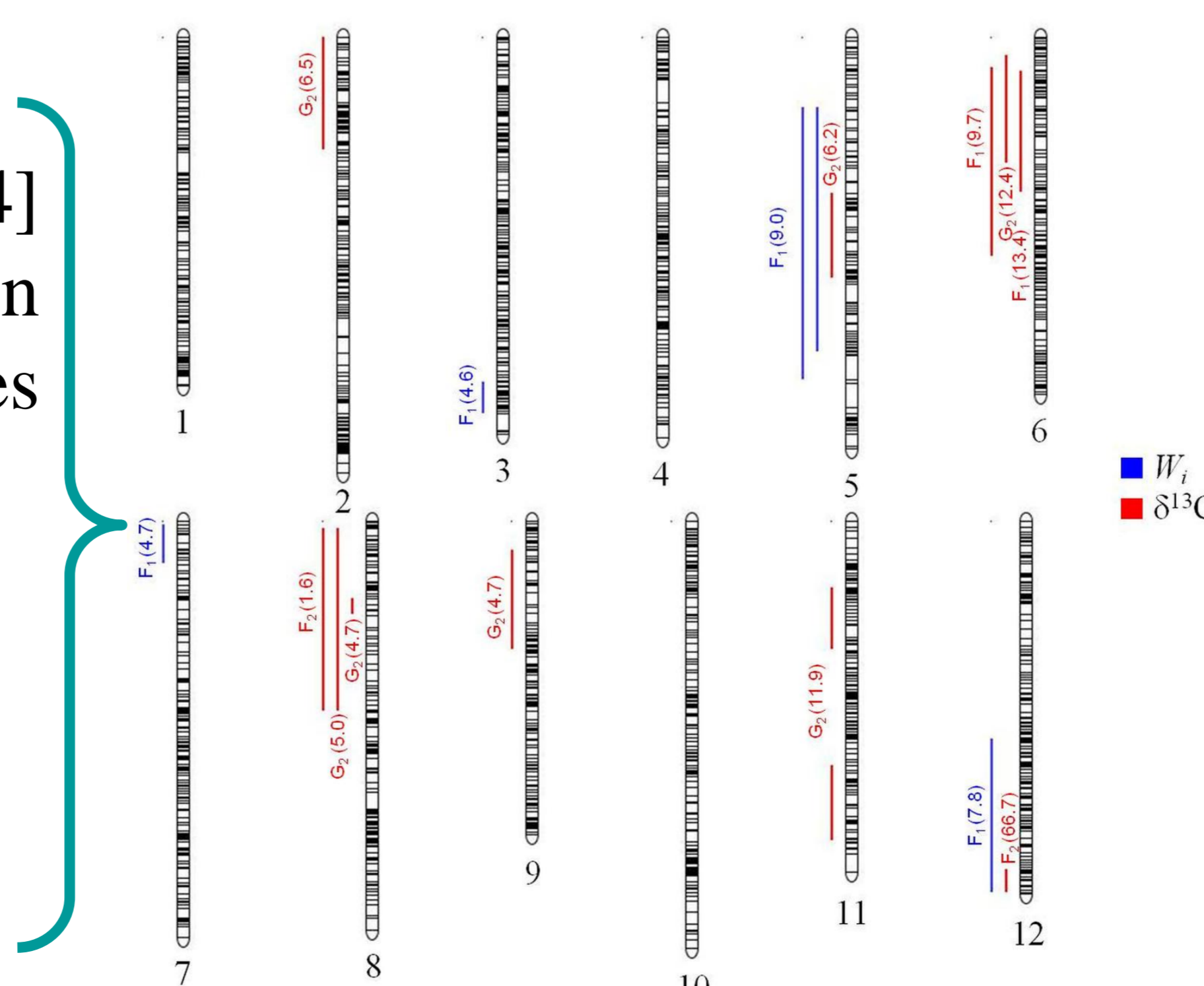
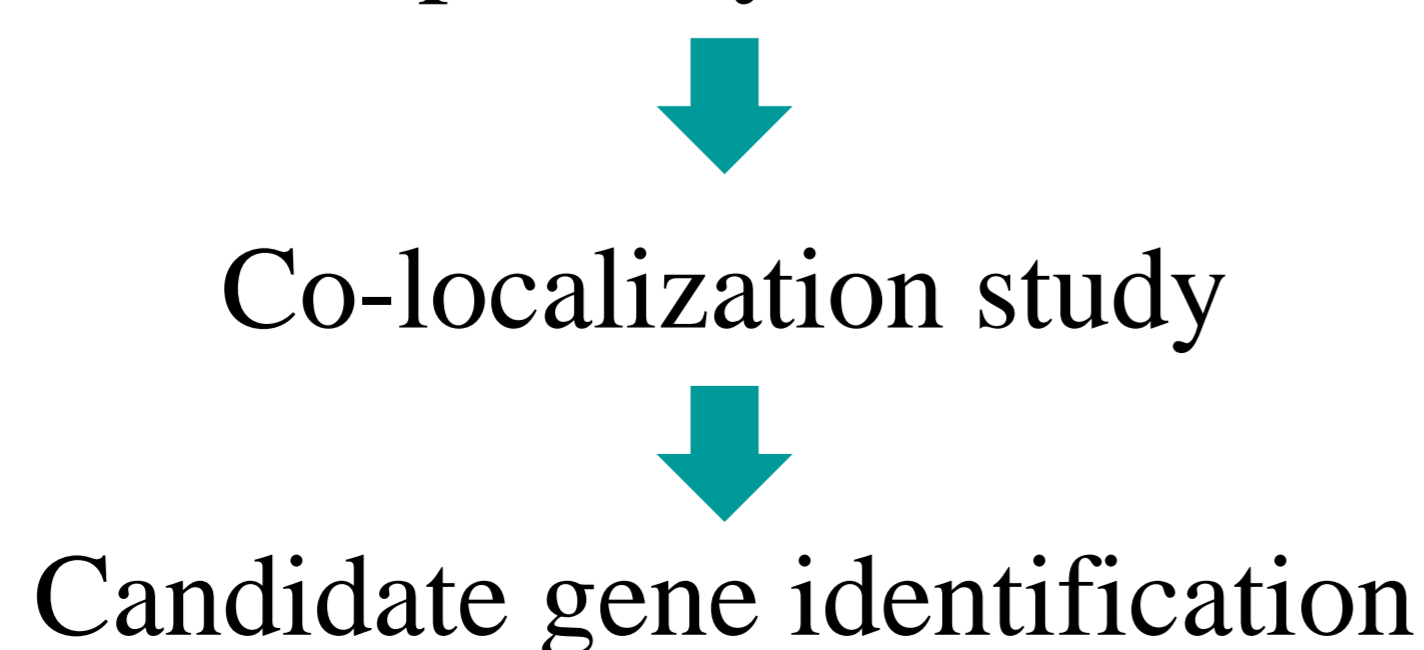
Preliminary QTL analysis
Composite Interval Mapping

Trait	Parent	Year	season	LG	LOD	PEV	Position	CI (cM)	P-value
Ψ _{predawn}			summer	6	5.2	12.4	113	109-115	0.007
F _m '	L	2015	spring	11	4.7	15.1	113	106-115	0.026
E			spring	2	4.7	10.3	167	163-170	0.027

Detected QTLs with moderate effect for chlorophyll fluorescence traits and transpiration rate in Landes parental tree

Perspectives:

Projection of QTLs on *P. pinaster* composite map [4] and comparison with previously detected QTL in maritime pine for :WUE from three independent studies F₁, F₂, G₂[2]; and for photosynthesis related traits [5]



- ✓ New measures in 2016
- ✓ Analysis of δ¹³C, cavitation resistance and growth in progress

References

- [1] Aranda et al. 2010. TGG
- [2] Plomion et al. 2016 JPH
- [3] Plomion et al. 2016 Mol Ecol Res
- [4] de Miguel et al. 2015 GBE
- [5] de Miguel et al. 2014 BMC Genomics