

GROWTH RESPONSE TO THINNING IN A MIXED PINE-OAK STAND OF *Pinus pinaster* AND *Quercus pyrenaica*

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INTRODUCTION

During the last decades the interest on mixed stands has increased in forestry due to their potential benefits, especially conifer-broadleaves mixtures. However, more knowledge is needed about their dynamic and response to silvicultural treatments and to climate change. We present **preliminary results** of a thinning trial in a pine-oak stand. The **main objectives** of the experiment are to study the **growth of each species with different composition and competition** degree and to analyze if there are differences in **climate-growth relationships between species and thinning treatments**.



Control plot



Heavy thinning form below

RESULTS

- Growth response to thinning in the first year is significant in pine but not in oak

ANOVA P-values

Species	Column	Row	Treatment
<i>Pinus pinaster</i>	n.s	n.s	0.041
<i>Quercus pyrenaica</i>	0.015	n.s	n.s

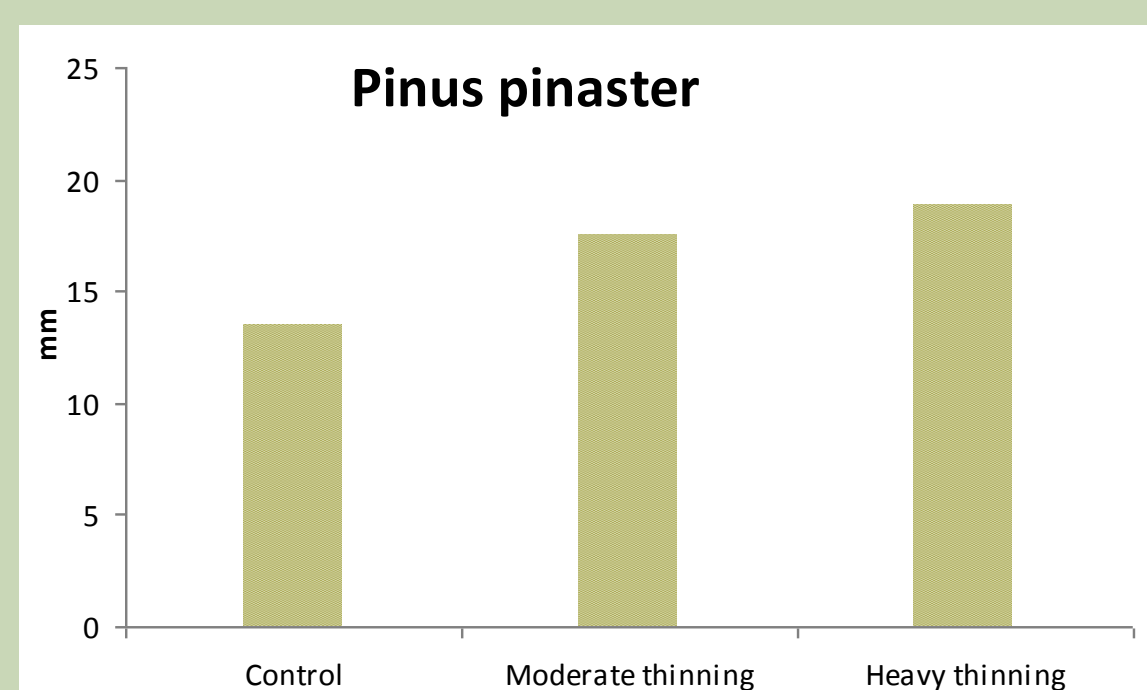
n.s.: P value > 0.05

- Covariance analysis indicates a significant initial diameter effect for both species, with higher growth in larger trees.

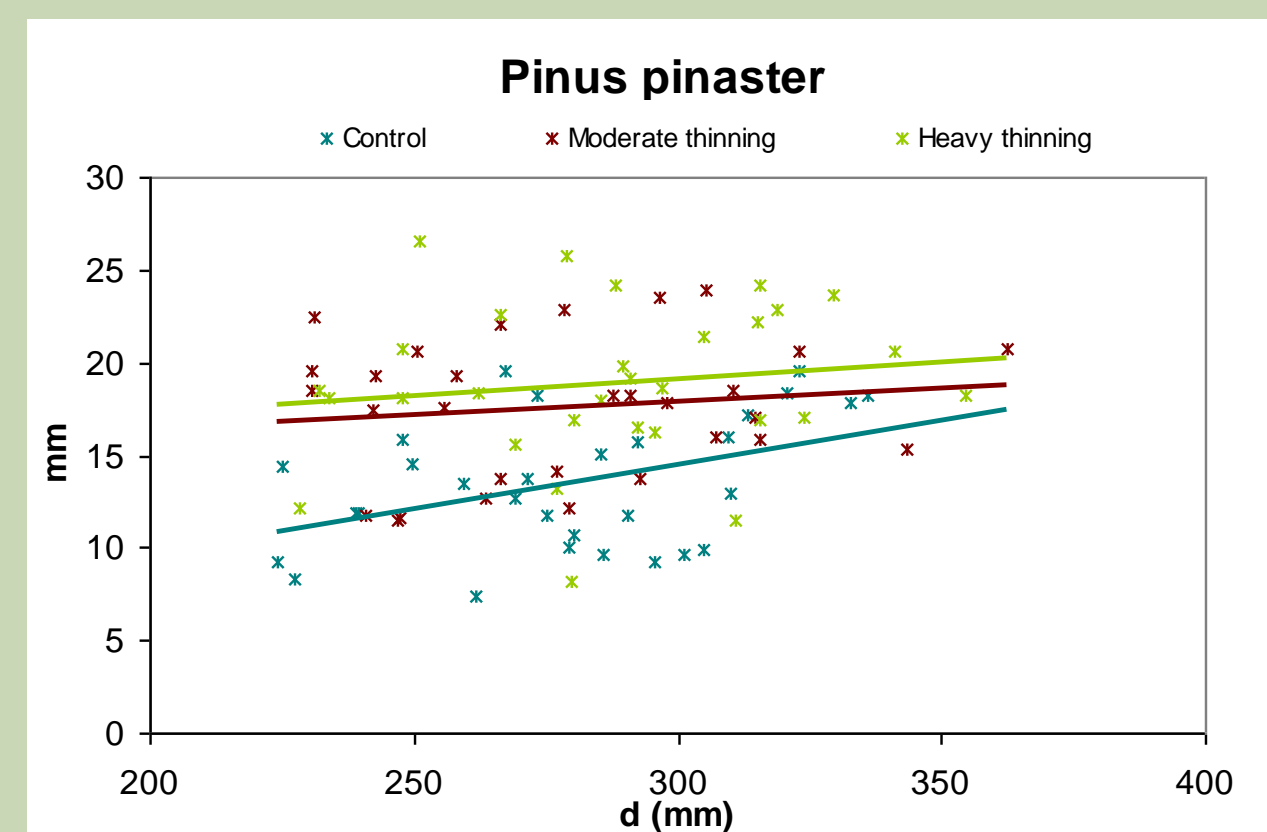
- The effect of the thinning is lower in dominant pines than in medium size ones

- Pine trees in thinned plots showed a higher growth than control ones during all the growing season, while in oak trees it occurred only during the summer

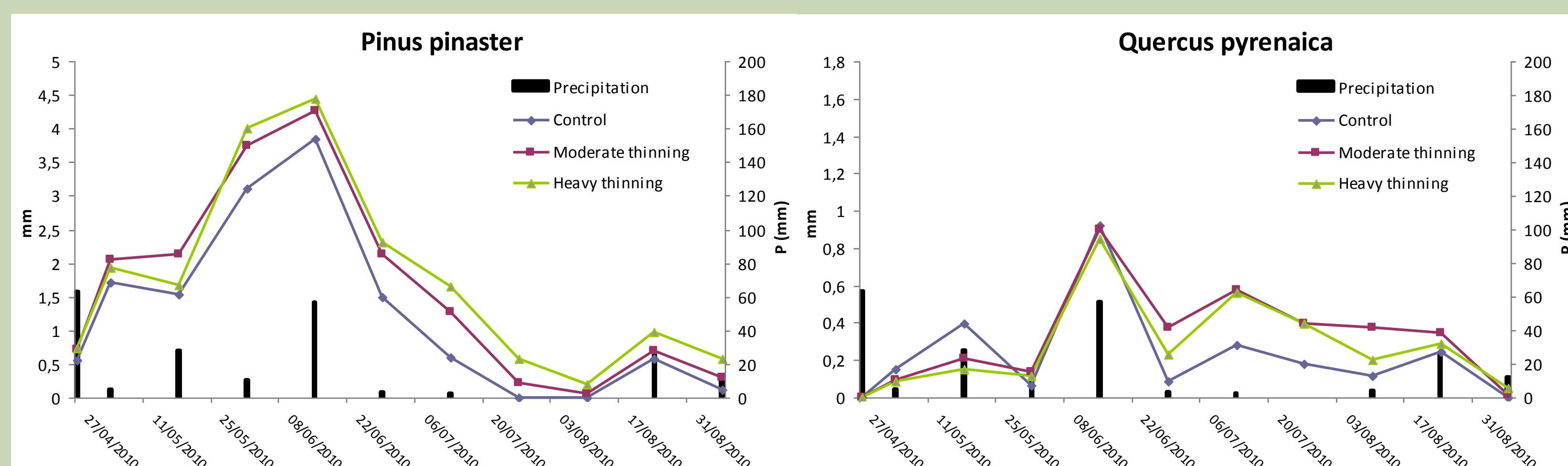
- Oak growth pattern showed a higher dependence of rainfall pattern than in pines, with higher correlations between growth and precipitation



Mean girth growth per treatment for pine trees



Girth growth-initial diameter per treatment



Precipitation and growth patterns during the first growing season after the thinning

MATERIAL & METHODS

Site: San Pablo de los Montes (Toledo)

Mediterranean climate, poor acid soil, NW aspect, 30% slope

Stand: a planted Mediterranean *Pinus pinaster* overstory with a coppice *Quercus pyrenaica* lower stratum

Plots: 9 plots of 0.07 ha

Design : Latin square design with 3 treatments in pine stratum*:

CONTROL: No thinning

MODERATE THINNING: 25 % of pine basal area removed

HEAVY THINNING: 40% of pine basal area removed

*winter 2009-2010

Measurements:

- Diameter and position of all trees and height and crown dimension of a sample
- girth growth every 2 weeks on 10 trees** per species and plot (with band dendrometers)
- climatic conditions** (with a weather station)

Analysis:

- variance analysis: girth growth= f(column, row, treatment)
- covariance analysis: effect of initial diameter
- growth pattern and climate: correlation

Main stand variables per treatment before and after thinning

Oak	N (trees/ha)	Dg (mm)	G (m ² /ha)	Ho (m)
Control	2013	70	7.6	6.9
Moderate thinning	1725	64	5.5	7.1
Heavy thinning	1632	64	5.5	6.0
Pine	<i>Before thinning</i>			
Control	591	264	32.2	11.7
Moderate thinning	575	262	30.5	11.2
Heavy thinning	610	268	34.4	11.3
Pine	<i>After thinning</i>			
Control	591	264	32.3	11.7
Moderate thinning	394	279	23.8	11.2
Heavy thinning	303	291	20.1	11.3

DISCUSSION

- The thinning effect on pine secondary growth is already patent in the first year after thinning, but not yet in the deciduous oaks with bud burst in late spring.
- However, during the summer oak's growth is improved by pine thinning (particularly in the drought period), probably because of the higher soil water availability in thinned stands
- Diameter growth depends on tree size and there is a high individual variability, so a deeper analysis considering tree size and competition status at individual tree level is required
- The higher correlation of *Quercus pyrenaica* growth with the precipitation can be explained by the more superficial root system and the water requirements of the species, being this mixed stand located in the south limit of the distribution area of the species
- **Thinning can be a useful measure for climate change adaptation in Mediterranean environments**, allowing to control climate-tree growth relationships