

World Sustainability Conference  
Life and Development in the 21 st Century: Developing Feasible Road Maps for  
Sustainable Communities

November 12, 2022

# Effects of *Pinus halepensis* reforestation on plant biomass and native species in the forest of Beni Sohane (Zloul valley – Morocco)



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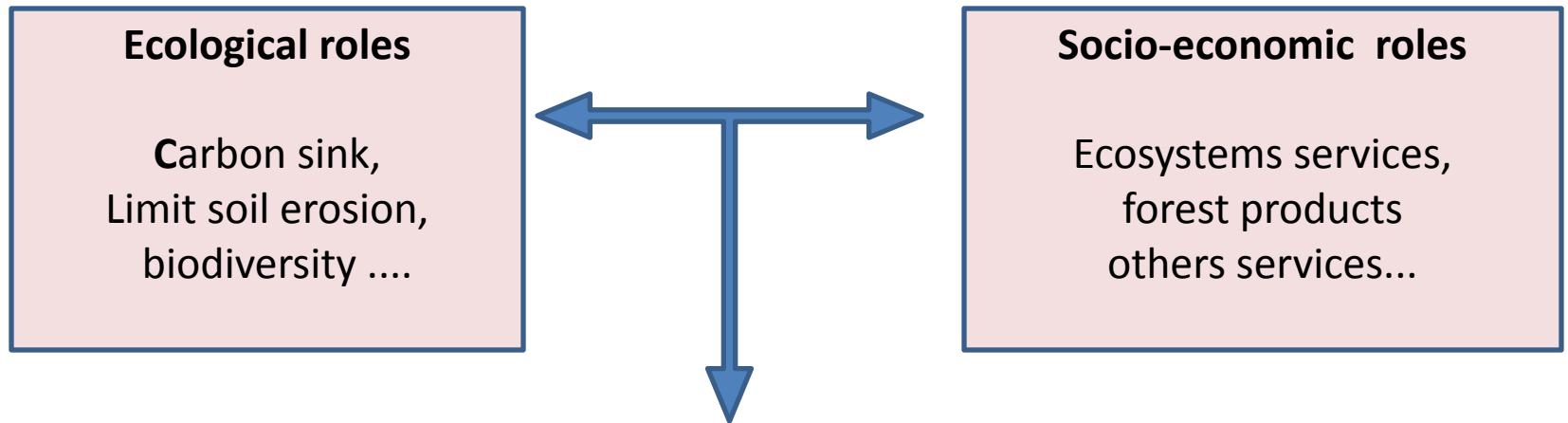
# Presentation outline

- ❖ Introduction
- ❖ Materials and methods
- ❖ Results
- ❖ Discussion
- ❖ Conclusion

# Introduction

## Deforestation

80 000 km<sup>2</sup> of forest are destroyed each year (FAO)



1 billion trees planted each year

**However,** Positive impact remains tributary of plant cover and tree species reforested !

## Introduction

Mediterranean: Large areas reforested by *Pinus halepensis* (20th century)

Morocco: Main reforested resinous species (plasticity, yield and economic importance)



Photo 1: reforestation of degraded areas

Degradation of several areas of the Beni Sohane forest



Reforestation  
(*Pinus halepensis*)

What is the impact of reforestation *Pinus halepensis* and their age on plant biomass and native species in the forest ?



Photo 2 : First wave reforestation  
(around 45 years old )



Photo 3 : Second wave of reforestation  
(around 25 years old )



Photo 4 : Thirth wave of  
reforestation (around 12 years  
old )

# Introduction

## Objectifs

Impact of *Pinus halepensis* reforestation

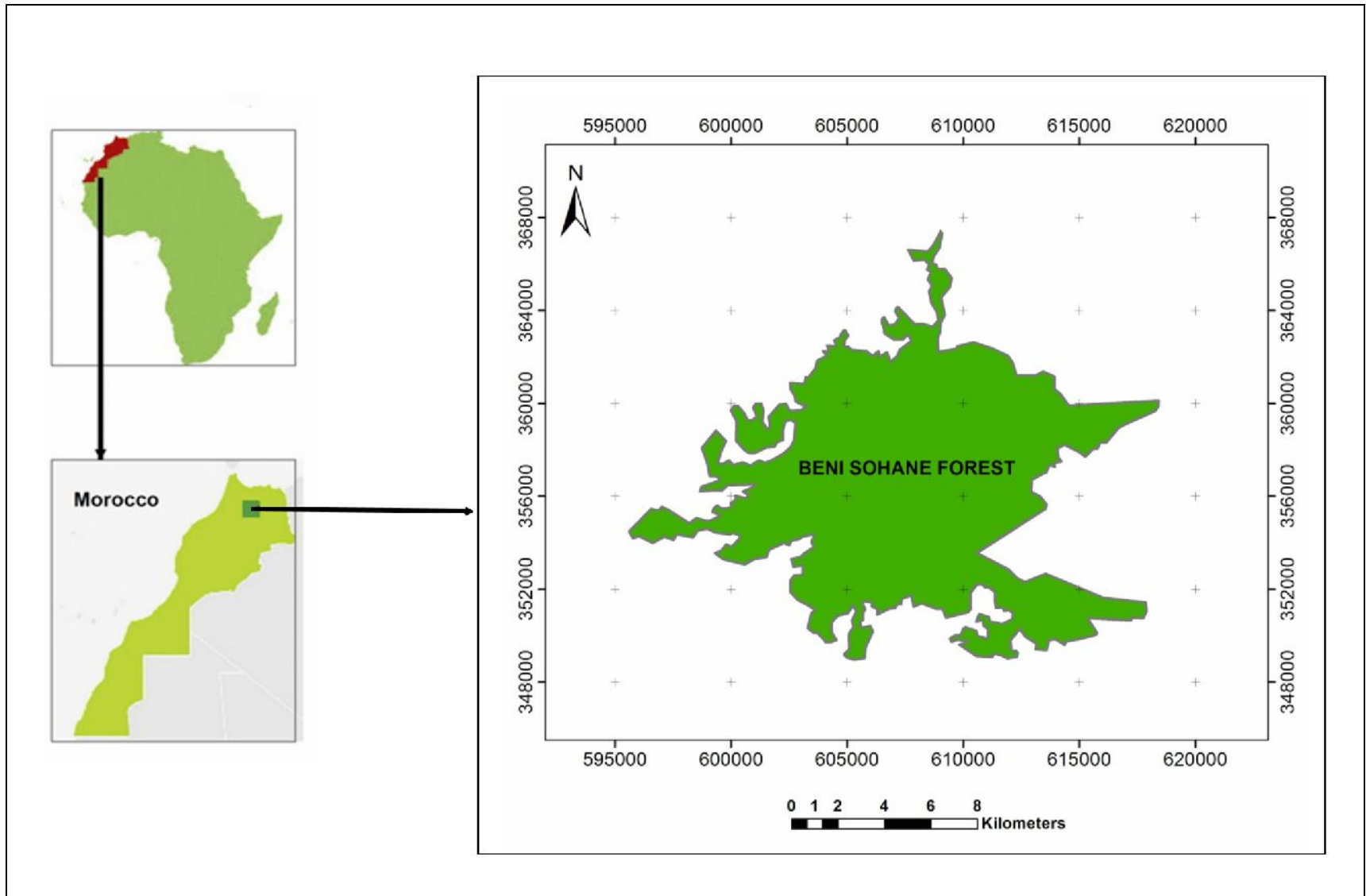
internode length

leaves dimensions  
(length and width)

Above-ground biomass  
(herbaceous strata)

- *Cistus creticus* L.
- *Pistacia lentiscus* L.
- *Phyllyrea augustifolia* L.
- *Quercus ilex* L.

# MATERIELS & METHODS



**Figure 1** : Study area localisation

## Plant biomass

- The observations were carried out on the plant biomass of the herbaceous layer in reforested plots of  $\pm 12$ ,  $\pm 25$ , and  $\pm 45$  -year-old, and native forest controls.
- repeated 10 times.
- dry matter has been Determined after drying to constant weight in an oven at  $60\text{ }^{\circ}\text{C}$ .
- Above-ground plant material on the ground has been cut using a semi-destructive method on randomly selected 2-square-meter plots.
- The harvest of plant biomass has been carried out during May, which corresponds to the full development of the herbaceous layer.



### Internode length and leaves dimensions

- The internodes and the leaves' dimensions (length and width) were measured at the height of between 1 and 2 meters with 40 repetitions.
- The internode length and leaves dimensions (length and width) were measured on plants randomly selected belonging to four native species: ***Quercus ilex L., Pistacia lentiscus L., Phyllyrea augustifolia L., and Cistus creticus L.***

### Statistic treatment

- Mean comparison was performed by :
  - Student test when normality and homoscedasticity were satisfied.
  - Non parametric Man Withney test when normality and homoscedasticity conditions were not non-satisfied.
- Statistical treatments were carried out using SPSS Statistics 22 software.

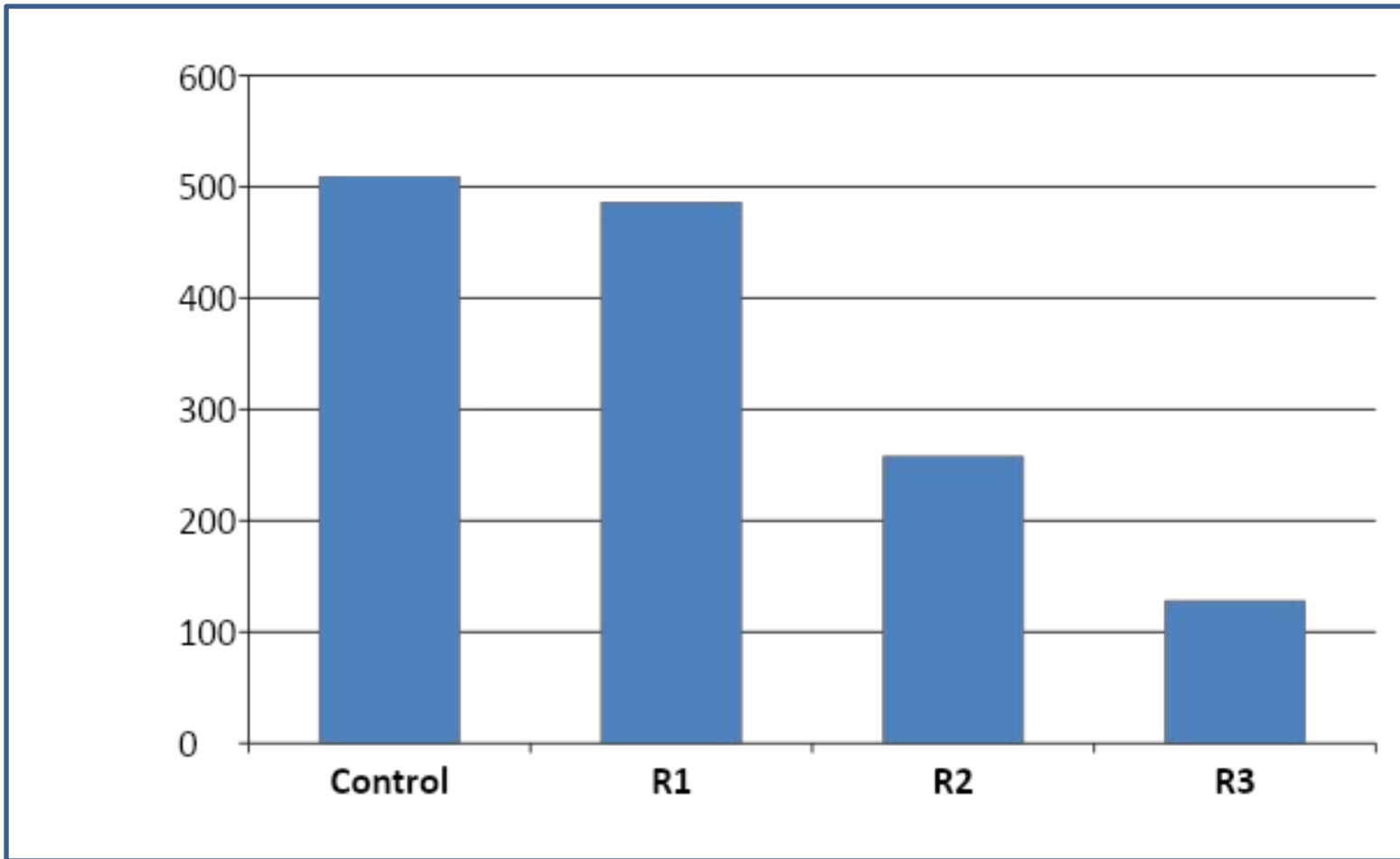


Figure 2 : Effect of Pinus haepensis reforestration on above-ground biomass

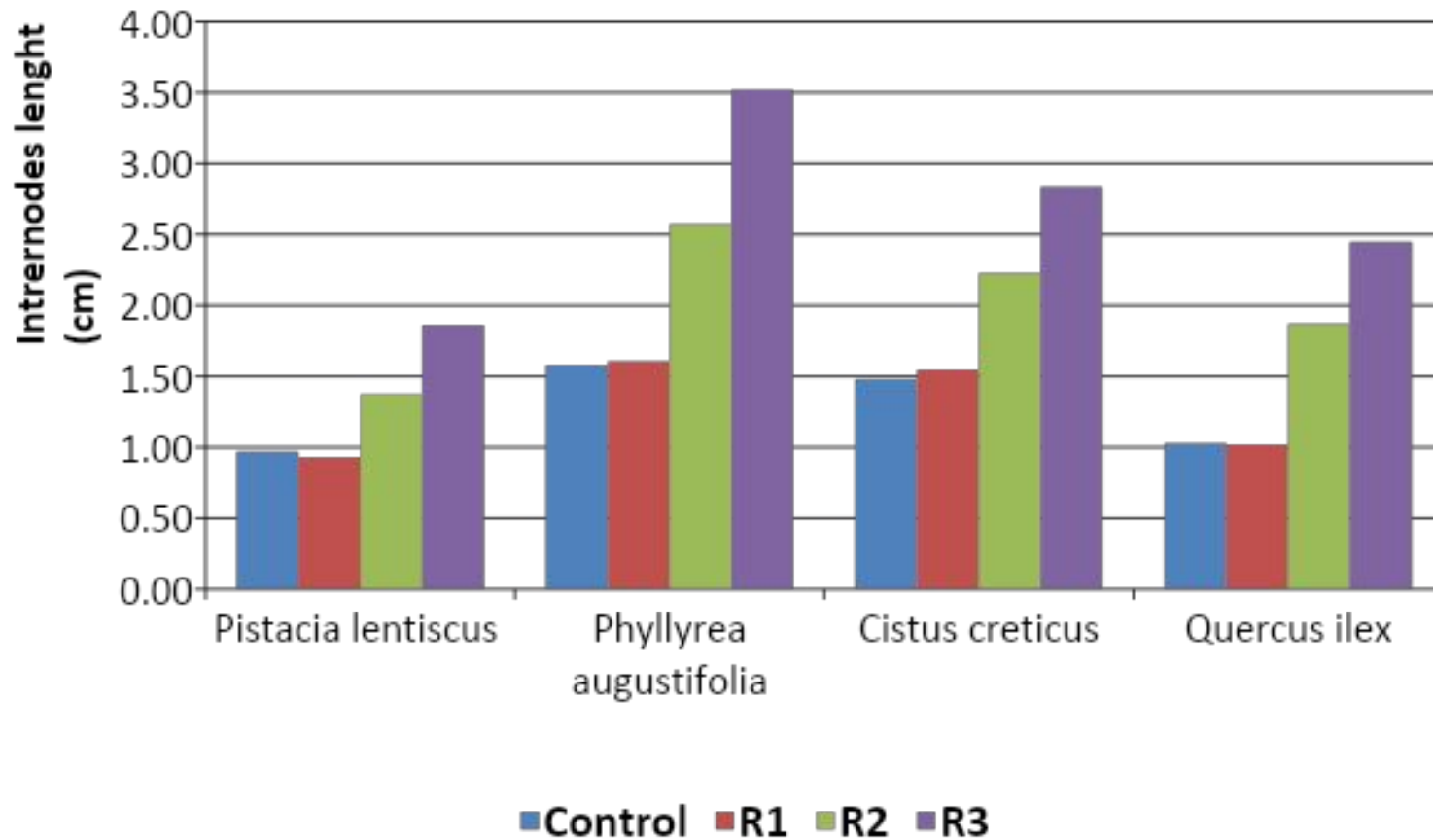


Figure 2 : Effect of Pinus haepensis reforestration on internodes length

# MAIN RESULTS

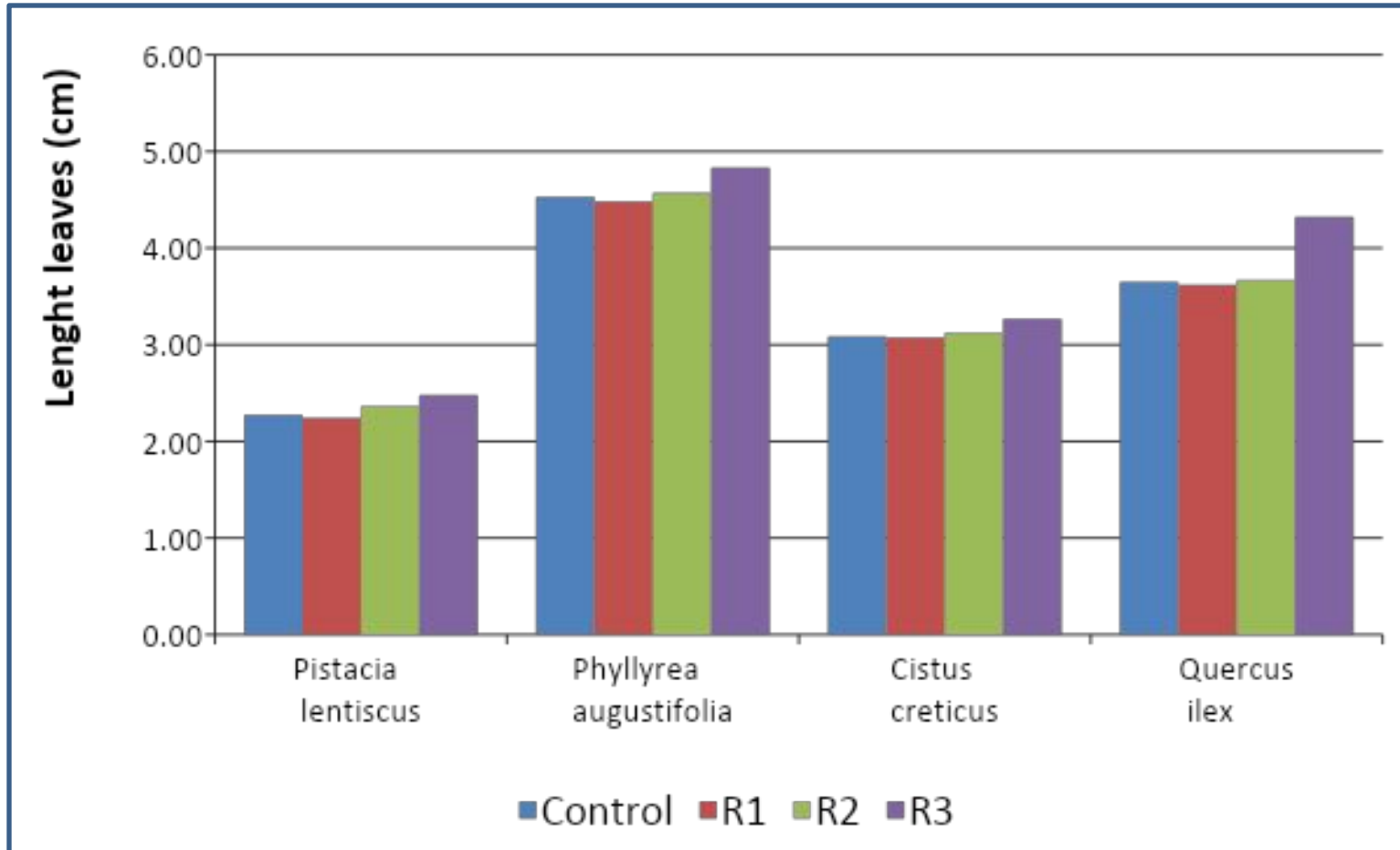


Figure «3 : Effect of Pinus haepensis reforestration on lenght leaves

# MAIN RESULTS

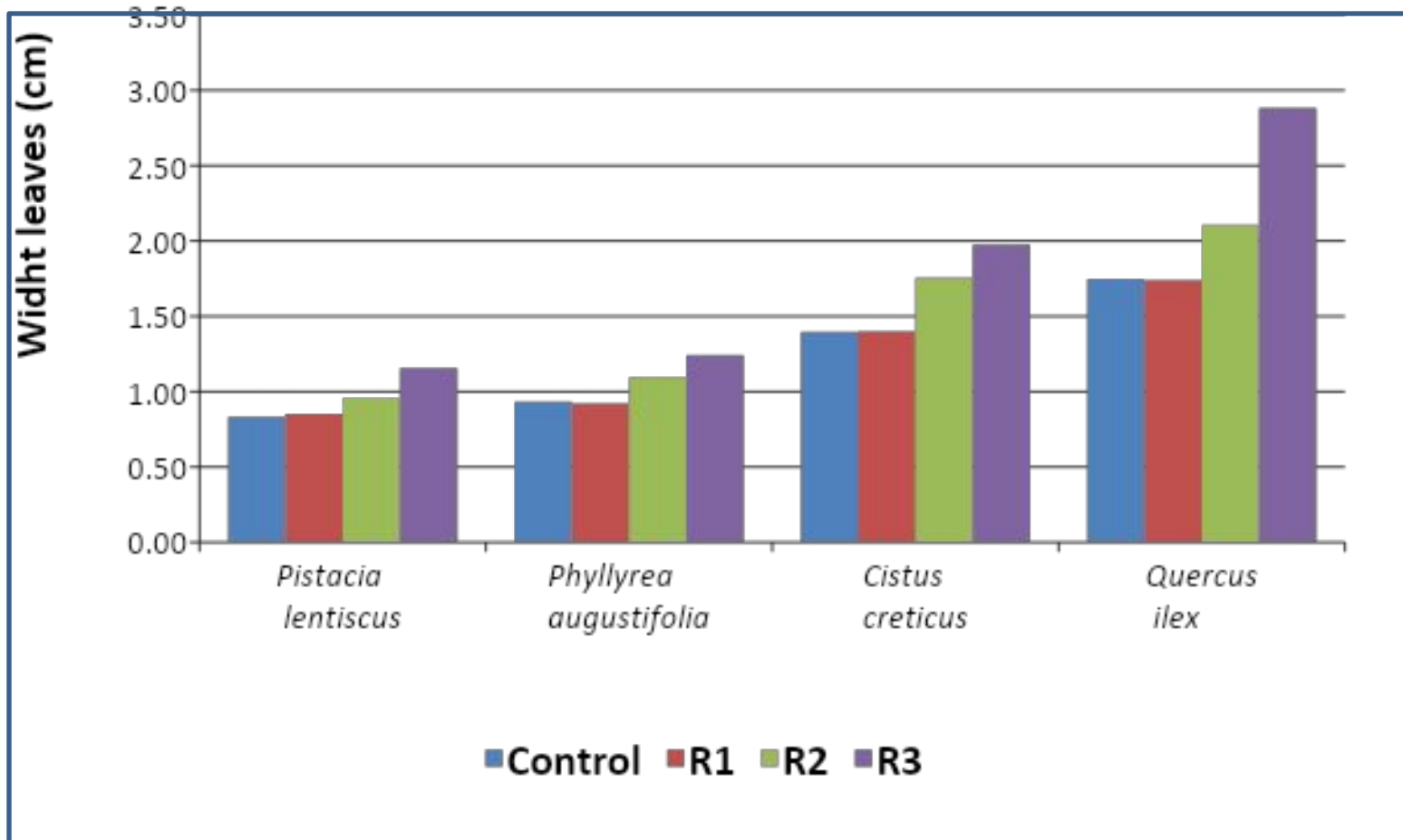


Figure 4 : Effect of Pinus haepensis reforestration on width leaves

# MAIN RESULTS

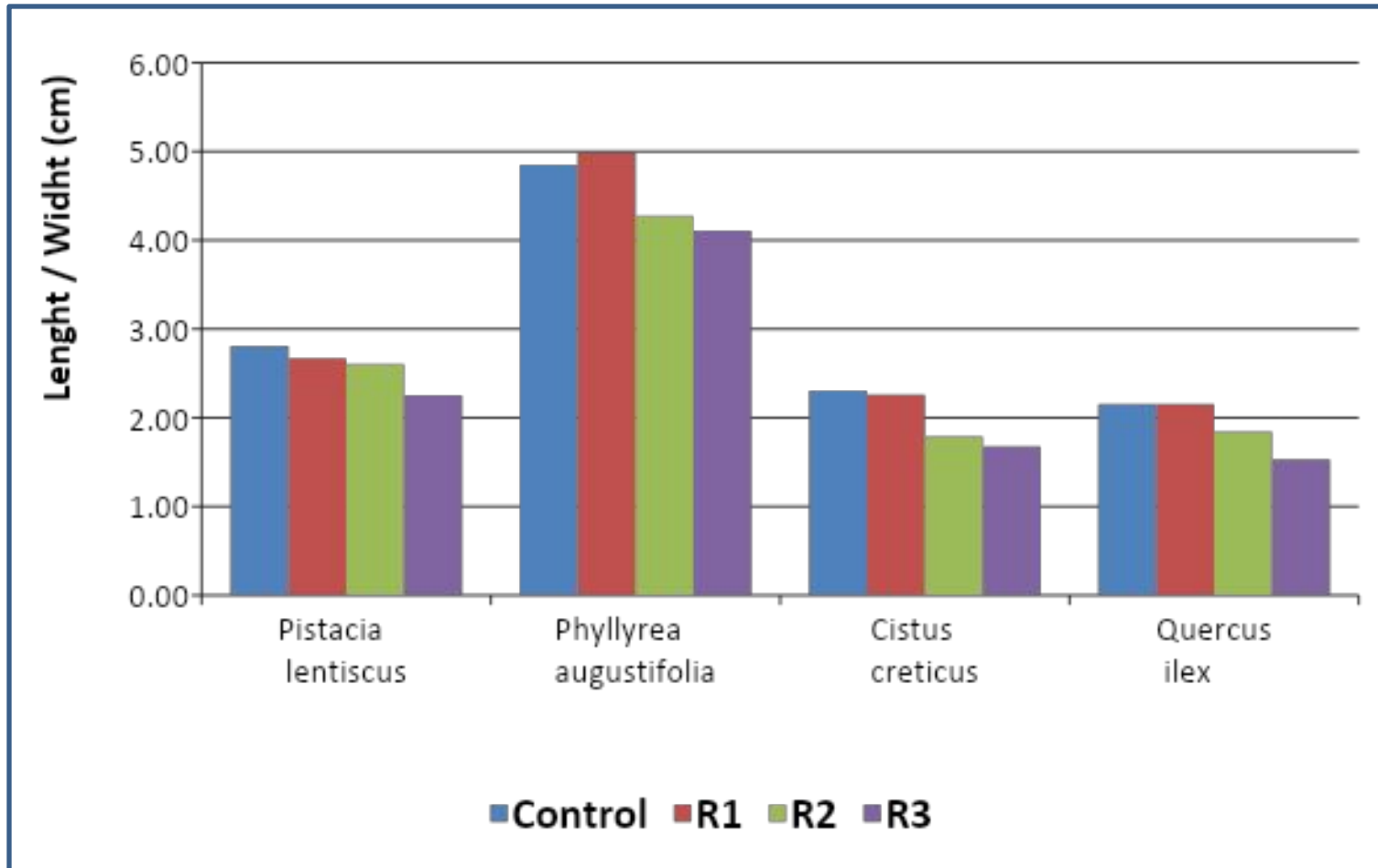


Figure 5 : Effect of *Pinus haepensis* reforestration on lenght width leaves

## Results

**Table 1** : Mann Whitney U non-parametric test of dry weight at 5% significance R3

Designations	U Mann-Whitney	Signification 5 %
R1	48,000	0.880
R2	28,000	0,960
R3	11,000	0,003

**Table 2** : Test student or Mann Whitney U non-parametric at 5% significance

Designations		Internode length	Leaves length	Leaves width	Ratio length/width
Cistus creticus	<b>R1</b>	<b>0,169</b>	<b>0,202</b>	<b>0,083</b>	<b>0,130</b>
	R2	0,000	0,000	0,000	0,000
	R3	0,000	0,000	0,000	0,000
Phyllyrea augustifolia	R1	0,089	0,910	0,180	0,300
	R2	0,000	0,000	0,001	<b>0,366</b>
	R3	0,000	0,000	0,000	0,000
Pistacia lentiscus	<b>R1</b>	<b>0,089</b>	<b>0,102</b>	<b>0,353</b>	<b>0,231</b>
	R2	0,000	0,005	<b>0,209</b>	<b>0,560</b>
	R3	0,000	0,000	0,000	0,000
Quercus ilex	<b>R1</b>	<b>0,102</b>	<b>0,072</b>	<b>0,088</b>	<b>0,120</b>
	R2	0,000	0,000	0,000	0,000
	R3	0,000	0,000	0,000	0,000





Photo 5 : Elongation of internodes  
of *Phyllyrea augustifolia*



Photo 6 : Impact of *Pinus* canopy on  
native species



Photo 7 : Impact of leaves litter  
herbaceous layer



Photo 8 : Elongation of internodes  
of *Cistus certicus*

# Discussion

- changes in the dimensions of internodes and leaves can be explained by the impact of shadow or Competition for light
- Negatif impact on biodiversity *Pinus halepensis* (Salvatore et al., 2012), *Pinus radiata* (Gutierrez Flores et al., 2017)
- *Pinus halepensis*
  - Resistance to water stress
  - Adaptation to different types of soil
  - Rapid growth (Letreuch Belarouci, 1991).
- Regression of the herbaceous layer: Competition for Water and nutrients, Light (Salvatore et al., 2012)
- Allelopathic effect: (terpenes and phenols) (Bonin, et al 2007).
- Leaf litter: physical barrier to germination (Buscardo et al., 2008)

## Conclusion

- it has a negative effect on aboveground biomass, which is exacerbated by the age of planting.
- the raising of *Pinus halepensis* trees which forms a canopy above all indigenous species leads to changes in the dimensions of internodes and leaves, especially for the old plantation
- It seems that thinning of young plantations A1 (would necessary ± 12-year-old ) to regulate their density and mitigate the negative impact of Pinus reforestation
- Gradual conversion of plantations Ages R 2 ± 25 -year-old and R3 ± 45 -year-old would be also beneficial for Beni Sohane ecosystems.
- Any reforestation of mountain habitats requires a detailed understanding of its impact on ecosystem balance. Consequently, it would be more fitting to prioritize native forest species over expansionist exotic species.

**THANK YOU FOR YOUR  
ATTENTION**