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Criteria to select stands for a coppice rotation in Eucalyptus plantation in Brazil

Rodrigo Hakamada – Professor at the University of São Paulo
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Researcher Ccarbon, IPEF

DecisionES 2025
Porto Seguro
Jun 30th to Jul 4th BR
Symposium on Ecosystem Services, Forest Management and Decision Making

DecisionES, Porto Seguro, July 2nd 2025

My First IUFRO meeting:
2008 – Porto Seguro

Pioneirismo de Portugal em Estudos de Irrigação !

E.globulus em Clima Mediterrâneo = Verão Quente e Seco !

Pereira, J. S., and S. Pallardy. 1989. Water stress limitations to tree productivity. Pages 37-56 in J. S. Pereira and J. J. Landsberg, editors. Biomass production by fast-growing trees. Kluwer Academic Publisher, Dordrecht.

Fabiao, A., M. Madeira, E. Steen, T. Katterer, C. Ribeiro, and C. Araujo. 1995. Development of root biomass in an Eucalyptus globulus plantation under different water and nutrient regimes. Plant and Soil 168/169:215-223.

Reed, D., and M. Tome. 1998. Total aboveground biomass and net dry matter accumulation by plant component in young Eucalyptus globulus in response to irrigation. Forest Ecology and Management 103:21-32.

Brazil Eucalyptus Potential Productivity Project (BEPP)

ELSEVIER

Forest Ecology and Management

Volume 259, Issue 9, 15 April 2010, Pages 1681-1683

Editorial

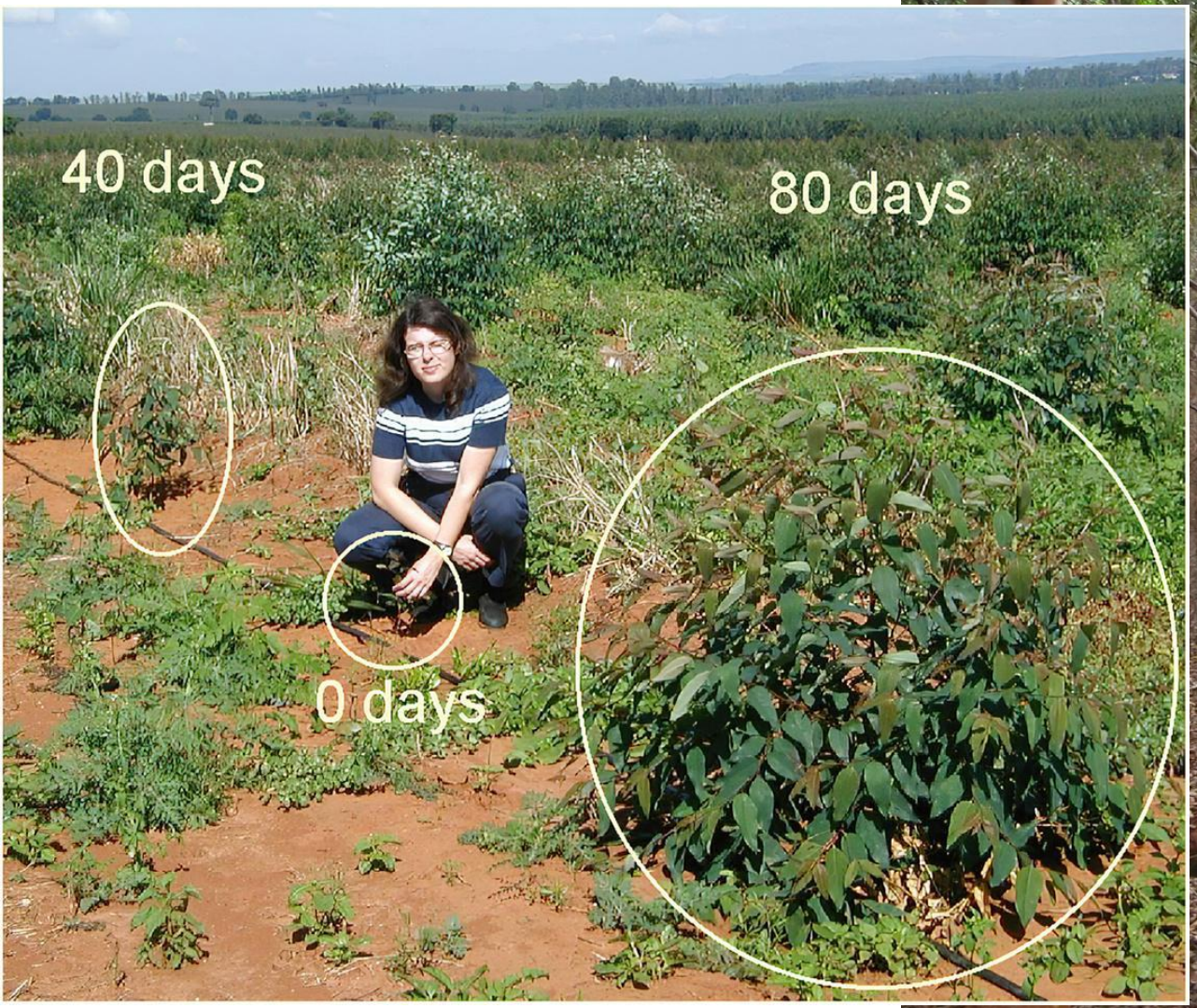
Applying ecological insights to increase productivity in tropical plantations

Dan Binkley [a], Jean-Paul Laclau [b c], José Luiz Stape [d], Michael G. Ryan [e f]

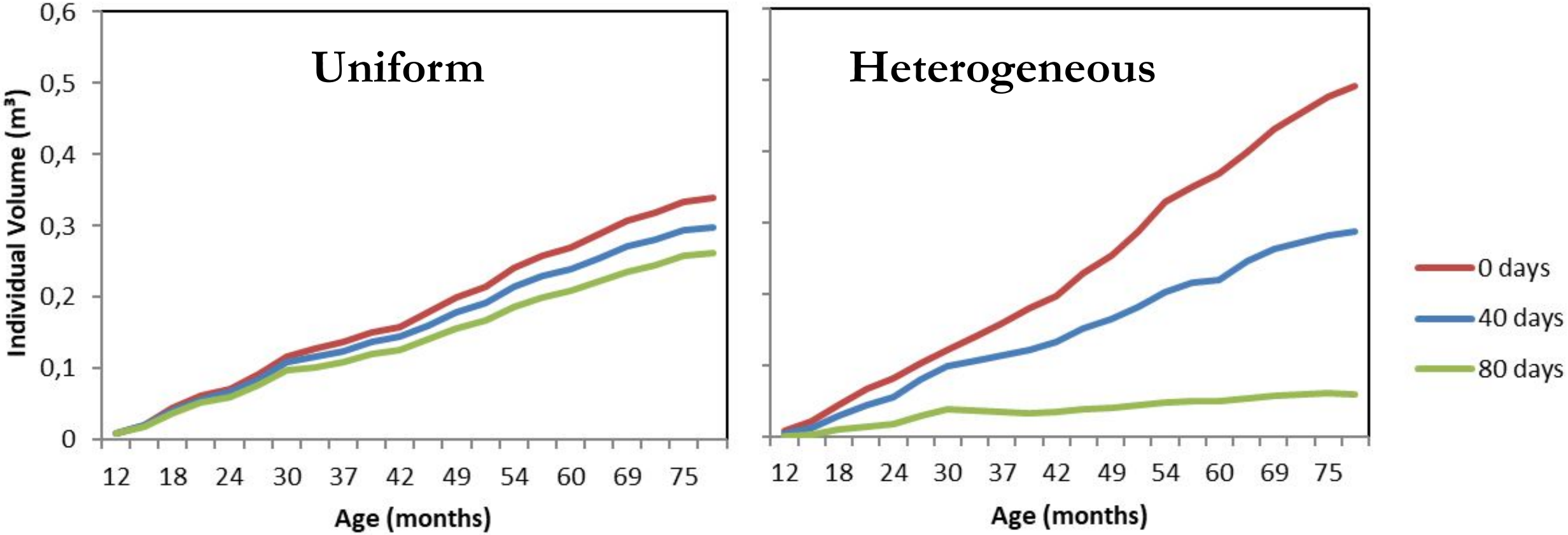
Highest MAI "ever" measured: Irrigated plot, 5 yr plantation!

$110\ m^3\ ha^{-1}\ ano^{-1}$

Effect of uniformity, PV50



Supressed trees do not achieve same growth of dominant trees with time



Each +1% in PV50 will increase 1m³ ha^{-1} yr^{-1}

Cooperative Program

TECHS

Tolerance of Eucalyptus Clones to Hydric, Thermal and Biotic Stresses

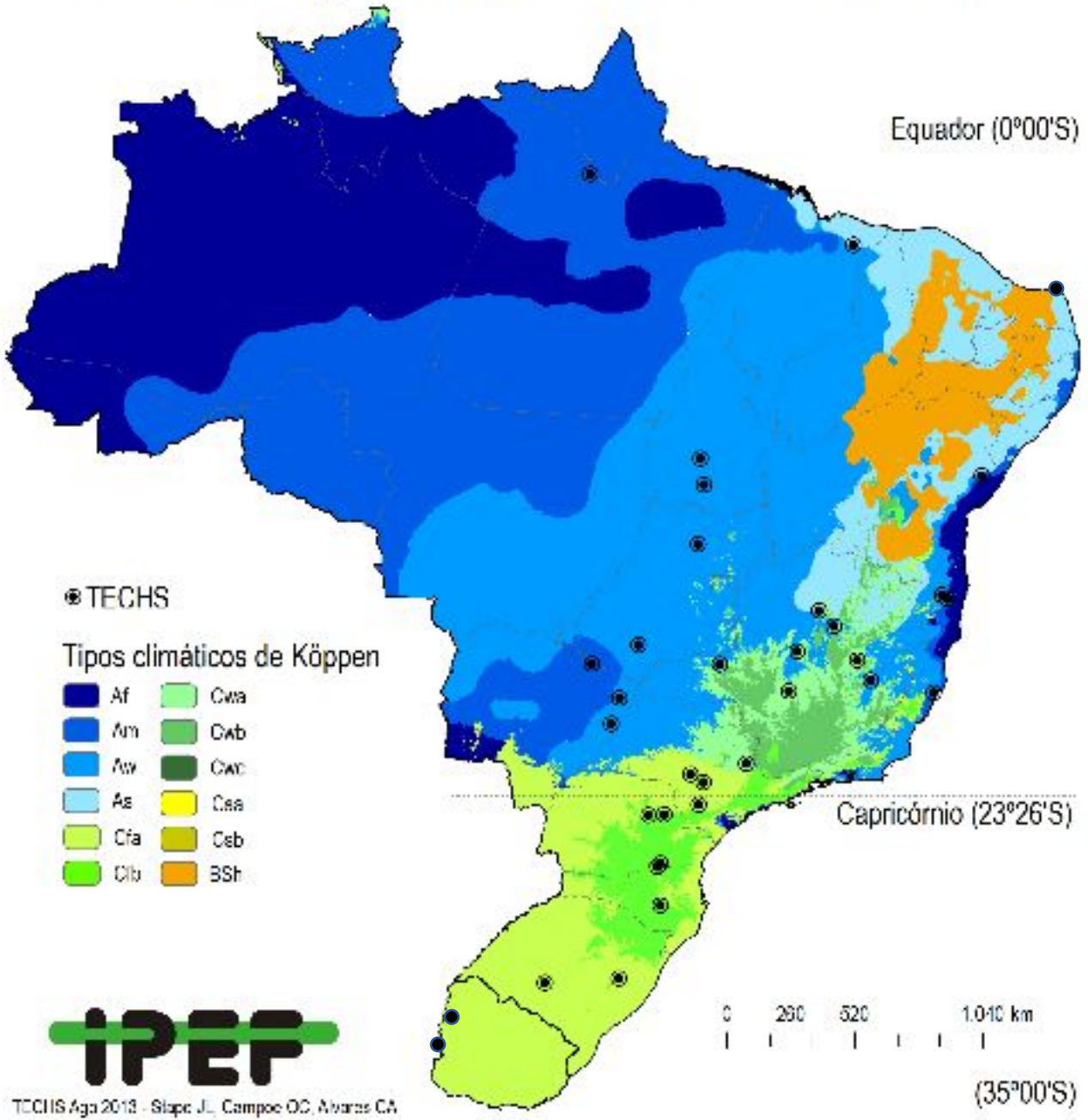
Prof. José Luiz Stape
(ESALQ, NCSU, UNESP)

Prof. Dan Binkley
(CSU)

Prof. Otávio Campoe UFLA

Cooperative Program TECHS

Tolerance of Eucalyptus Clones to Hydric, Thermal and Biotic Stresses



Alvares et al. (2013)

Cooperative Program TECHS

Tolerance of Eucalyptus Clones to Hydric, Thermal and Biotic Stresses

26 companies, 18 clones, with and without rainfall exclusion

Spacing trial

Special edition *FE&M* = ~40 articles

ScienceDirect

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Forest Ecology and Management

Supports open access

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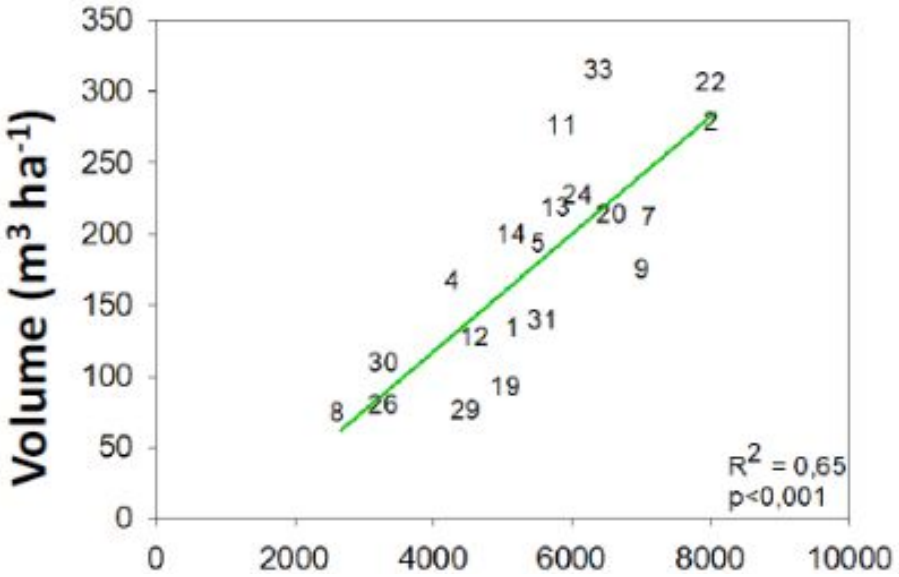
Influences of temperature, drought and genetics on Eucalyptus production: the TECHS Project

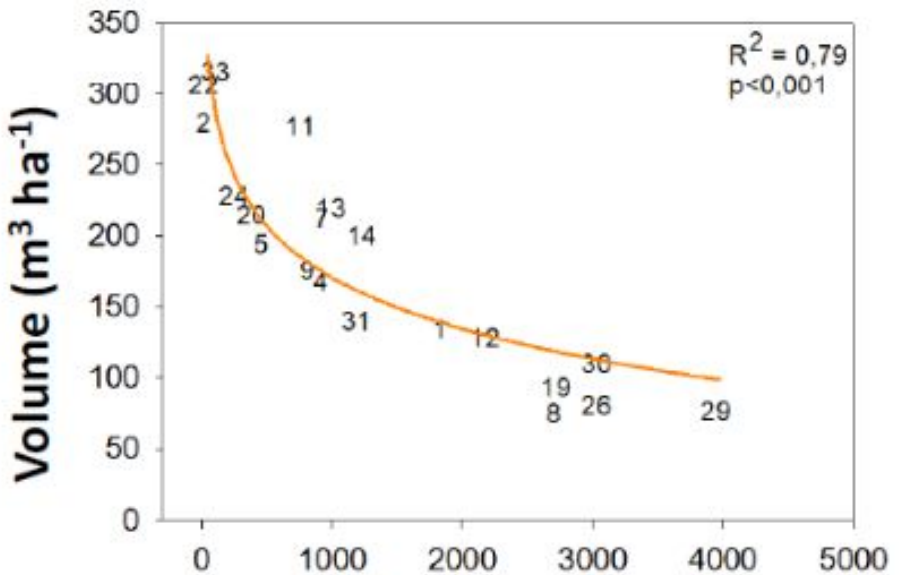
Edited by Otávio C. Campoe

https://www.sciencedirect.com/journal/forest-ecology-and-management/special-issue/105HD8378W8

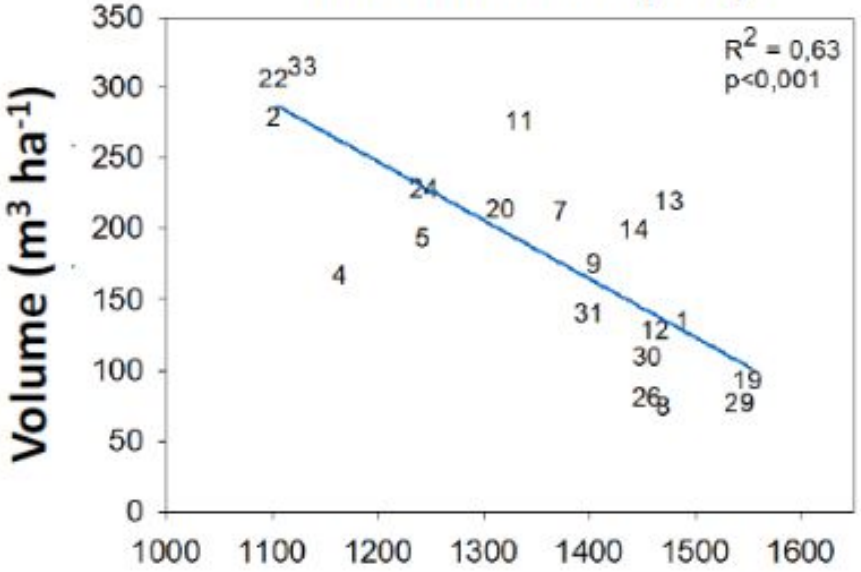
Productivity x Climate



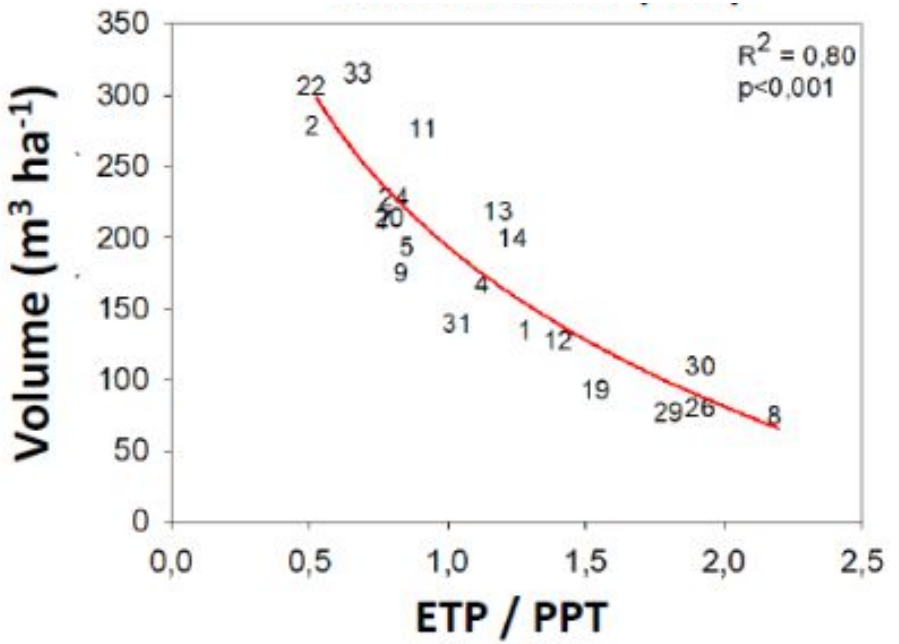
Acumulated PPT 6 years (mm)



Acumulated Water Deficit 6 years (mm)



Acumulated Temp. 6 years (ºC)



Productivity x Climate

- Each 5% of PV50 reduction (silvicultural quality) will reduce MAI in 5 $m^3\ ha^{-1}\ yr^{-1}$
- **Each 125 mm of rainfall will improve MAI in 5 $m^3\ ha^{-1}\ yr^{-1}$**
- Each 80 mm of water deficit will reduce MAI in 5 $m^3\ ha^{-1}\ yr^{-1}$
- **Each 1ºC out of the ideal monthly temperature (18-22ºC) will reduce MAI in 5 $m^3\ ha^{-1}\ yr^{-1}$**

Harvesting of TECHS areas. What´s next?

Cooperative Program of Productivity and Ecophysiology of Coppiced Eucalyptus Clones PCOPPICE (2020 – 2028)

Organizations associated with PCOPPICE

Sprouts potential

Productivity

Functional traits

Uniformity, Dominance

Water balance

Carbon Balance

Root System

Soil atributes

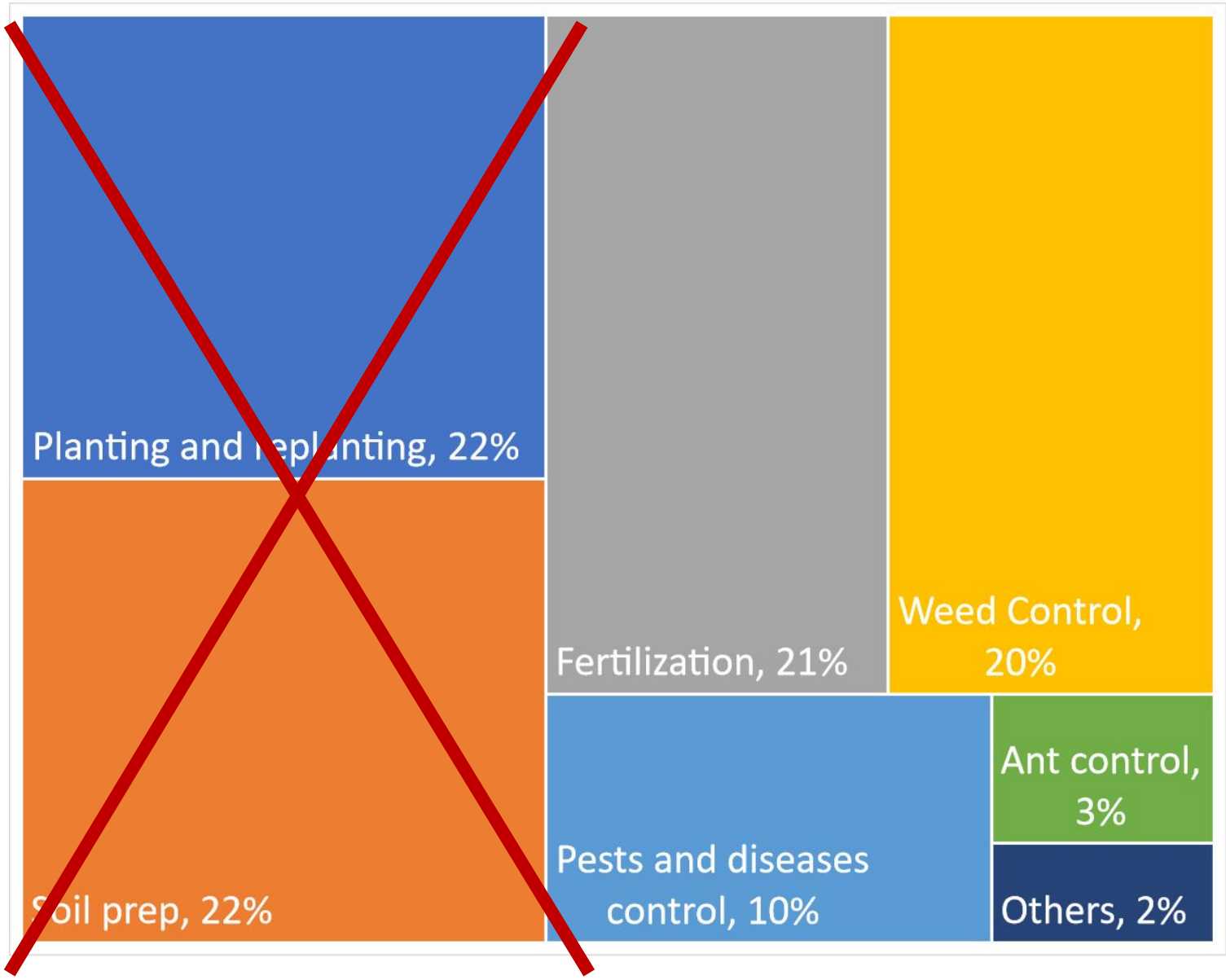
Modelling, Economics

Forest Products (Pulp, Bioenergy, charcoal, etc)


Coppice: high potencial, very few studies
Planted trees
40 m³ ha⁻¹ ano⁻¹
Coppice
45 m³ ha⁻¹ ano⁻¹
Sylvamo –SP state
7 years
Clones IPB01 and IPB02

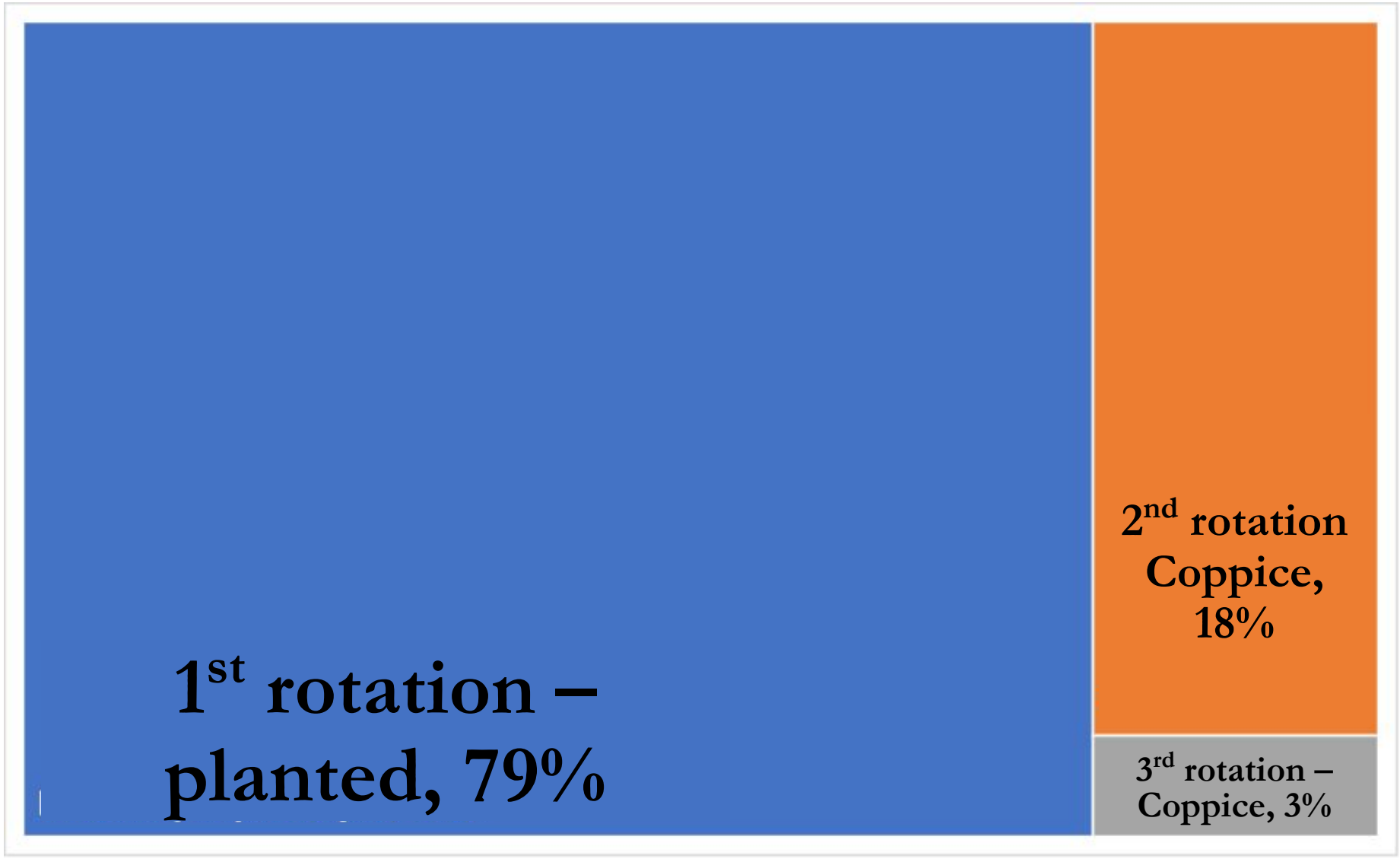
Why to use coppice as a silvicultural system?

Short rotation *Eucalyptus* costs



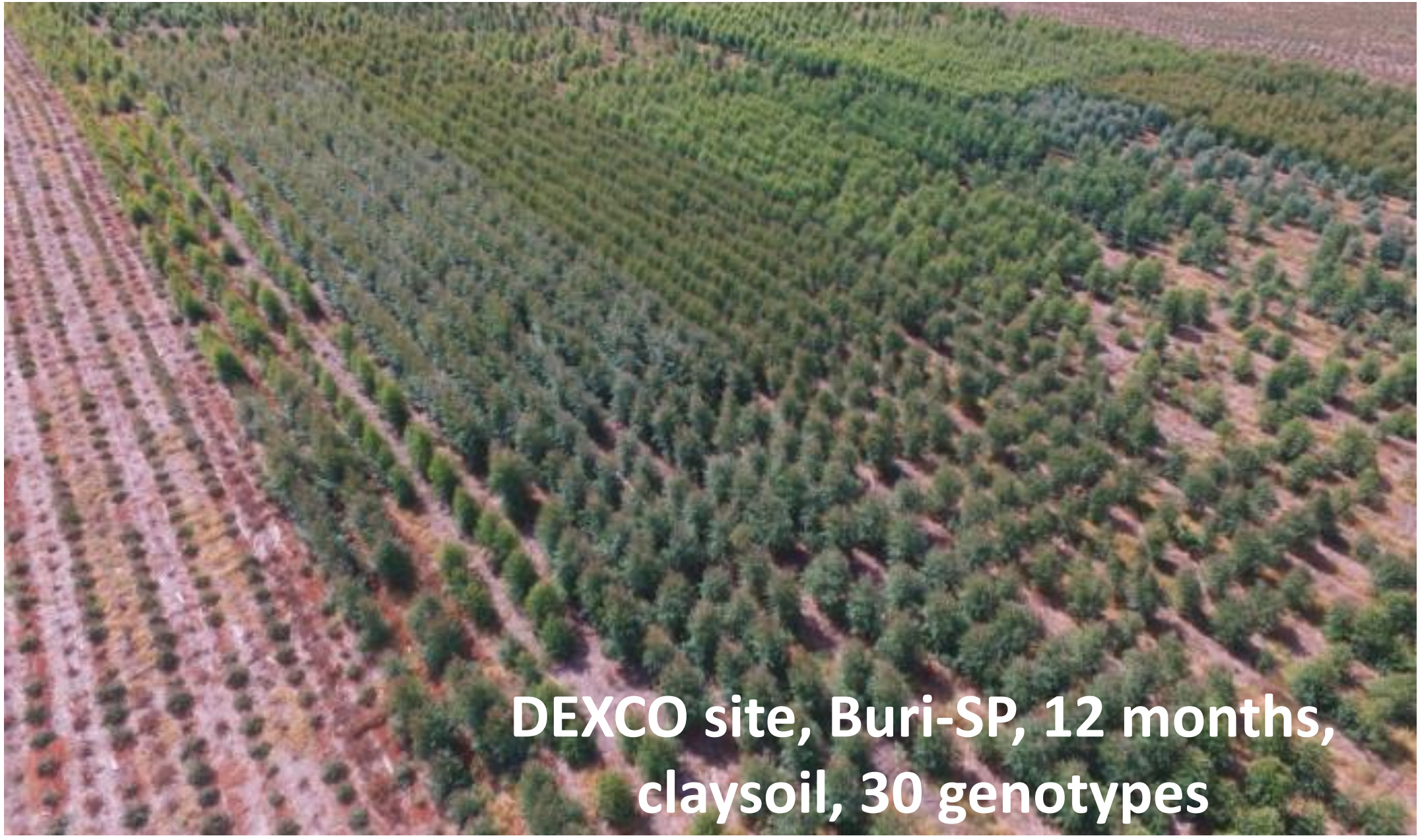
~52% of the costs of high tree system!

Actually coppice represents 21% of the Eucalyptus area but almost nothing is investigated.

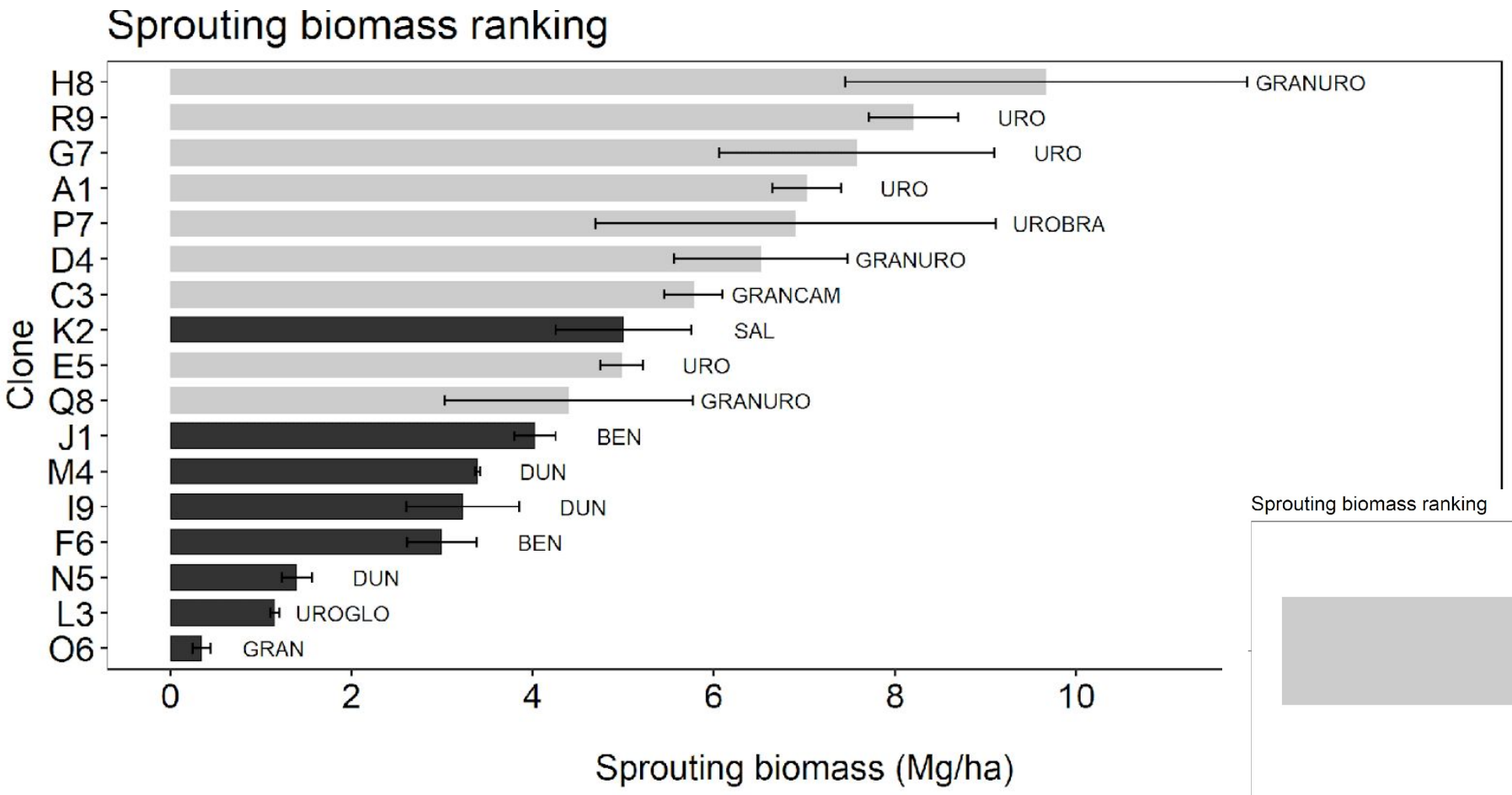


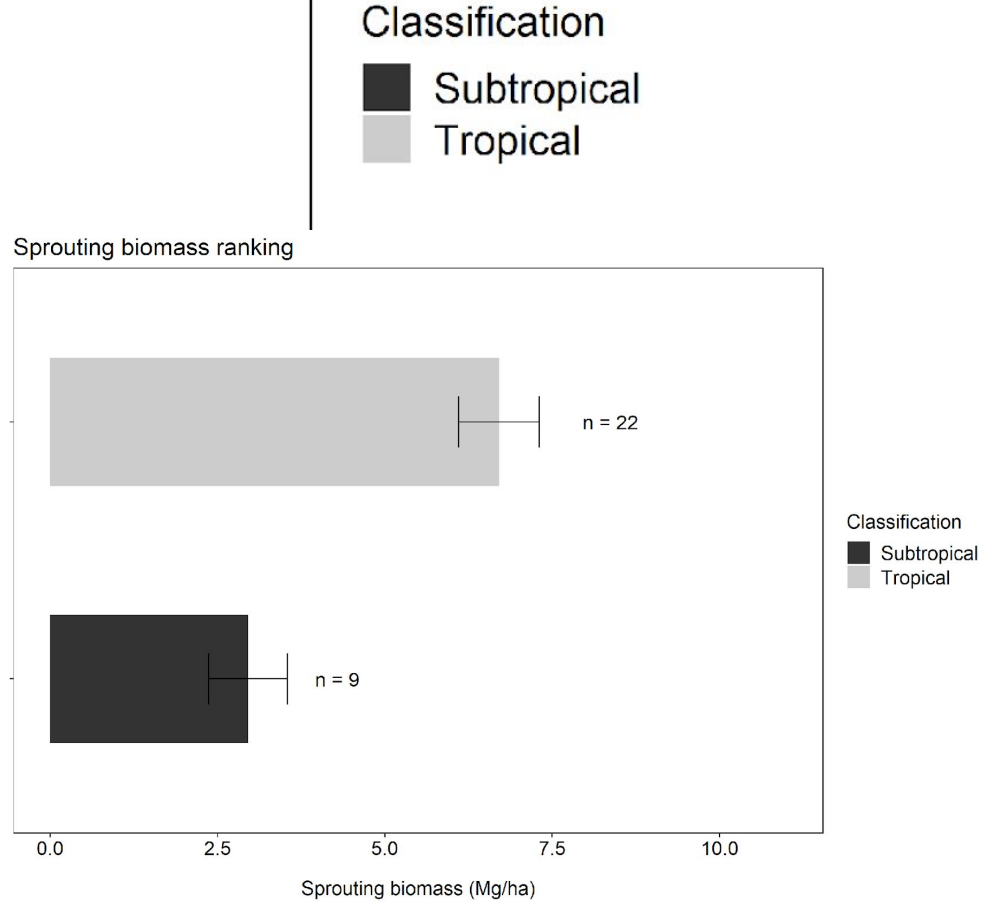
Some results of PCOPPICE, Eucflux and other research site at the Univ. of São Paulo related to decision making

1) How does sprouting capacity varies among distinct genotypes?



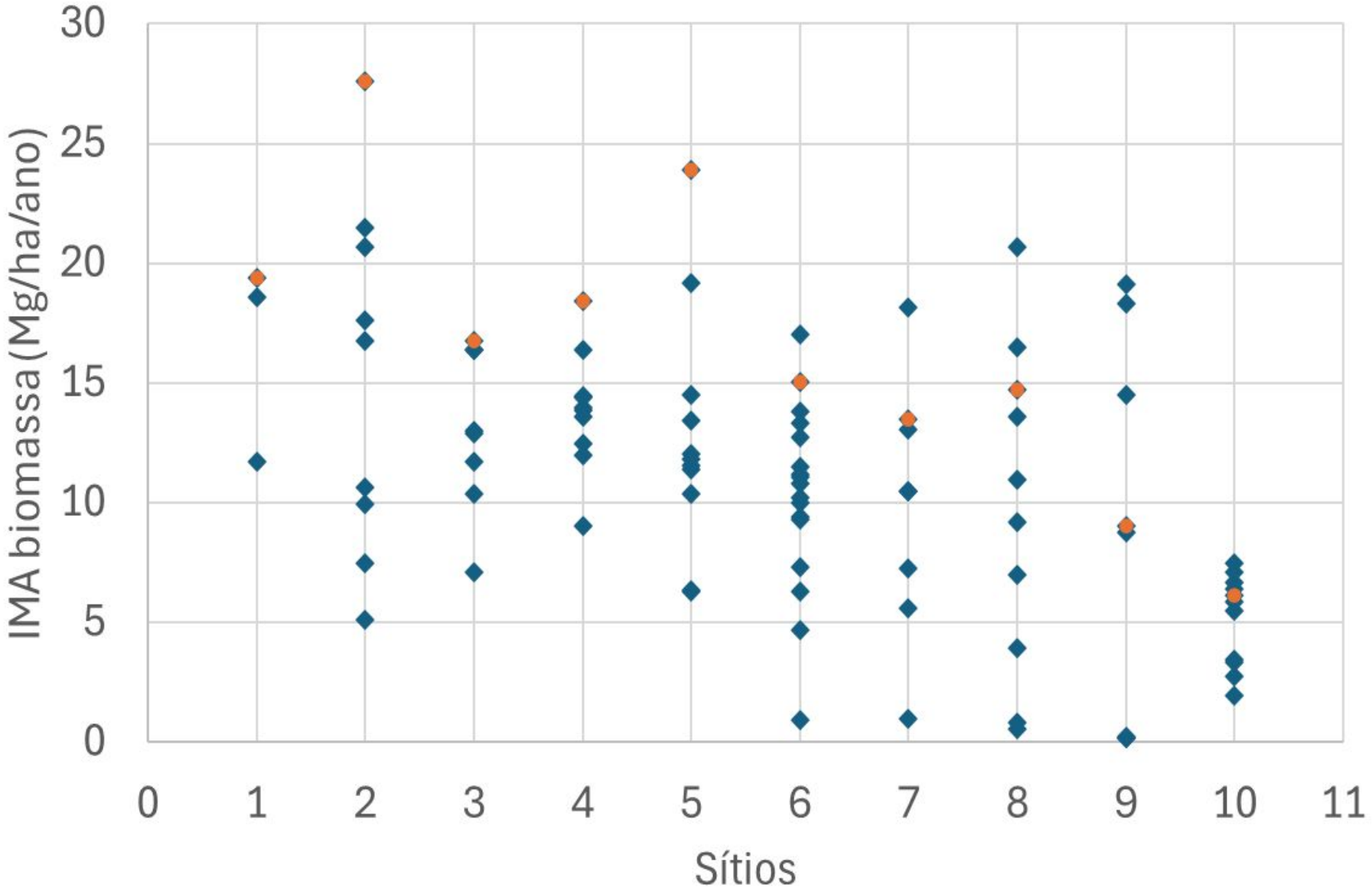
1) How does sprouting capacity varies among distinct genotypes?





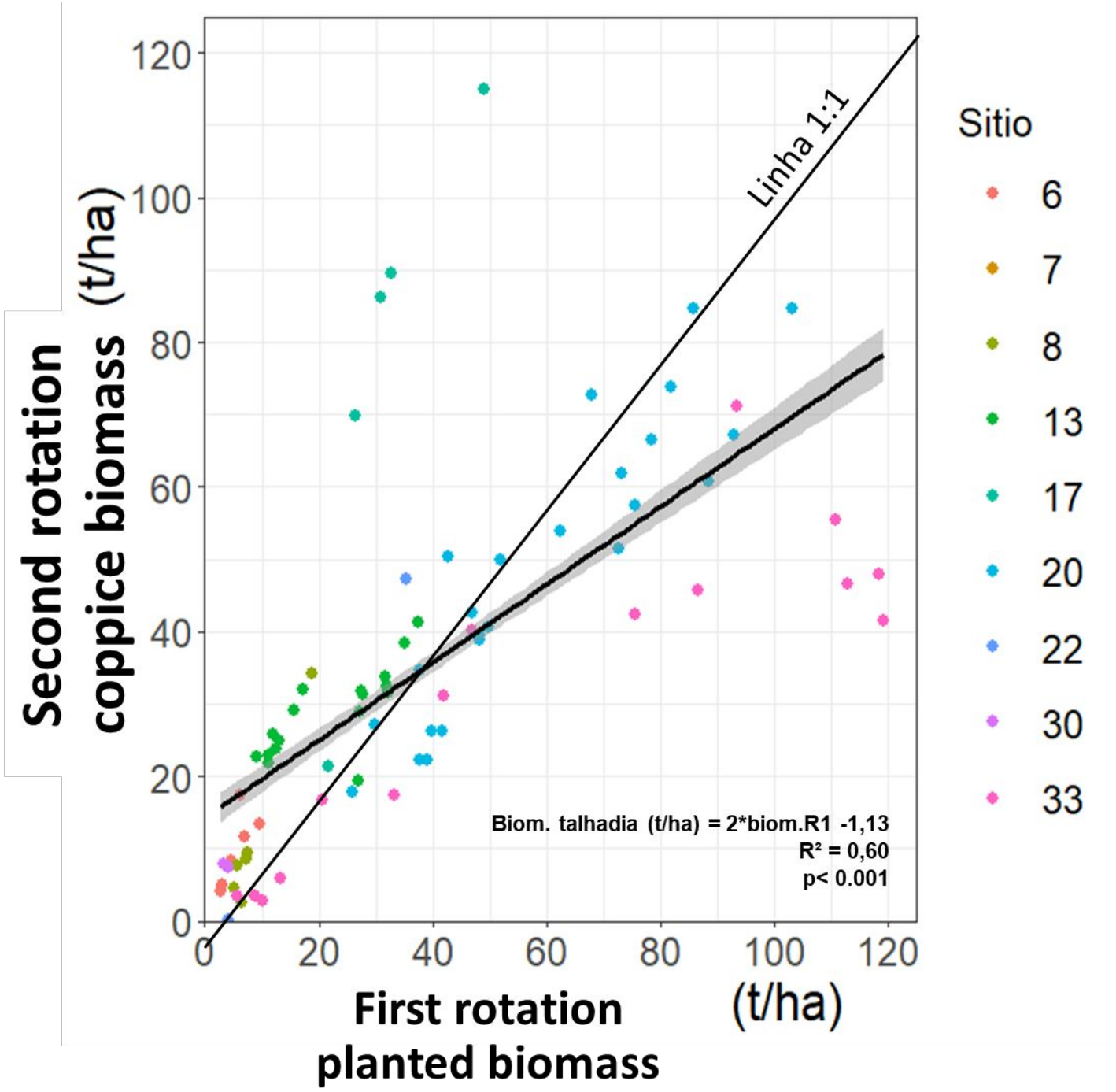
Fernandes *et al*, Plants, 2023

1) How does sprouting capacity varies among distinct genotypes?

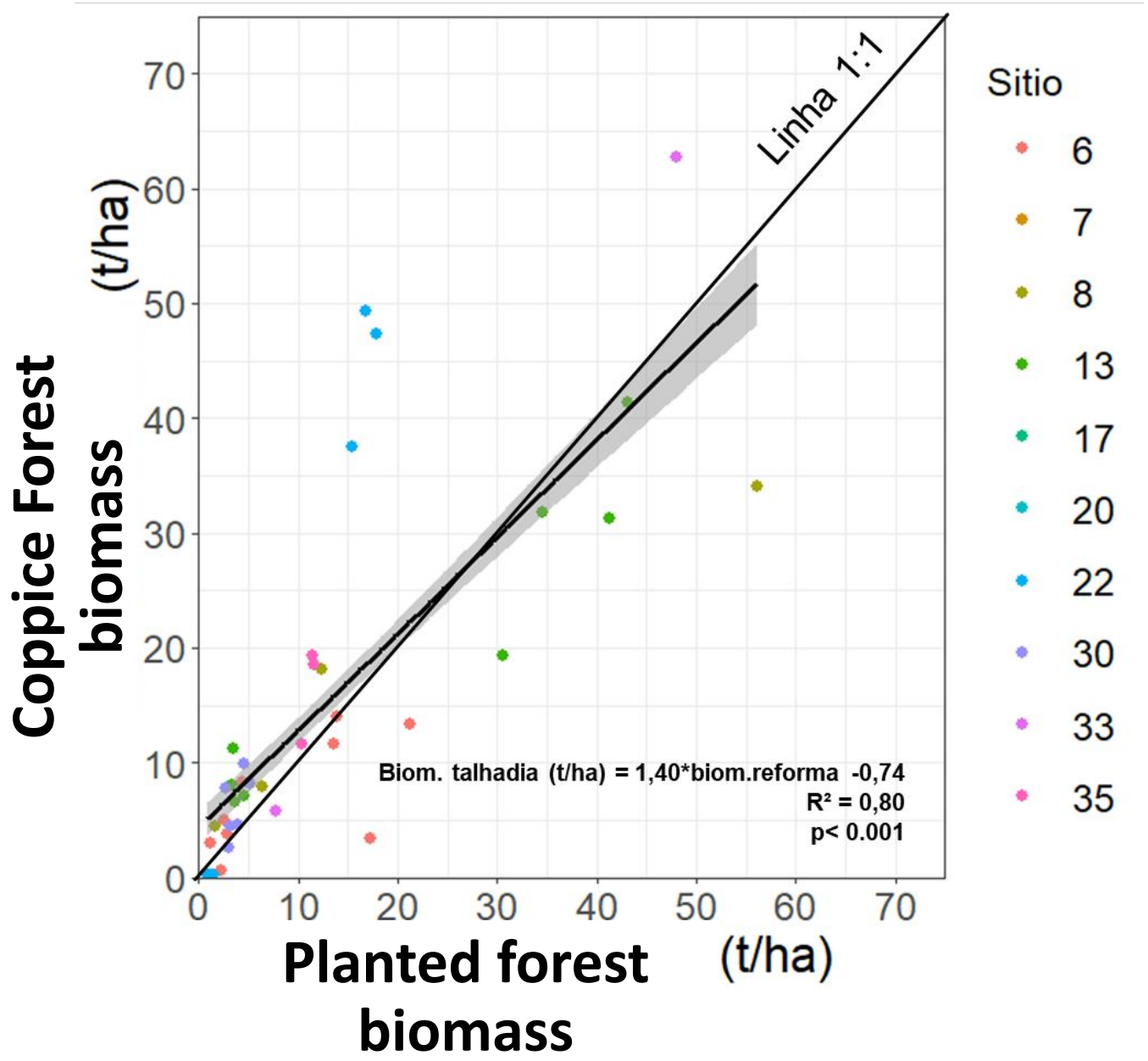


Productivity varied in average by 2,5 fold: a lot of room to improve decisions in term of genotypes recommendation

2) Do stands or clones with higher productivity during the 1st planted rotation will also be the most productive during the 2nd coppice rotation?

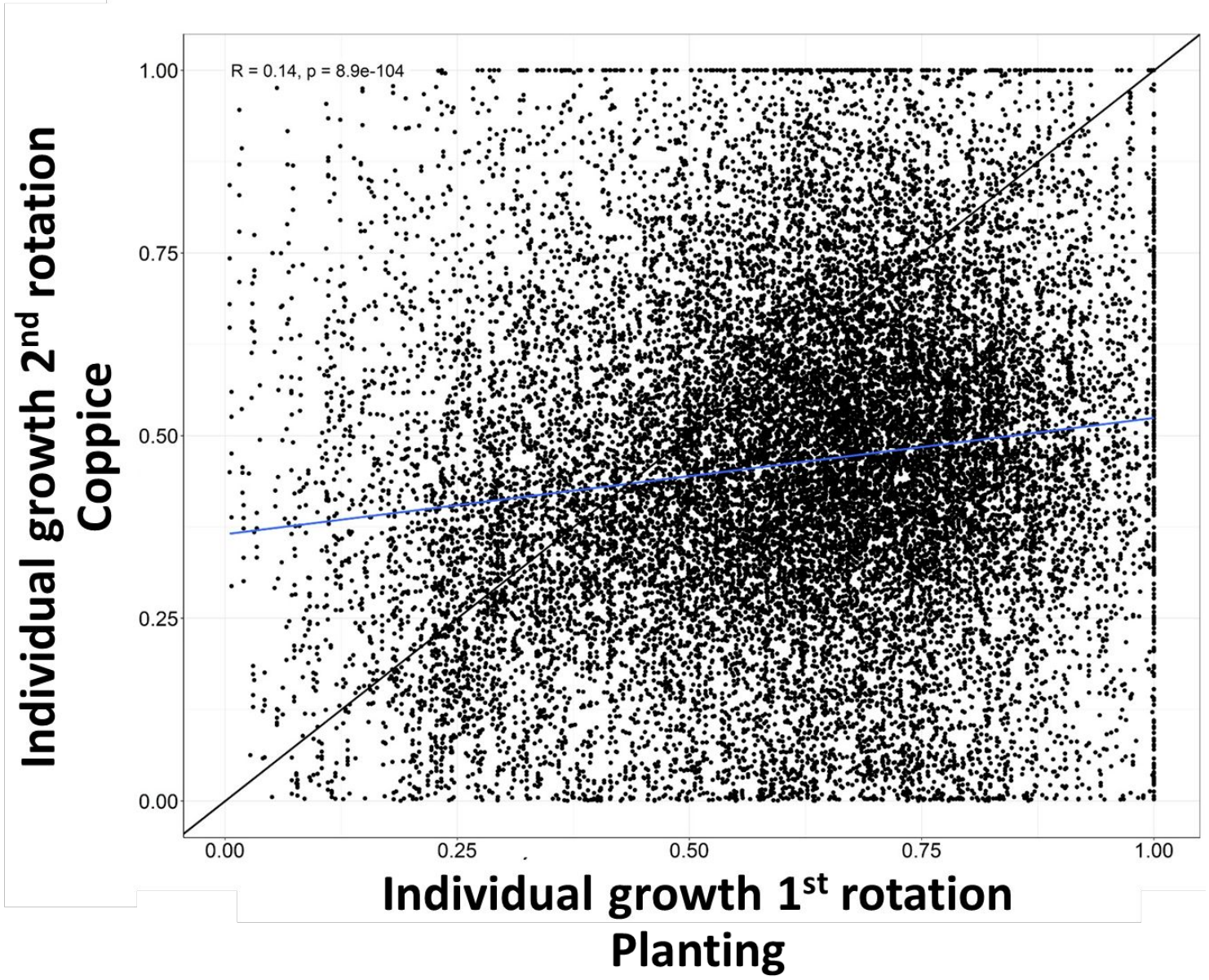


2) SIDE A SIDE, how is the behavior of planted x coppice forest?



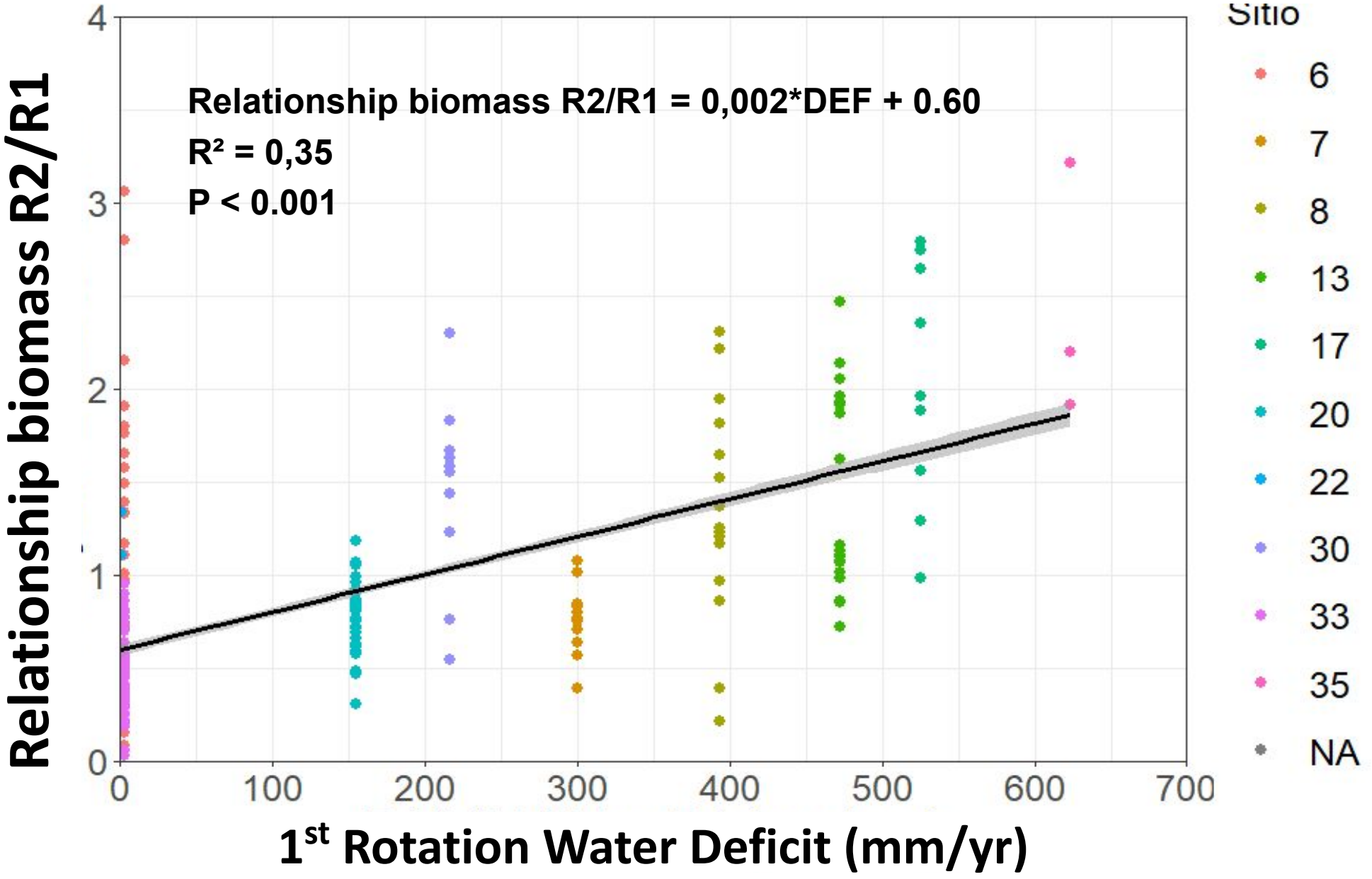
COPPICE + 20% productive (and has 50% of the costs!)

2) Do trees maintain its social position between rotations?



No, individual growth is silvicultural dependent

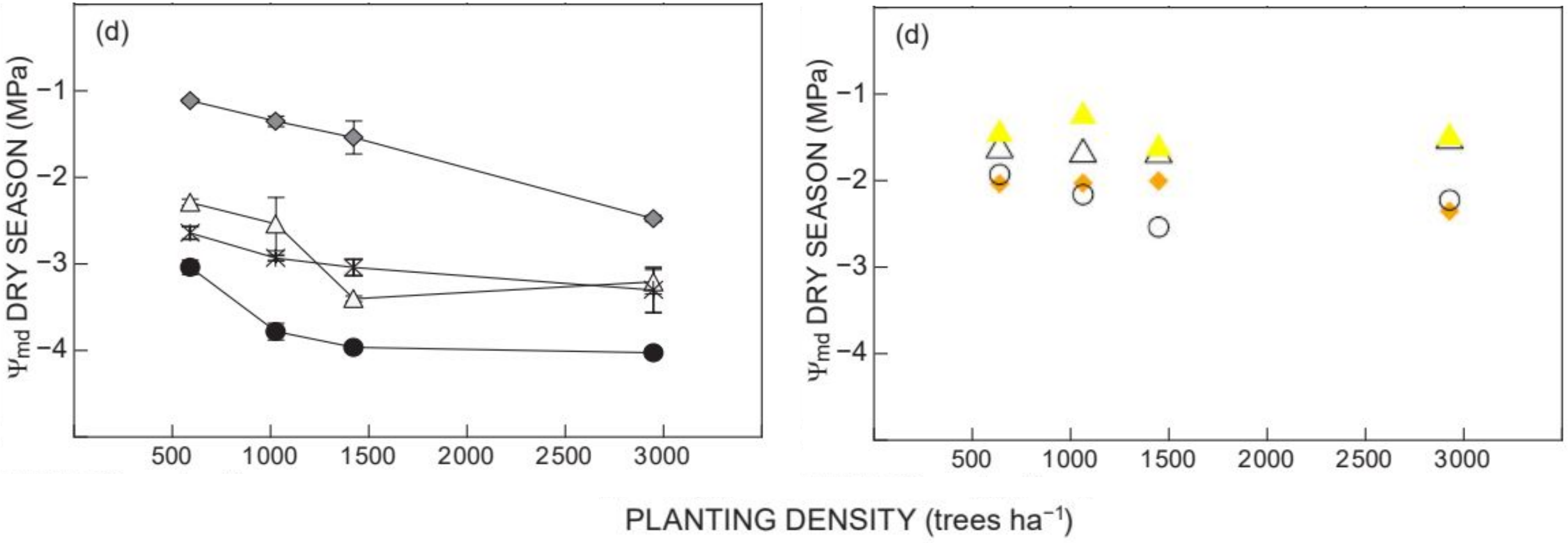
Which factors influence in the 2nd rotation productivity?



Do coppice trees tolerate more hydric deficit than planted trees?

Planted

Coppiced



EXACLTY the same trees when managed under a coppice system "realize" less stress!

Another results that will impact decision in the coppice management:

Maximal survival before losing productivity = 20%

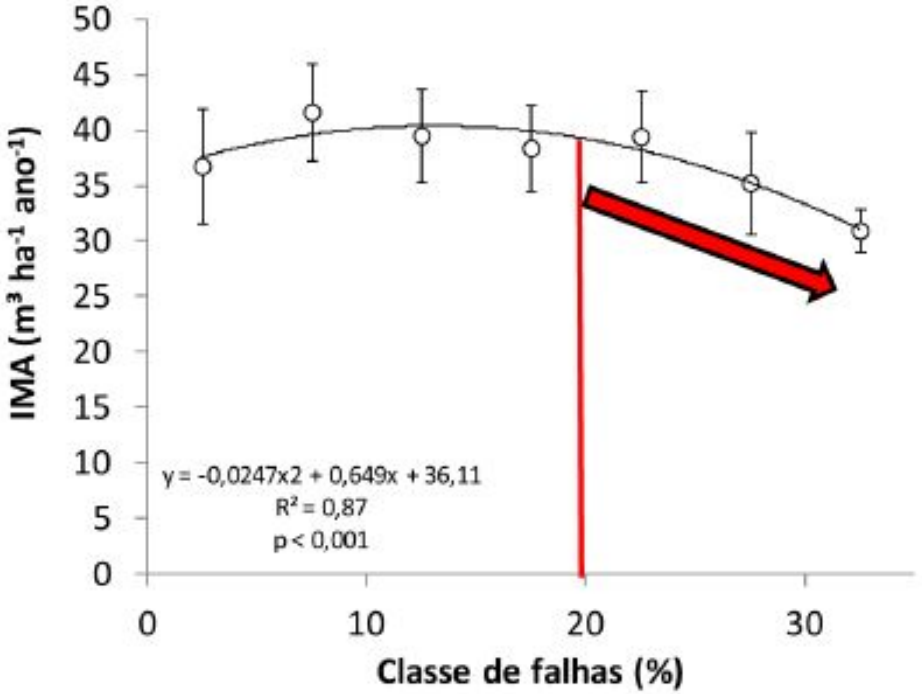


Figura 3 - Incremento Médio Anual (IMA) de acordo com a classe de falhas em escala comercial (10.500 hectares).

Harvesting time of the year x survival: best period = dry período

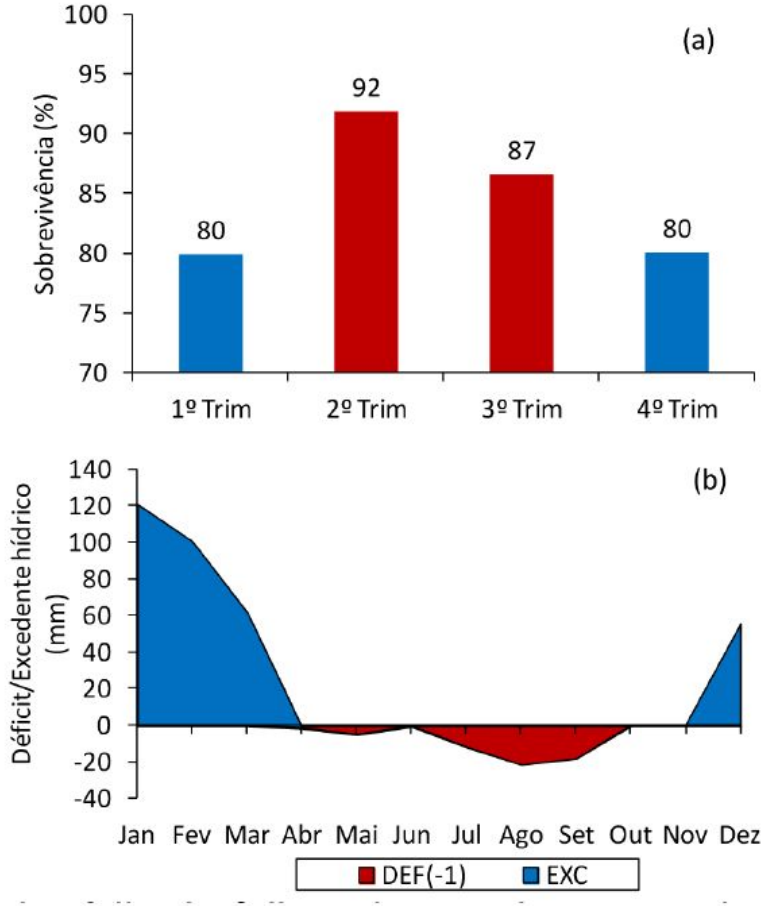


Figura 5 - (a) Percentual médio de falhas de acordo com o trimestre do ano em que foi realizada a colheita. (b) Balanço hídrico por Thornthwaiter & Mather (1955) no período de entre 1941-1970.

Trees, Forests and People 9 (2022) 100293

Contents lists available at ScienceDirect

Trees, Forests and People

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Legacy of harvesting methods on coppice-rotation *Eucalyptus* at experimental and operational scales

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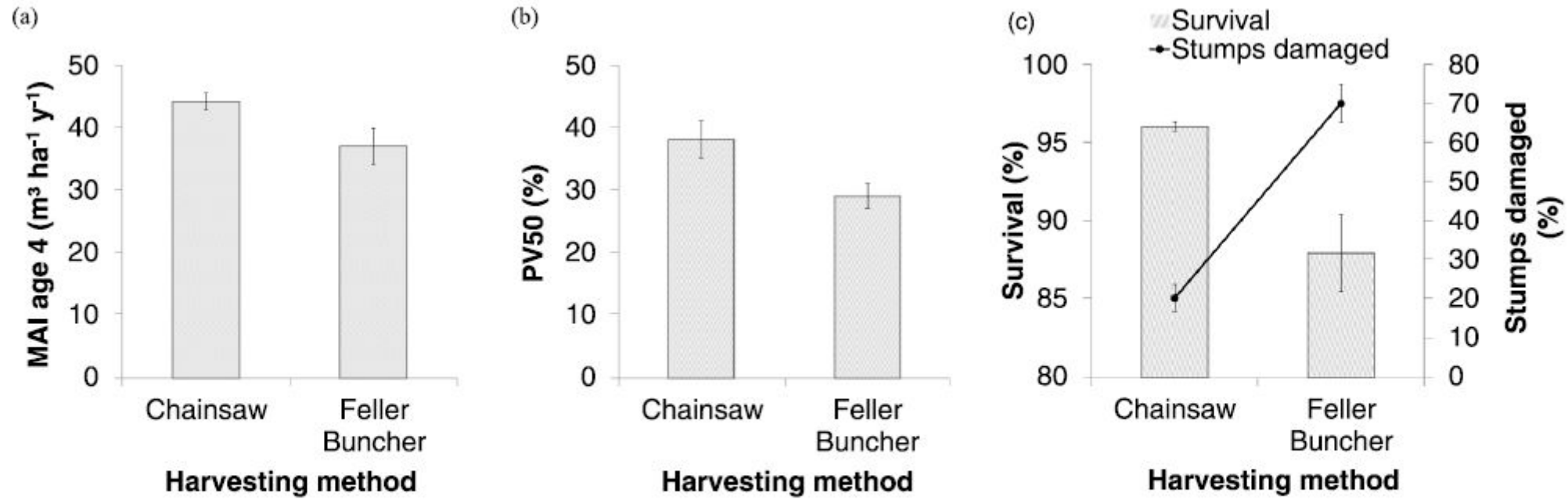

Fig. 7. Higher average Mean Annual Increment (MAI) (a) at 4 years old when trees were cut with chainsaw compared with Feller Buncher, for the operational scale. The harvesting method also influenced uniformity (PV50, b), survival (c) and percentage of stumps with any level of damage. Error bars are standard errors for treatment means. All variables were significantly different between treatments ($P < 0.0001$).

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Abstract

- Even superior genotypes varies productivity more than 2.5 fold within the same site!
- More productive sites/treatments in the 1st (planted) rotation will led to will a higher productivity in the 2nd one (coppice)
- Coppice forest has a least the same productivity of planted forest (and is 50% cheaper!)
- In a individual scale, dominant trees in the 1st rotation will not be necessarily dominant in the second (silviculture dependent)
- A lot of new results of ecophys and silviculture of coppice will be produced in the coming years!

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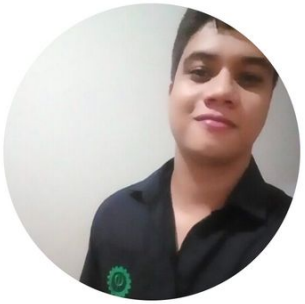

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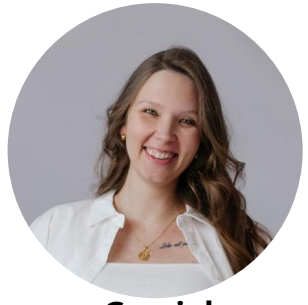

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Muito obrigado, thanks, gracias!

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