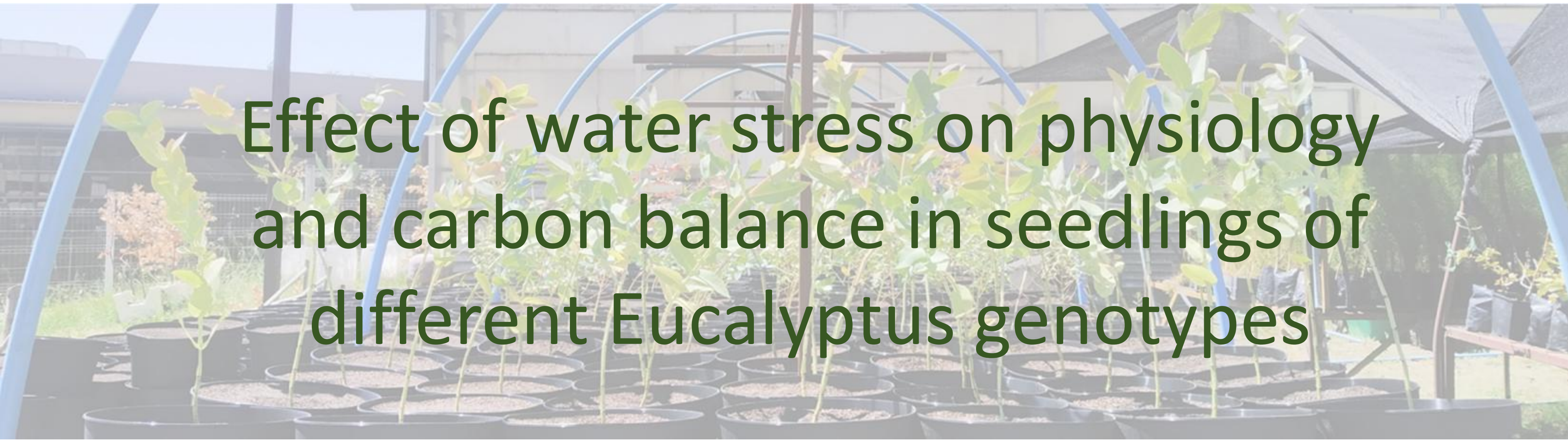

Effect of water stress on physiology and carbon balance in seedlings of different Eucalyptus genotypes

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Content

1. Introduction

- Eucalyptus is a genus covers about 25 million hectares planted in the world.
- In Chile, 856,000 ha planted.
- The main species are *E. globulus, E. nitens* and new hybrids of these species.
- Genetic improvement programs currently focused on climate change that include new species.
- Restrictions to increase planted areas due to water deficit, frost and low soil fertility.

1. Introduction

- The response of carbon balance to water deficit can be an indicator of selection of genotypes at early ages that have higher chances of survival to establishment and are more productive.

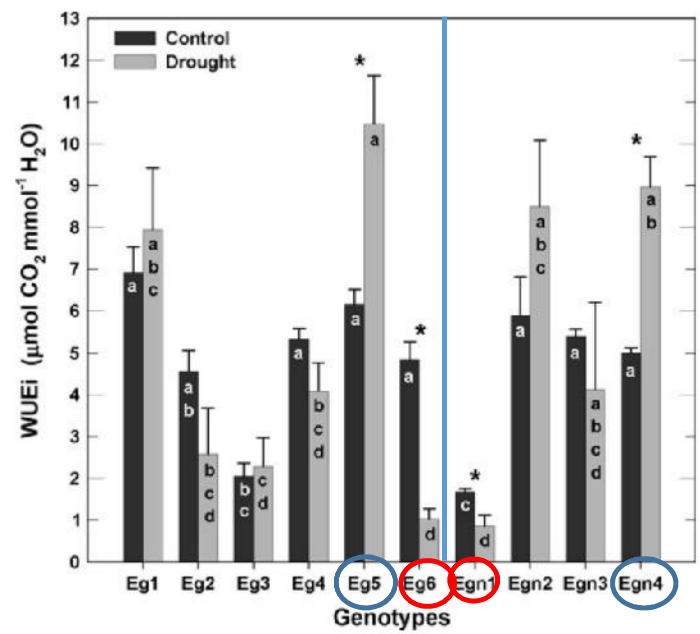


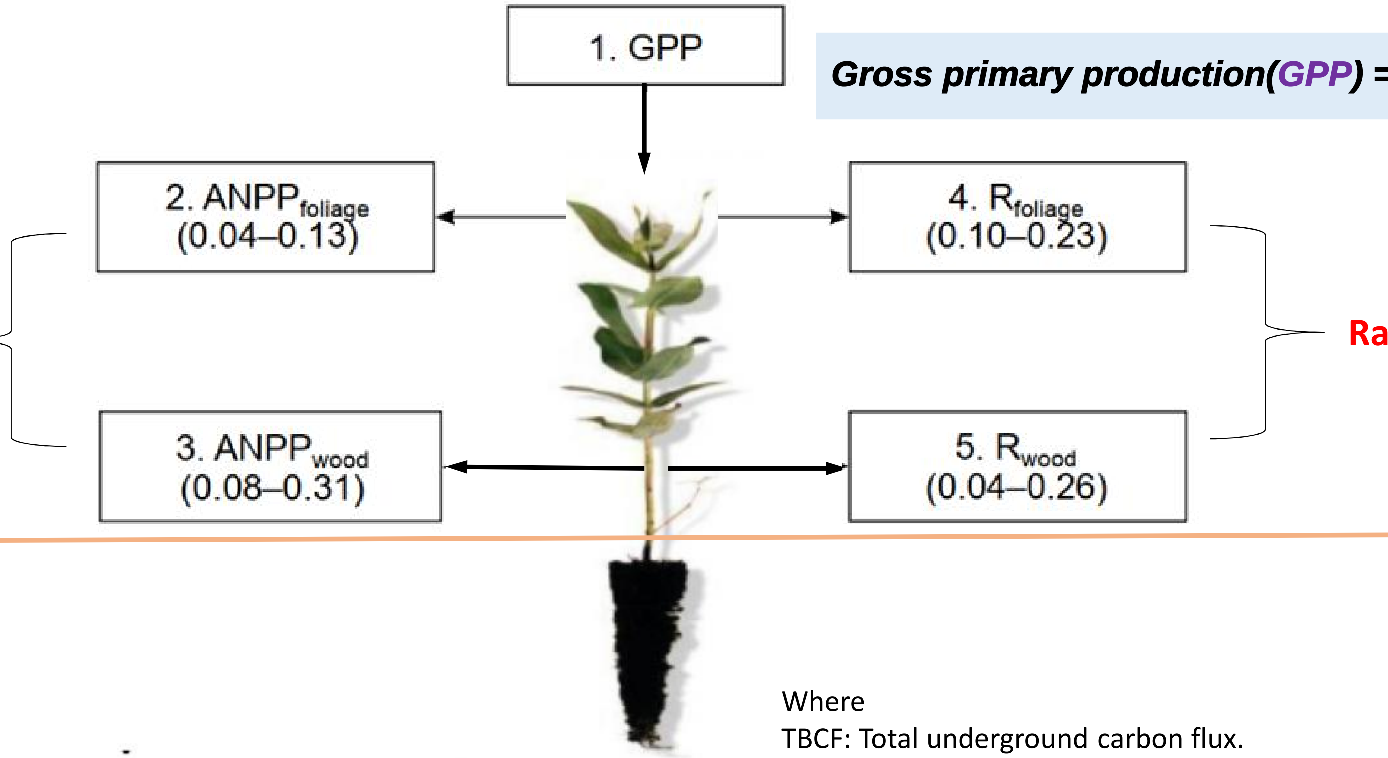
Figure 1. Instant water use efficiency (WUEi) for each eucalyptus genotype in control (dark bar) and drought (grey bar) treatment. Navarrete et al., 2013.

1. Introduction (C balance)

Aboveground

***Gross primary production(GPP)* = ANPP + Ra + TBCF**

Ryan, M. G., et al. 2004



Belowground

$$\textbf{TBCF} = F_S + F_E - F_A + \Delta[C_S + C_R + C_L]/\Delta t$$

(0.25–0.63)

Where
TBCF: Total underground carbon flux.
FS: Soil respiration
Cs: Change in mineral soil (C stored)
FE: Erosion or leaching
Cr: Biomass of coarse and fine roots
FA: Leaf litter Cl: change in the organic horizon.

Recent evidence....

Contrasting clones of Eucalyptus in a strong climatic gradient of forest plantations (Campoe et al., 2020)

Site	Water deficit mm yr^{-1}
T.03	578
T.17	544
S.22	145
S.24	5

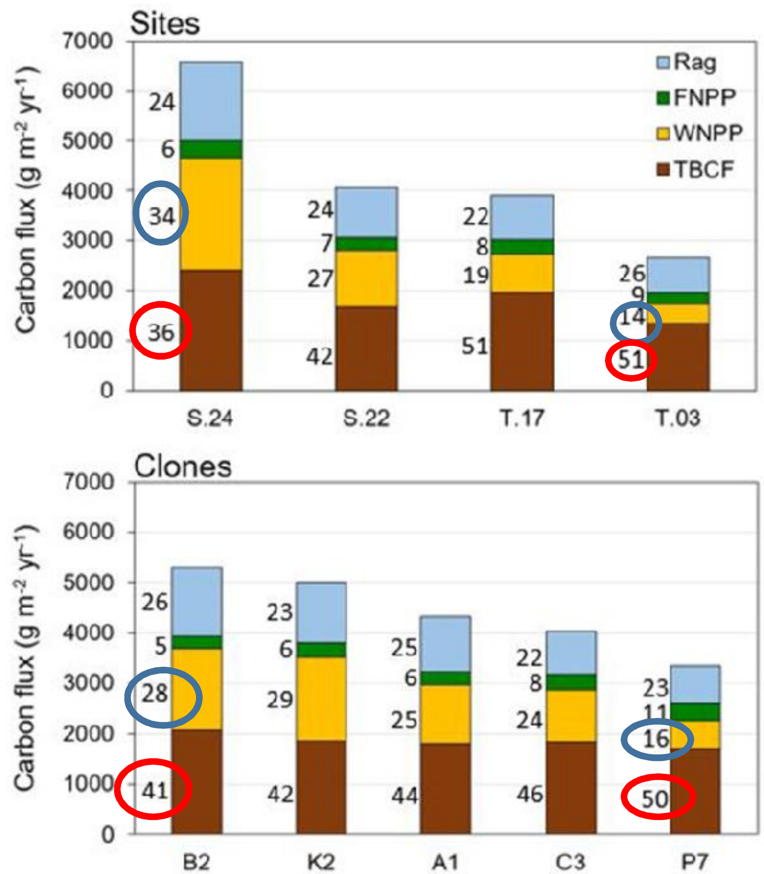


Figure 2. Carbon fluxes for sites (average of clones) and for clones (average of clones at all sites). The partition (%) is presented numerically next to each bar. Campoe et al., 2020.

2. Objetive

The study analyzed the physiological response photosynthesis (An) and predawn leaf water potential (Ψ_{PLWP}) and the change in carbon balance (C) in ten Eucalyptus genotypes exposed to different water deficits, with the hypothesis that it is possible to identify and differentiate genotypes with tolerance to drought.

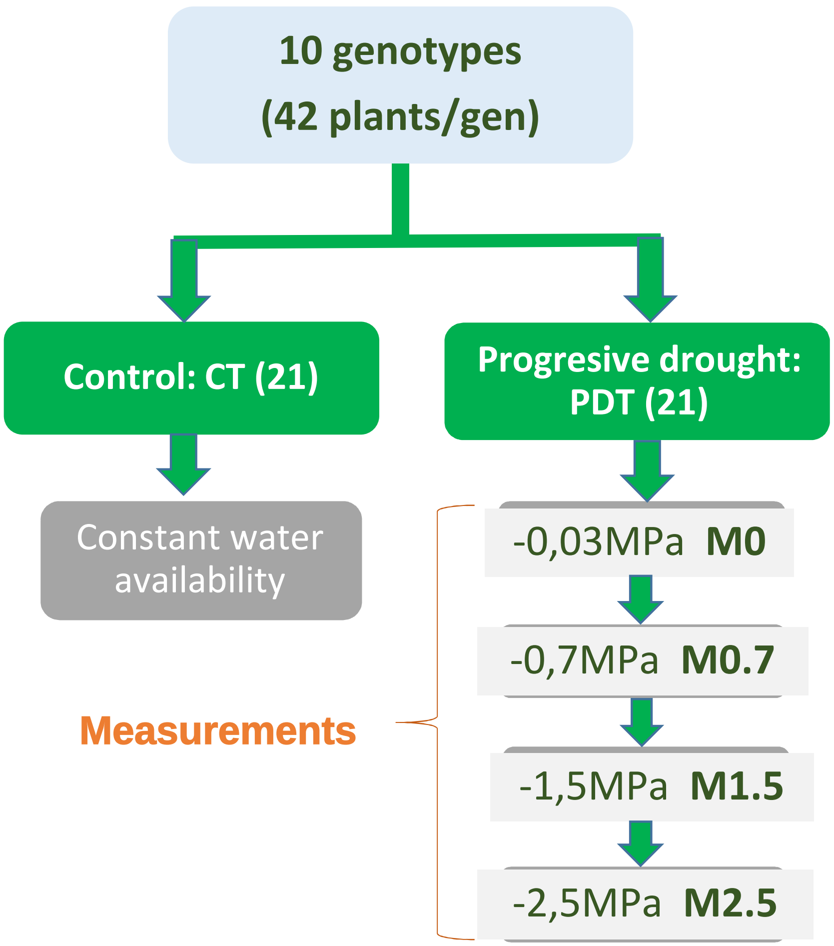
3. Methodology

- 10 Eucalyptus genotypes were selected.
- Material was selected with similar diameter and height.
- The material was acclimatized for 15 days and the study was carried out in 60 days.

No.	Genotype	Code
1	*Eucalyptus nitens*	En1
2	*Eucalyptus nitens*	En2
3	*E. globulus*	Eg
4	*E. nitens x E. globulus*	Eng1
5	*E. nitens x E. globulus*	Eng2
6	*E. nitens x E. globulus*	Eng3
7	*E. nitens x E. globulus*	Eng4
8	*E. camaldulensis x E. globulus*	Ecg
9	*Eucalyptus badjensis*	Eb
10	*Eucalyptus smithii*	Es

3. Methodology

- Daily evaluations for each genotype of soil water potential (Ψs) with 229-L SMP Sensor.
- With LICOR 6400XT was used to measure photosynthesis (An).
- Soil respiration was evaluated with LICOR-850.
- The balance of C was evaluated with periodic growth measurements and at the end of the study a destructive sampling was used.
- Ryan et al. (2004) equations were used to estimate GPP.



4. Results

- The most drought-tolerant genotypes used two response mechanisms: the maintenance of Ψ_{PLWP}, with low rates of AN (En2) and the reduction of Ψ_{PLWP}, without drastically reducing A_N (Eng1, Eng3 and Eg). Both mechanisms allowed to maintain the adequate TCR that allows them a prolonged survival and increased underground production at the expense of maintaining aerial production.

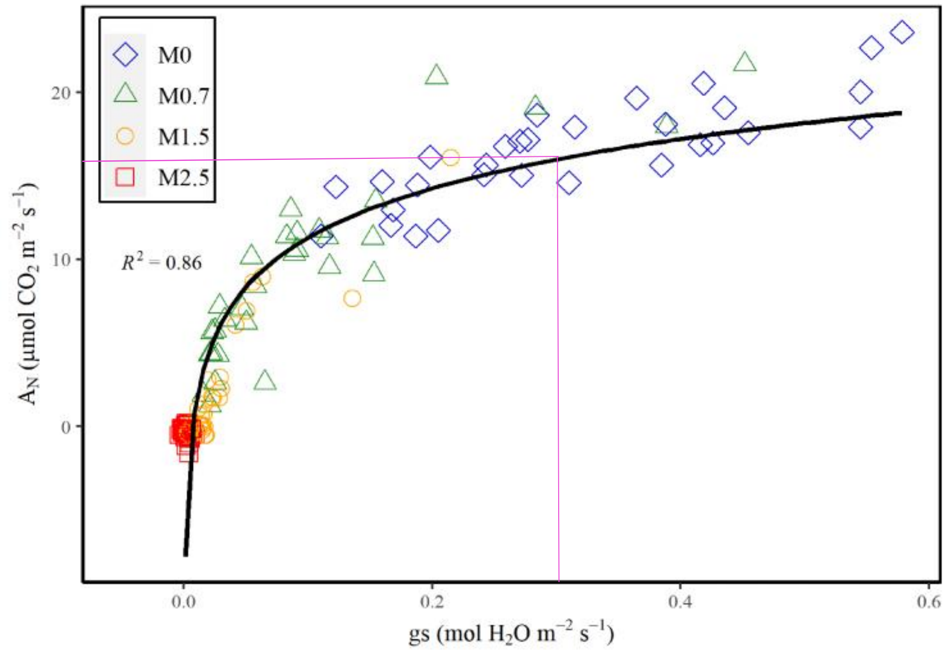


Figure 3. Relationship between the mean net photosynthesis rate AN (µmol CO2 m-2 s-1) and the mean stomatal conductance gs (mol H2O m-2 s-1) for the 10 genotypes of Eucalyptus spp. subjected to the drought treatment in the four sampling instances M0, M0.7, M1.5 and M2.5.

4. Results

- The genotypes most sensitive to drought Ecg and Eng2, although they did not show the greatest decrease in leaf water potential, did show a considerable reduction in the photosynthetic rate and therefore growth rates are severely affected for all biomass components. In this way, the carbon flux decreased in both the above-ground and below-ground components.

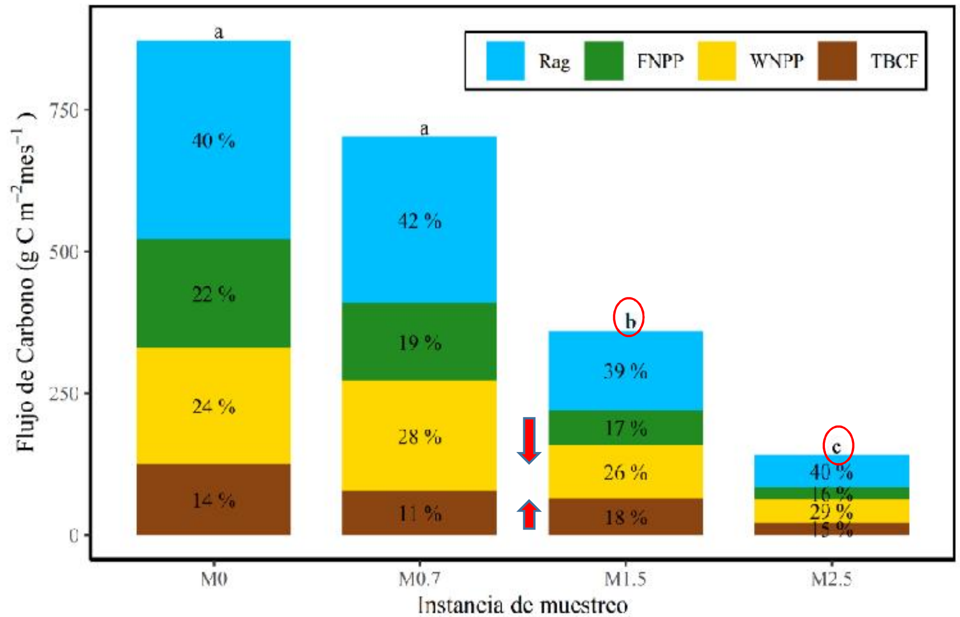


Figure 4 Average carbon flux of the genotypes (g C m-2 month-1) in the sampling instances M0, M07, M1.5 and M2.5 for the drought treatment. The letters above the bars indicate significant differences between the means of the genotypes of the charcoal flux (GPP) between sampling instances. The partition is presented numerically in % within each bar.

4. Conclusions

- It is possible to identify genotypes of *Eucalyptus* in the nursery stage tolerant to drought, by evaluating physiological responses of predawn leaf water potential and photosynthesis.
- It is important to understand the balance between the carbon balance and the division into above- and below-ground components, because it provides new knowledge of genotype selection in order to increase productivity and response of plantations to drought.

5. Acknowledgment

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