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Temperature and water stress integral influence in physiological responses among eucalyptus genotypes

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Abstract: Water stress is expected to reduce photosynthesis and leaf water potential to regulate plant water use. We hypothesized that higher summer temperatures increase photosynthesis and decrease water use, which are more pronounced in more stressed genotypes. This study investigated photosynthesis (An), stomatal conductance (gs), and water stress integral (WSI) changes in the early development of *E. globulus*, *E. nitens*, and *E. nitens* × *E. globulus* hybrids during winter and summer. An, gs, and WSI showed a significant interaction ($p>0.001$) between genotype and season. Regardless of the season, *E. globulus* showed no significant changes in An, while higher increase was observed in E. gloni (50%) in summer. There was an increment in gs between the seasons (167%), which was more pronounced in *E. nitens* (300%). This implied significant changes in iWUE between taxa and seasons. The lowest iWUE in summer was related to the lowest WSI, with *E. nitens* being different from other taxa ($p=0.01$). We observed a positive relationship between WSI and iWUE in summer, but negative in winter. The results suggest that WSI in winter helps to promote stomatal closure, which increases iWUE, since An presented small changes. Regardless of genotype, warm periods increased An and decreased iWUE, which imply different strategies of eucalyptus plantations in regions with water deficit.

Keywords: forest management;
forest physiology;
water use efficiency

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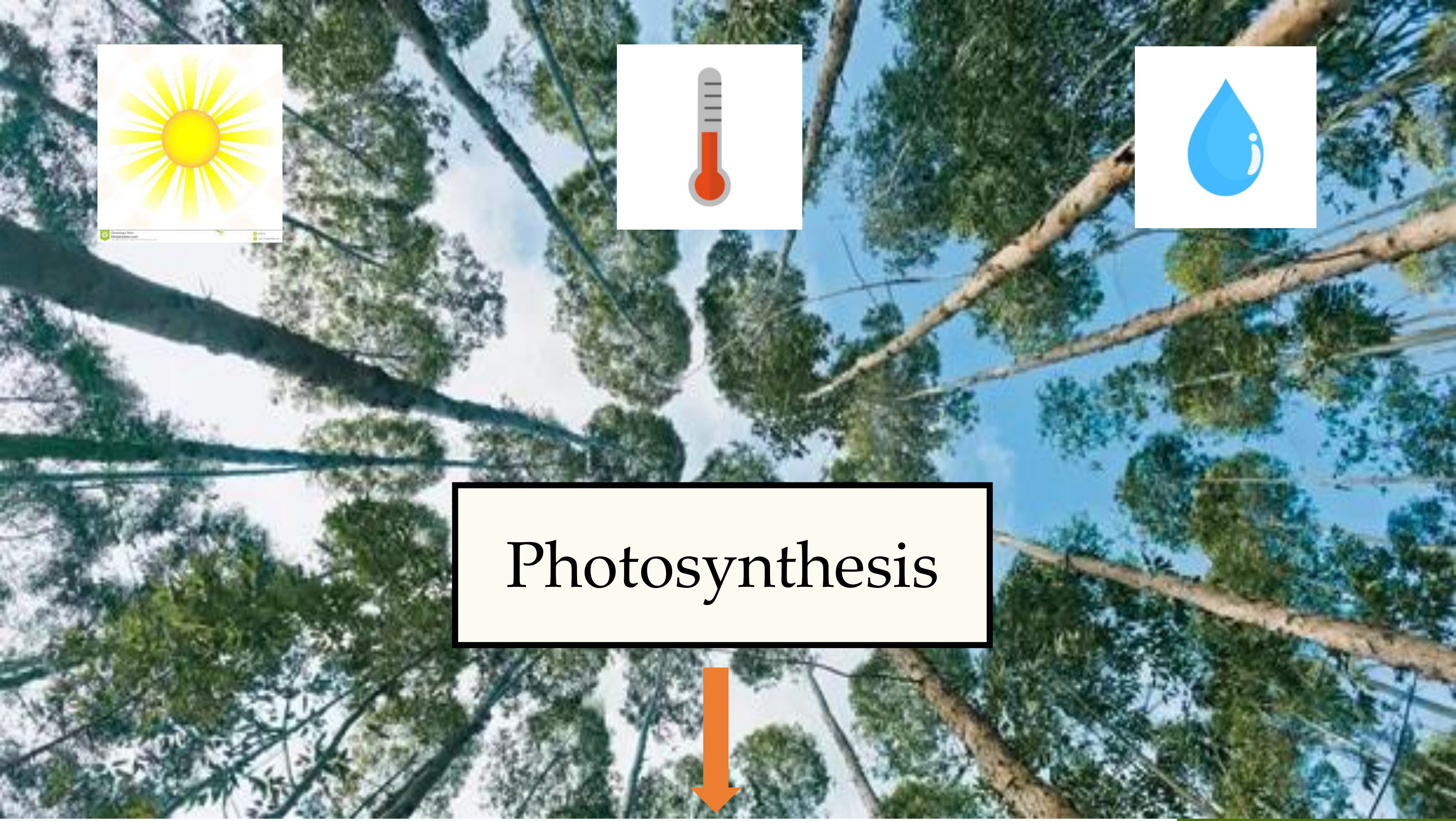

Photosynthesis

Growth / Yield

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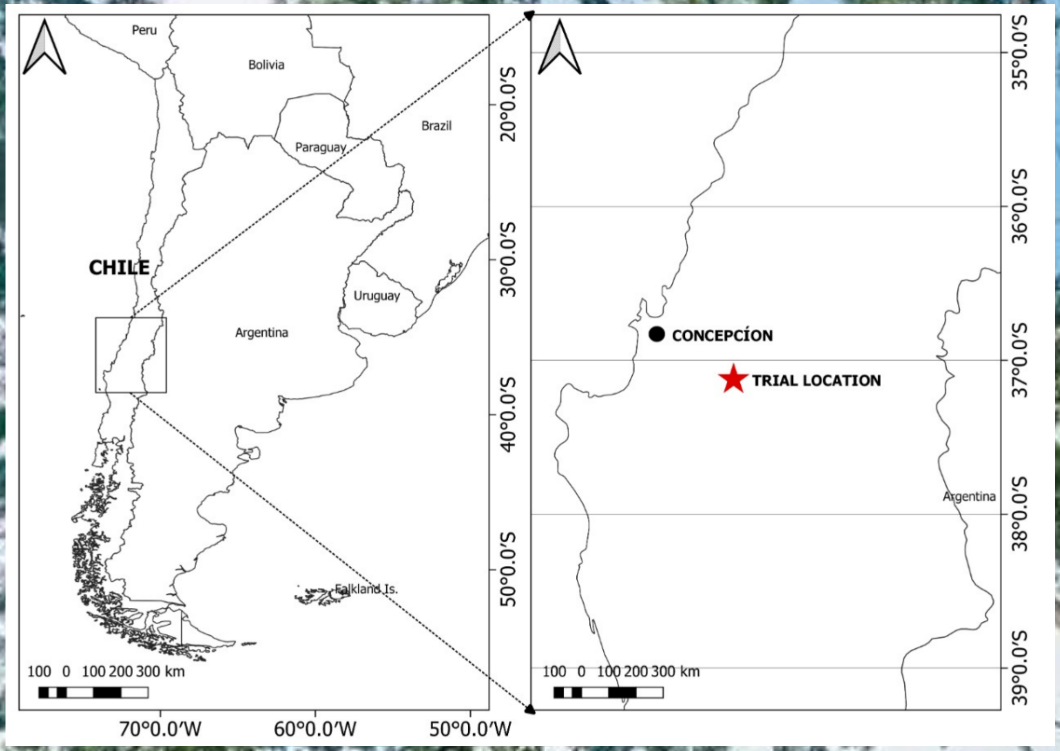

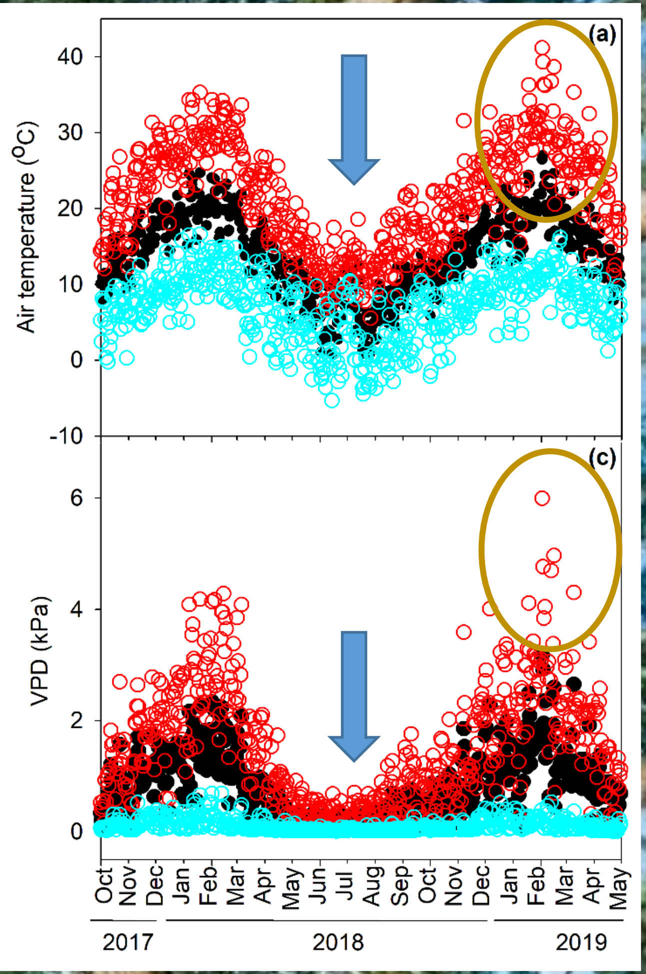

With temperature increments, changes in photosynthetic rates will be greater than winter;
The increase in atmospheric demand (VPD) leads to a decrease in intrinsic water use efficiency, and genotypes that presented the highest WSI will be the least efficient in water use

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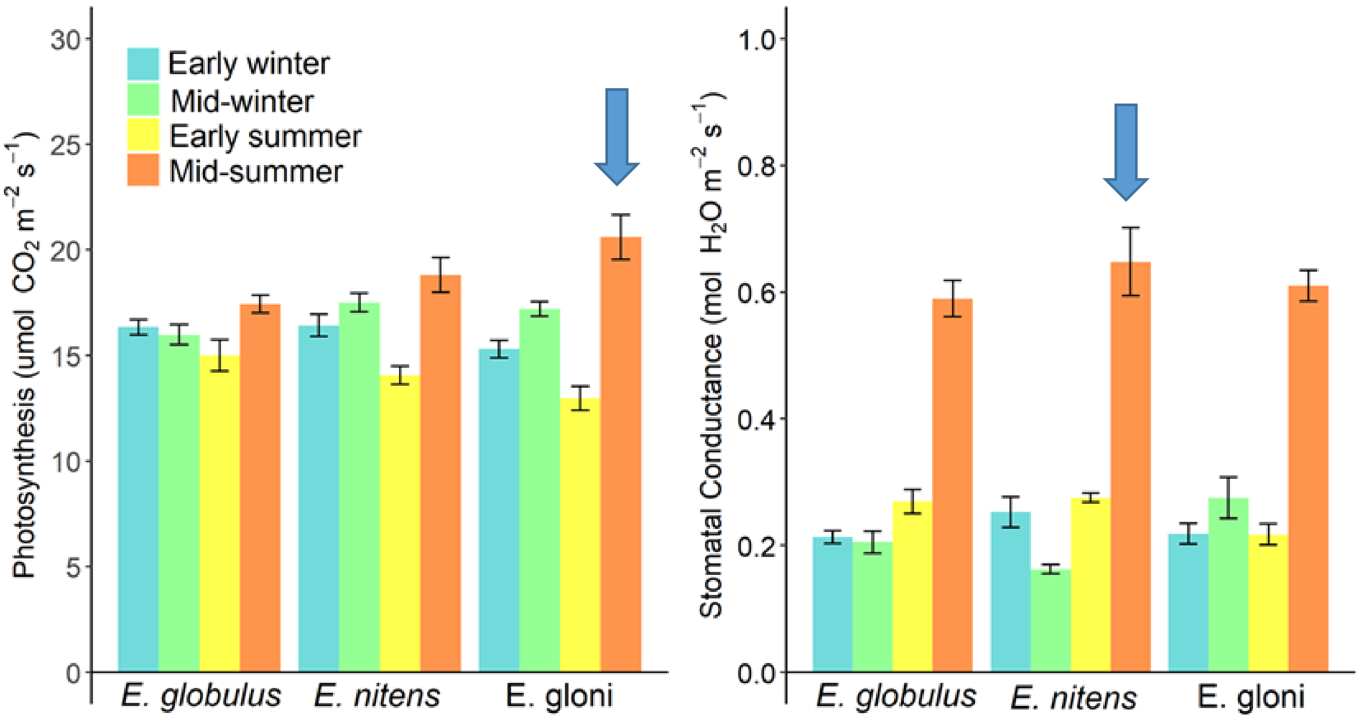
Experiments

E. globulus;
E. nitens;
E. nitens x *E. globulus*;

Measurements

Early winter;
Mid-winter;
Early-summer;
Mid-summer;

Results and Discussion



(a) (b)

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Results and Discussion

Model	Effects	Parameters		RMSE	R^2
		a	b		
All genotypes	Winter & Summer	20.491 *	0.085 *	2.47	0.28
	Winter	18.597 *	0.028 *	1.44	0.21
	Summer	24.624 *	0.179 *	2.61	0.52
E. globulus	Winter & Summer	18.319 *	0.034 *	1.95	0.16
	Winter	19.251 *	0.038 *	1.4	0.21
	Summer	19.927 *	0.083 *	2.14	0.30
E. nitens	Winter & Summer	18.189 *	0.023 *	2.09	0.07
	Winter	16.181 *	0.009 ns	1.19	0.03
	Summer	26.580 *	0.253 *	0.93	0.89
E. gloni	Winter & Summer	23.818 *	0.119 *	2.75	0.45
	Winter	18.834 *	0.034 ns	1.41	0.32
	Summer	29.024 *	0.253 *	2.97	0.64

506
240

52%

1797
105

94%

553
114

79%

$$An = \frac{a * gs}{b + gs}$$

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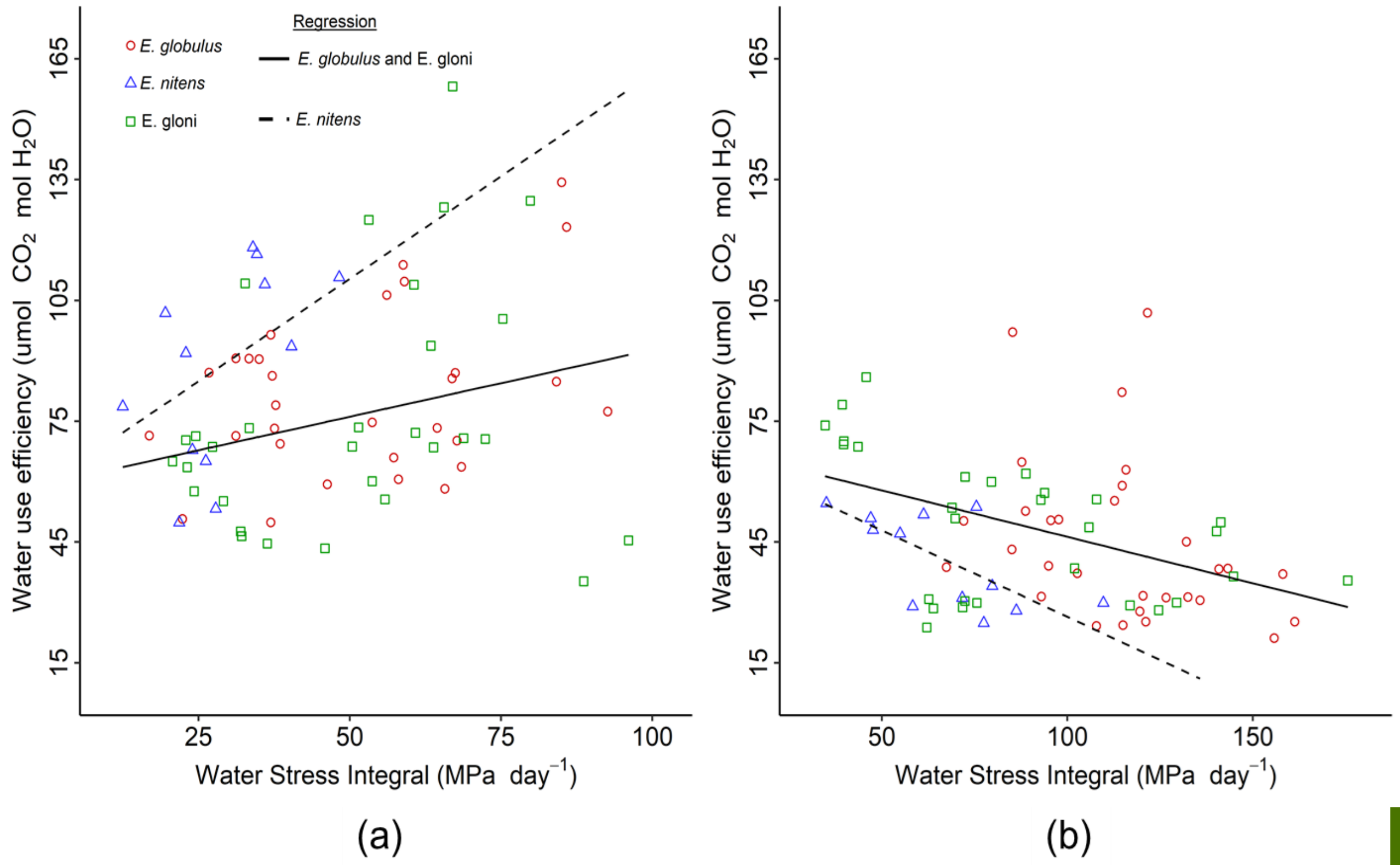
Results and Discussion



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Conclusions

High incremental changes in photosynthesis were observed in summer, showing a positive relationship with temperature

Because of irrigation during summer, stomatal conductance followed photosynthesis behavior, decreasing intrinsic water use efficiency during periods of higher atmospheric demand

Significant changes were observed between WSI and iWUE during the seasons and taxa, being *E. nitens* more sensitive to changes in WSI and less tolerant to drought than *E. globulus* and E. gloni.

Acknowledgments

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