

Department of Biology

Examination paper for BI20221 Plant ecophysiology

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Examination date: 13. December 2016

Examination time (from-to): 09:00-12:00

Permitted examination support material:

Open-book exam; textbook, scientific articles, dictionary and notes are all permitted

Other information:

Language: English

Number of pages (front page excluded): 2

Number of pages enclosed:

Informasjon om trykking av eksamensoppgave

Originalen er:

1-sidig **2-sidig**

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Checked by:

Date

Signature

Numbers in parentheses are the points for each question; 100 points total.

1. The attached figure is from a study comparing photosynthetic performance in *Nicotiana tabacum* (tobacco), a C3 herbaceous plant, and *Eucalyptus camaldulensis* (red river gum), a C3 woody sclerophyllous* tree. The data show that the photosynthetic performance of the two species is similar in some respects, but very different in others
 - a. Describe briefly how photosynthetic rate is measured and the intercellular CO₂ concentration (C_i) is estimated from raw gas concentration measurements. (10)
 - b. Based on the data, can you say whether one or both these species (or the leaves used to make the measurements) are best adapted to growing in sun or shade? Explain your answer. (10)
 - c. Based on your understanding of photosynthesis, how do you think these two species could achieve such similar photosynthetic rates despite differences in other parameters? (10)
2. What is “vulnerability to embolism”? How does it differ among tree species adapted to different environments? Include a diagram of vulnerability curves of some representative species in your answer. (20)
3. How can plants safely accumulate high concentrations of toxic metals? What are the advantages and disadvantages of metal hyperaccumulation? Use specific examples in your answer. (20)
4. “Will forests and other natural ecosystems offset some of the increase in atmospheric CO₂ by increasing their rates of net primary production (NPP)?” This is an important question for the 21st century. Discuss possible reasons why increased NPP may or may not be stimulated by increased CO₂ levels, with reference to the kinds of experiments and data that are being used to answer this question. (30)

*sclerophyll: “a woody plant with evergreen leaves that are tough and thick in order to reduce water loss.”

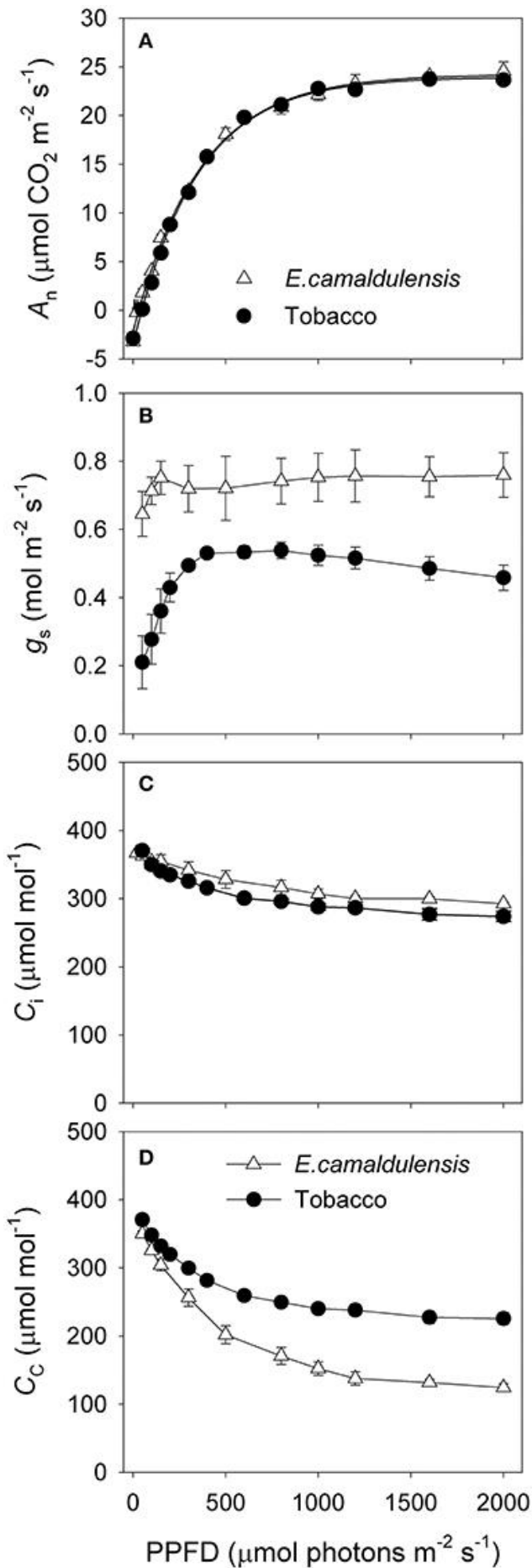


Figure 3. Light response changes in (A) photosynthetic rate (A_n), (B) stomatal conductance (g_s), (C) intercellular CO_2 concentration (C_i), and (D) chloroplast CO_2 concentration (C_c) for leaves of *Eucalyptus camaldulensis* and *N. tabacum*. Measurements were conducted at 25°C and $400 \mu\text{mol mol}^{-1} \text{CO}_2$. The value of C_c was based on the calculation of g_m on assumptions of Γ^* being $40 \mu\text{mol mol}^{-1}$ and L_{abs} being 0.85 . Values are means \pm SE ($n = 4$). Source: Huang, W. et al., 2016. The Sclerophyllous *Eucalyptus camaldulensis* and Herbaceous *Nicotiana tabacum* Have Different Mechanisms to Maintain High Rates of Photosynthesis. *Frontiers in plant science*, 7. 24 November 2016 | <http://dx.doi.org/10.3389/fpls.2016.01769>