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Plant growth #1. Photosynthesis by Kazuhiko KOBAYASHI

The aim: to understand plant photosynthesis and its determinants from sub-cellular to canopy scales

0. Why photosynthesis (O₂-emitting photosynthesis) is important for us?

1. Starting with chloroplasts, where light energy is captured and carbon is fixed
 - a. Where are they and how do they look like? See Figs. 1 & 2.
 - b. What are they doing in there at all? See Fig. 3.
 - b1. Light absorption: Figs. 4 & 5.
 - b2. Light energy capture and conversion to chemical energy: Figs. 6 & 7.
 - b3. Carbon fixation: Figs. 8 & 9.

2. Driving the photosynthetic process in aerial environment
 - a. Light: effects on leaf photosynthesis (Figs. 10 & 11) and control via leaf morphology (Fig. 12), reflectivity (Fig. 13), and angle (Fig. 14). *Light is not just energy source, but could be a stressor.*
 - b. CO₂: effects on leaf photosynthesis (Figs. 15 & 16), and control by stomata (Fig. 17).
 - c. Water: diffusion in air (Fig. 18) and control by stomata (Fig. 17).
 - d. Nitrogen: effects on photosynthesis (Fig. 19).
 - e. Ozone: effects on leaf tissues and photosynthetic rates...

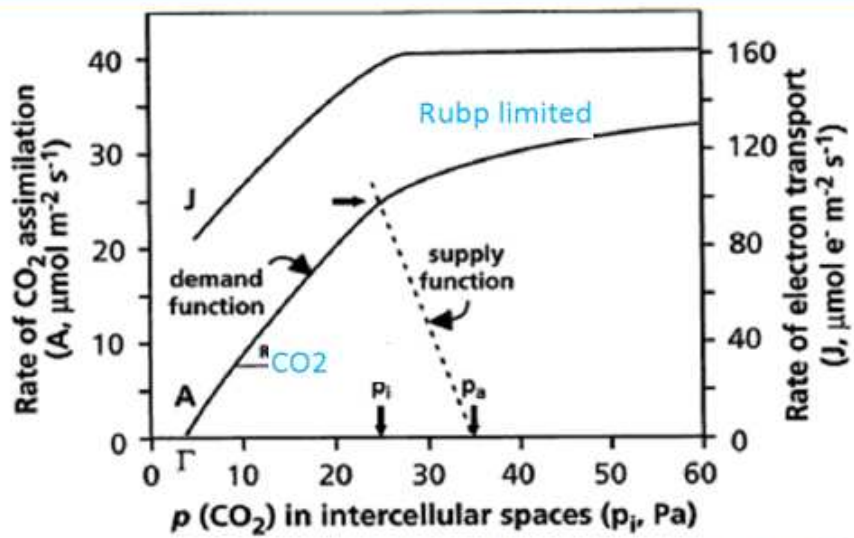
References

- 1) Evans, L.T. (1993) Crop Evolution, Adaptation, and Yield. Cambridge University Press.
- 2) Jones, H.G. (1992) Plants and Microclimate Second edition. Cambridge University Press.
- 3) Lambers, H., Chapin III, F.S., Pons, T.L. (1998) Plant Physiological Ecology. Springer-Verlag.
- 4) 種生物学会編 (2003) 光と水と植物のかたち 植物生理生態学入門. 文一総合出版.
- 5) 東京大学光合成教育研究会編 (2007) 光合成の科学. 東京大学出版会.

Question:

Explain, in plain words in either English or Japanese, what the demand line, the supply line, and the intersection between them mean in Fig. 15. Also explain the merit for the leaf to operate photosynthesis near the break points of the CO₂-limited and energy (RuBP-regeneration)-limited lines as in the case of the water-stressed bean plants as shown in the figure at the bottom.

Fig. 15. CO₂ in intercellular space and leaf photosynthesis rate.



Ci in Fig. 1

Source: Ref. 3.

