

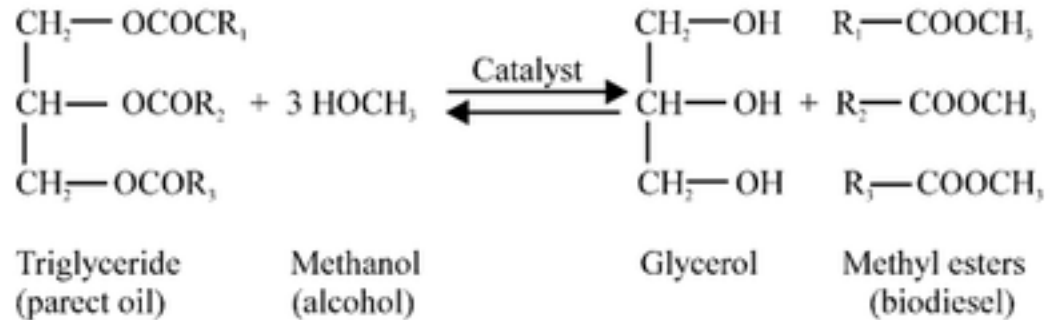


UNIVERSITÀ
DEGLI STUDI
DI PADOVA

Il ruolo del Cloroplasto nella Produzione di lipidi in alghe unicellulari

Tomas Morosinotto, 24 Maggio 2011

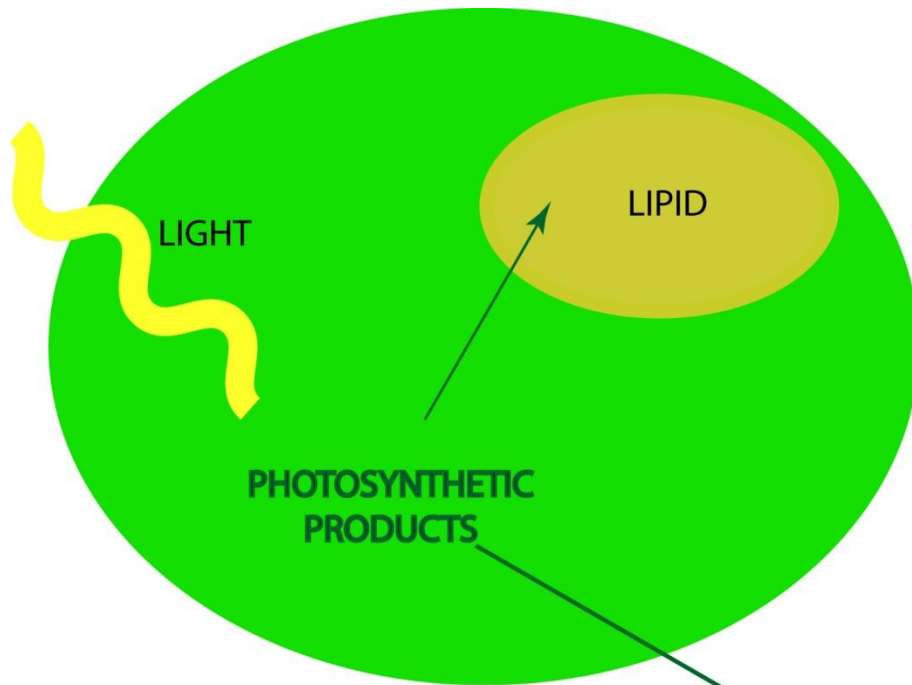
Biodiesel is the product of Triacylglycerol (TAG) transesterification



Biodiesel can be produced from triacylglycerols of any origin

Major issue is feedstock availability





In unicellular algae all tissues are photosynthetically active

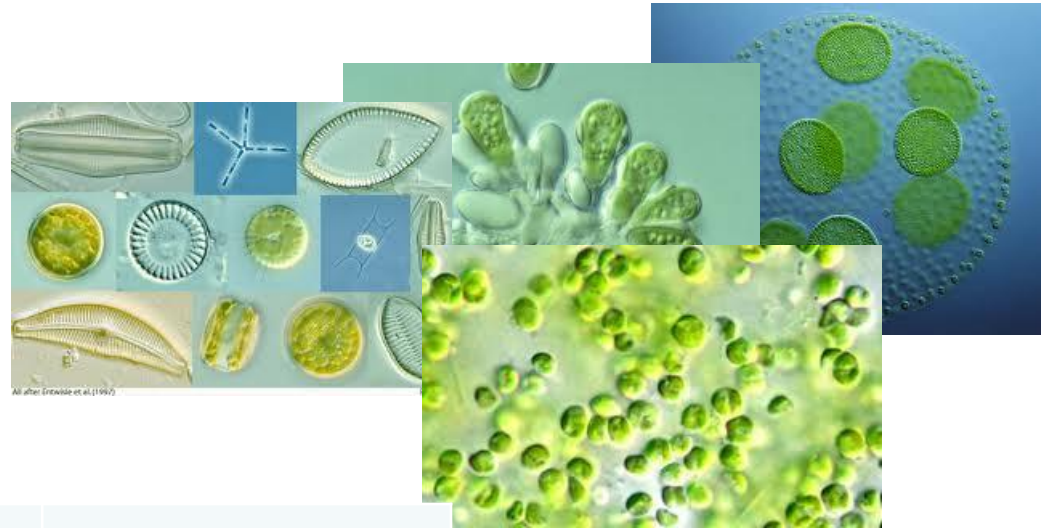
Lipids reach $\approx 40-80\%$ of the total dry weight

~~NON
PHOTOSYNTHETIC
TISSUES~~

ALGAE have POTENTIAL but RESEARCH is still needed

Algae

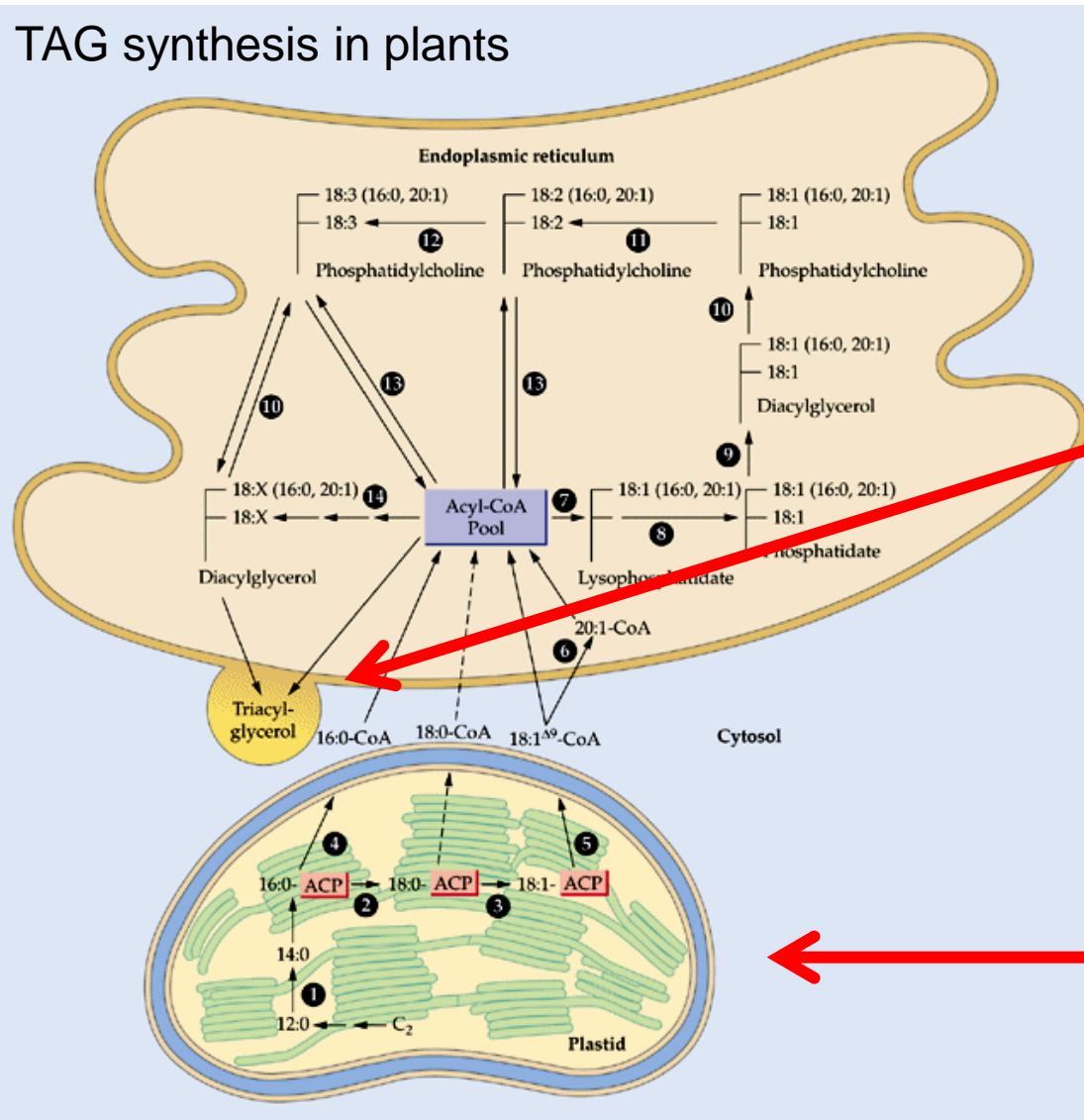
Photosynthetic organisms
with a large biological
diversity



Microalga species (genera)	Lipid content (% w/w DW)	Lipid productivity (mg L ⁻¹ d ⁻¹)
<i>Botryococcus</i>	25.0–75.0	-
<i>Chlorella</i>	5.0–58.0	11.2–40.0
<i>Dunaliella</i>	17.5–67.0	33.5
<i>Isochrysis</i>	7.1–33.0	37.8
<i>Nannochloris</i>	20.0–56.0	60.9–76.5
<i>Nannochloropsis</i>	22.7–29.7	84.0–142.0
<i>Neochloris</i>	29.0–65.0	90.0–134.0
<i>Phaeodactylum</i>	18.0–57.0	44.8
<i>Scenedesmus</i>	11.0–55.0	-

Nannochloropsis
species are
particularly
promising

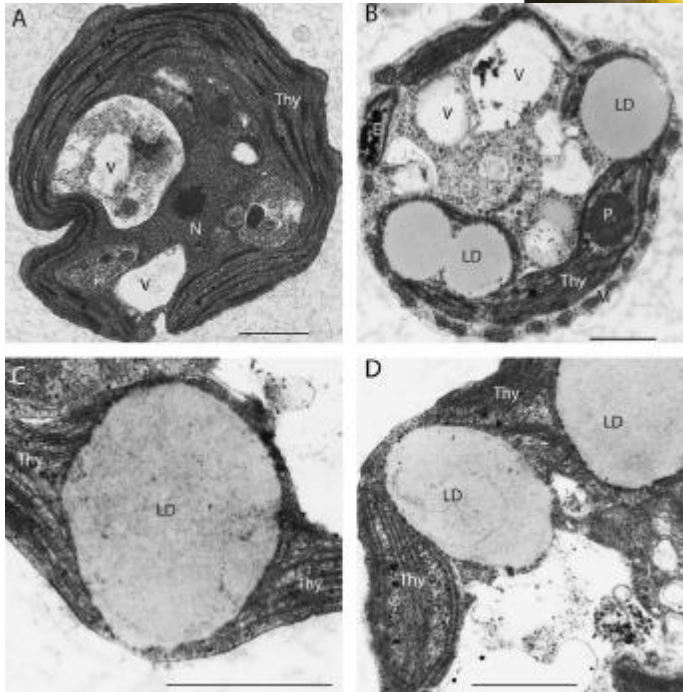
TAG synthesis in plants



TAG synthesis in the ER

Fatty acids synthesis in the chloroplast

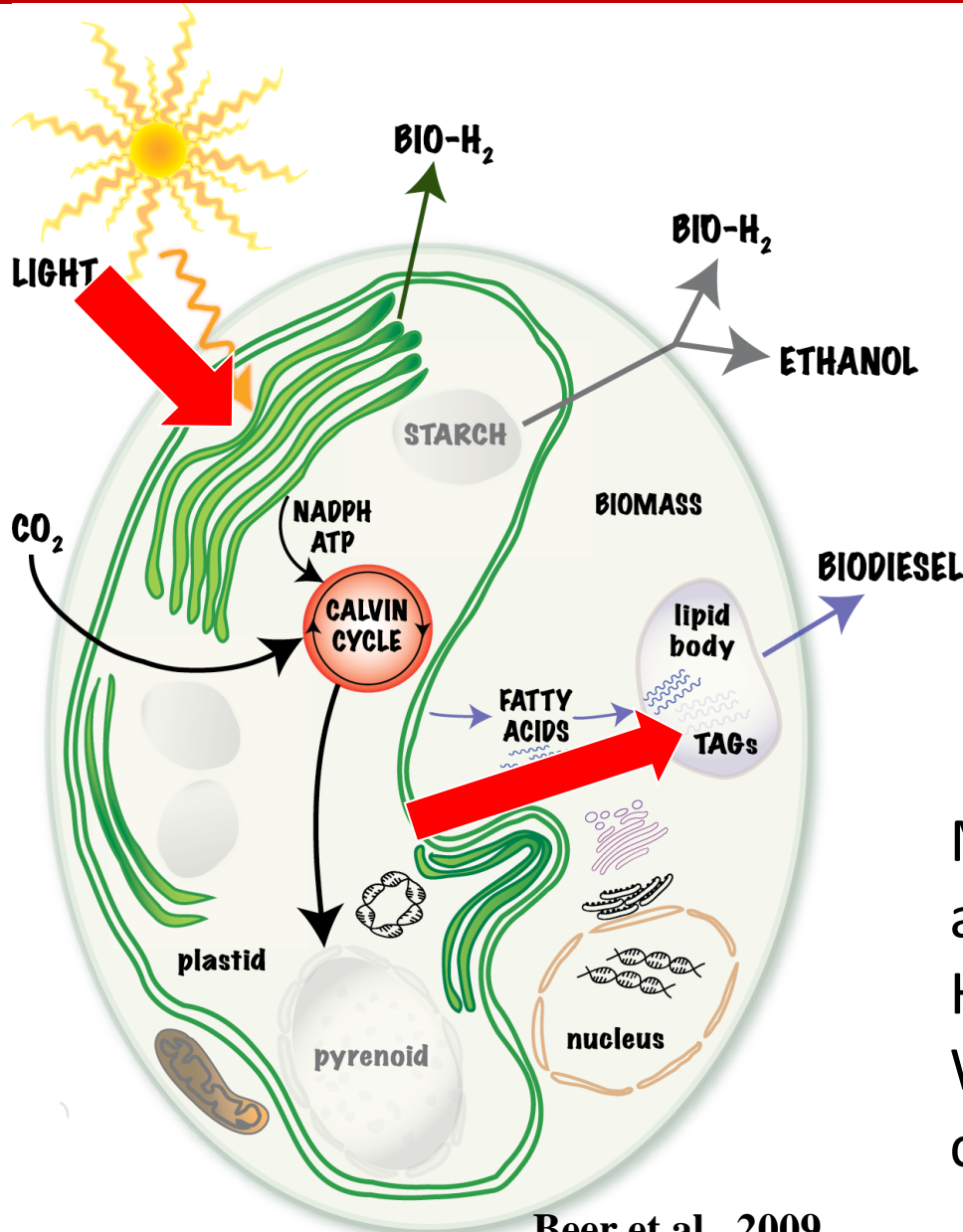
Is this true for algae as well?



Lipid bodies imaging in *Nannochloropsis gaditana* cells. Red fluorescence corresponds to the chloroplast while the yellow one is from lipid bodies stained with Nile Red.

Oil bodies in the cytoplasm

Oil bodies within the chloroplast



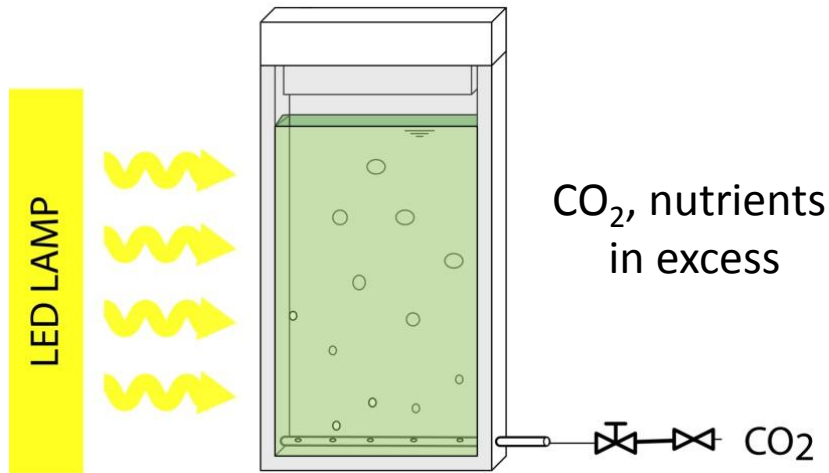
Beer et al., 2009

Contributions of Chloroplast research to the field

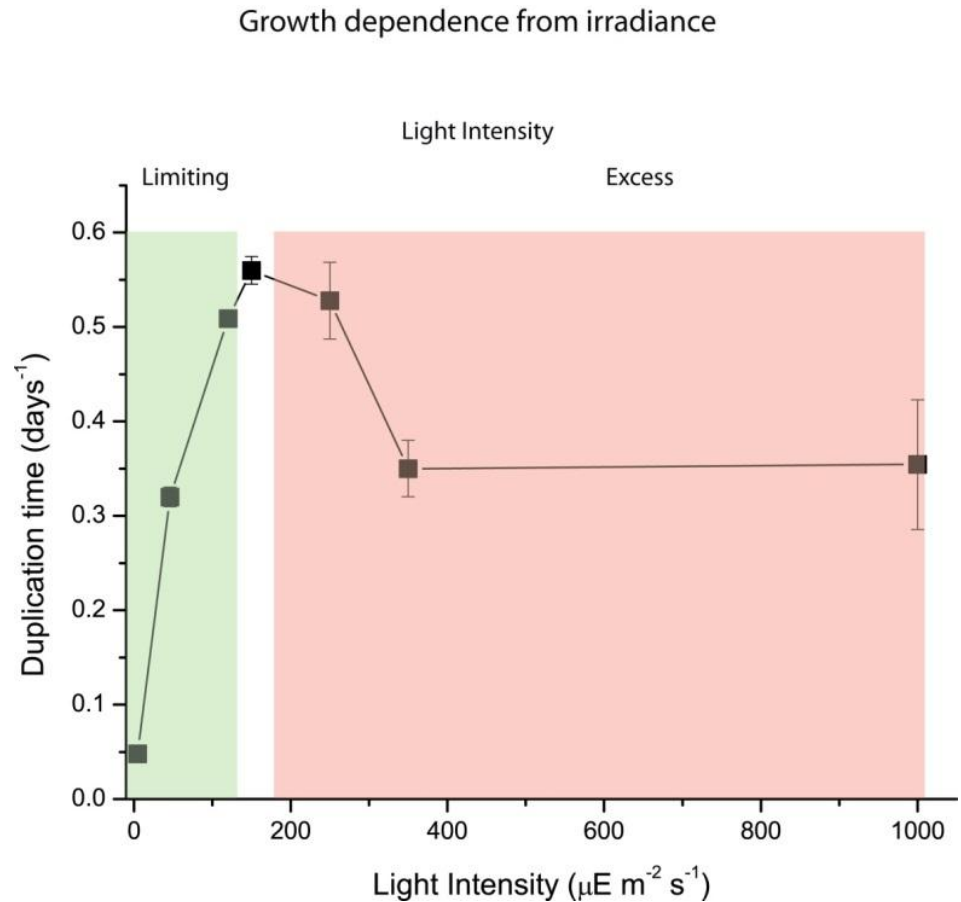
All energy comes from sunlight: optimizing algae light use efficiency is seminal for any algae large scale cultivation

Maximizing production of Fatty acids and TAGs:
How is the biosynthesis regulated?
What is the influence of chloroplast?

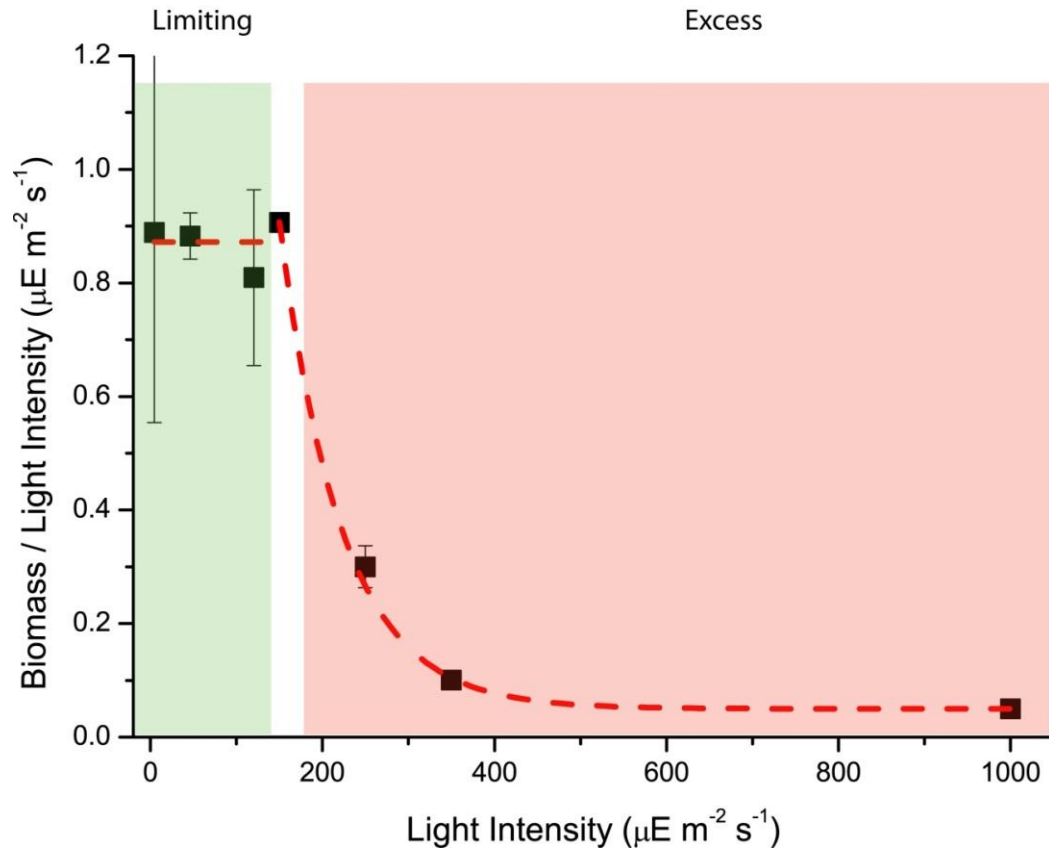
Experimental Photobioreactor to highlight illumination influence



Light can be limiting or in excess



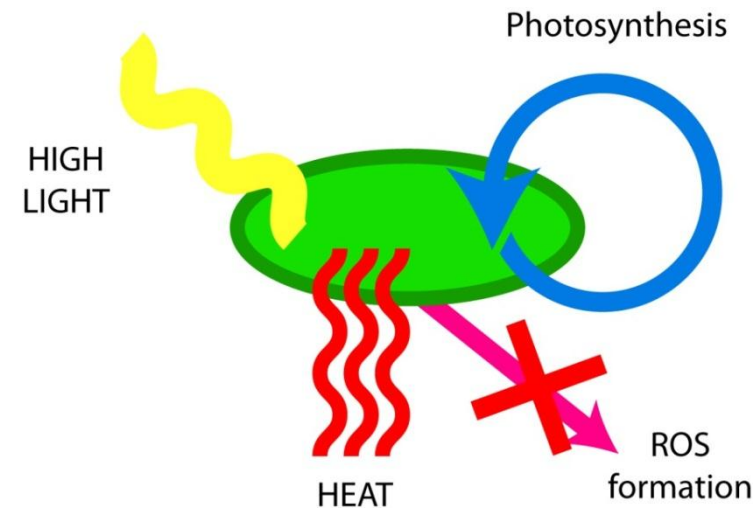
Algae photosynthetic productivity evaluated from **Biomass production / Light Intensity**



Strong light is exploited with low efficiency

Causes:

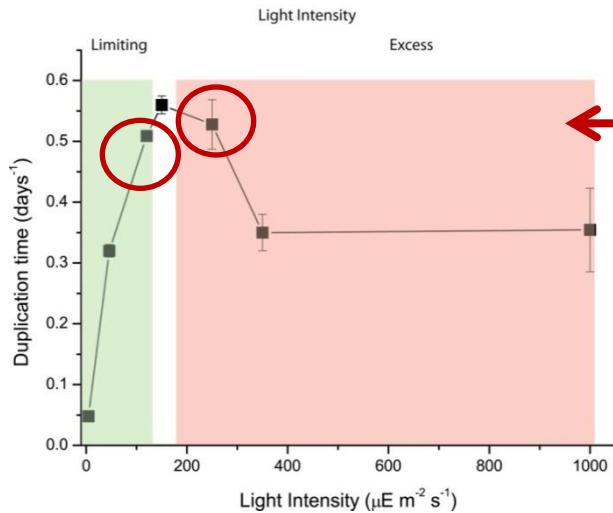
- Heat dissipation mechanisms
- ROS damages and repair



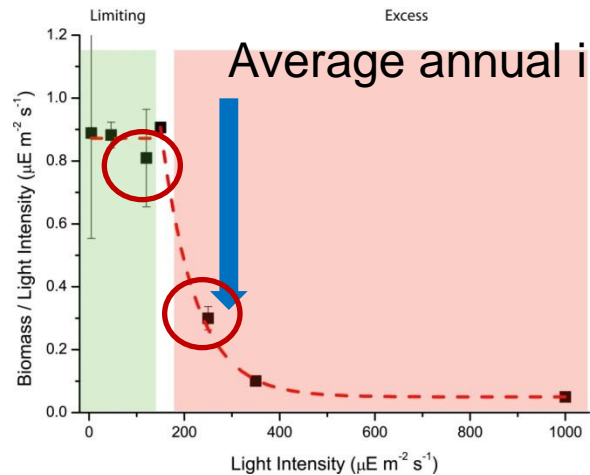
Algae photosynthetic productivity evaluated from

Biomass production / Light Intensity

Growth dependence from irradiance



Similar Growth

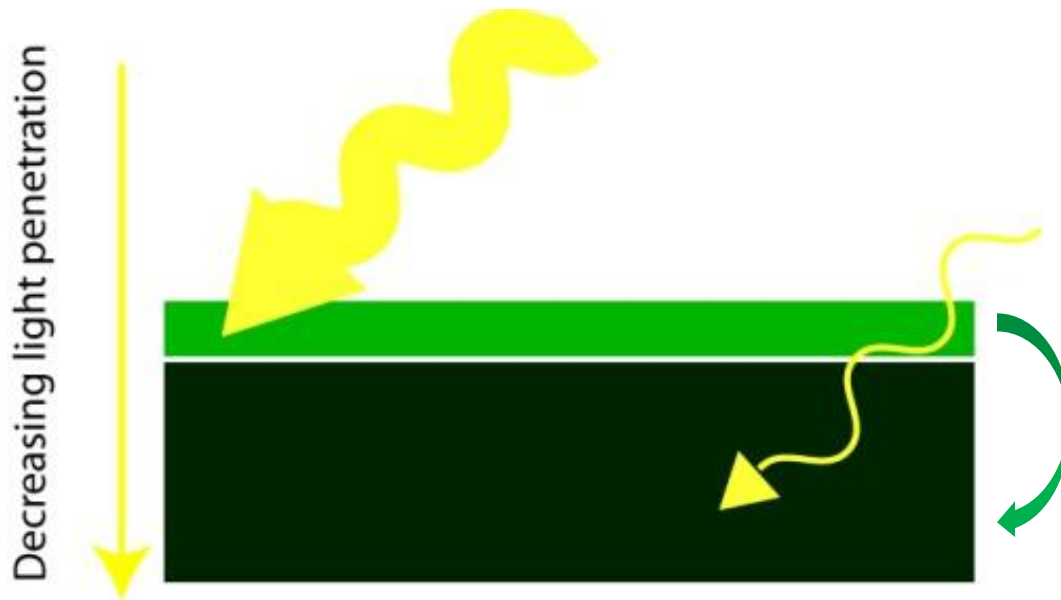


Average annual irradiation in Padova

≈ 50% less light use efficiency

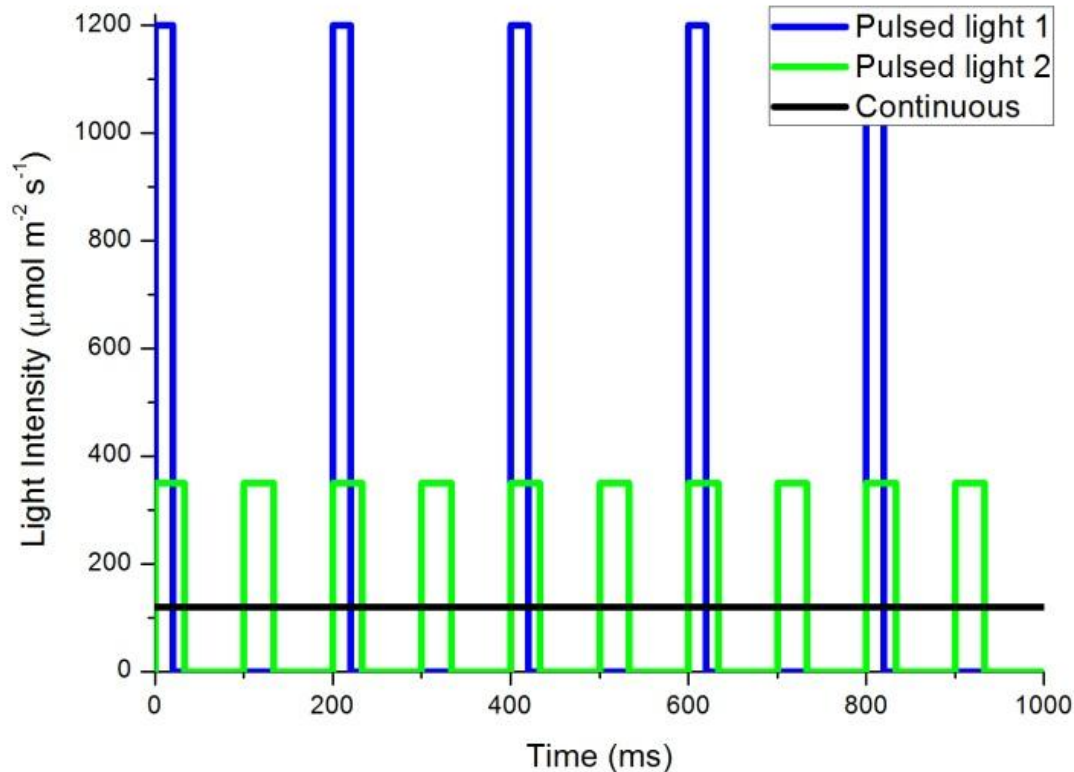
How can we use strong light more efficiently ?

In Photobioreactors cells are exposed to dark /
light cycles

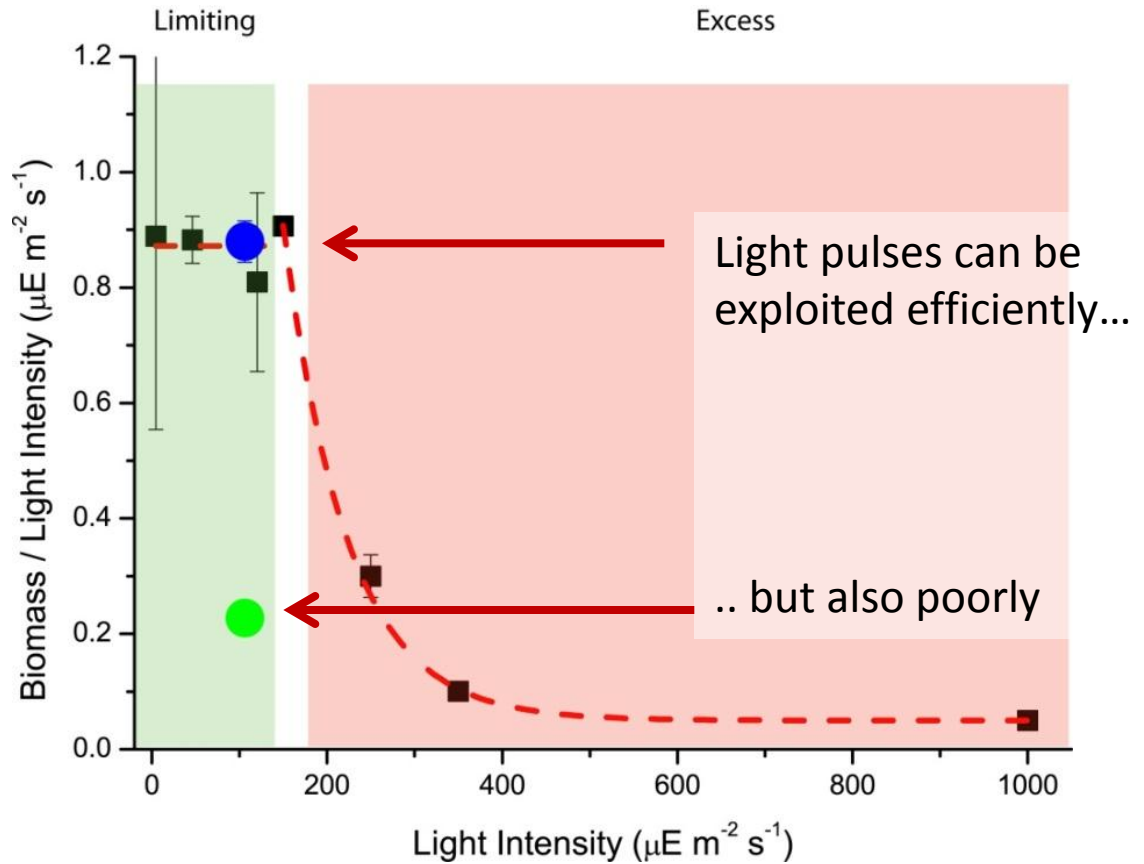
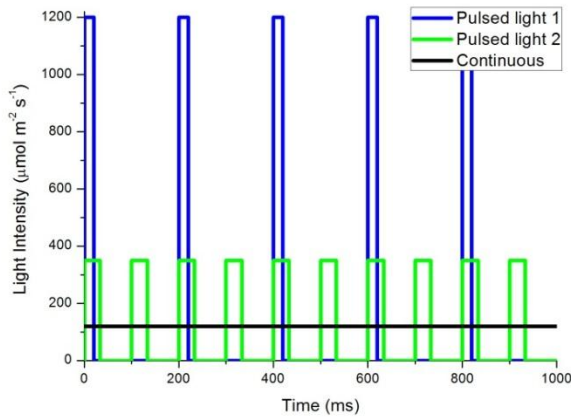


How this affect light use efficiency?

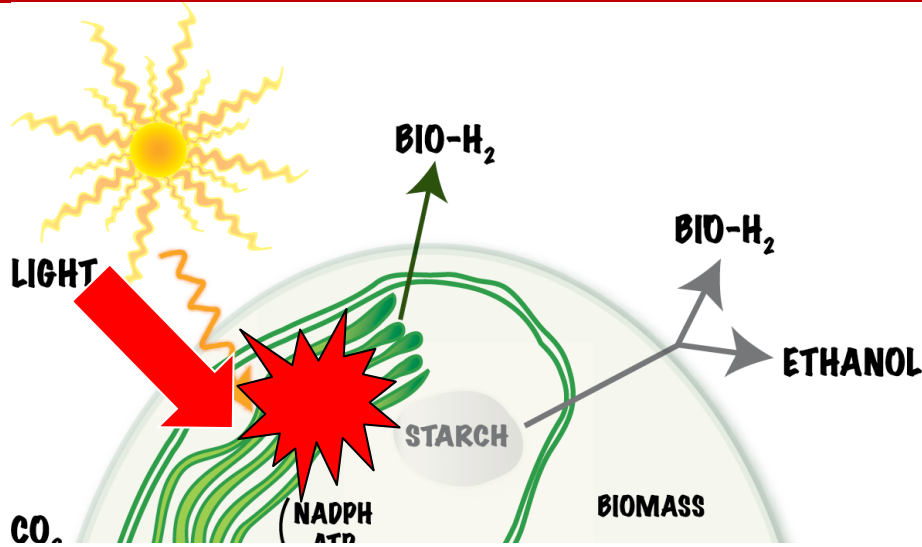
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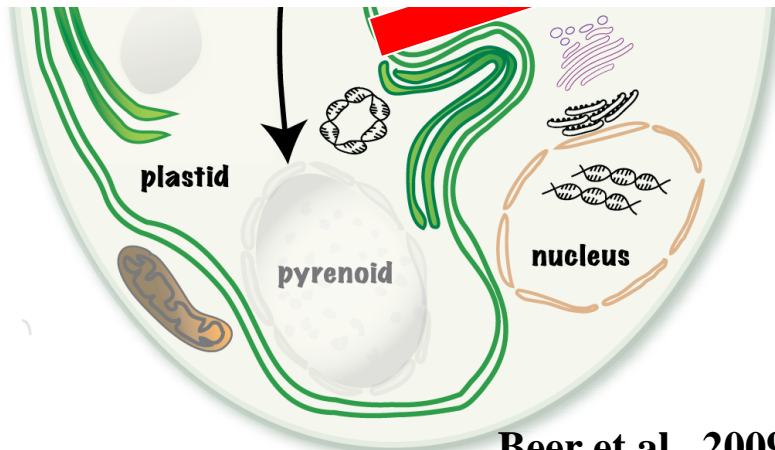
The same amount of energy (I_a) is provided by continuous light or with pulsed light



Light pulses with optimized duration and frequency can be exploited with high efficiency even if very strong



Light is also a signal for the cells,
how this affects lipids
accumulation?



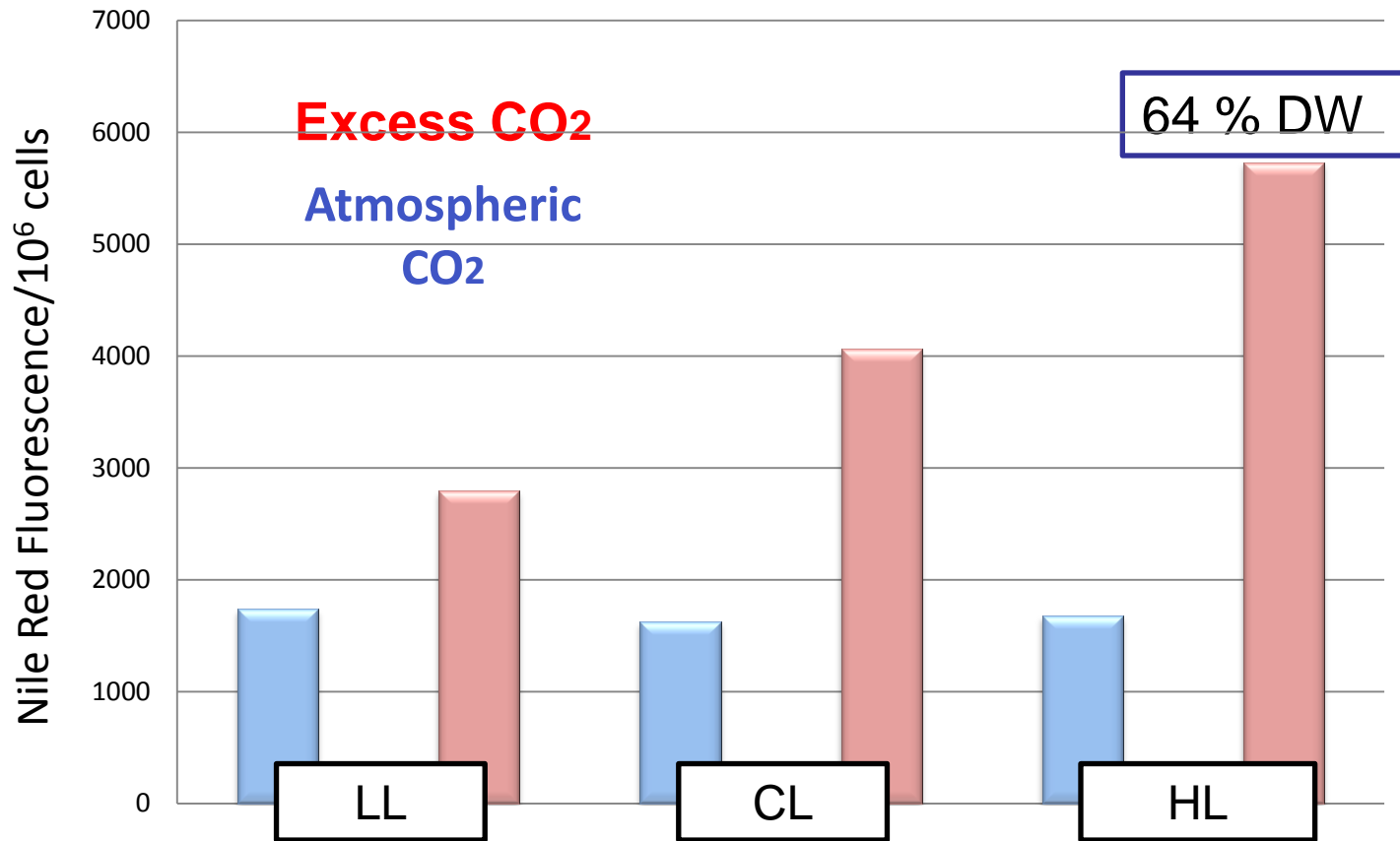
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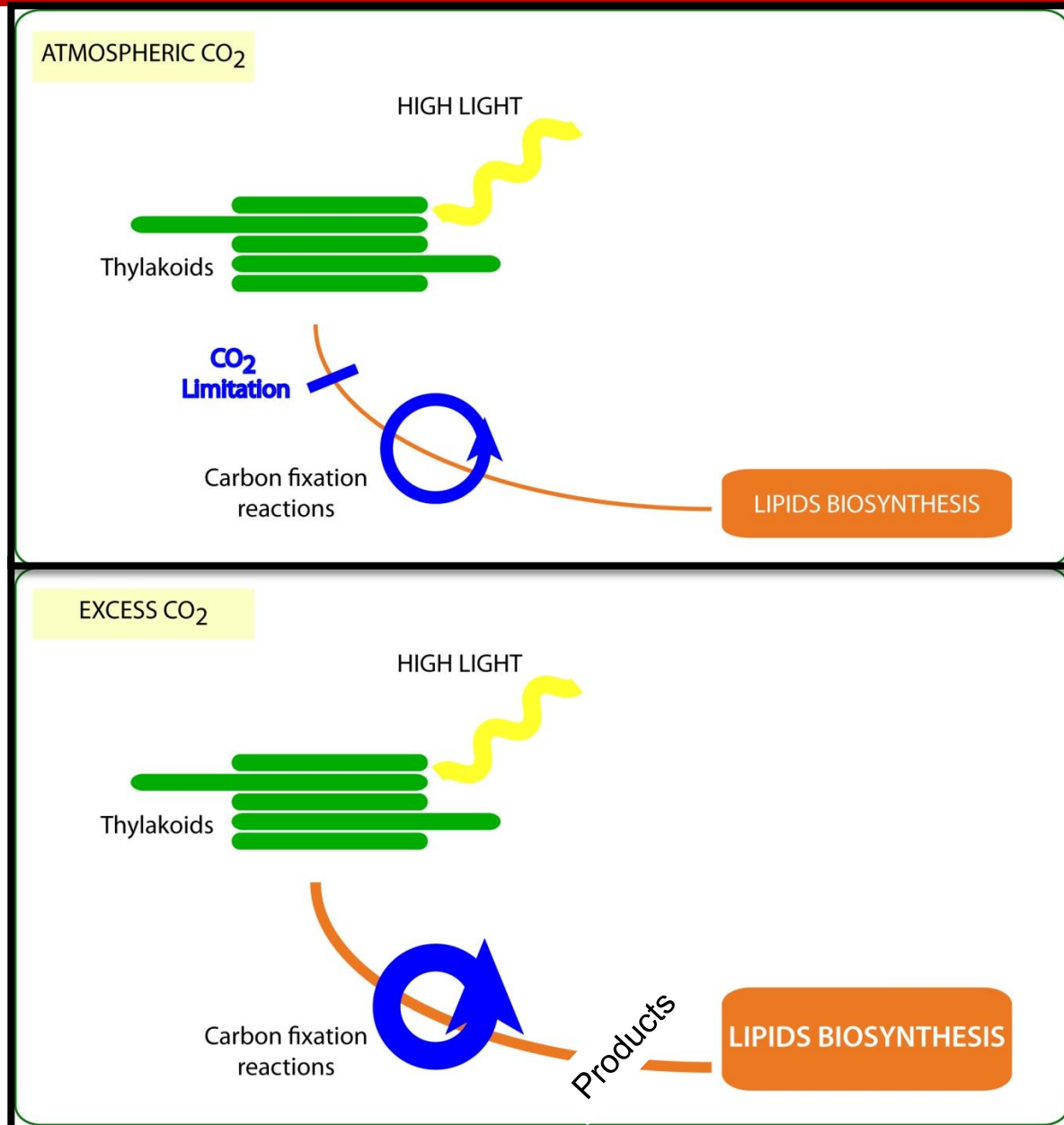
Maximizing production of
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How is the biosynthesis
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influence of chloroplast?

Influence of illumination intensity on lipids biosynthesis



Strong light induce lipids accumulation only in the presence of excess CO₂

Light influence on lipids accumulation





Diana Simionato

Giorgio M. Giacometti

Dipartimento di Biologia, Università di Padova

Eleonora Sforza

Fabrizio Bezzo

Alberto Bertuccio

Dipartimento di Ingegneria Industriale
Università di Padova (Italy)