Carbon dioxide concentration in Mediterranean greenhouses: how much lost production?

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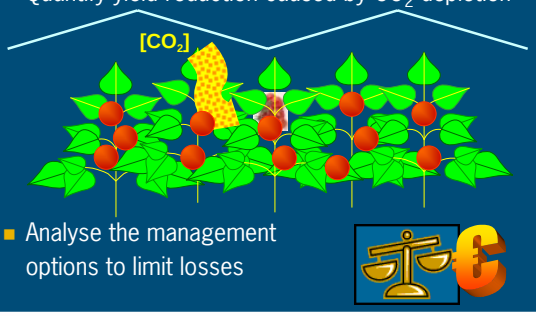
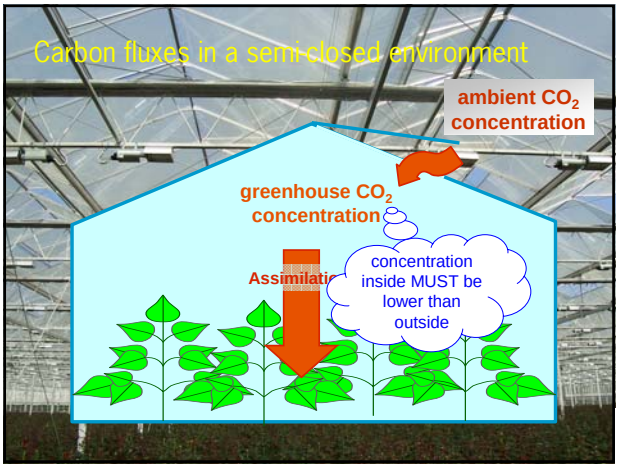
Aims:

- Quantify yield reduction caused by CO_2 depletion

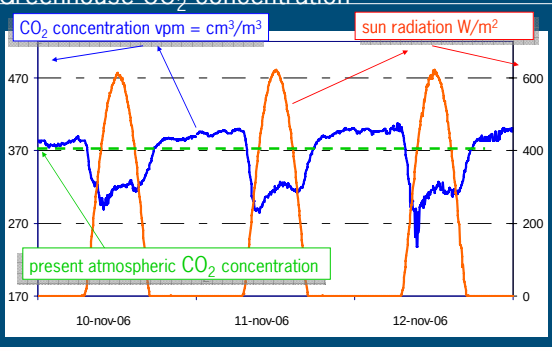


- Analyse the management options to limit losses

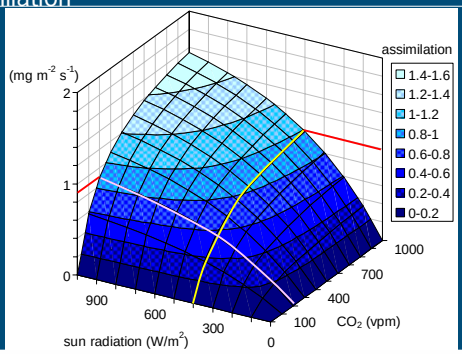
Carbon fluxes in a semi-closed environment



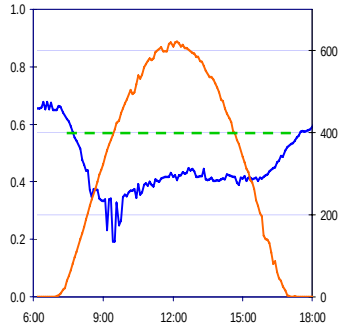
Greenhouse CO_2 concentration



Assimilation

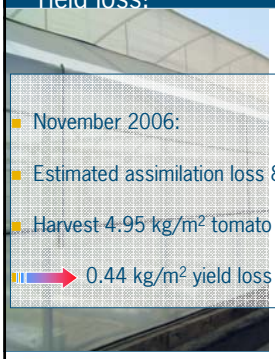


Lost assimilation?

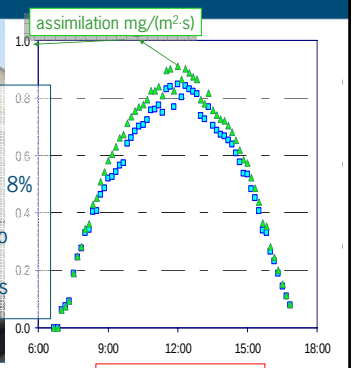


Almeria, 12 nov 2006

Yield loss?



- November 2006:
- Estimated assimilation loss 8%
- Harvest 4.95 kg/m² tomato
- 0.44 kg/m² yield loss



Almeria, 12 nov 2006

440 g/m² = how much lost revenue?

Year	Price €/kg	Estimated loss €/m²
2003	1.05	0.47
2004	1.15	0.51
2005	0.55	0.24

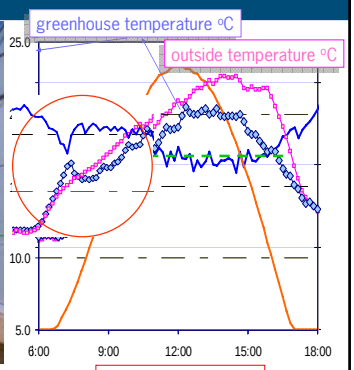
- Truss tomato Almeria producers' price in November

→ 2400 to 5100 €/ha in one month

Fundación Cajamar, Almeria, 2006

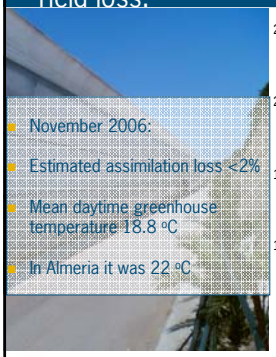
More ventilation?

Thanks to
Azienda Fratelli Dezio, Vittoria,
for free access to their data

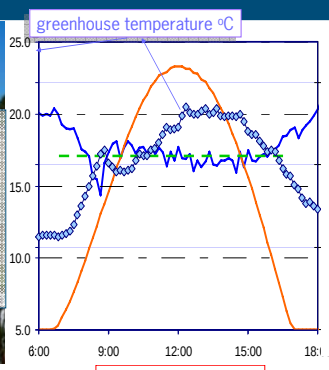


Ragusa, 11 nov 2006

Yield loss?



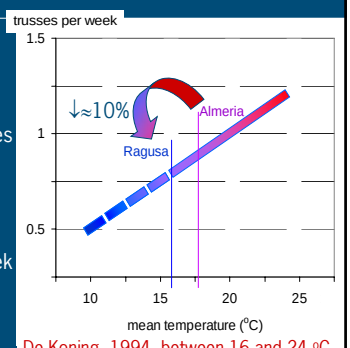
- November 2006:
- Estimated assimilation loss <2%
- Mean daytime greenhouse temperature 18.8 °C
- In Almeria it was 22 °C



Ragusa, 11 nov 2006

Loss of revenue?

- Number of harvested trusses is proportional to mean temperature
- +2 °C → +0.1 truss /week



De Koning, 1994, between 16 and 24 °C

Heating?

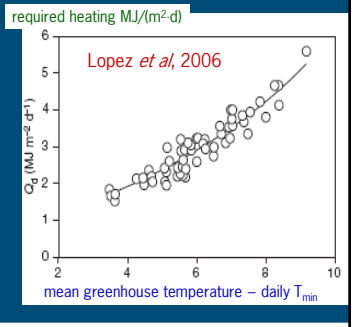
November 2006

Running costs:

- mean temperature ↑ 1.6 °C
- would have required:
- ≈ 0.5 $kg_{propane}/m^2$ ≈ 32 $€_{cent}/m^2$

Benefits:

- 24 to 51 $€_{cent}/m^2$



Carbon dioxide fertilization?

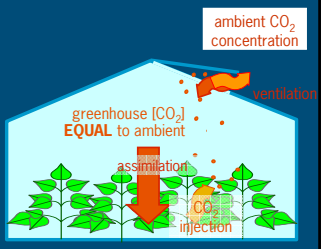
November 2006

Running costs:

- 0.44 kg x 6% d.m. in fruits
- / 0.65 harvest index
- ≈ 0.041 kg/m² "missing" dry matter
- /0.7 CO_2 fixation efficiency
- × weight (CH_2O/CO_2)
- ≈ 0.082 kg_{CO2}/m^2 < 2 $€_{cent}/m^2$

Benefits:

- 24 to 51 $€_{cent}/m^2$



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Conclusions

- Ventilation is often a trade-off between carbon dioxide depletion and excessive cooling (and prevention of pathologies)
- Both low [CO_2] and low temperature reduce yield and there is no sure way to tell each time what is better and what is worse
- However, it is much cheaper to compensate for carbon depletion than for excessive cooling
- Thus the best strategy by far is to ventilate as little as possible and supply CO_2 up to the outside concentration

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