Carbon Dioxide Irrigation: Using CO_2 to Make the Deserts Bloom

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Initial experiments confirmed that water usage was in line with expectations

	Chlorella vulgaris	*Lemna minor*
Dry weight of biomass (g)	13.25	3.17
Water loss in vented air (g)	0.23	0.50
Water chemically incorporated in dry biomass (g)	7.36	1.76
Total water consumed (g)	8.59	2.26
WUE (total water consumed: dry weight of biomass)	0.65:1	0.71:1

Limitations:

- Small scale experiments
- Aquatic species only
- Temperature controlled

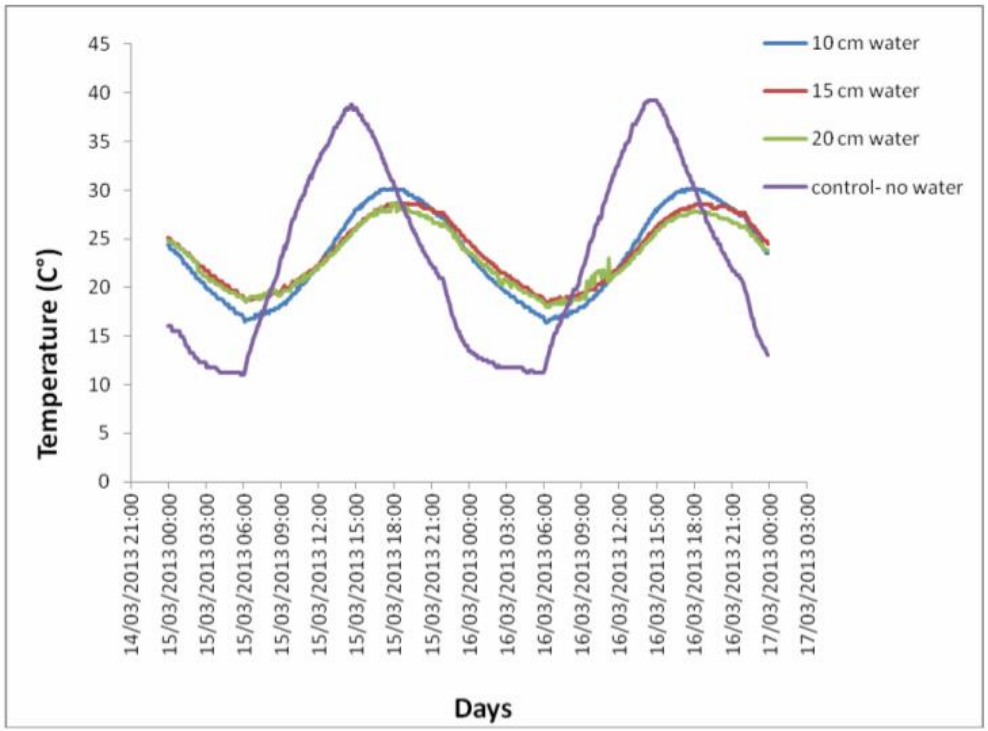
Recent Experiments at Plant Sciences

- Larger sealed tanks
- Terrestrial and aquatic species
- Temperature of greenhouse raised to 40C during the day and reduced to 10C at night to simulate the diurnal temperature change in a desert environment

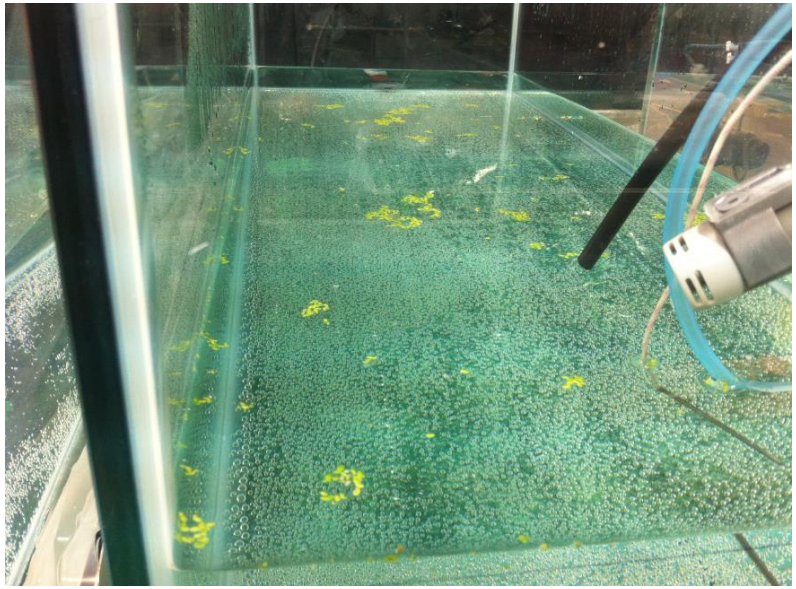
Three Challenges

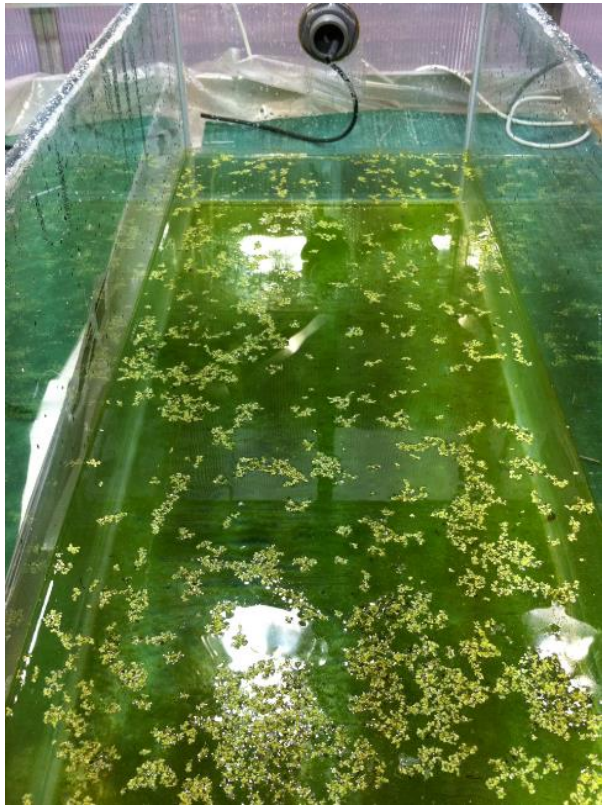
- Temperature control
- Humidity control
- Cost

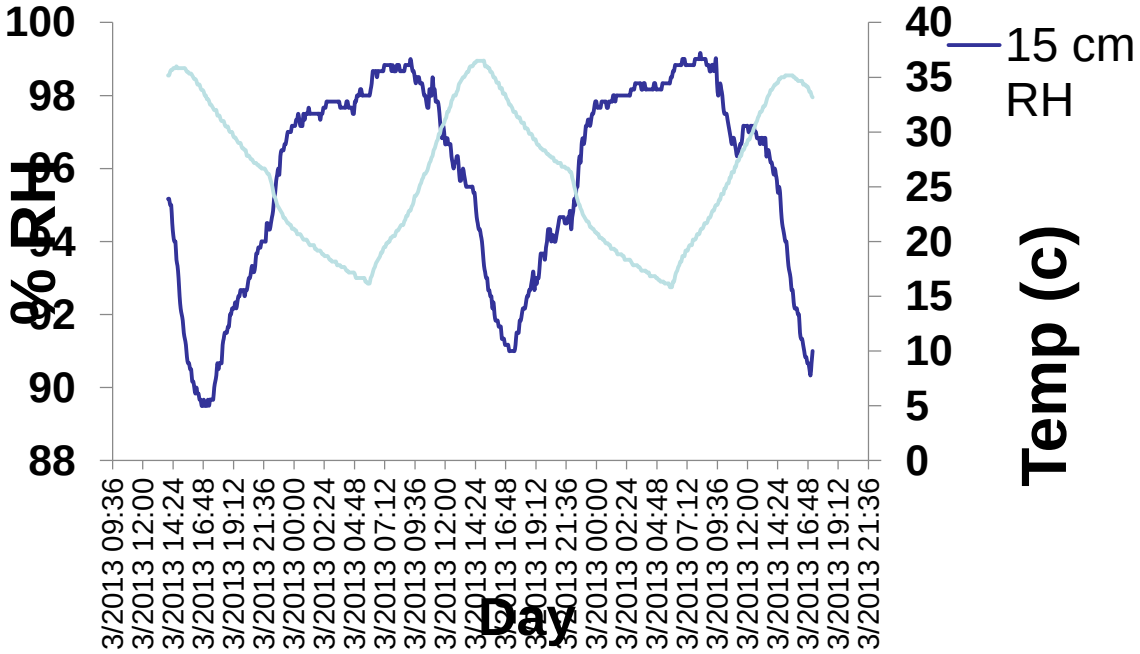
Initial set-up and abiotic experiment to test solution to temperature control challenge



Experiment to test solution to humidity control challenge

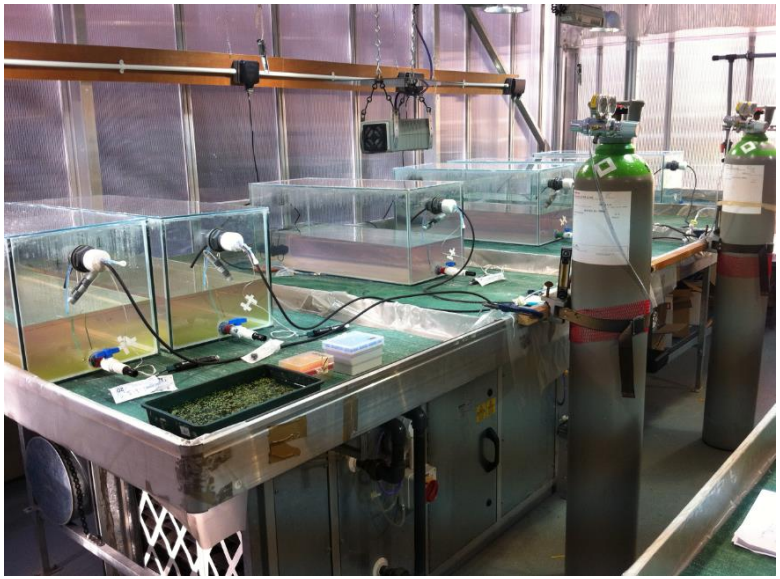






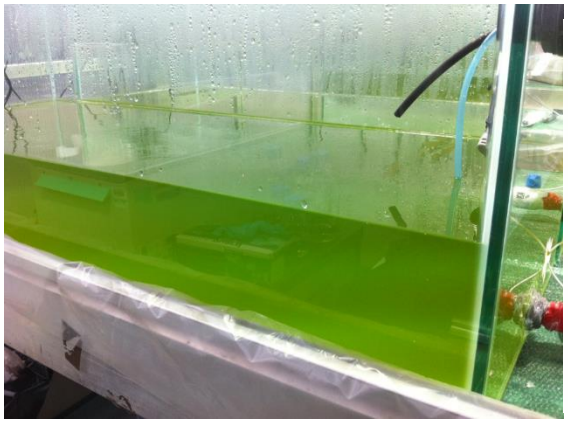
Experiments demonstrating the performance of terrestrial species in the sealed system

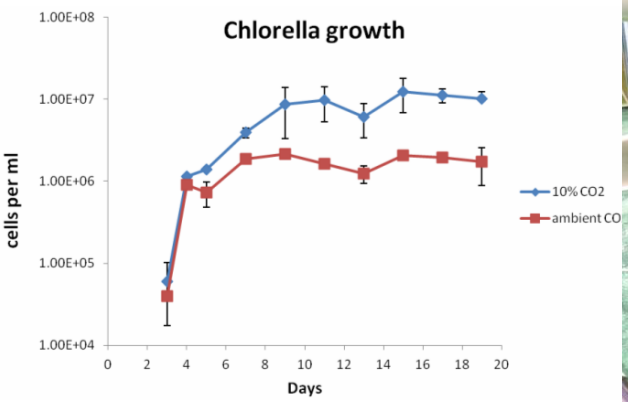
Experiments to demonstrate the 99% reduction in water required to produce biomass at mesocosm scale

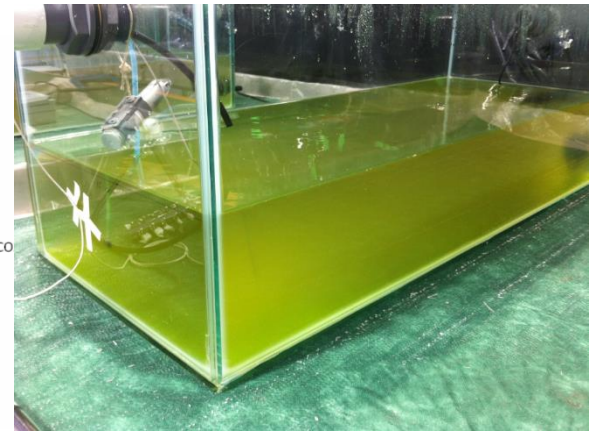


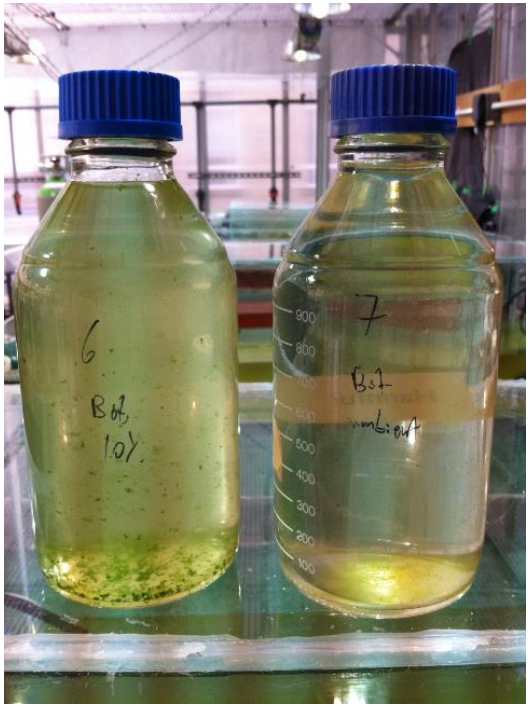
	Chlorella vulgaris (10% CO_2)	*Chlorella vulgaris* (Ambient)	*Botryococcus braunii* (10% CO_2)	*Botryococcus braunii* (Ambient)
Dry weight of biomass (g)	4.26	1.11	3.93	0.96
Water loss in vented air (g)	0.94	1.38	2.50	0.81
Water chemically incorporated in dry biomass (g)	2.37	0.62	2.18	0.53
Total water consumed (g)	3.31	2.00	4.68	1.34
Total water consumed: dry weight of biomass	0.76:1	1.80:1	1.19:1	1.40:1

Experimental results demonstrating that the CO_2-fertilisation effect in action in the sealed system









Tank number (species)	Conditions	Biomass increase (mg/L)
1 (Chlorella)	10% CO2	69
2 (Chlorella)	10% CO2	73
3 (Chlorella)	ambient CO2	17
4 (Chlorella)	ambient CO2	20
5 (Botryococcus)	10% CO2	89
6 (Botryococcus)	10% CO2	42
7 (Botryococcus)	ambient CO2	15
8 (Botryococcus)	ambient CO2	17

Implications

- The CO_2 Irrigation concept is confirmed: very low water loss
- We can definitely grow algae in this system
- Humidity levels still problematic for terrestrial species
- The body of water acted as a thermal buffer