

Effects of dynamic control in greenhouses?

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Control of climate requires

Sensors

Heating

Ventilation

Shading

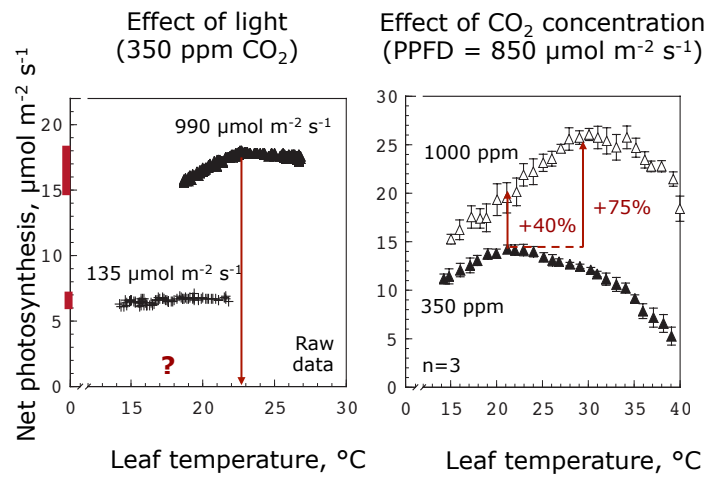
Light

CO₂

Nutrients and water

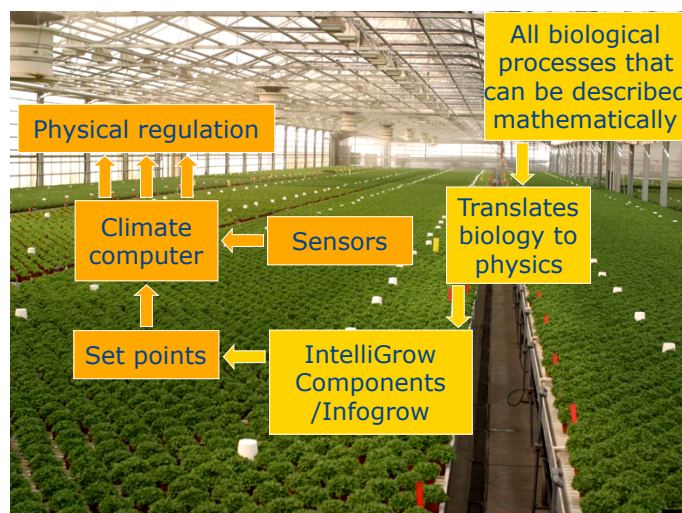


Why and how a dynamic climate?



Department of Food Science *Chrysanthemum indicum*-hybr. 'Coral Charm'

Principles of dynamic climate control



Energy saving in rose production

Standard
climate

'Vanilla' grown **without**
chemical growth regulators



Energy savings...
31% 0%

24%

24%

20%

14%

IntelliGrow – combined with mean temperature control

Argyranthemum frutescens, Growth regulated Jan-Marts

Treatment	DW (g)		Bud and Flowers		Mean Height		% energy use STD 18/17
Std1 8/17	6,1	bc	78,4	ab	138,1	a	100
Avg1 8	6,5	ab	79,4	ab	145,0	a	100
90F17Avg18	5,6	d	78,4	ab	125,6	b	68
90F15Avg18	5,7	dc	70,8	b	126,3	b	92
80F17Avg18	6,7	a	86,3	a	143,8	a	95
80F15Avg18	6,5	ab	77,8	ab	138,8	a	43
Production time (days)	49,0						
Mean temperature (°C)	18.1-18.9						



Std 18/17

90F17Avg18

Avg18

80F15Avg18

80F17Avg18

90F15Avg18

The dynamic greenhouse climate

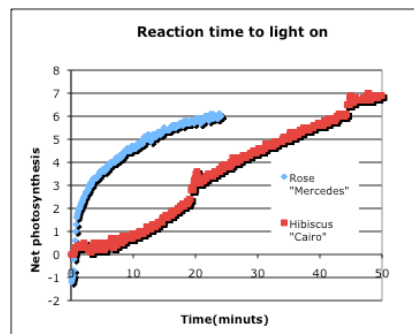
General principles

- Larger span between minimum and maximum temperature
- Larger span in CO₂
- Vents are more closed
- Energy savings are from 30 – 40%

Overall more dynamic climate!

Next step - dynamic use of light

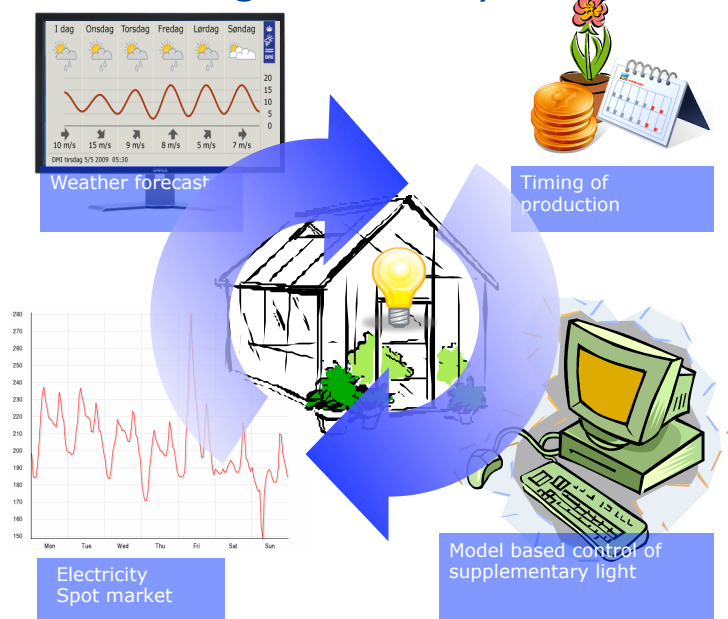
- Higher DLI increases the carbon gain – but at a cost
- Differences in response times of species
- Related to morphology, genetics or annual variation
- And - a dynamic reaction to previous conditions



Dynamics - Use of supplemental light

- Challenges – increasing prices for electricity
- Larger input of non-fossil energy (wind, sun)
- Potential overload of the grid – (smart grid solutions needed)
- Daily fluctuations in prices
- Governmental requirements concerning energy reductions

Background – DynaLight



Dynalight - Dynamic light control

Controls:

1. Weather forecasts (light level)
2. Actual electricity costs (24 hrs)
3. Photosynthesis sums for species (in different season)

Setups (presets):

1. Typically choice of photosynthesis light sum
2. Choice of lighting periods
3. Choice of price levels

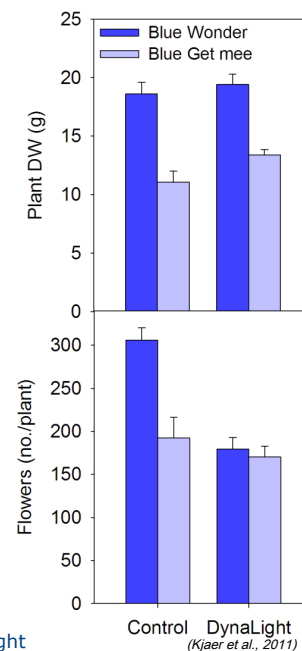
Plant responses in DynaLight?



Control

(Mærsk-Møller et al., submitted)

DynaLight



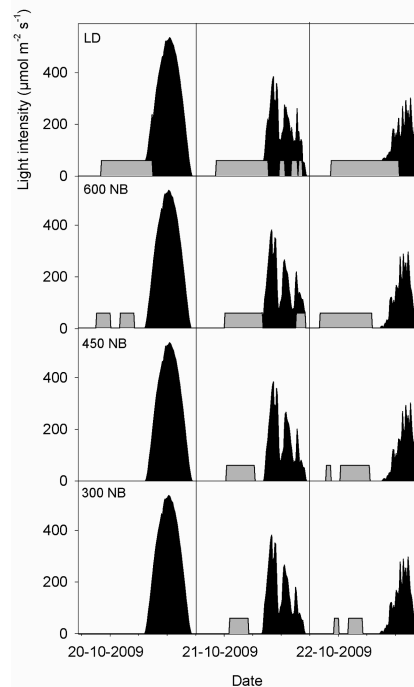


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Dynalight

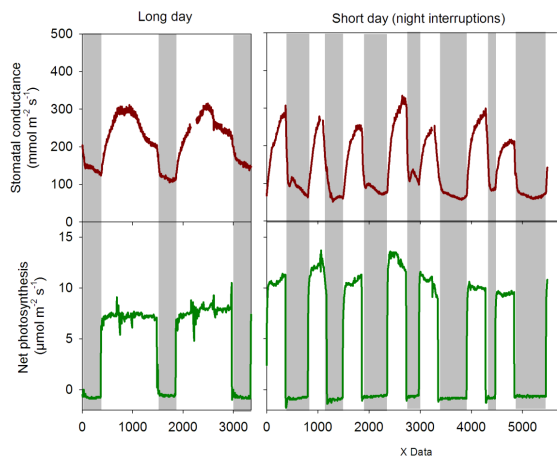
*Light patterns
become
irregular*

Duration and light intensities ($\mu\text{mol m}^{-2} \text{s}^{-1}$) of **solar** irradiation (dark areas) vs. **supplemental** light (grey areas) in four treatments with different light control strategies



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Rapid adaptation of photosynthesis to irregular light conditions



Stomatal opening is rapidly induced by the onset of light

The plants are **not** able to sense day length in the irregular light conditions

Dynamic light does not affect plant growth

Current conclusions –DynaLight

Cost savings due to:

- Lower prices
- Less use of light

In rose (autumn) – up to 30%

No effects on plant quality

In commercial Kalanchoe nursery not less than 15% energy saving (in €)

Last weeks savings...

LED vs SONT 40%

Dynamic control 60%

The research project is part of funding from The Ministry of Food (GUDP) and Ministry of Energy (EUDP), Aarhus University and

GREENGROWING



THIS PROJECT WAS PART FUNDED BY EU THROUGH THE EUROPEAN REGIONAL DEVELOPMENT FUND AND THE NORTH SEA REGION PROGRAMME 2007–2013.

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