

Effects of high light intensity, high humidity and a wide temperature range on growth, development and energy consumption of potted plants

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Background

- Several pot plant species in the Netherlands are cultivated under heavily shaded conditions
 - hypothesis: more sunlight is tolerated at higher humidity
- Combined with growing under a wider range of temperatures should lower the use of fossil energy
- What are the (im)possibilities?!

All year round trial

■ 4 growth periods

- Half compartments in shifts (70 m²)
- Cultivation time about 6 months
 - 1: wk 37 '09 - wk 04 '10
 - 2: wk 45 '09 - wk 16 '10
 - 3: wk 07 '10 - wk 28 '10
 - 4: wk 17 '10 - wk 38 '10

■ 7 different crops

- Anthurium, Areca, Calathea, Dracaena, Ficus, Guzmania, en Oncidium (and Dendrobium from 2e period)



Climate settings

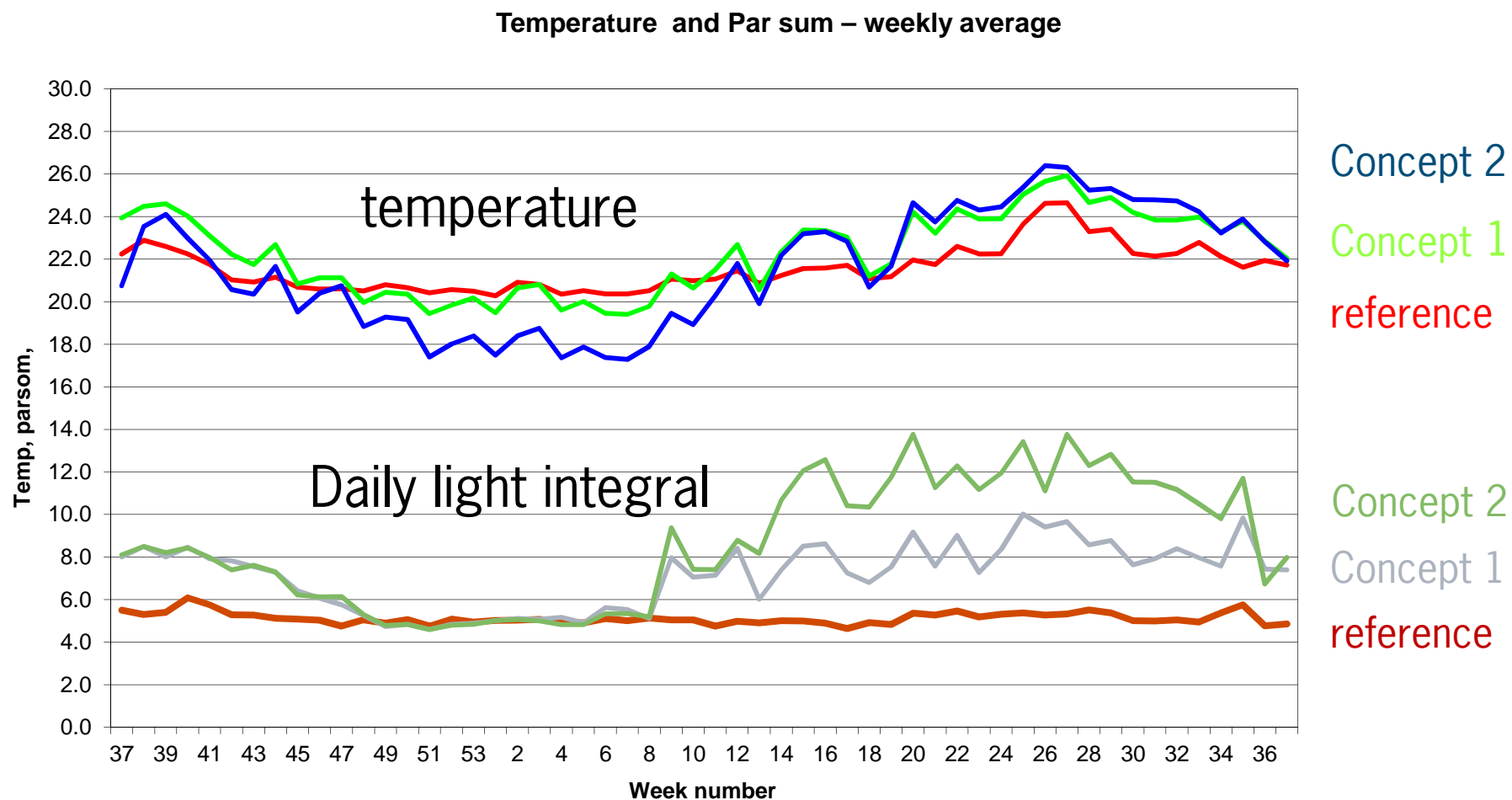
	Reference (9.06)	Concept 1 (9.07)	Concept 2 (9.08)
Light	5 mol/m ² /day		
Shade screens closed	300 w/m ²	450 w/m ² 500 w/m ²	450 w/m ² 500 w/m ²
Screen type	LS10 (energy), LS 16 (shadow), 50% whitewash	LS 10, Diaphragm, 25% whitewash	LS 10, Diaphragm
Temperature	19°C night /21°C day. Ventilate above 23°C	Heating from 17.5°C; ventilate above 28°C	Heating below 15°C; ventilate above 28°C
Fogging system	Below 40% RH	Below 60% RH	Below 80% RH

Diaphragm-screen

(80% diffuse/20% black, proportional effect between 42-64%)



Light and temperature levels (weekly average)



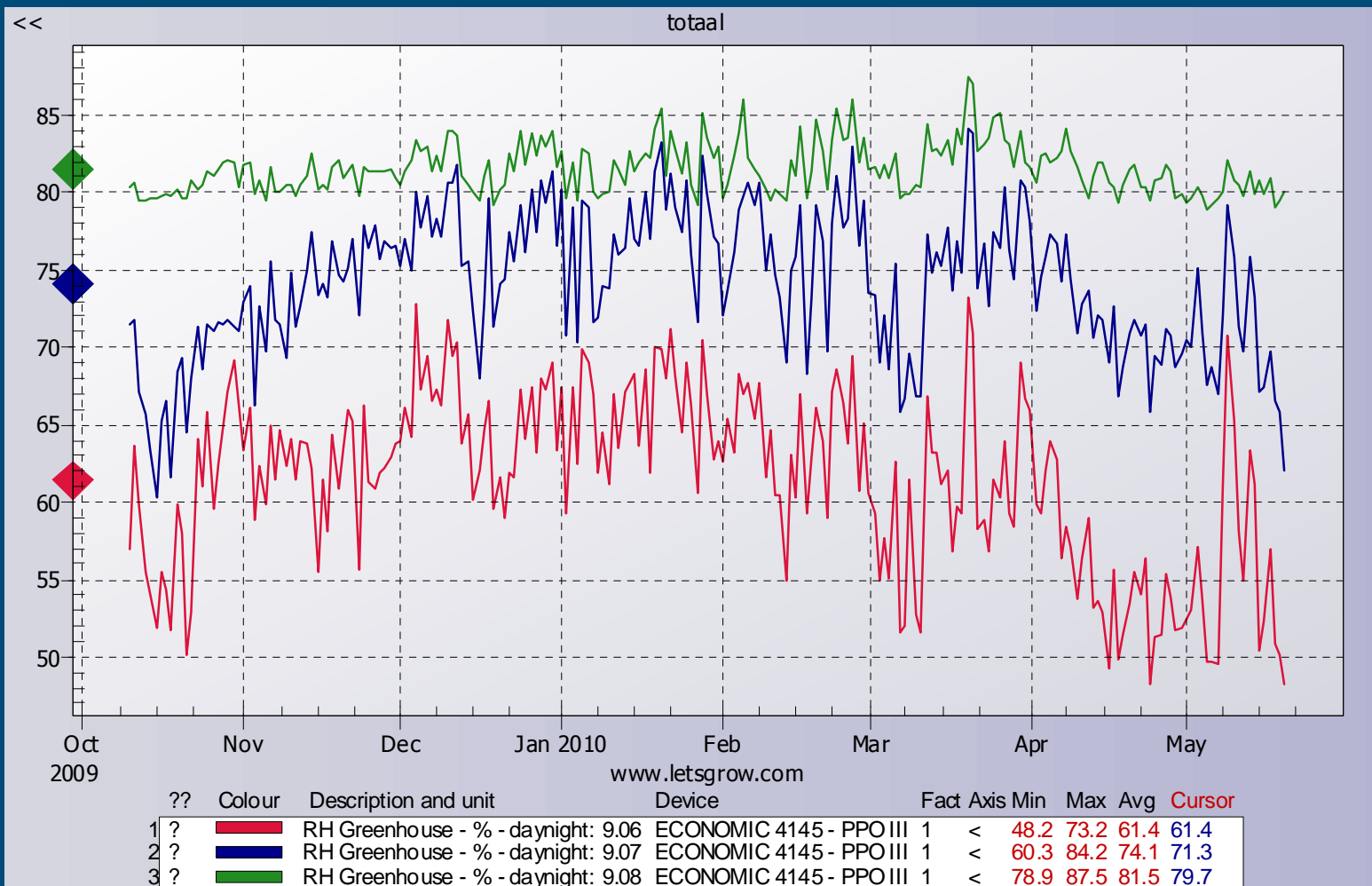
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Relative humidity



Concept 2

Concept 1

reference

Previous

Next

Energy consumption

	Heating [MJ/m ²]			Electricity [kWh/m ²]	Savings on heating [%]	
	Reference	Concept 1	Concept 2	All compartments	Concept 1	Concept 2
period 1	90	37	12	70	59	86
period 2	145	55	29	63	62	80
period 3	140	20	7	12	86	95
period 4	64	1	0.3	8	98	100
Total	264	67	33	95	75	88
	savings on primary fuel (%)				19.5	22.5

Results: Fresh Weight

	Increase in Plant Fresh Weight (%)			
	Concept1	Variation	Concept2	Variation
period 1	8	-12/+22	11	-3/+44
period 2	8	-22/+46	4	-18/+34
period 3	23	-6/+65	36	-17/79
period 4	50	-8/+106	40	+2/+74
average	22	-22/+106	23	-18/+79

Results: Leaf Area

	Increase in Leaf Area per Plant (%)			
	Concept1	Variation	Concept2	Variation
period 1	10	-12/+17	13	-9/+44
period 2	4	-15/+36	0	-18/+31
period 3	17	-19/+58	26	-7/+73
period 4	23	-15/+84	24	-4/+65
average	13	-14/+84	16	-28/+73

Development: extra side shoots

Increase (%)	Anthurium		Calathea	
	Concept 1	Concept 2	Concept 1	Concept 2
period 1	3	14	3	3
period 2	33	36	9	9
period 3	35	-8	7	18
period 4	73	20	7	10

Development: extra internodes

Increase (%)	Ficus		Dracaena	
	Concept 1	Concept 2	Concept 1	Concept 2
period 1	5	3	12	8
period 2	6	11	-9	-9
period 3	5	3	-2	15
period 4	6	12	11	0

Development: extra flowers

Number of flowers (%)	Anthurium	
	Concept 1	Concept 2
period 1	11	22
period 2	67	116
period 3	44	78
period 4	125	125

Development: Delayed flowering in period 2

Delay of flowering (days) period 2 (wk 45- wk 16)		
	Concept 1	Concept 2
Dendrobium	0	14
Guzmania	21	21
Oncidium	28	35
No delay in other trial periods		

Results period 1 (wk 37 – wk 4)



■ Concepts had:

- More fresh weight and leaf area with Anthurium, Areca, Calathea, Dracaena, Ficus, Guzmania (0-60%)
- Most plants were taller, Anthurium equal en Calathea shorter
- Oncidium more and heavier flowering inflorescence

Quality rating period 1



- Concept 1 had better quality with all potplant except Areca (leaf yellowing)
- Concept 2 had better quality than the reference, but not as good as concept

Results period 2

(wk 45 – wk 16)

- Concept 1
 - No delay in growth or flowering
- Concept 2
 - No delay in growth, but delay in flowering

Quality rating period 2



- Concept 1 had better quality with all potplant except Areca (leaf yellowing)
- Concept 2 was equal with the reference

Results period 3 and 4

wk 7-28 and wk 17-38

■ Teeltconcept 1

- More growth and flowering
With 6 out of 8 crops

- Less growth with Dracaena (unequal plants), Oncidium (but more branching and flowers)

■ Teeltconcept 2

- More growth and flowering with 7 out of 8 crops
(Oncidium had less growth)



Quality rating

3 and 4 period



- Concept 1 had better quality with all potplant except Areca (leaf yellowing)
- Reference was better than concept 2 caused by the leave coloring (light green instead of dark green)

Conclusions period 1

- Period 1 had a modest improvement on growth and no delay in development and flowering in winter

Conclusion period 2

- Concepts had no delay in growth for most species
- Concepts resulted in delayed flowering in Dendrobium, Guzmania and Oncidium in the winter period (low light, low temperature)

Conclusions period 3 and 4

- Most potplants showed a lot of extra growth in both concepts.
- Concept 2 resulted also lighter green or yellowing leaves in Anthurium, Dracaena or leaf damage in Areca and Guzmania

General conclusions

- It's possible to save energy, get more growth and reduce production time by allowing more natural light, a wider temperature range and higher humidity, but not always without delay (winter time) or loss of quality (summer time).
- Concept 1 would be the best option – less energy and good quality
- Optimization of natural light can probably be achieved by applying diffuse glass and/or diffuse screens, and perhaps new greenhouse concepts (e.g. focus greenhouse with fresnel lenses)

Thank you for your attention



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