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 (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

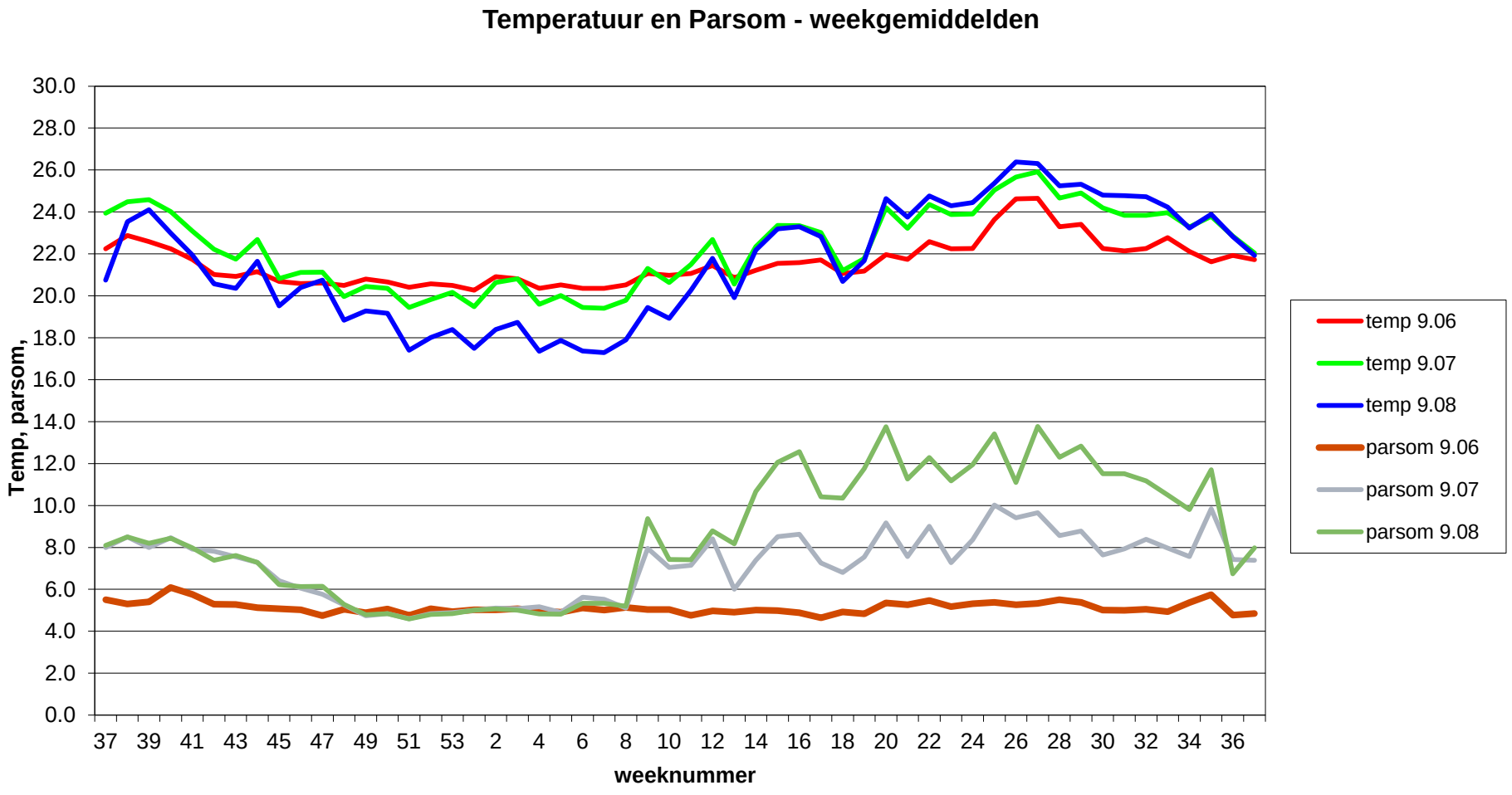
	Reference (9.06)	Concept 1 (9.07)	Concept 2 (9.08)
Light	5 mol/m2/day		
Shade screens closed	300 w/m2	450 w/m2 500 w/m2	450 w/m2 500 w/m2
Screen type	LS 16, 50% whitewash	LS 10, Diaphragm, 25% whitewash	LS 10, Diaphragm
Temperature	19°C night /21°C day. Ventilate above 23°C	Heating from 17.5°C; ventilate above 28°C	Heating below 15°C; ventilate above 28°C
Fogging system	Below 40% RH	Below 60% RH	Below 80% RH

Diaphragm-screen

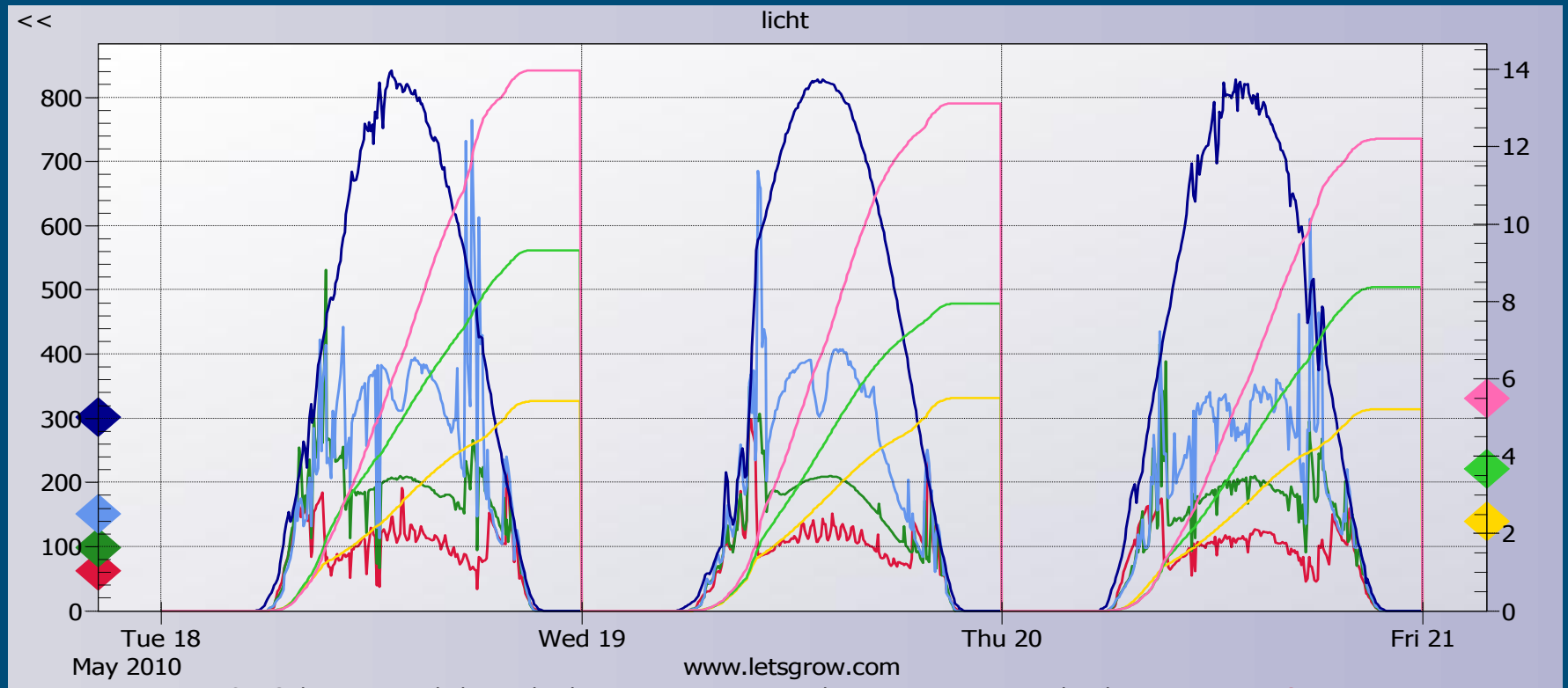
(80% diffuse/20% black, proportional effect between 42-64%)



Light and temperature levels (weekly average)



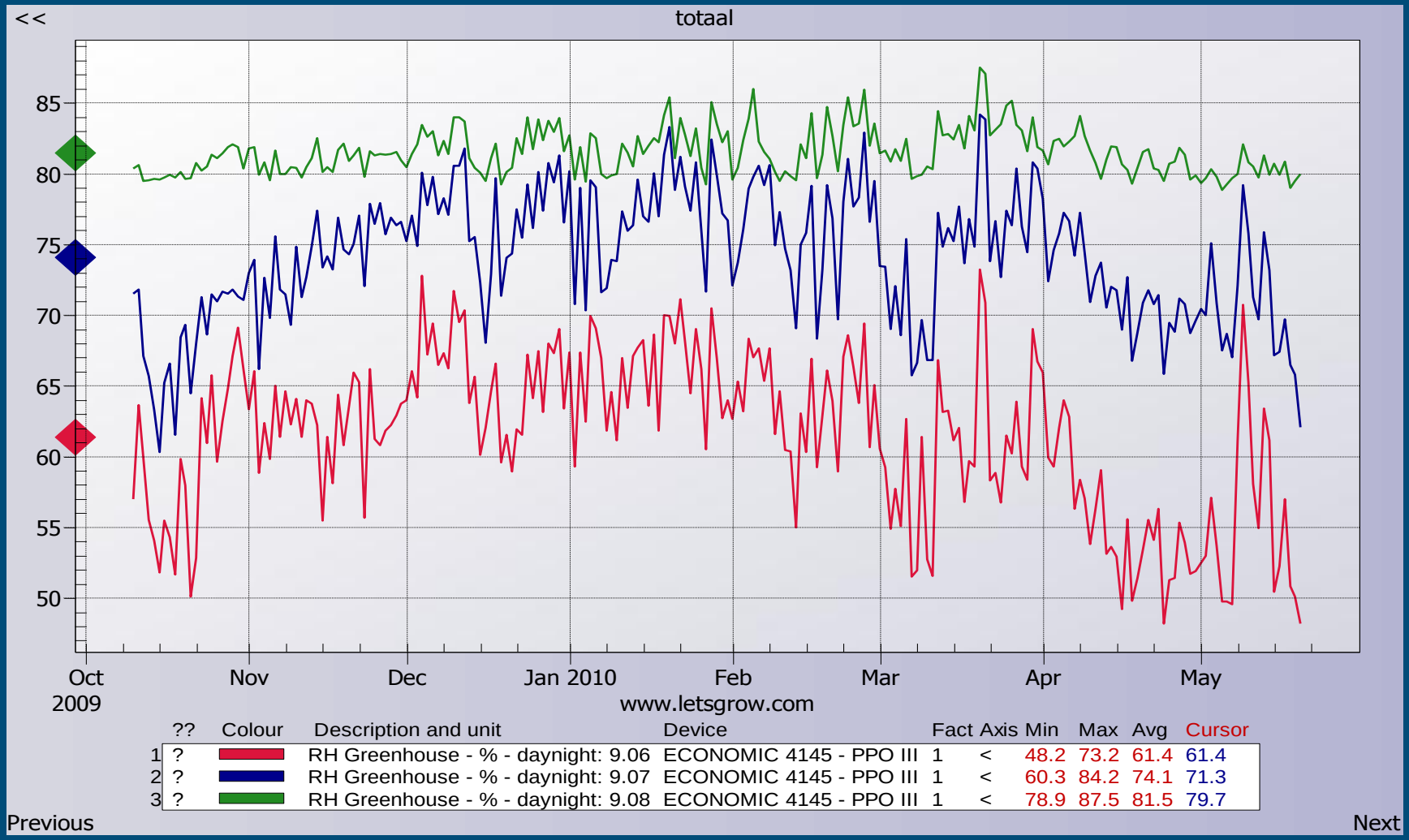
Example (19-21 mei 2010)



	?	Colour	Description and unit	Device	Fact	Axis	Min	Max	Avg	Cursor
1	?		plant: PAR - µmol/m²/s -: 9.06	iSii 4145 - PPO III	1	<	0.0	298.0	62.1	0.0
2	?		plant: PAR - µmol/m²/s -: 9.07	iSii 4145 - PPO III	1	<	0.0	531.0	98.7	0.0
3	?		plant: PAR - µmol/m²/s -: 9.08	iSii 4145 - PPO III	1	<	0.0	764.0	151.4	0.0
4	?		radiation - W/m² -: De Kring - Bleiswijk	Live Meteo Data	1	<	0.0	842.0	302.1	3.0
5	?		PAR sum - mol/m² -: 9.06	iSii 4145 - PPO III	1	>	0.0	5.5	2.3	0.0
6	?		PAR sum - mol/m² -: 9.07	iSii 4145 - PPO III	1	>	0.0	9.3	3.7	0.0
7	?		PAR sum - mol/m² -: 9.08	iSii 4145 - PPO III	1	>	0.0	14.0	5.5	0.0

Previous Next

Relative humidity



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Energy consumption

	Heating [MJ/m²]			Electricity [kWh/m²]	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

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		

Conclusions period 1



- Typical low light-induced delay of phasic development and flowering in winter was largely prevented by the stimulated growth in autumn by more natural light in both concepts.

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, but gave 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 bij allowing more natural light, a wider temperature range and higher humidity, but not always without delay (winter time) or loss of quality (summer time).
- Optimization of natural light can probably be achieved by applying diffuse glass and/or diffuse glass, and perhaps new greenhouse concepts (e.g. focus greenhouse with lenses)

Thank you for your attention



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