

# Cyclic Lighting in Strawberry Greenhouse Cultivation:

Sustainable Alternatives for the Incandescent Lamps



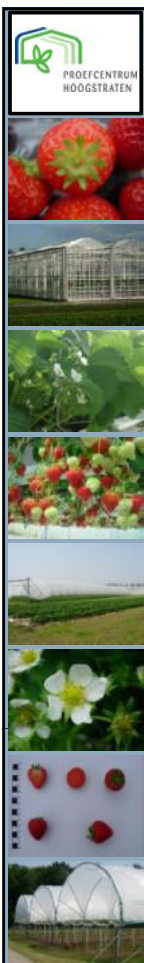
02/09/2010

Tom Van Delm



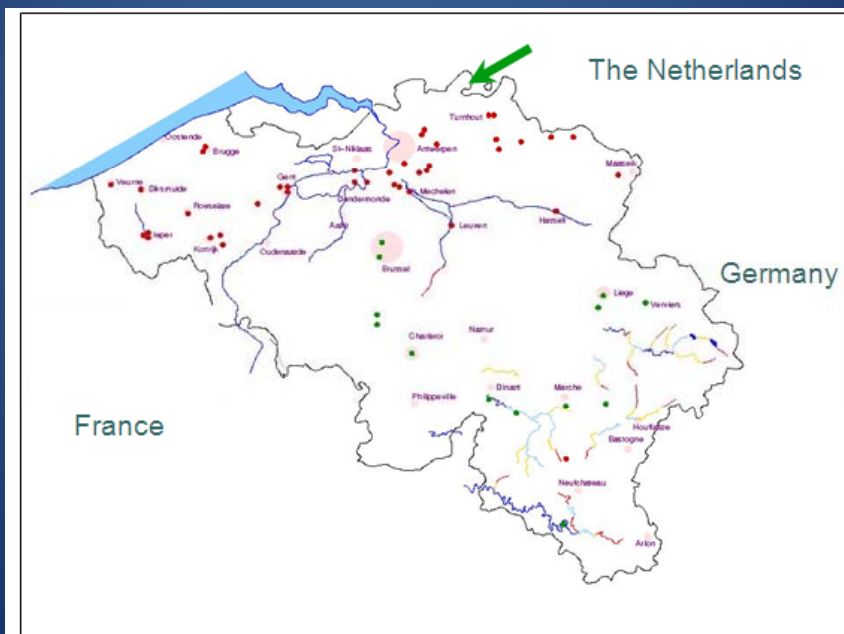
## Overview

- Introduction
- Cyclic lighting in glasshouse
- Trial setup
- Results
  - ~ Lighting period
  - ~ Stretching
  - ~ Production and grading
  - ~ 50% of harvest
- Conclusions



# Introduction

- Research centre Hoogstraten - Meerle

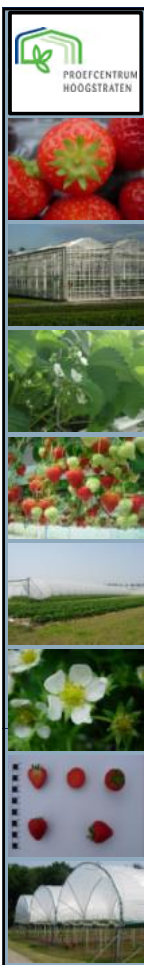




# Introduction

- Research centre Hoogstraten - Meerle



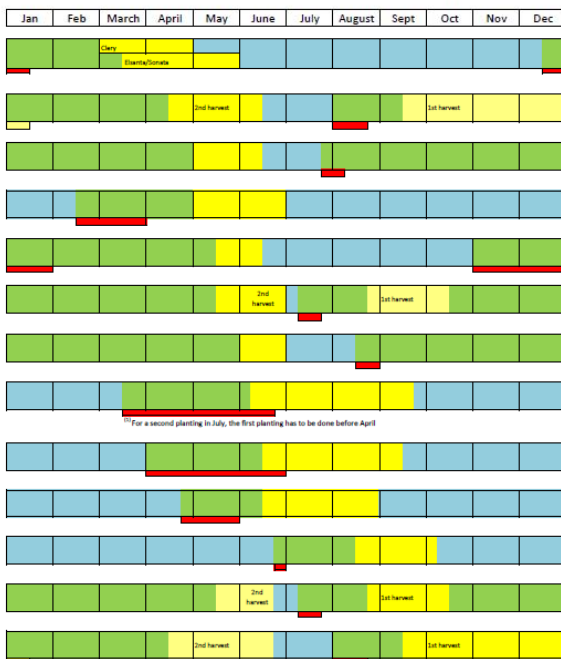


# Strawberry cultivation in Hoogstraten



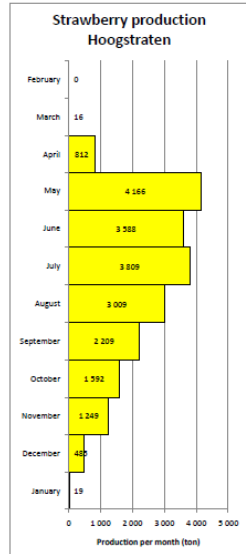
- GLASS GREENHOUSE**  
End Dec -begin Jan planting  
Clery/Sonata/Elsanta) (T/S)
- August planting (T/S) (\*)
- PLASTIC TUNNEL**  
 August planting Darselect(F/G)
- PLASTIC GREENHOUSE**  
 Spring planting Elsanta (T/S) (\*\*)
- PLASTIC TUNNEL**  
 Autumn/winter planting Elsanta (WB/G)
- PLASTIC GREENHOUSE**  
 July planting Elsanta (T/S) (\*\*)
- NON-COVERED FIELD**  
 August planting Elsanta (F/G)
- TABLE TOPS**  
 Spring planting Elsanta  
Table Tops (T/S) (1)
- NON-COVERED FIELD**  
 Delayed cultivation Elsanta (WB/G)
- GLASS GREENHOUSE**  
 spring planting Elsanta (T/S)
- TABLE TOPS**  
 2nd planting Elsanta (T/S)
- PLASTIC GREENHOUSE**  
 July planting Elsanta (T/S) (\*\*)
- GLASS GREENHOUSE**  
 August planting Elsanta (T/S) (\*)

## Strawberry cultivation Hoogstraten (Belgium)



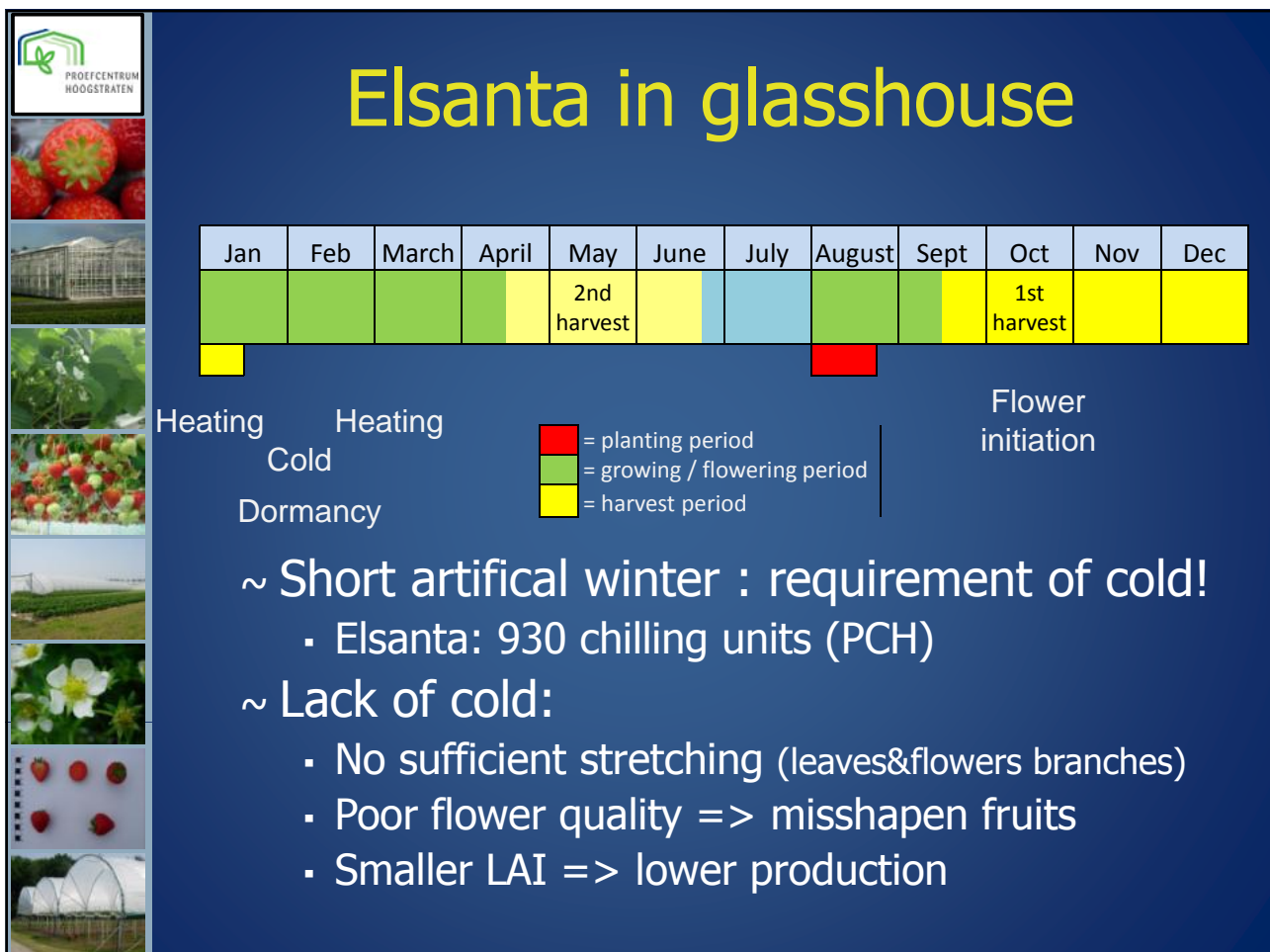
**Legend**

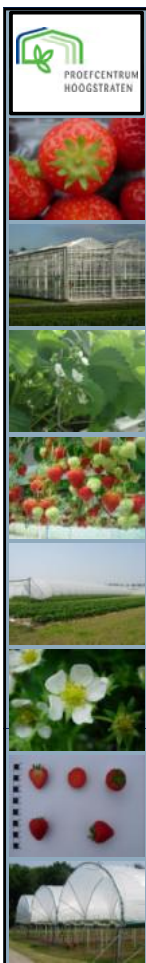
- = planting period
- = growing / flowering period
- = harvest period
- S = substrate
- G = Ground
- F = Fresh plant
- T = Tray plant
- WB = Waiting bed plant



Proefcentrum Hoogstraten, Voort 71, 2328 Meerle (Hoogstraten) - tel: 0032 33 15 70 52 - fax: 0032 33 15 00 87 - www.proefcentrum.be

19/08/2010

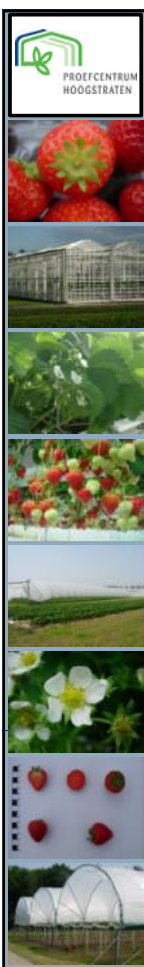




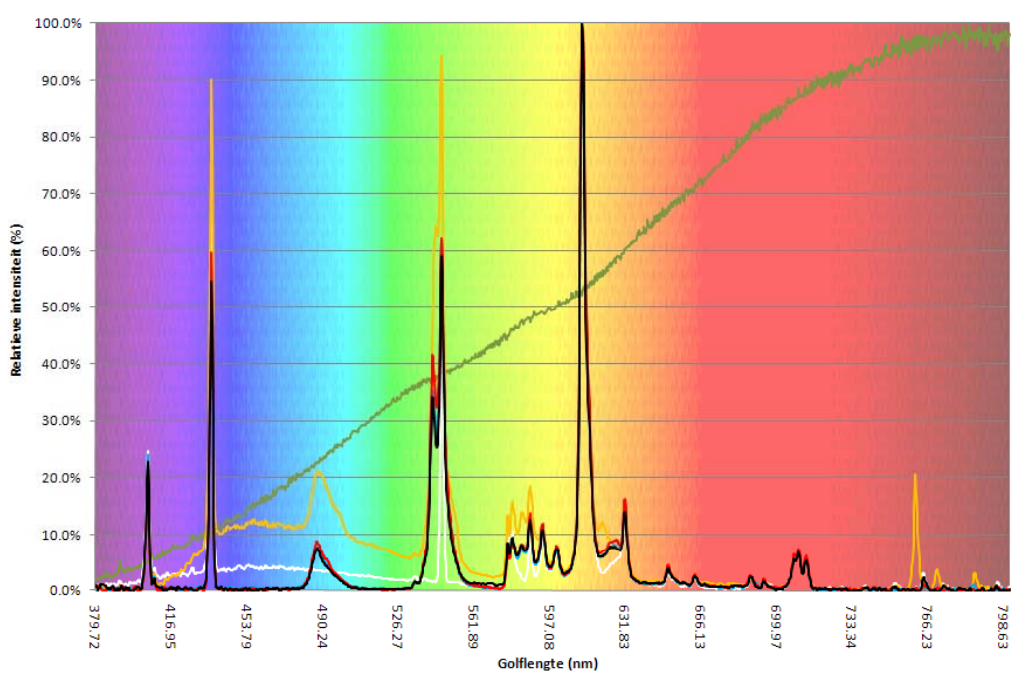
## Cyclic lighting in glasshouse

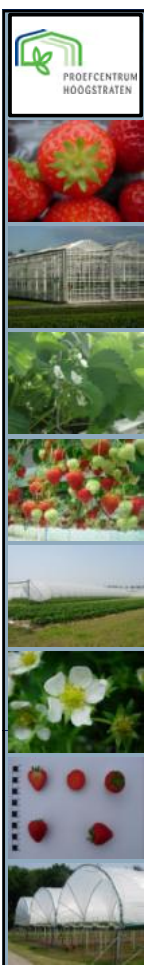
- Lack of cold: compensated by lighting
    - ~ Sun down to sunset: 15 to 30 min./hour
    - ~ Ca. 35 nights
    - ~ 8-10W/m<sup>2</sup>
    - => Break dormancy
  - Incandescent lamp
    - ~ Fading out:
- => alternatives?  
fluorescent, LED,...?





# Spectrum





# Trial setup

- Planting date: 13 August 2009
- Variety: Elsanta
- Density: 10.5 plants/m<sup>2</sup>
- First Harvest: 24 September – 14 December
- Stop heating: 11 January 2009
- Start heating: 8 February 2009

Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
				2nd harvest					1st harvest		



- = planting period
- = growing / flowering period
- = harvest period



## Trial setup

- 11 different objects:

Object		Spectrum		
1. Unlighted			0 W	
2. Incandescent lamp	Cyclic		100 W	
3. LED 1	Continuous	R+FR	10 W	Lemnis Lighting
4. LED 2	Continuous	B+R+FR	10 W	Lemnis Lighting
5. LED 3	Continuous	B+R+FR	10 W	Lemnis Lighting
6. LED 4	Continuous	R+W	17 W	Philips
7. LED 5	Continuous	R+W+FR	17 W	Philips
8. Fluorescent 1	Continuous		20 W	Spranco-matic
9. Fluorescent 1	Cyclic		20 W	Spranco-matic
10. Fluorescent 2	Continuous		23 W	Megaman
11. Fluorescent 2	Cyclic		23 W	Megaman

Trial in  
cooperation with:

lemnis  
lighting



**PHILIPS**

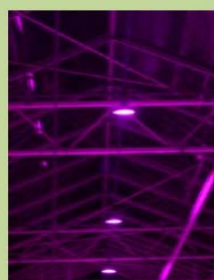
# Trial setup



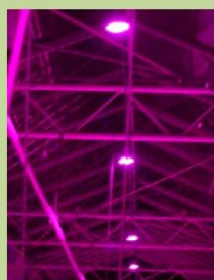
Incandescent lamp



LED 1



LED 2



LED 3



Unlighted



LED 4



LED 5



Fluorescent 1  
cyclic&continuous



Fluorescent 2  
cyclic&continuous

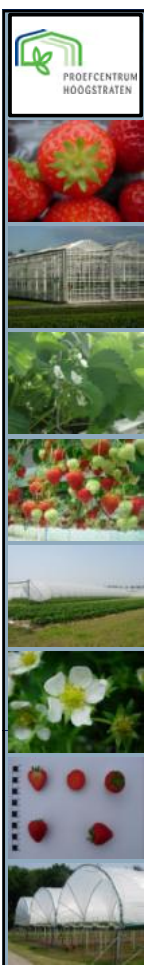


Overview



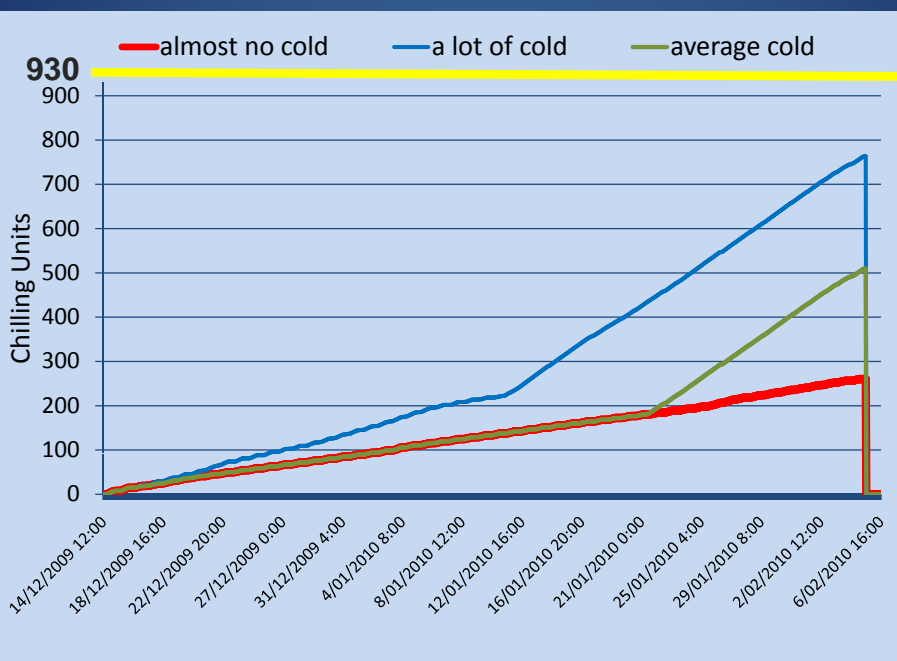
# Trial setup



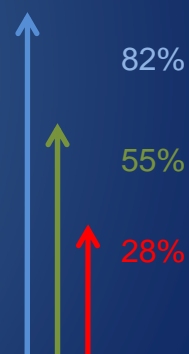


# Trial setup

- 3 different cold treatments



Cold requirement  
Elsanta





## Results: Lighting period

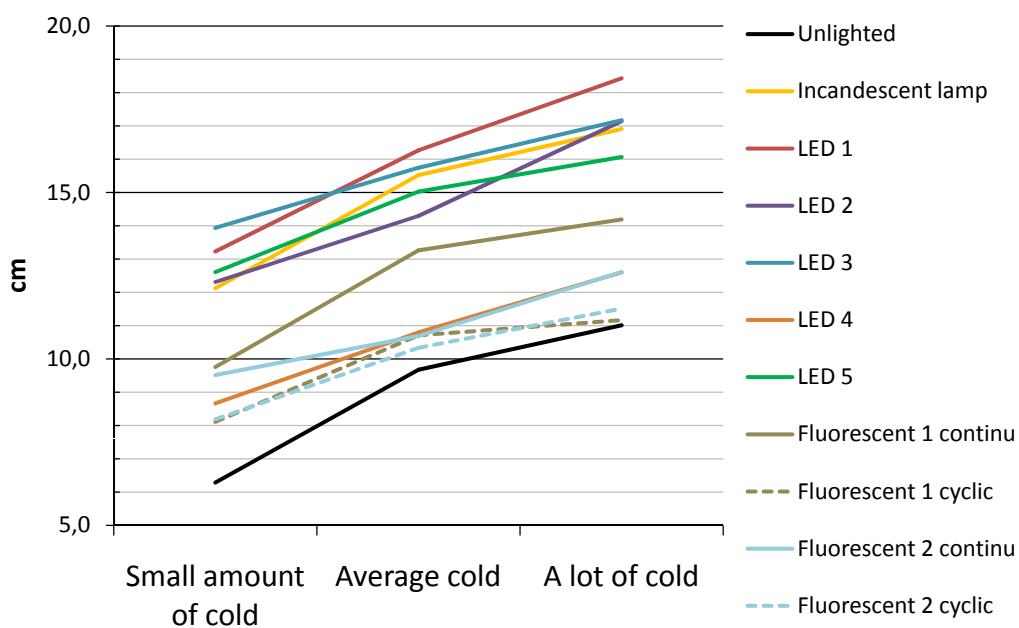
- Start lighting: 8 February 2010

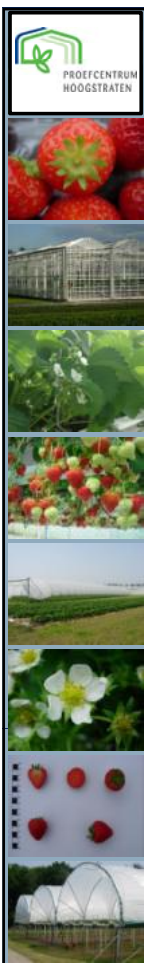
Object		Spectrum	Lighting period (days)
1. Unlighted			0
2. Incandescent lamp	Cyclic		37
3. LED 1	Continuous	R+FR	37
4. LED 2	Continuous	B+R+FR	37
5. LED 3	Continuous	B+R+FR	37
6. LED 4	Continuous	R+W	39
7. LED 5	Continuous	R+W+FR	37
8. Fluorescent 1	Continuous		42
9. Fluorescent 1	Cyclic		45
10. Fluorescent 2	Continuous		42
11. Fluorescent 2	Cyclic		45



## Results: Stretching of leaves

- Average stretching 4 youngest leaves





# Results: Stretching of leaves

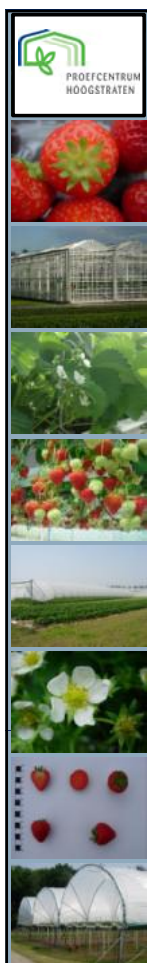
- Stretching during grow (first leaves)



Unlighted plants  
Small amount of cold

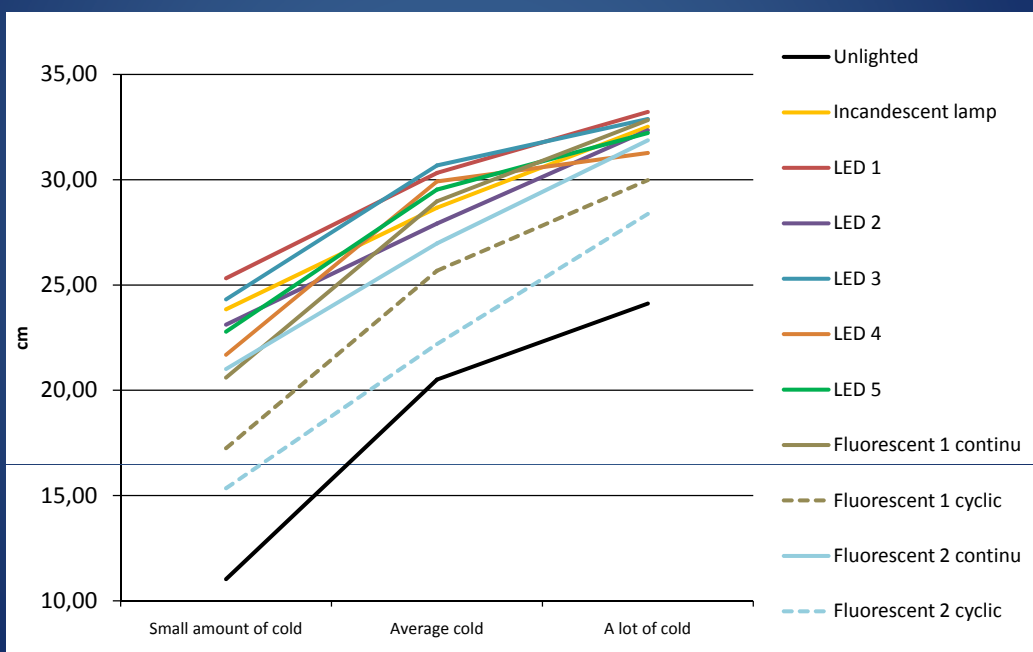


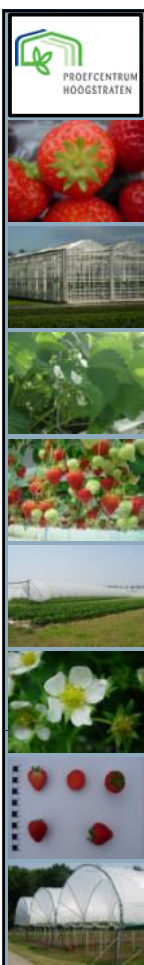
LED  
Small amount of cold



## Results: Stretching of leaves

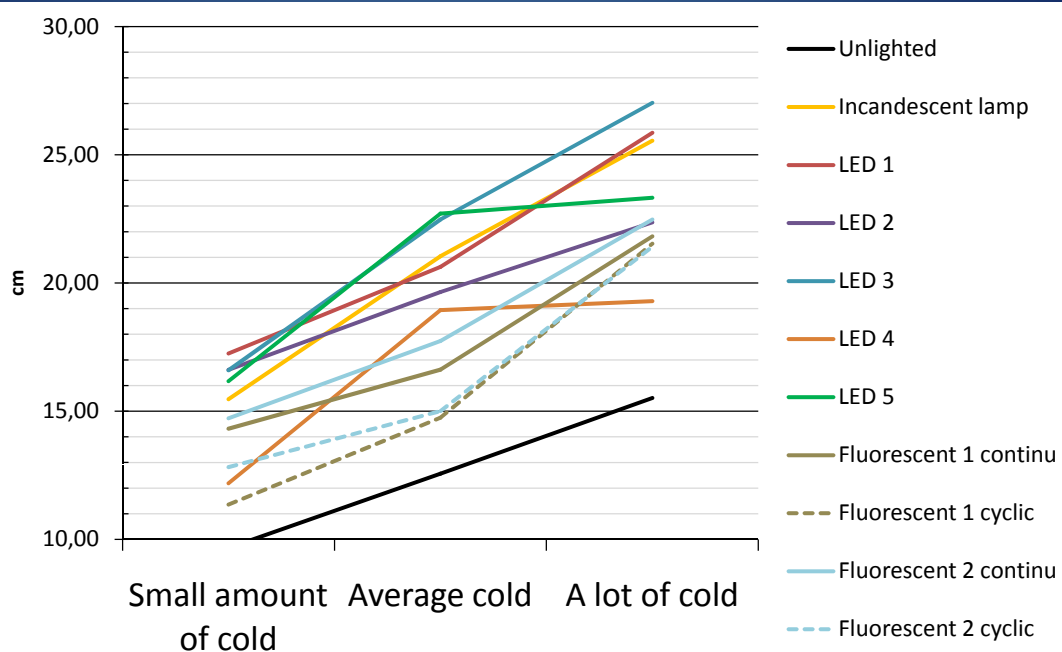
- Final stretching of the crop

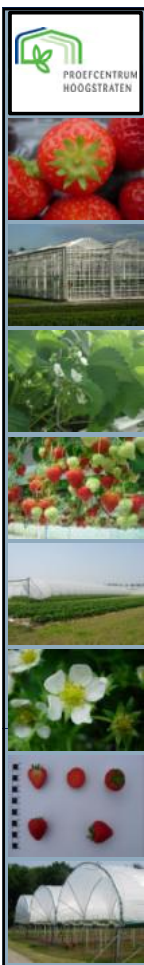




## Results: Stretching of flower branches

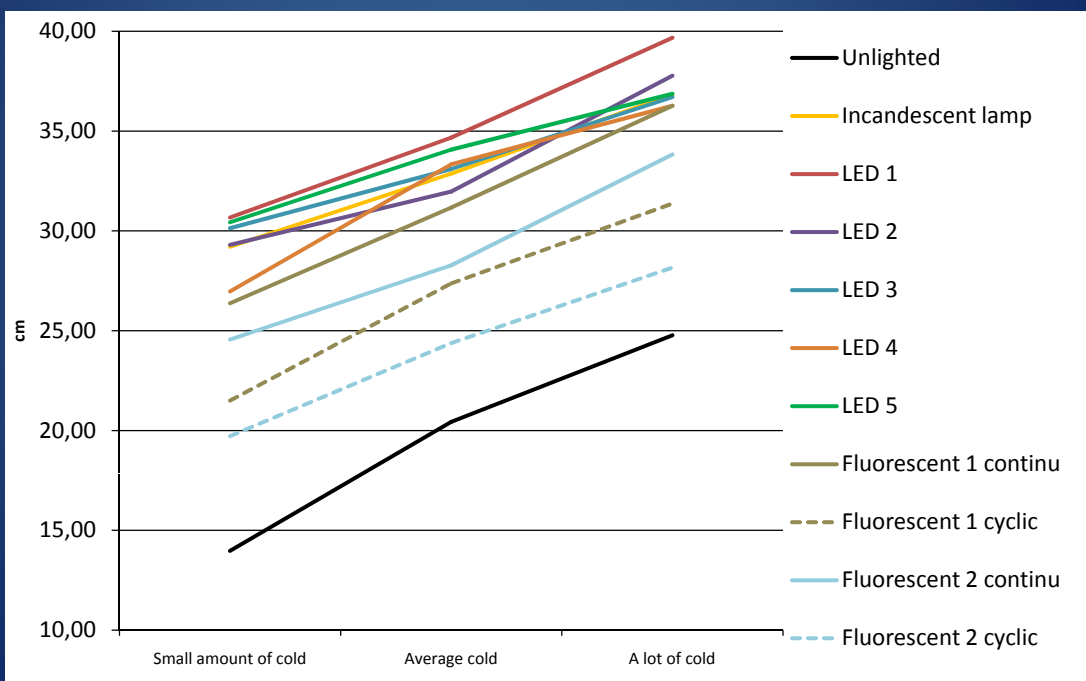
- Average stretching of 2 youngest flower branches

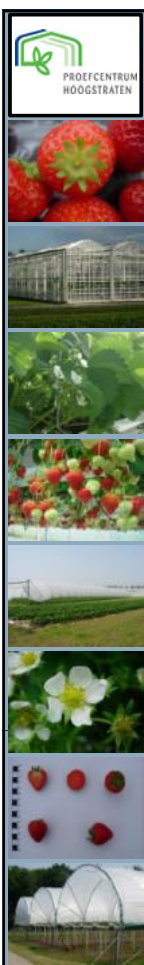




## Results: Stretching of flower branches

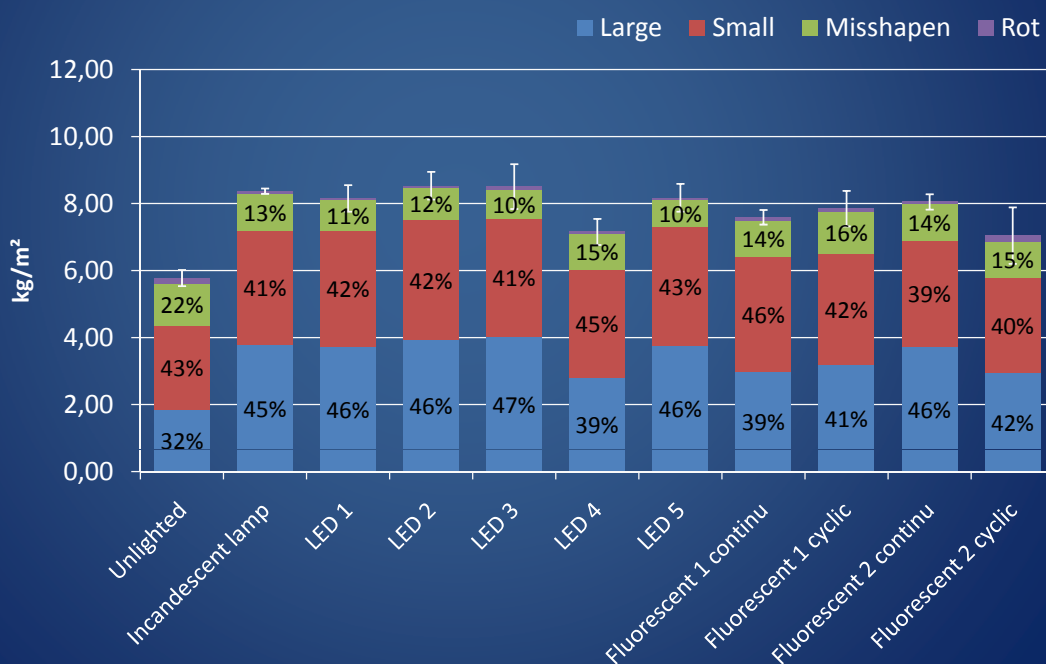
- Final stretching of the flower branches

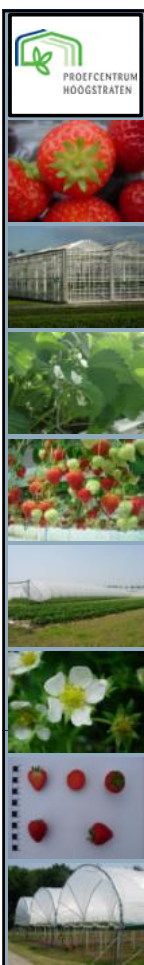




# Results: production & grading

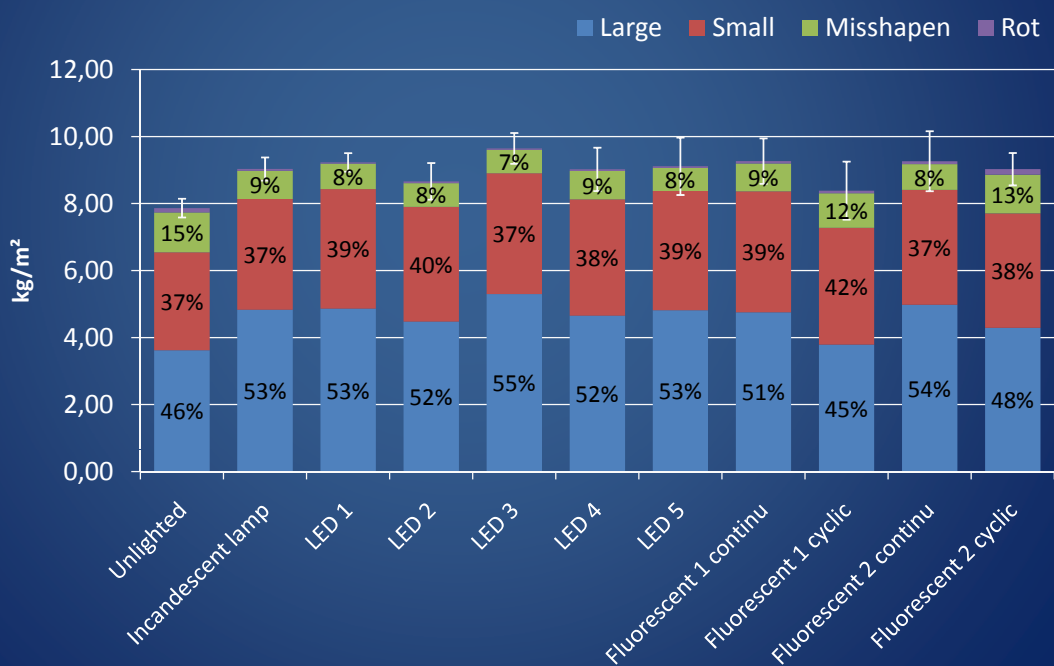
- Very warm winter (small amount of cold)

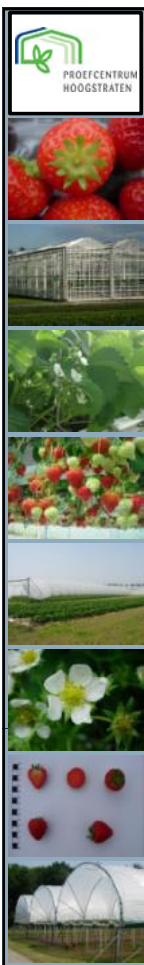




# Results: production & grading

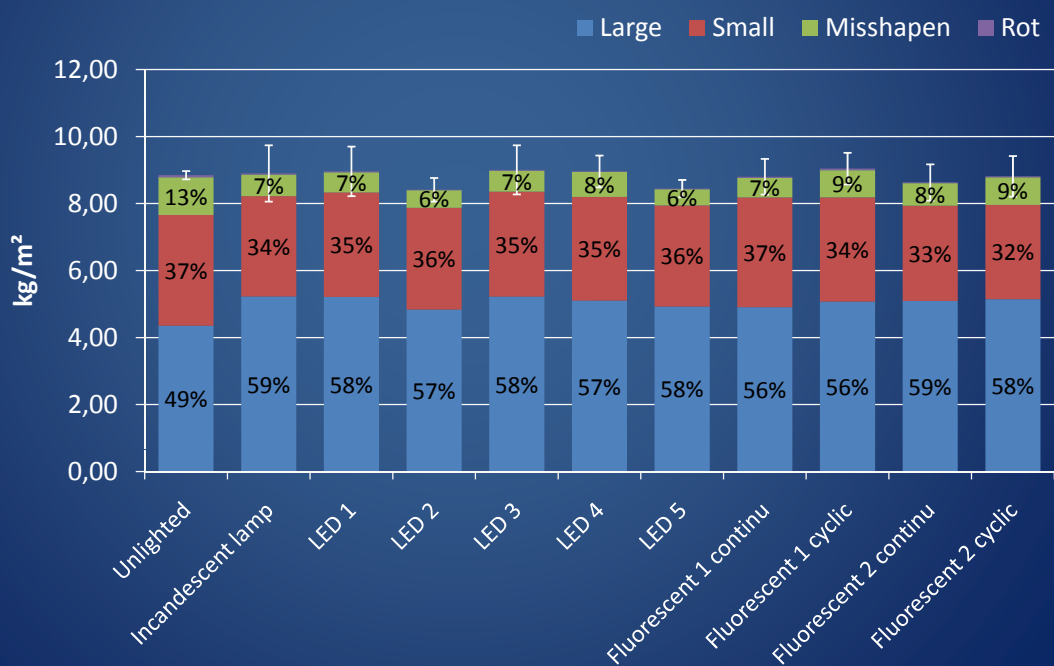
- Warm winter (average cold)

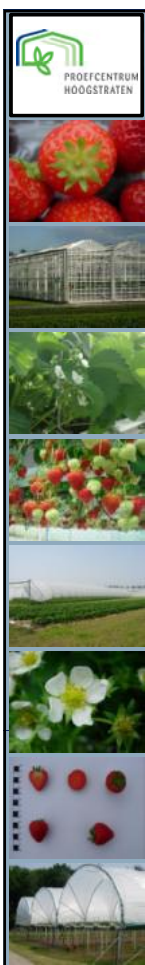




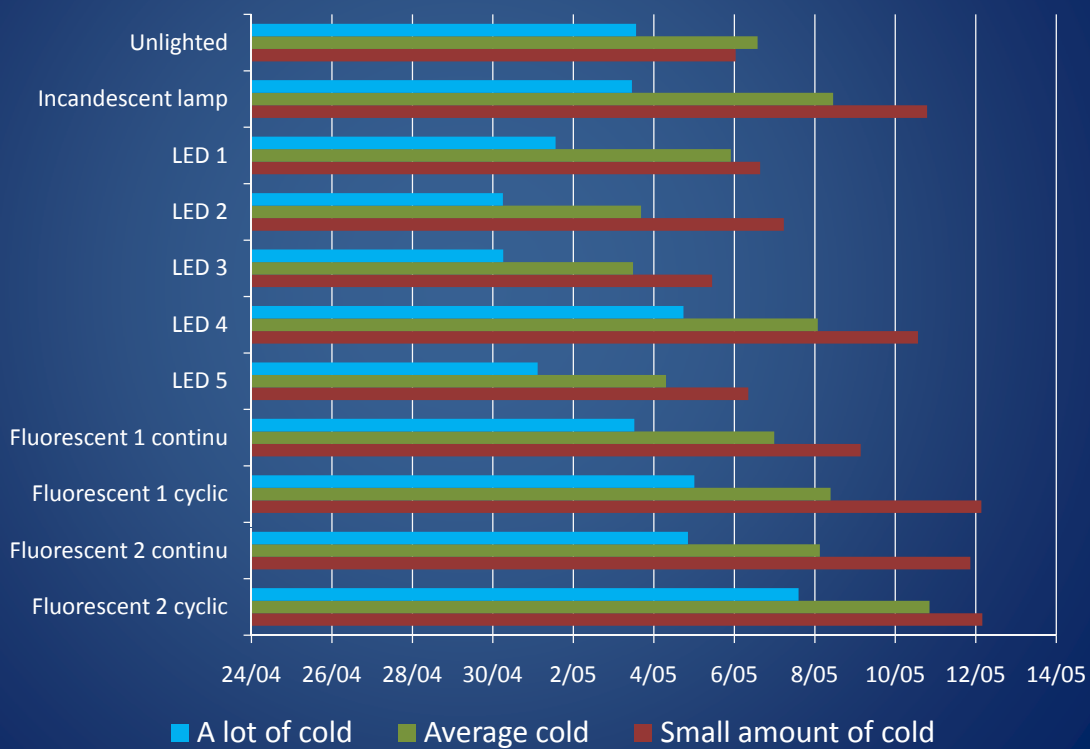
# Results: production & grading

- Cold winter (a lot of cold)





# Results: date of 50% harvest





## Conclusions

- For all lamp types:
  - ~ The effect of lighting is higher with less cold
- Incandescent lamps:
  - ~ Can compensate lack of cold:  
Better production, grading and stretching

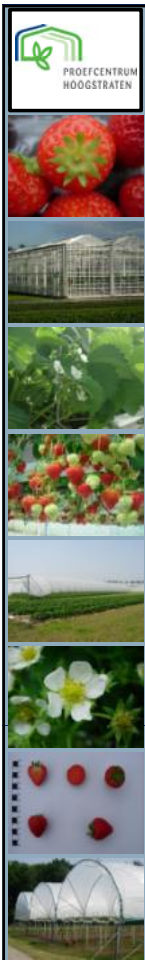




## Conclusions

- Fluorescent lamps
    - ~ Less effective than incandescent lamps
    - ~ Reaction of the plants is slow
    - ~ They do work,
      - in a cold winter, similar with incandescent lamp but slower
      - but with a small amount of cold it is difficult
- ⇒ Continuous lighting
- ⇒ Few nights longer

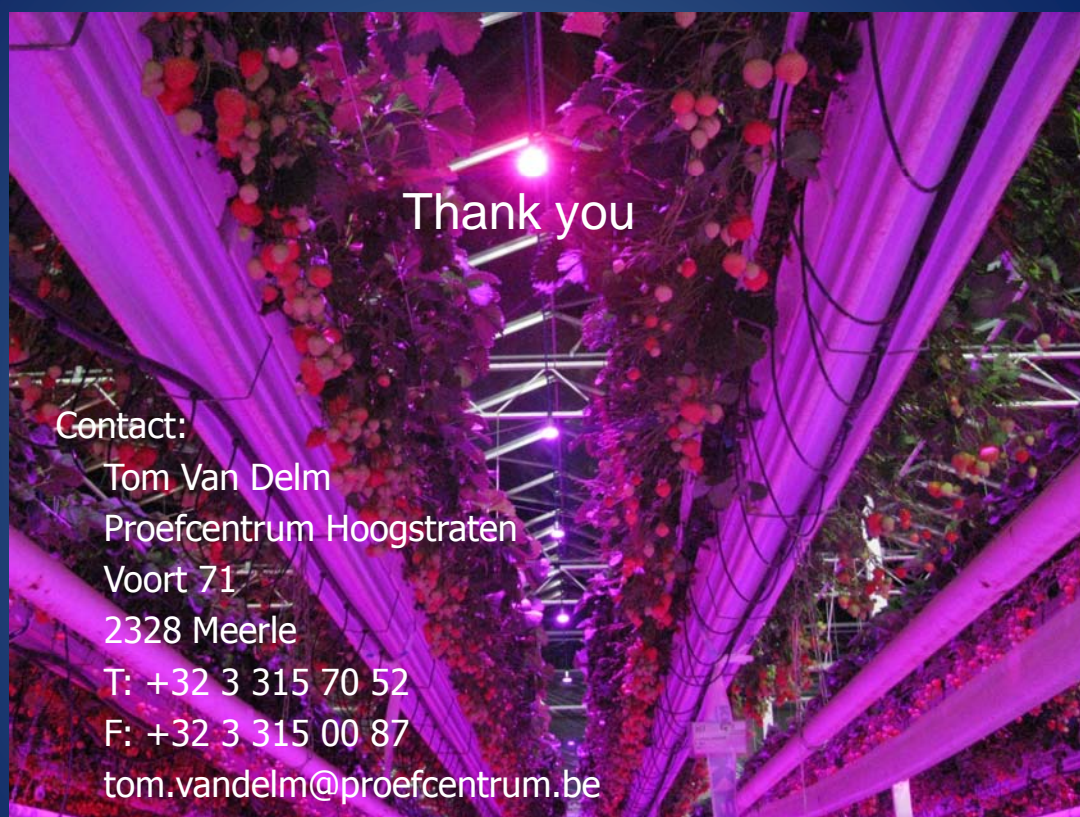




## Conclusions

- LED's
  - ~ Spectrum is important
    - FarRed: necessary
    - Blue: no surplus value
    - Ratio Red/FarRed : less important then presence of FarRed
  - ~ They can replace incandescent lamp
  - ~ Further research necessary for optimizing spectrum, strategy and density
  - ~ High price is countered by low energy consumption





Thank you

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