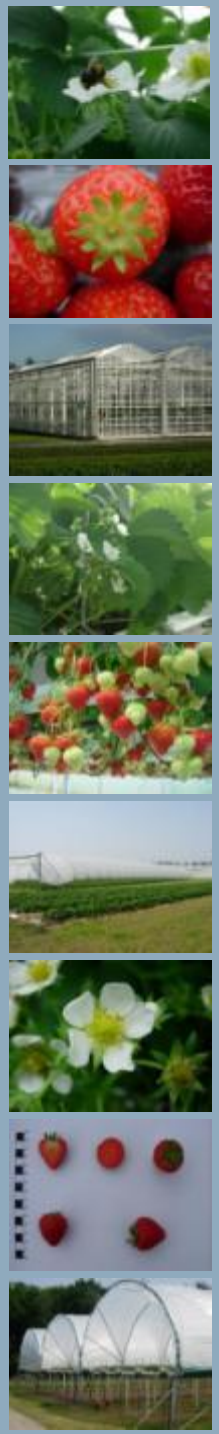

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Cyclic Lighting in Strawberry Greenhouse Cultivation:

Sustainable Alternatives for the Incandescent Lamps

02/09/2010

Tom Van Delm

PROEFCENTRUM HOOGSTRATEN








Overview

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

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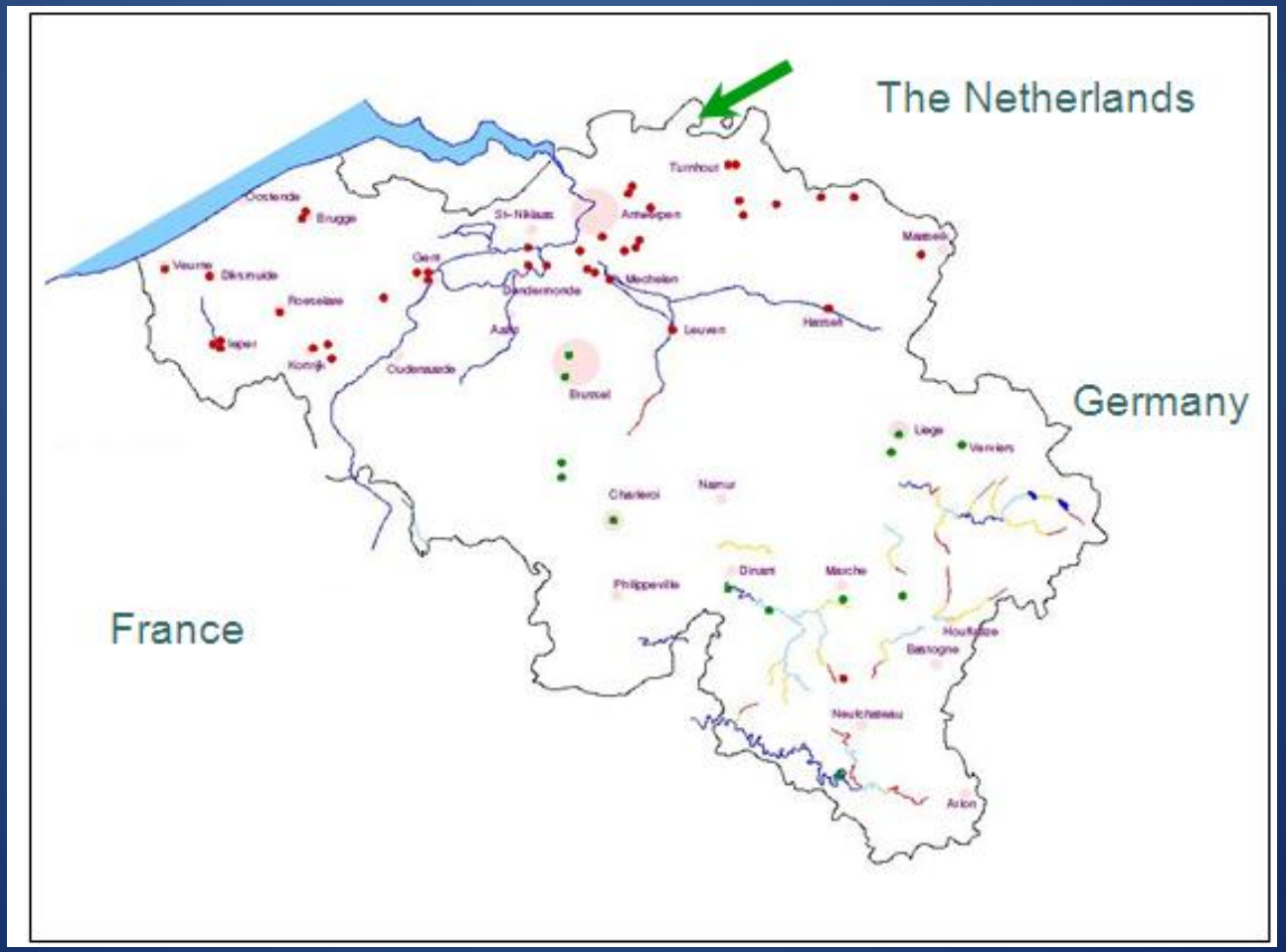
Introduction

- Research centre Hoogstraten - Meerle



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Introduction

- Research centre Hoogstraten - Meerle

Strawberry cultivation in Hoogstraten








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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)

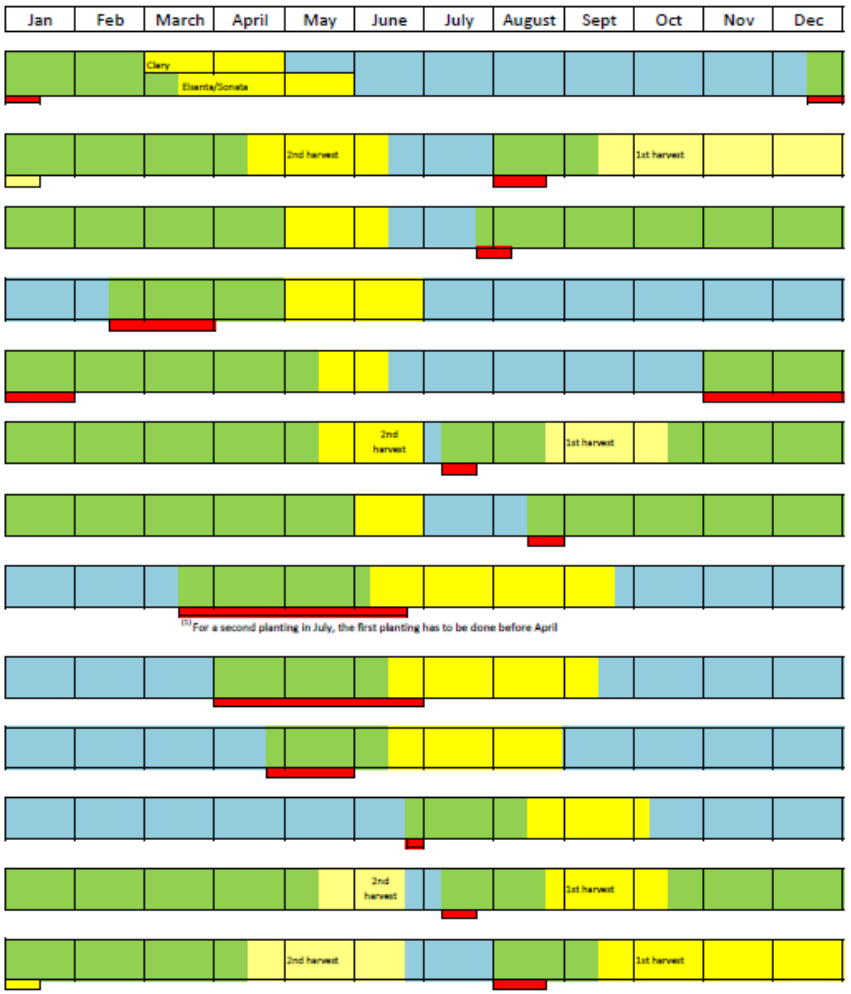
GLASS GREENHOUSE
spring planting Elsanta (T/S)

TABLE TOPS
2nd planting Elsanta (T/S)

PLASTIC GREENHOUSE
July planting Elsanta (T/S) (**)

GLASS GREENHOUSE
August planting Elsanta (T/S) (*)

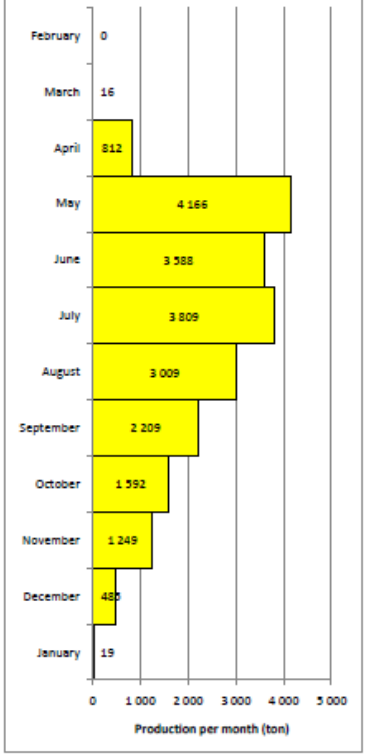
Strawberry cultivation Hoogstraten (Belgium)



(1) For a second planting in July, the first planting has to be done before April

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

Strawberry production Hoogstraten



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

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Elsanta in glasshouse

- ~ Short artifical winter : requirement of cold!
  - Elsanta: 930 chilling units (PCH)
- ~ Lack of cold:
  - No sufficient stretching (leaves&flowers branches)
  - Poor flower quality => misshapen fruits
  - Smaller LAI => lower production

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Cyclic lighting in glasshouse

- Lack of cold: compensated by lighting
  - ~ Sunset to sunrise: 15 to 30 min./hour
  - ~ Ca. 35 nights
  - ~ 8-10W/m²
  - => Break dormancy
- Incandescent lamp
  - ~ Fading out:

⇒alternatives?
fluorescent, LED,…?




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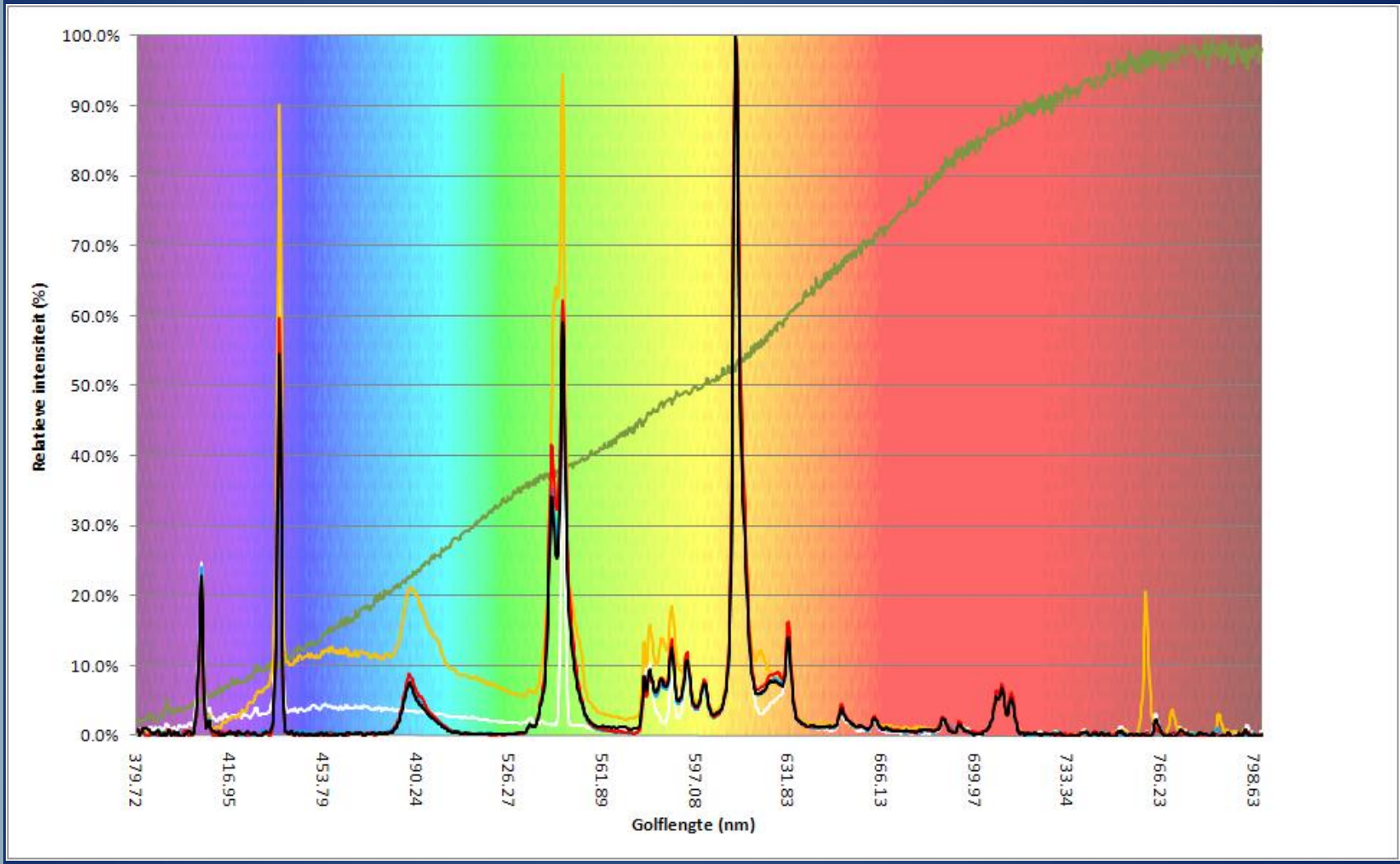
Spectrum



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Trial setup

- Planting date: 13 August 2009
- Variety: Elsanta
- Density: 10.5 plants/m²
- 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:

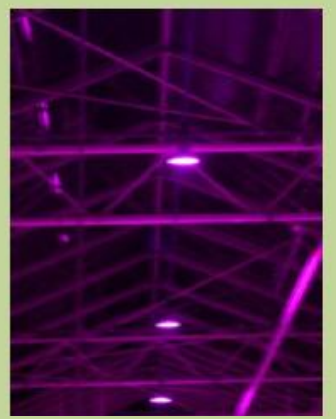
Object		Spectrum		
1. Unlighted			0 W	
2. Incandescent lamp	Cyclic		100 W	
3. LED 1	Continuous	R+FR	10 W	Lemnis Lighting
4. LED 2	Continuous	B+R+FR	10 W	Lemnis Lighting
5. LED 3	Continuous	B+R+FR	10 W	Lemnis Lighting
6. LED 4	Continuous	R+W	17 W	Philips
7. LED 5	Continuous	R+W+FR	17 W	Philips
8. Fluorescent 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:

Trial setup

Incandescent lamp

LED 1



LED 2

LED 3

Unlighted

LED 4

LED 5

Fluorescent 1
cyclic&continuous

Fluorescent 2
cyclic&continuous

Overview

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Trial setup

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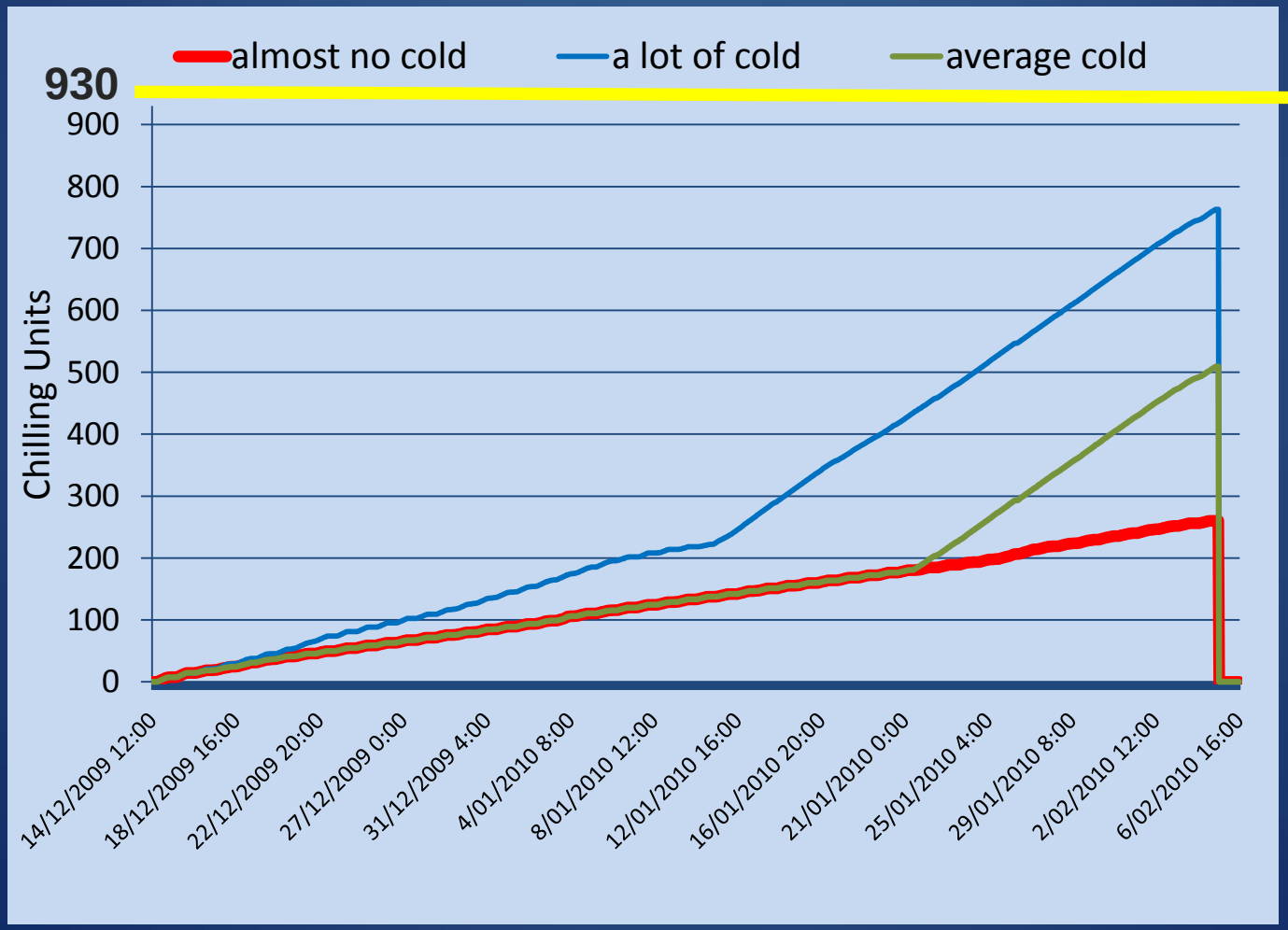
Trial setup

- 3 different cold threatments









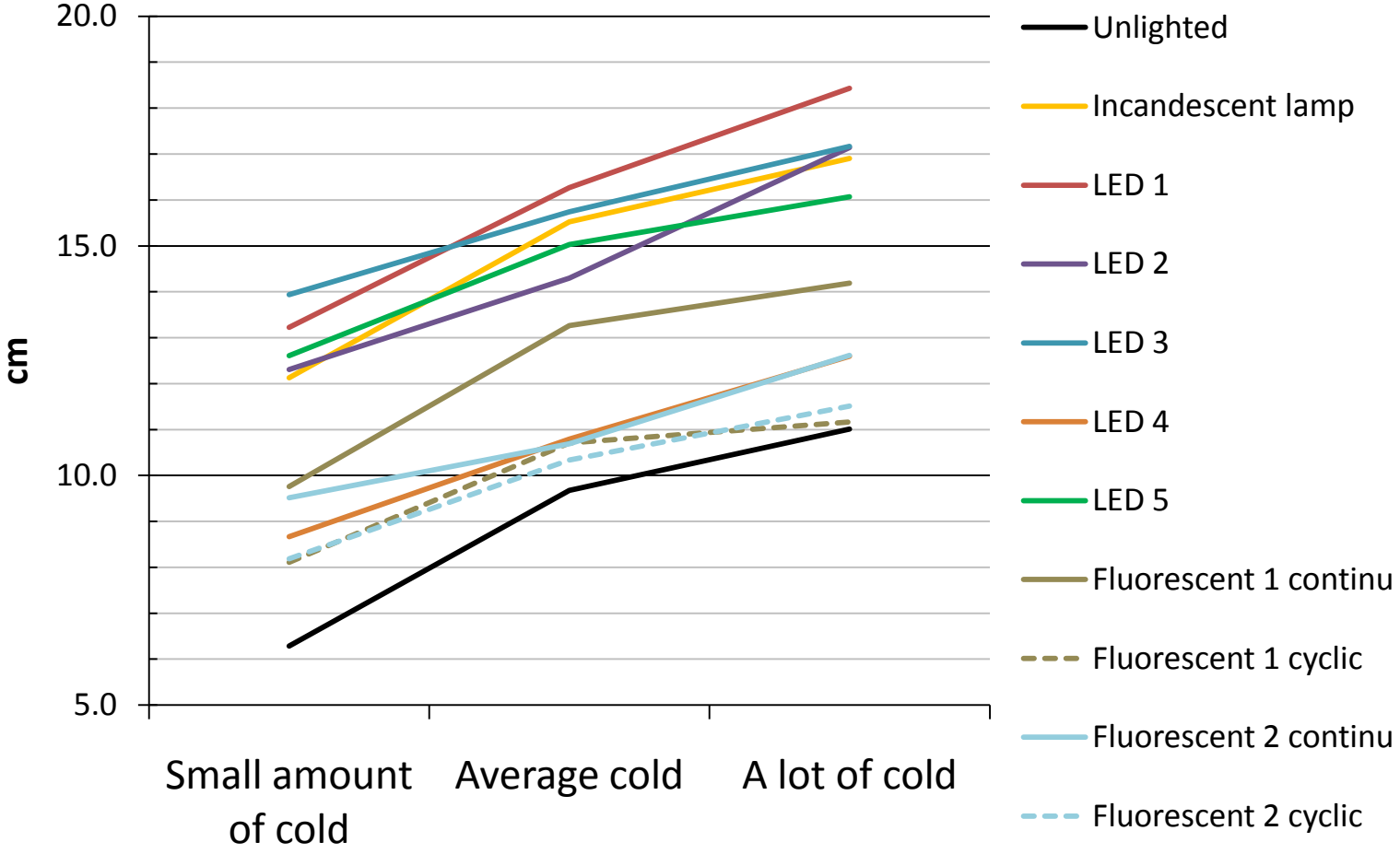

Results: Lighting period

- 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

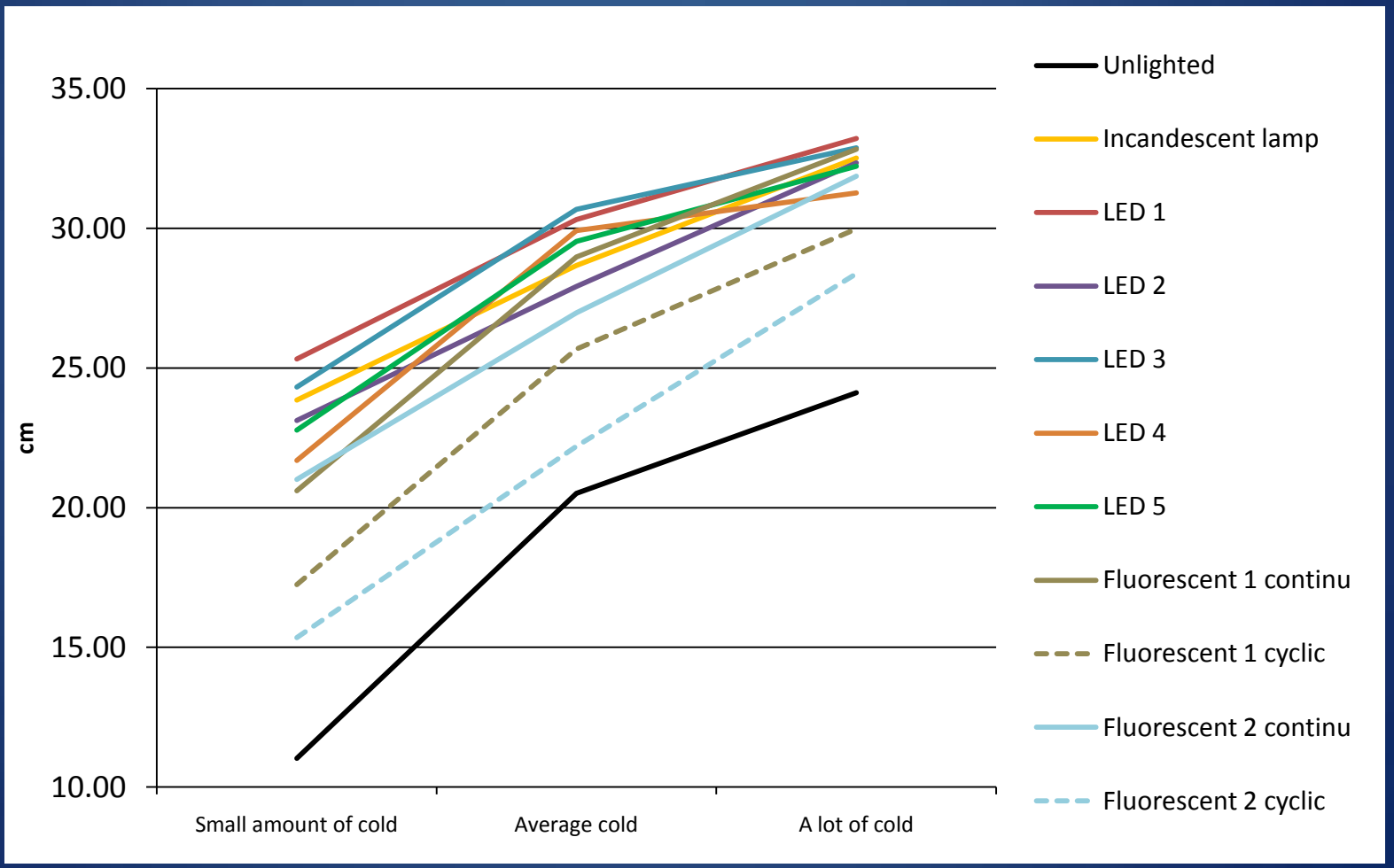
- Stretching during grow (first leaves)

Unlighted plants
Small amount of cold

LED
Small amount of cold

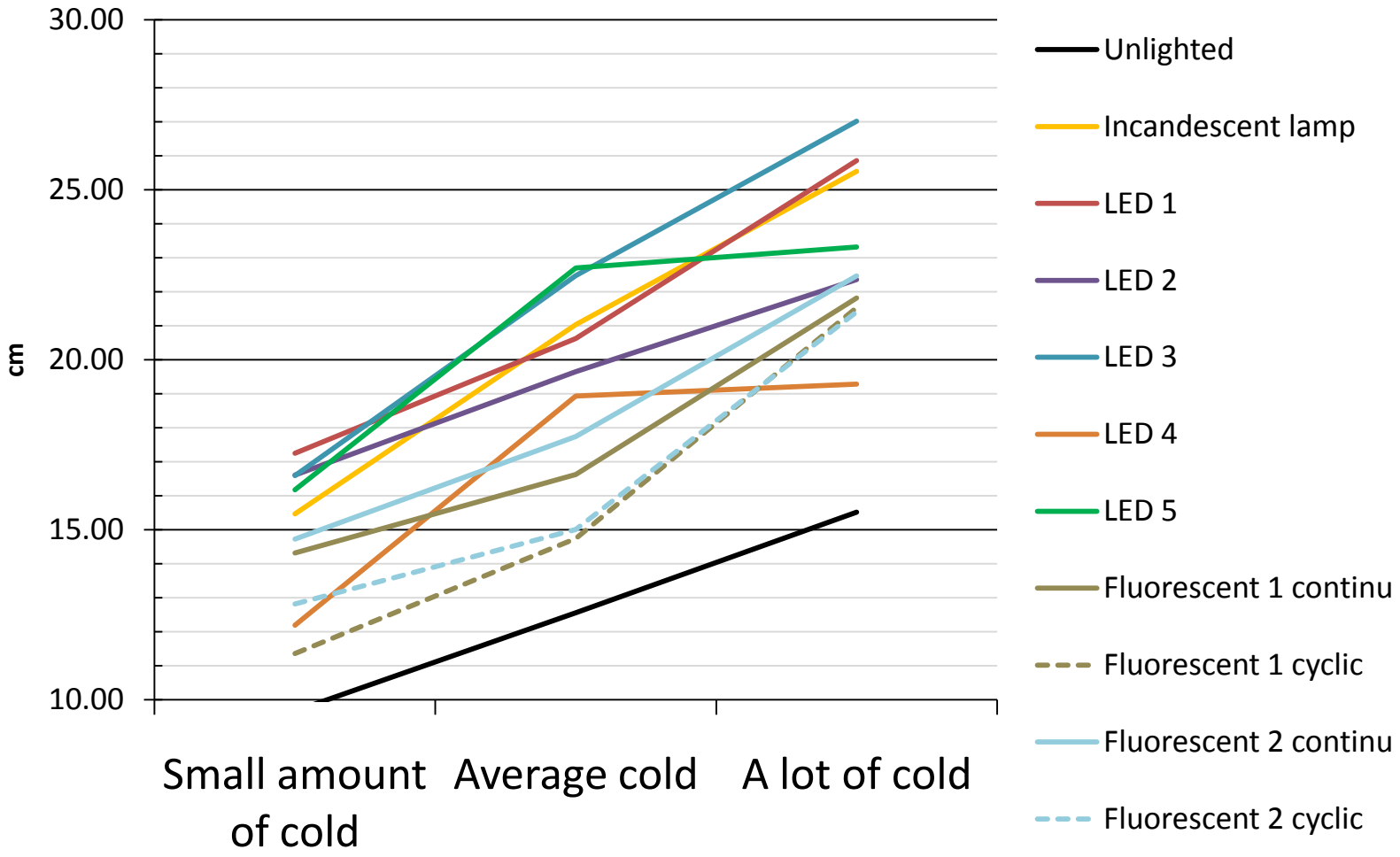
Results: Stretching of leaves

- Final stretching of the crop



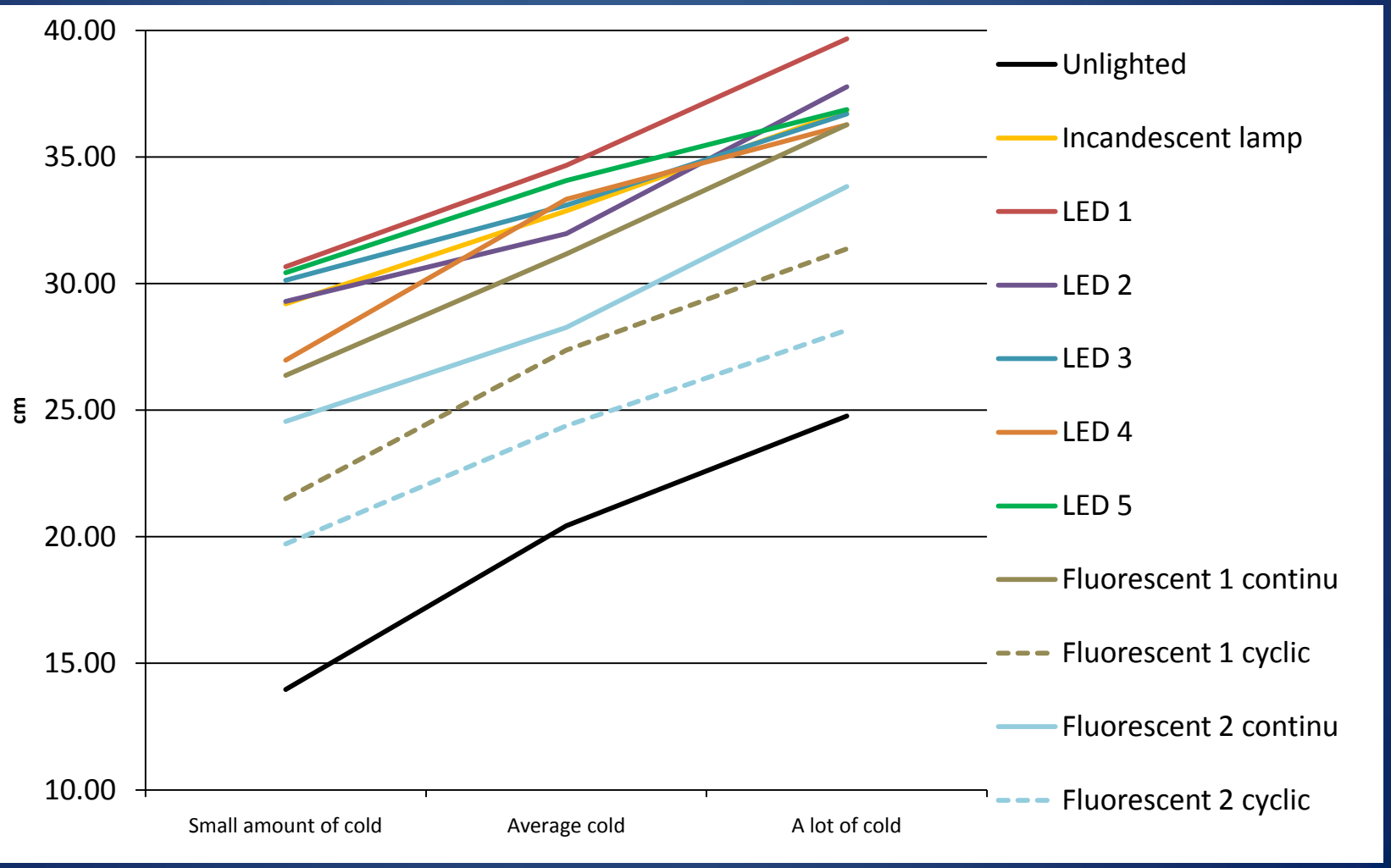
Results: Stretching of flower branches

- Average stretching of 2 youngest flower branches



Results: Stretching of flower branches

- Final stretching of the flower branches



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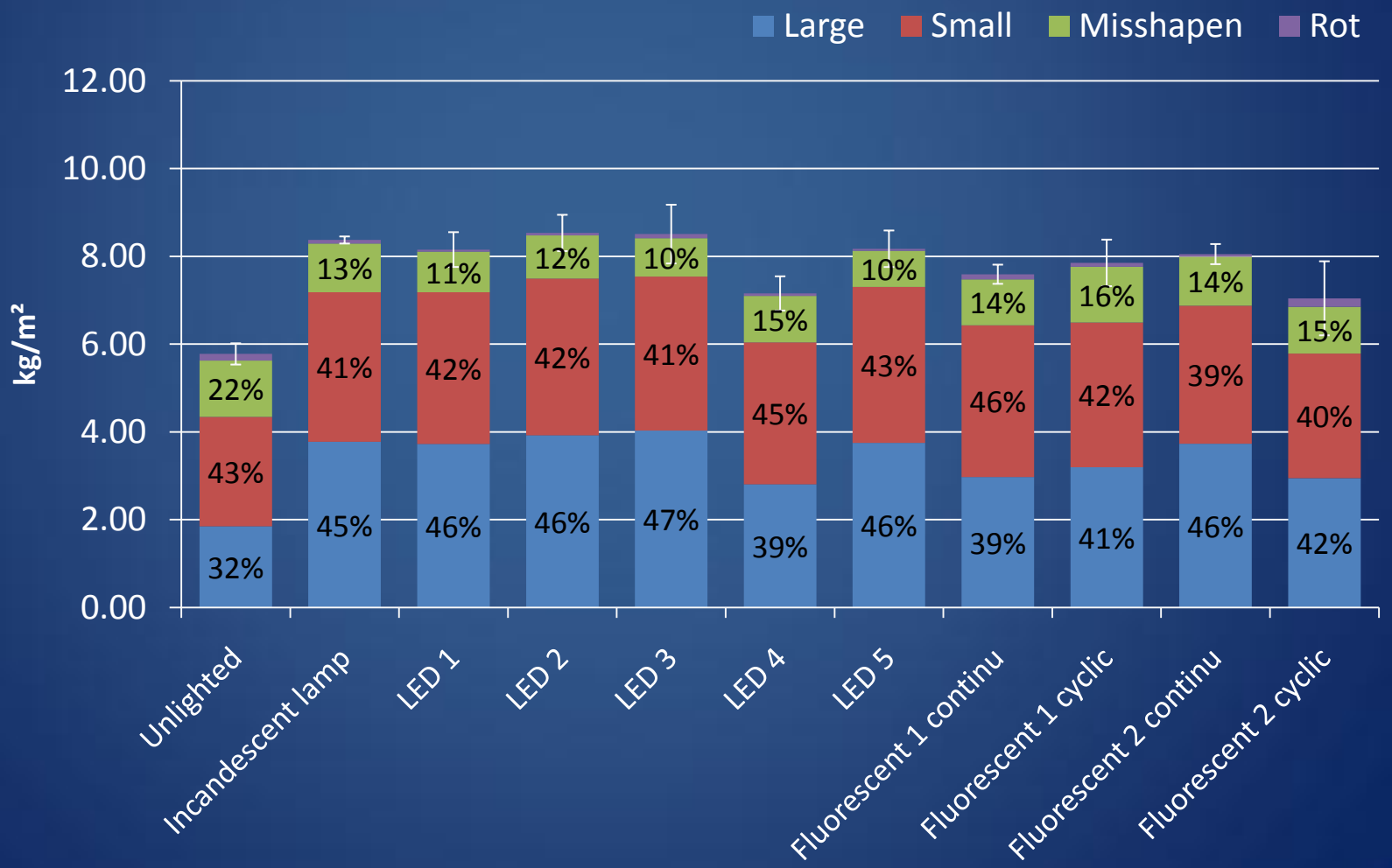
Results: production & grading

- Very warm winter (small amount of cold)



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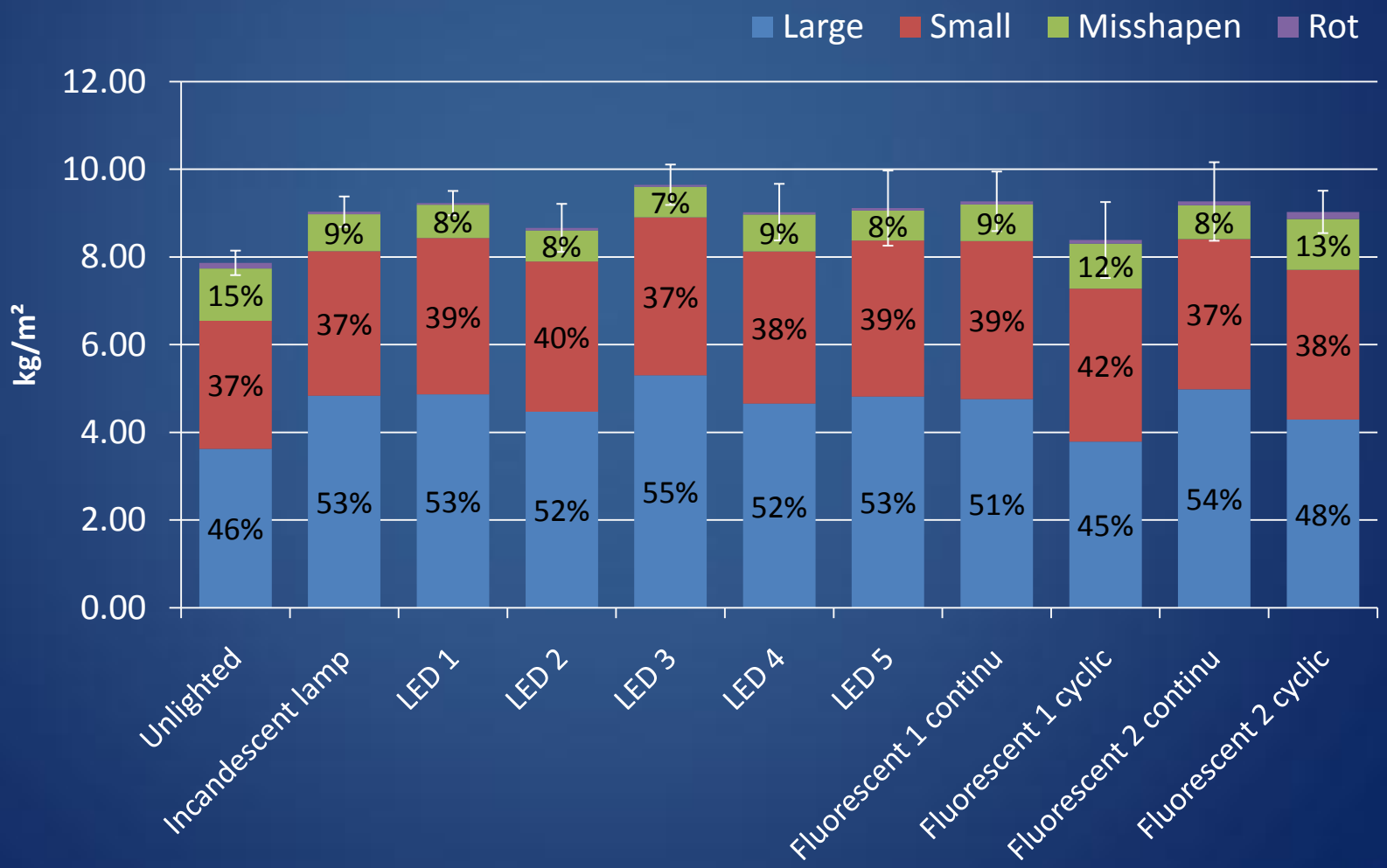
Results: production & grading

- Warm winter (average cold)



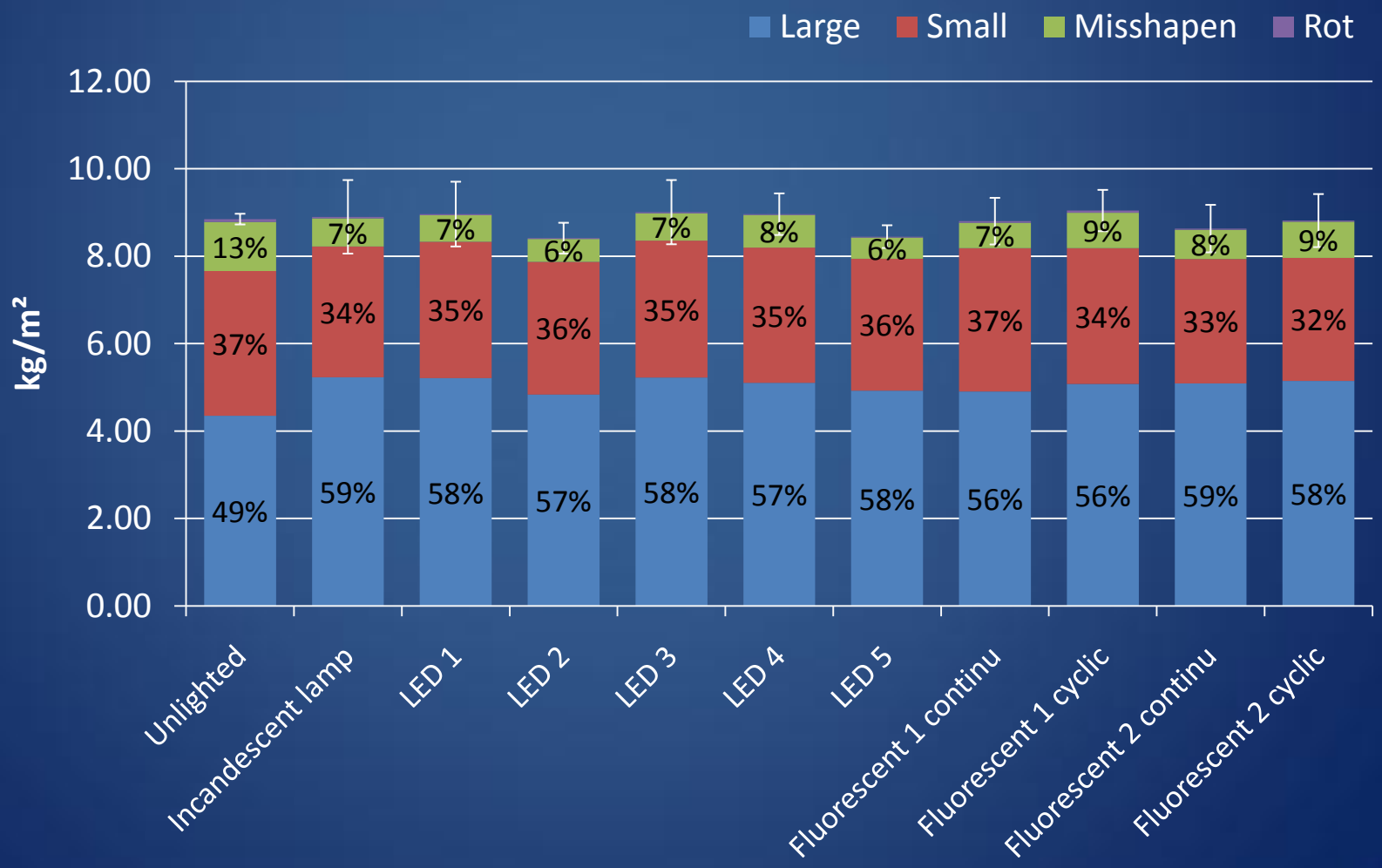







Results: production & grading

- Cold winter (a lot of cold)



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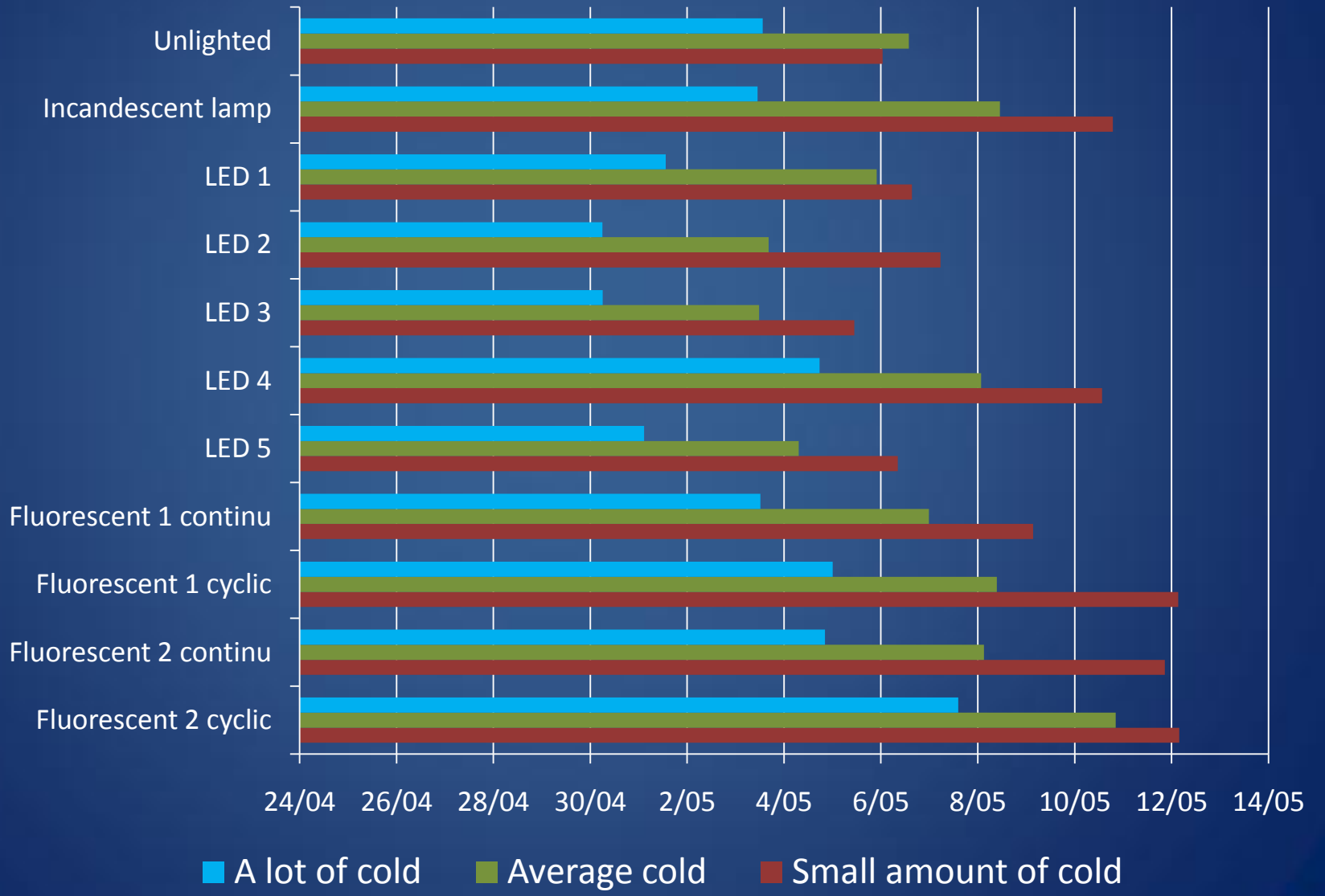
Results: date of 50% harvest










Costs and energy use

- Data

	Power (Watt)	Cost (ex. VAT)	Life (hours)
Incandescent lamp Superlux Agro	100	€ 6,00	2000
Incandescent lamp Osram/Sylvania	100	€ 1,05	1000
Fluorescent lamp Rainbow	20	€ 3,00	8000
Fluorescent lamp Megaman Nature color	23	€ 10,80	15000
LED-lamp 10W	10	€ 35,00	30000
LED-lamp 17W	17	€ 35,00	30000








Costs and energy use

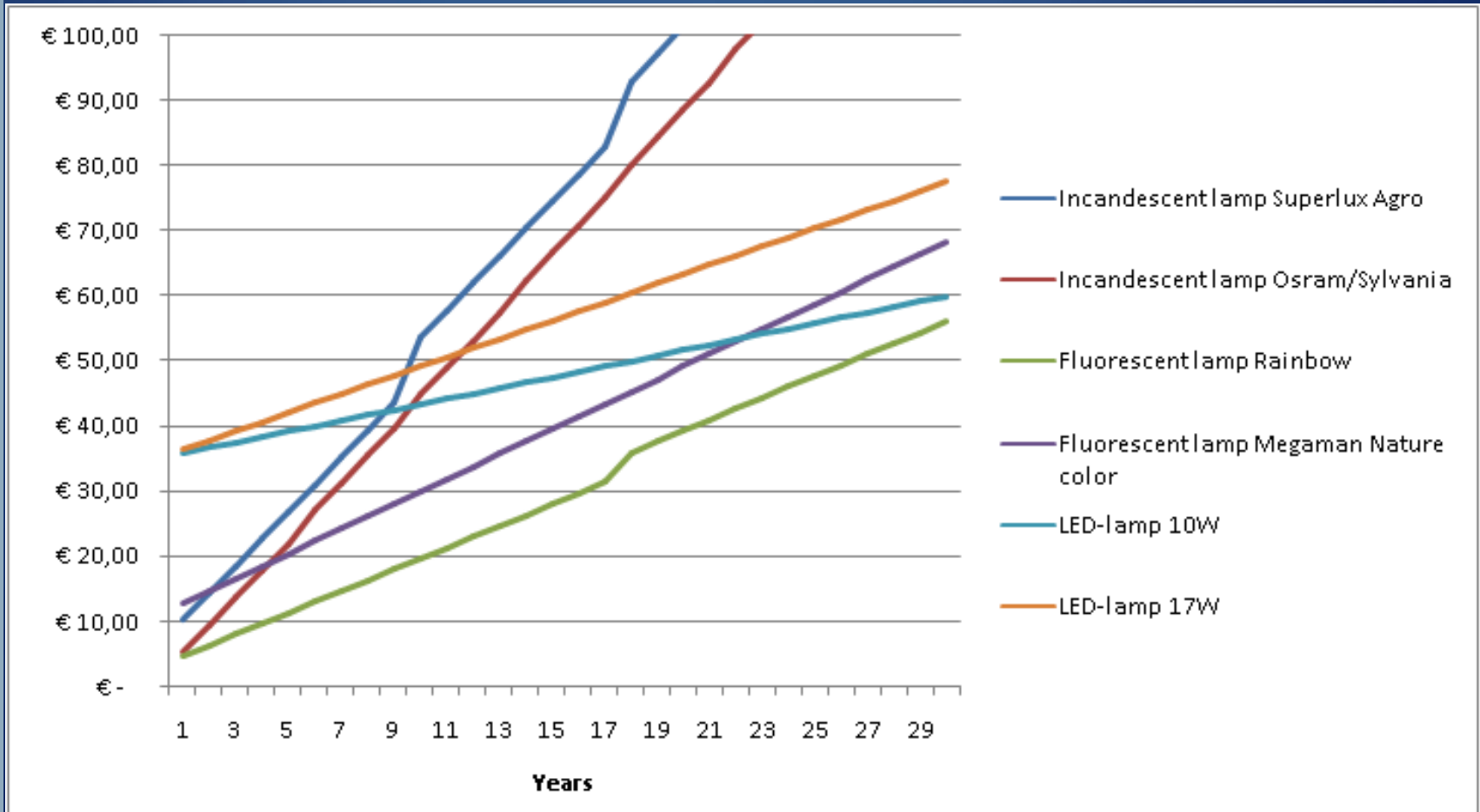
- Assumptions:

  ~ Nights of lighting per year : 35
  ~ Hours per night : 14
  ~ Cost / kWh : € 0,17

  ~ Lamps fulfill their theoretical life expectation
  ~ Cyclic lighting : ½ hour per hour

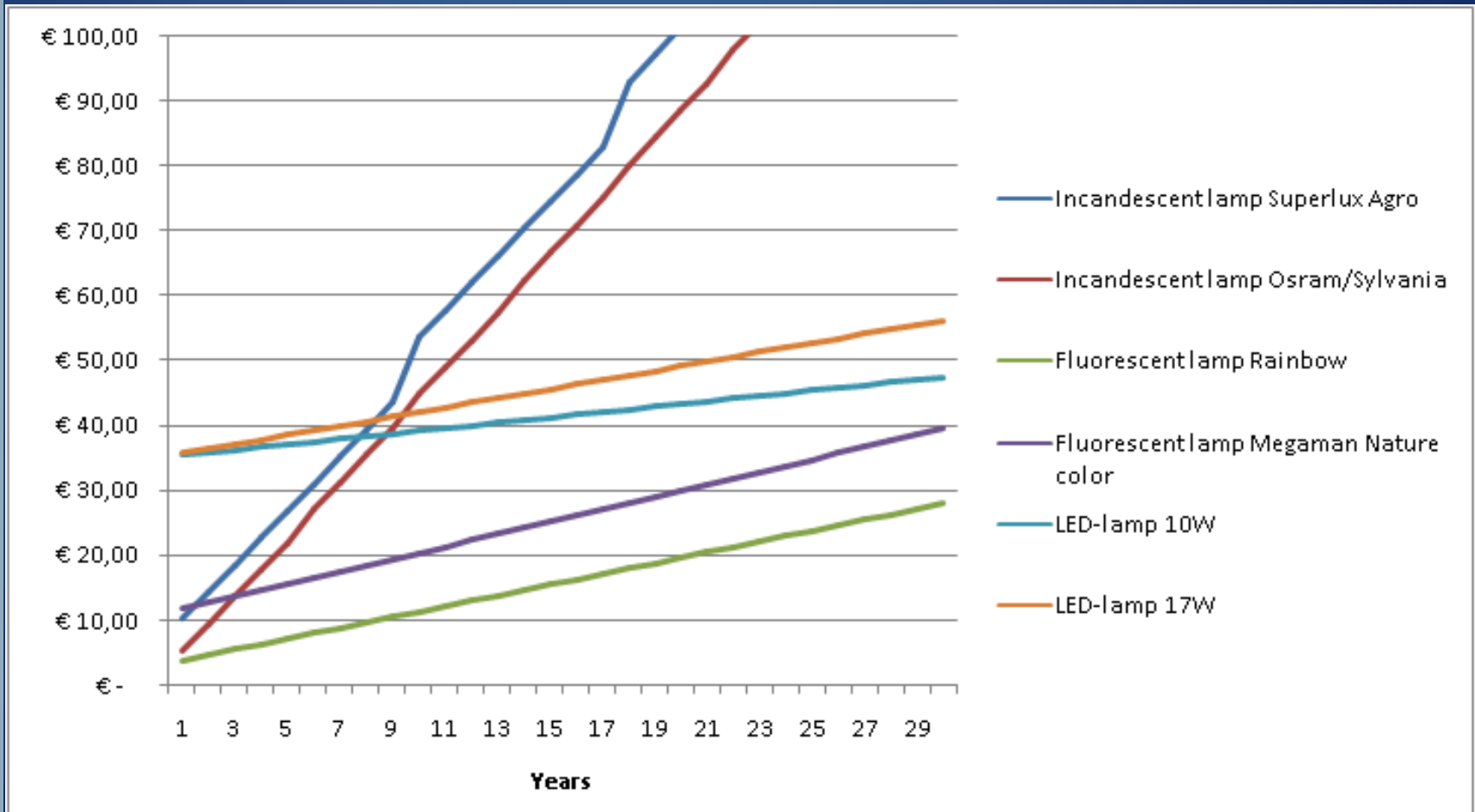
Costs and energy use

- Incandescent lamps : cyclic
- Fluorescent lamps : continu
- LED : continu



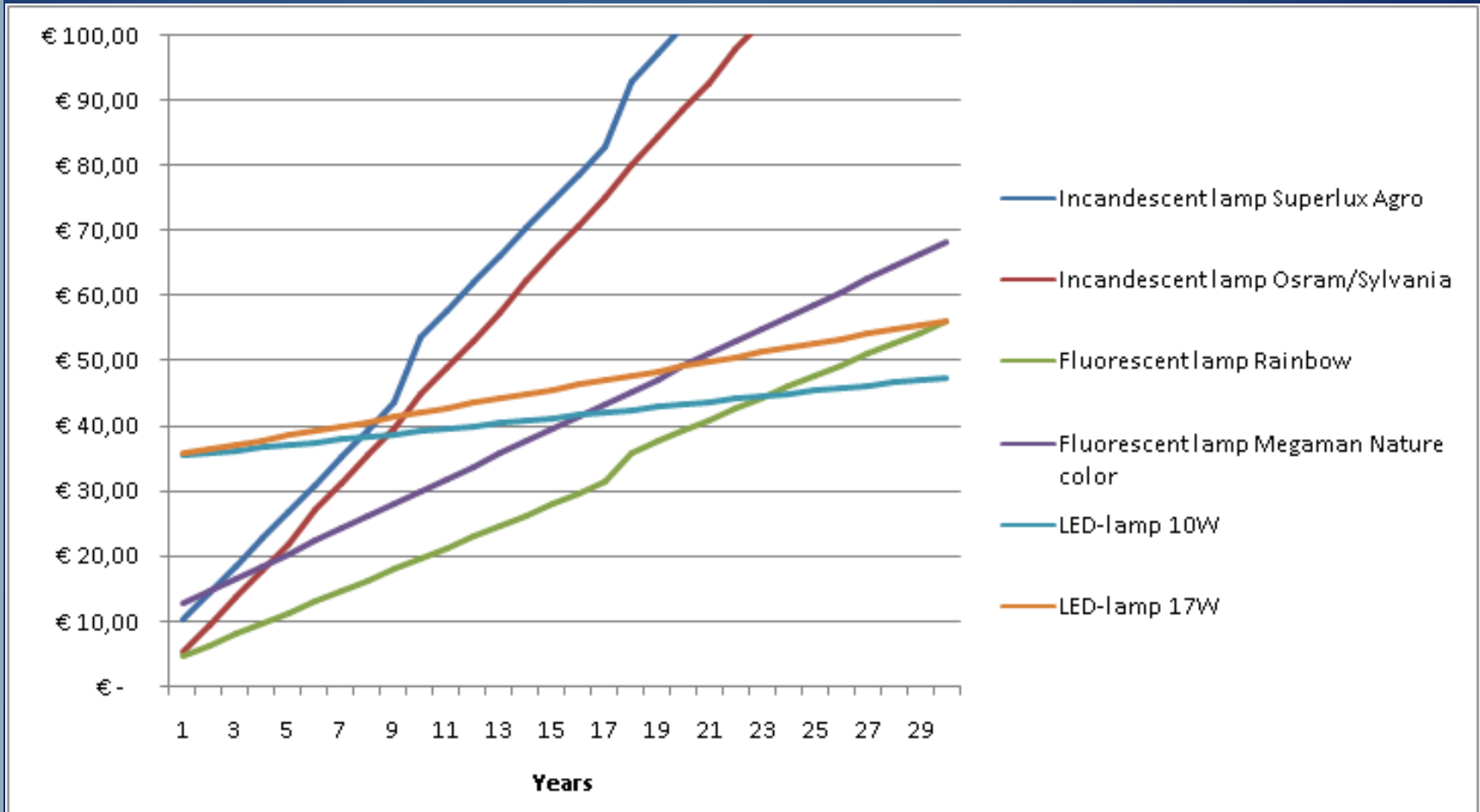
Costs and energy use

- Incandescent lamps : cyclic
- Fluorescent lamps : cyclic
- LED : cyclic



Costs and energy use

- Incandescent lamps : cyclic
- Fluorescent lamps : continu
- LED : cyclic



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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

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Conclusions

- Fluorescent lamps
  - ~ Less effective then 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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