

How does WUR support/enhance innovation in the horticulture sector?  
How does WUR cooperate with growers?

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Long history of innovation

- Wageningen University founded in 1918 (based on 1876 Rijkslandbouwschool) currently 9426 students and 106 nationalities on Wageningen Campus
- Horticulture applied research started already 1899 in Naaldwijk and in Aalsmeer currently 1.2 ha very modern research facilities in Bleiswijk



Greenhouse Horticulture - Multidisciplinary

- Fundamental research → Applied research
- Chain: Breeding → technology → grower → consumer
- Expertise: Genetics, physiology, plant nutrition, entomology.. artificial intelligence, robotics, electronics, economics




## Innovation and Demonstration Centre (IDC) Energy

- What: innovations for energy saving in greenhouse production by new technologies and new cropping strategies
- Who: Wageningen UR, greenhouse supply industry, growers
- New ideas – facts&figures – many visitors



WAGENINGEN UR  
Ministerie van Economische Zaken  
LTD Oostvacht  
AGG ALS  
European Union

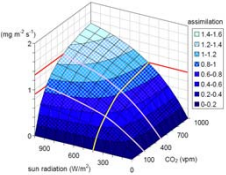
## IDC Energy - research issues 2015



- New sensors & ICT
- Energy saving greenhouse concepts
- Dehumidification
- Next Generation Cultivation Strategies (Climate control)
- Low temperature heating
- Diffuse light Maximum sunlight

## The basics of modern energy saving crop production

Next Generation Cultivation Strategies



Analysis of humidity effects on growth and production of glasshouse fruit vegetables

Development and dry matter distribution in glasshouse: a quantitative approach temperature

Different phds, the scientific basics

- Udink ten Cate ('70), Bot ('80), de Zwart ('90), Vanthoor (2012): Modeling and control of greenhouse physics, dynamic modeling, incl. crop and economics
- Stanghellini C. Transpiration of greenhouse crops.
- Campen J. Dehumidification of greenhouses
- And many more....
- Effects of CO2 concentration on photosynthesis, transpiration and production of greenhouse fruit vegetable crops

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## “Het Nieuwe Telen” integrated approach of energy saving crop production

Next Generation Cultivation Strategies

- Test integrated approach in research
- Monitor at growers
- Result: 10-30% energy saving



Research Knowledge transfer


Commercial growers

Already 146 ha commercial greenhouses with HNT


WAGENINGEN UR



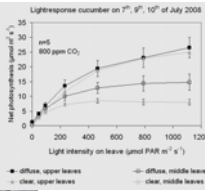
## Diffuse light



Diffuse light




Crop physiology



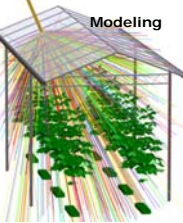
Lightresponse cucumber on 7<sup>th</sup>, 9<sup>th</sup>, 10<sup>th</sup> of July 2008

Net photosynthesis (µmol of A<sub>2</sub> / m<sup>2</sup> s) vs Light intensity on leave (µmol PAR m<sup>-2</sup> s<sup>-1</sup>)


Legend: ● diffuse, upper leaves; ○ diffuse, middle leaves; ▲ clear, upper leaves; ▼ clear, middle leaves




Measurements & protocols



Modeling



New material development



Logos: HORTI GLASS, sunfire, svensson, Cultilene, Scheuten, Bonor, HERMADIX, GLASOM, BOROSIL, ReduSystem



Diffuse light tomato  
+8-10% yield



Diffuse light cucumber  
+5-10% yield



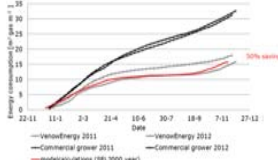
Diffuse light anthurium and bromelia  
+25% faster +25% freshweight

Already 125 ha commercial greenhouses with diffuse glass


## VenLowEnergykas

Goal: Greenhouse concept with highest energy saving and good tomato production


- Double glass with low u-value and high light transmission
- Mechanical dehumidification with heat-regain
- "Next Generation Cultivation Strategies" (climate control)
- Result: ca. 50% energy saving



Energy saving graph showing Energy (kWh/m<sup>2</sup>) vs Date for VenlowEnergy 2011, Commercial grower 2011, VenlowEnergy 2012, Commercial grower 2012, and modelcalculatie (38,2000 year). A 50% saving is indicated.



VenLowKas



Logos: WAGENINGEN UR, maurice, BOAL SYSTEMEN, Climco solar|glass, Scheuten

## VenLowEnergykas

- Upscaling to practice
- Ca. 1.ha commercial greenhouse ID Kas®
- Duijvestijn tomato grower



Duijvestijn Tomaten  
Gedrukt voor een groenere wereld



ID Kas™



Logos: BOAL SYSTEMEN, solar|glass, TECHNOKAS, Scheuten



## IDC Taste




- **What:** quantify and improve taste of fresh products
- **Who:** Wageningen UR, international breeding companies, consumers





Met steun gefinancierd in de toelating. Dit project wordt mede mogelijk gemaakt door het Europese Fonds voor Regionale Ontwikkeling en de Europese Unie en een bijdrage van de provincie Zuid-Holland






## IDC Taste

Research to increase taste & healthy components



Consumer panel



Sensory modeling  
Genetic modeling



DOI: 10.1039/C5MB00477B (Paper) Mol. BioSyst., 2015, 11, 3101-3110

Expert panel



Measurements



## Expertisecentre Agro-robotics @WUR

Intrarow weeding (B2B)



Stekete IC

Sweet pepper harvest (EU, companies)



Move sensor module into manipulator workspace



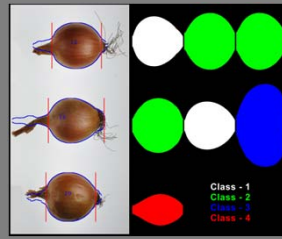





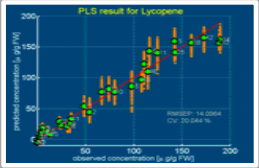


## Expertisecentre Agro-robotics @WUR

Phenotyping and breeding (e.g. ImageJ plugin for variety testing)

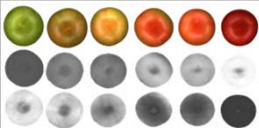
Postharvest quality and sorting (e.g. hyperspectral)



PLS result for Lycopene

R-squared = 0.82  
CV = 20.64%

“WUR intelligence inside” commercial machines





### International Activities

Multinational companies,  
High-tech companies,  
Food companies,  
international gov

E.g. Japan:  
Mitsubishi Chemicals,  
Asahi Glass, Kaneka,  
Kuraray, Kajima,  
Nippon Del Monte Agri,  
Kikkoman,....

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For quality of life

State Visit @WUR

Royal Visit Japan

Seminars @WUR

Visitors @WUR

International training courses

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For quality of life

### Questions?

Flowers

Vegetables

Crop production & quality

Climate control & energy

Soilless cultivation

Robotics & Logistics

Biological control

Sensors and TCI

Water & nutrients