

## What makes good water management in horticulture?

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## There will be more people in the world and they will be richer (FAO, 2009)

- World food production must increase by 70% by 2050
- 90% of the growth in crop production will come from intensification
  - higher yields
  - increased cropping intensity
- This would be in line with past trends...
- ...but represents a major challenge for future private and public research



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## Will there be enough water?

### Virtual water content of diets

Diet	Water (m <sup>3</sup> /person/day)
Reference (US)	5.4
5% reduction animal products	4.6
Poultry replace 50% of beef	4.8
Vegetables replace 50% of red meat	4.4
50% reduction in animal products	3.4
Vegetarian	2.6
Survival	1.0

Domestic water use in Europe is between 0.1 and 0.2 m<sup>3</sup>/person/day

Source: World bank, 2006

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GREENHOUSE

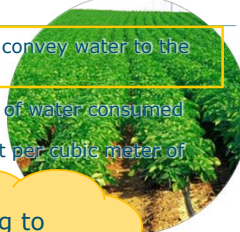
Increasing the vegetable content in our diet does more for the world than installing water saving devices at home

Source: World bank, 2006

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## Emphasis will be on three components of water productivity (World Bank, 2006)

- increasing irrigation efficiency to convey water to the plant root more efficiently
- improving yields per cubic meter of water consumed
- increase income and employment per cubic meter of water consumed.



...and I am going to show that technology and competences are essential in all

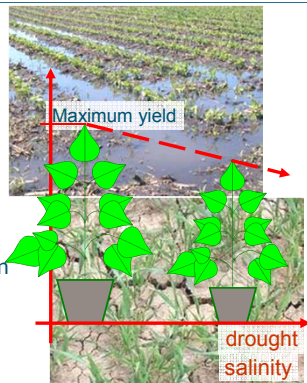
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## Efficiency of water use



### Water: why in excess?

- Yields are reduced by water deficit
- Yields are reduced by salinity
- and not by excess water (within limits)
- Melius abundare quam deficere (better to be on the safe side)*



### Good management = irrigation when needed



Treatment	Water Use (mm)	Fertilizer (Kg/ha)	Mean crop weight (g)	Class 1 (%)
A (ref)	186	100	516	98.6
B	70	100	528	98.8
C	70	83	592	97.2
D	70	58	595	98.4

irrigation was controlled by soil sensors, to maintain pre-set soil water content and EC levels

FLOW-AID consortium, 2010 (EU-FP6)  
Jos Balendonck

### Closed cycle irrigation on substrate

#### A grower in Italy

	Leaching	Supply		Saving
		Open	Closed	%
Water $m^3 ha^{-1}$	1067	5334	3982	25
N $kg ha^{-1}$	211.7	1041	621	40
P $kg ha^{-1}$	21	196	149	24
K $kg ha^{-1}$	230.7	1384	1234	11

Euphoros consortium, EU FP7 2010  
Luca Incrocci



### A typical win-win?

- Investment could be recovered in 2 years
- Thereafter a saving of some 3500 €/years
- Yet ...
  - Fear of "untested" techniques
  - Poor faith in advisory services
  - Concern for root pathologies
- The grower won't do it ... unless required by regulations



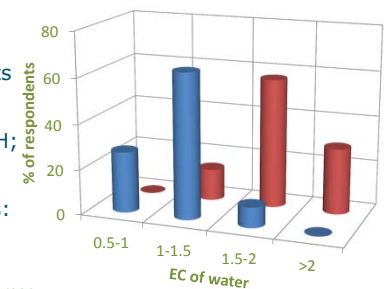
### If a grower could choose:



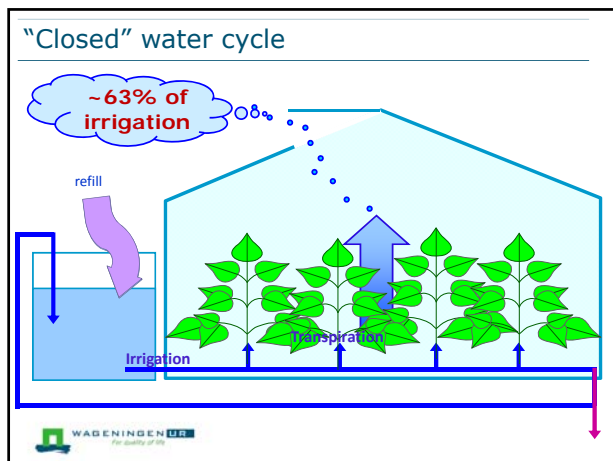
### What is the maximum acceptable EC of water?

Question to growers in "mature" and "growing" markets

- Growing markets: POL; H; IT; GR
- Mature markets: NL; B; UK; DK; F; FIN; USA



Source: Peter Stradiot, Innogreen



### How much leaching is necessary?

■ Water volume in system:  $\pm 10 \text{ L/m}^2$   
 ■ Concentration of irrigation water:  
 ●  $0.5 \text{ mmol/L}_{\text{Na}}$   
 ●  $1 \text{ mmol/L}_{\text{Na}}$

	Tomato	Rose
Transpiration $\text{L/m}^2/\text{year}$	750	900
$C_{\text{max}}$ $\text{mmol/L}$	8	4
$N_{\text{leachings}}/\text{year}$	5 10-11	13 30
Water <sub>leaching</sub> $\text{L/m}^2/\text{year}$	50 110	130 300

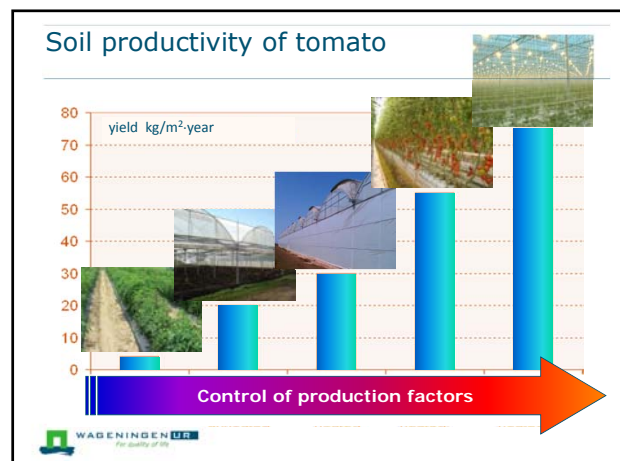
How much N, P, K in the environment?

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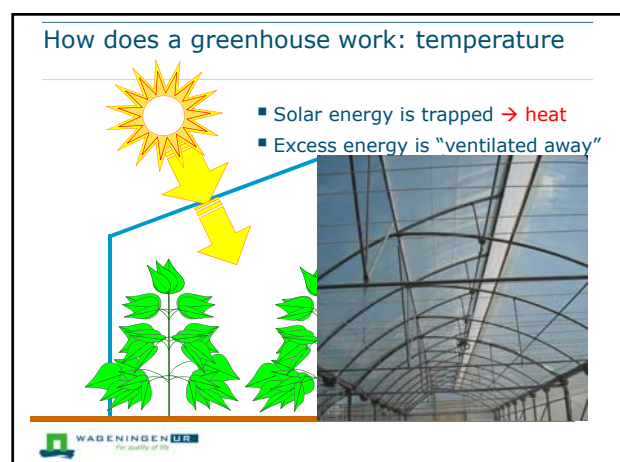


### Water productivity of tomato ( $\text{kg/m}^3$ )

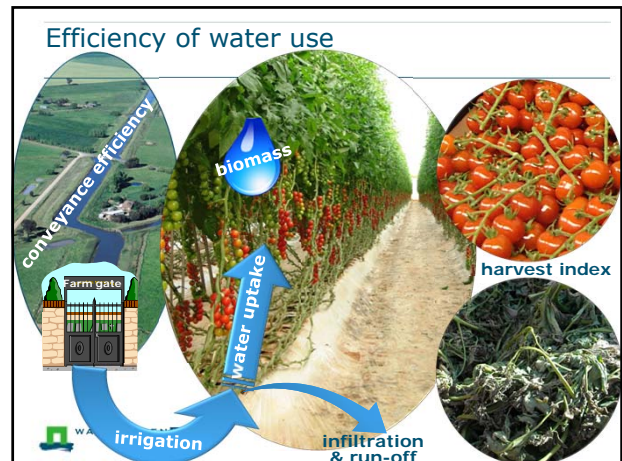
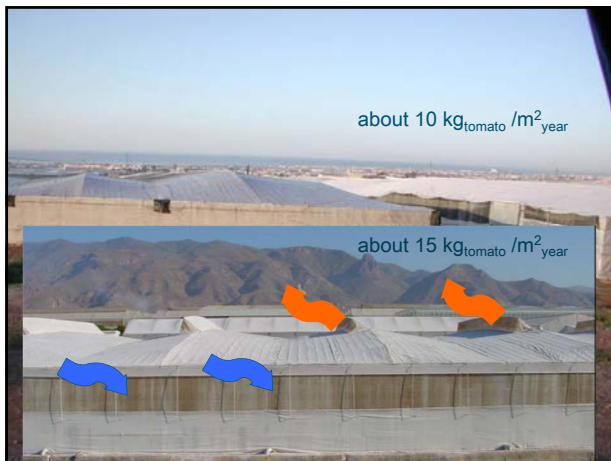
Management	Environment	
	Outdoors	Greenhouse
Average	1.4	8.2
Excellent	4.8	18.9

results of a national survey carried out by the University of Sevilla on behalf of the Spanish government  
 Adapted from: E. Fereres, personal communication

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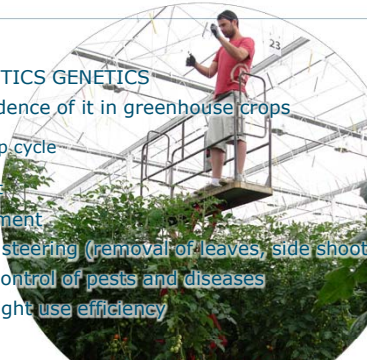
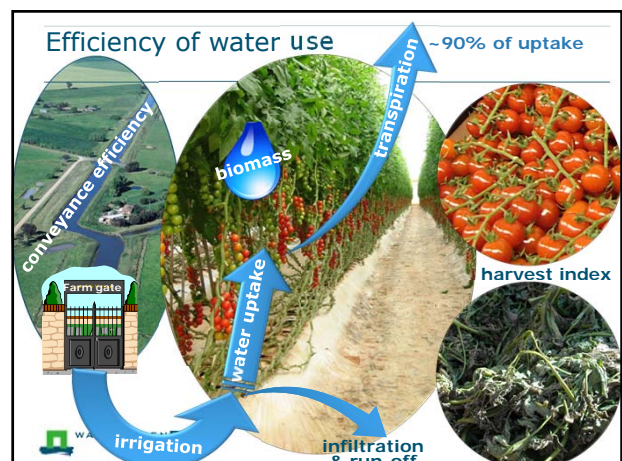
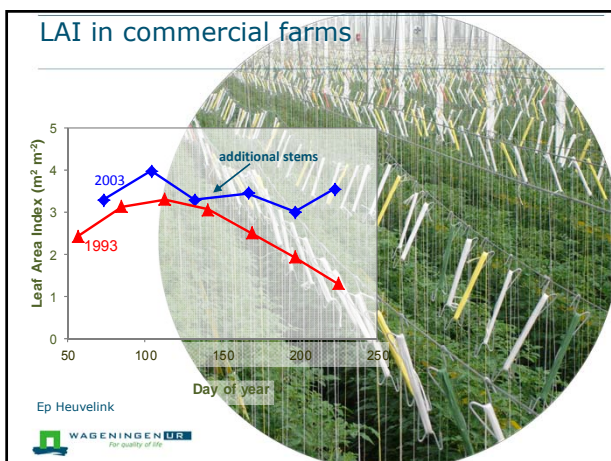




crop	harvest index
Sorghum	0.20—0.35
Rice, Soya	0.25—0.35
Mais, Sunflower	0.30—0.35
Pepper	0.20—0.40
Legumes	~0.50
Wheat	0.30 → 0.5
Round tomato	~0.65
Potatoes, Beets, Cassava	0.70—0.80
Lettuce and leaf vegetables	0.90

**Factors affecting harvest index**

- GENETICS GENETICS GENETICS
  - but no evidence of it in greenhouse crops
- Length of the crop cycle
- Crop management
  - CO<sub>2</sub> enrichment
  - Generative steering (removal of leaves, side shoots)
  - Improved control of pests and diseases
  - Improved light use efficiency

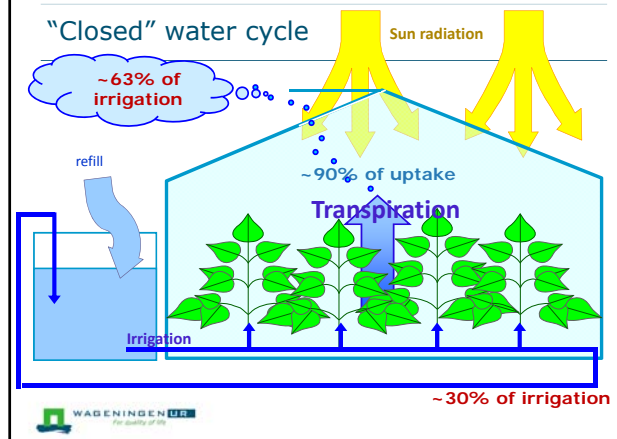



## Transpiration (TE) of crops

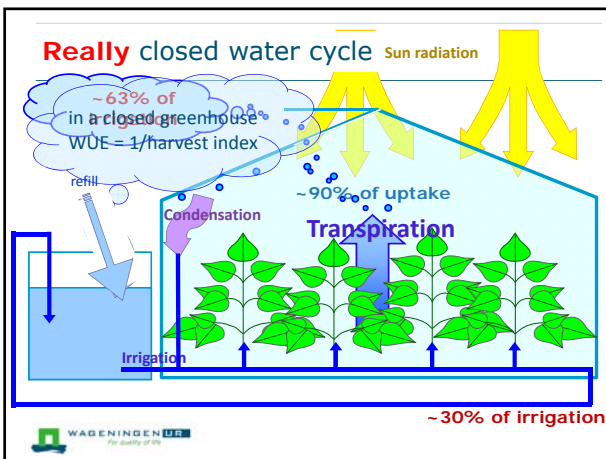
	TE (kg <sub>CO2</sub> /kg <sub>H2O</sub> )	1/TE (l/kg)
C <sub>3</sub>	0.002	500
C <sub>4</sub>	0.004	250
CAM	0.015	67

GENETICS...  
what can we do?

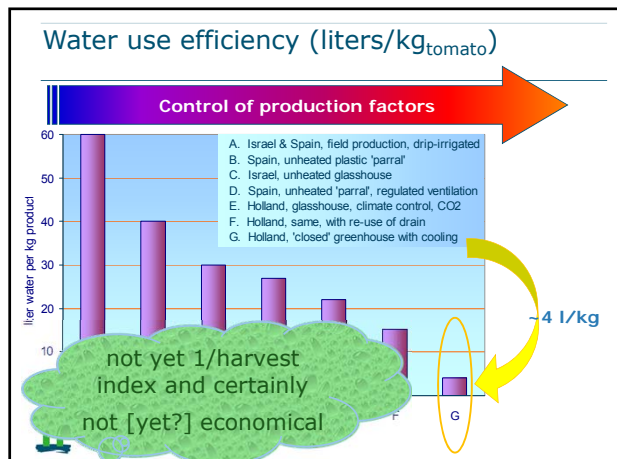
## "Closed" water cycle



## Really closed water cycle



## Water use efficiency (liters/kg<sub>tomato</sub>)



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## Productivity of irrigation water (gross income)

	Almeria	Open field vegetables	Greenhouse vegetables
Productivity €/m <sup>3</sup>		1.6	6.12

- Water use in Dutch greenhouses is about 800 m<sup>3</sup>/ha
- Economic water use efficiency is:  
 $\frac{60 \text{ €/m}^2}{0.8 \text{ m}^3/\text{m}^2} \approx 75 \text{ €/m}^3$  water

...high productivity of water = high value of water

### Good water management

- High productivity of crops
  - good crop management → skills
- Reduce excess irrigation
  - Smart irrigation → technology → skills
- Reduce **need for** excess irrigation
  - Irrigation water of good quality → investment & skills



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For some pictures and unpublished data:

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- Peter Stradiot, Herent, BE