Specific (water) demands of greenhouse horticulture

Closing of the water cycle

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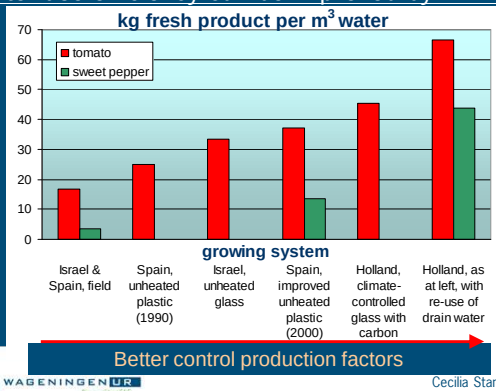
Water use efficiency can be improved by .....



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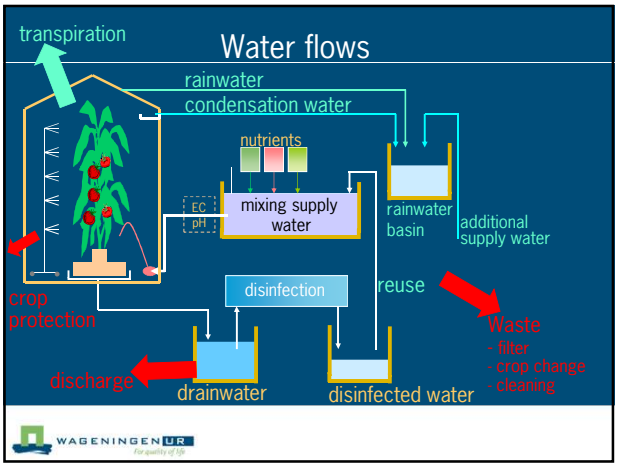
Cecilia Stanghellini

Water flows



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Greenhouse in

- Rainwater
  - Tank size (>500m³/ha)
  - Sodium contents (Na^+)
  - Chemicals
- Tapwater
  - salts
- Surface water
  - Salts, pathogens, chemicals
- Groundwater
  - salts
- Condensationwater
  - chemicals

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Greenhouse out

- Drainwater
  - Pathogen removal: UV, heat treatment)
- Leaching
  - Sodium
  - Growth inhibition
  - Mistakes (unbalanced solution, overflow tanks)
- Filter cleaning water
  - Nutrients, chemicals, pathogens
- Leakage
  - Diffuse source, uncontrolled

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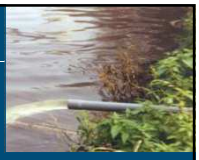
Reasons for discharge



- Sodium in supply water
- Growth inhibition
  - Root exudates
  - Accumulation of Plant Protection Products
  - Microbial reactions
- Unbalanced nutrient composition
- Technical failures of equipment

Water fluxes in rose cultivation

Basin size	rainwater	additional water	discharge
500 m³/ha	43%	57	5
1500	63	37	4.5
3000	97	3	4
[Na] in additional water			
0.8	44	56	4
1.8	43	57	5
2.8	40	60	12

- But discharge varies between 10 and 40%

Discharge (N load)

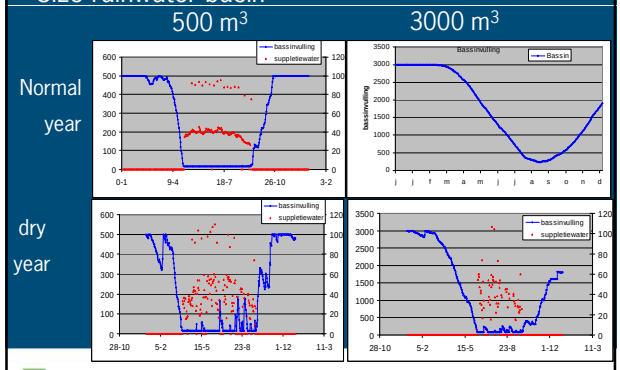
Norms for discharge on N (kg N/ ha/ yr)

emissie groep	Gewas-indeling	2010 - 2014	2015-2017	2018-2020	2021-2025	2024-2026	v.a. 2027
2	paprika	50	33	25	17	8	ca. 0
5	tomaat	125	83	67	42	21	ca. 0
8	gerbera, roos	250	167	125	83	42	ca. 0

Calculated load:

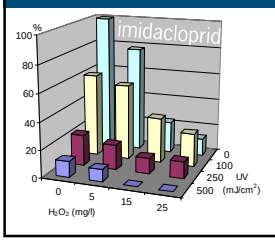
Na gehalte (mmol/l)	1.0		1.8	
Year	normal		Dry	
basin (m³)	3000	500	1500	3000
paprika	76	328	242	119
tomaat	116	350	278	180
gerbera	82	534	424	285
roos	99	675	533	365

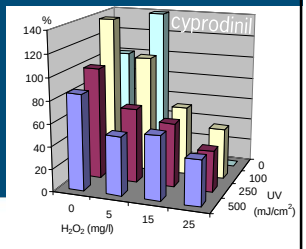
Size rainwater basin



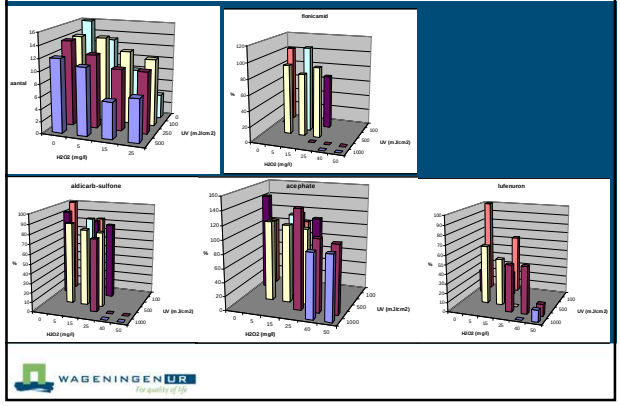
Results (degradation of PPPs)

- Drainwater compared with treatments
  - 9-14 PPPs found in drainwater
  - 40% of originally found PPPs disappeared
  - Others decreased by 60-100%
  - Few: no effect

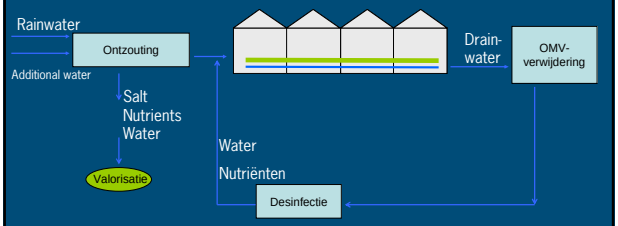




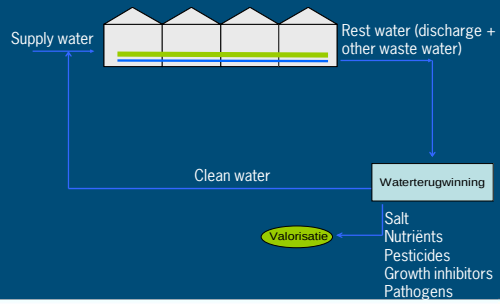
Advanced oxidation higher levels of H_2O_2 and UV



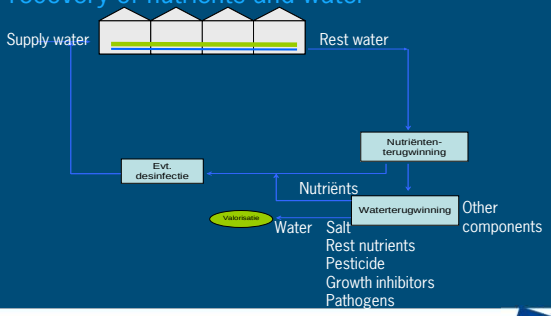
Closing the water cycle concept 1: desalination incoming water



Closing the water cycle concept 2: water purification



Closing the water cycle concept 3: recovery of nutrients and water



Methods

Concepts	Most promising methods
Water recovery	**Reverse osmosis** **Membrane destillation**
Nutrients recovery	**Ion exchange** **Electrodialyse** **Capacitieve De-ionisatie**
Desalination	Ion exchange Electrodialyse Reverse osmosis
Removal organic molecules	Advanced oxidation (i.e. H_2O_2 + UV) Membrane destillation

Standard water

- EC 3, pH 5 – 6
- K =7, Ca = 8, Mg = 3.5
- Na = 6, Cl = 6
- NO3 = 17, SO4 = 6, H2PO4 = 0.7
- Trace elements (umol/l): Fe = 50, Mn =20, Zn = 5 B=50, Cu =2
- PPP: selection

Goals for greenhouse horticulture

- Reuse as long as possible
  - No discharge on sewage system or surface water
  - Reduction in costs for nutrients and water
- Nursery, if discharge, then purification
  - Removal of PPP, nutrients
- Area: combination of discharge fluxes and purification
  - Reuse by growers: limited support
  - Advantages larger scale

Thanks
for your
attention !

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