

Disease management in soilless culture

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Soilless culture systems in greenhouses

- No soil-borne diseases
- No methyl-bromide
- Higher production & quality
- Higher investment
- Better control
- Less water
- Less fertilizers
- ➔ Water & Disease management
- ➔ Developments in legislation



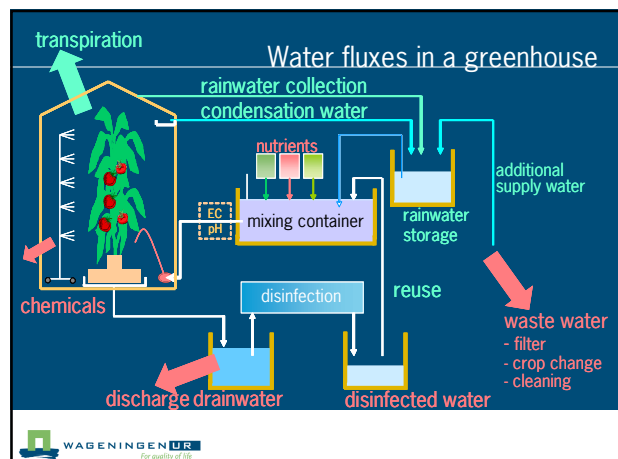
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EU Water Framework Directive

- Since 2000
- Goal: excellent chemical and ecological quality of surface water in 2015
- Practically: no emission of nutrients and chemicals from open air and greenhouse production
- ➔ Dutch greenhouse horticulture: almost zero emission in 2027
- ➔ Soilless systems: recirculation with disinfection
- ➔ Analyzing the risks for disease development



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Incoming water fluxes and risks

	pathogens	nutrients	costs
■ Rainwater	■ +	■ --	■ -
■ Tap water	■ --	■ ++	■ ++
■ Surface water	■ ++	■ ++	■ --
■ Well water	■ -	■ ++	■ --
■ Reverse osmosis water	■ -	■ --	■ ++
■ Condensation water	■ -	■ --	■ --

- ➔ Drainwater ➔ disinfection
- ➔ Rainwater + RO or well water

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++ high risk

-- low risk

Physical disinfection methods (1)

- Heat treatment
 - dosage: 95°C for 30 s
- UV radiation (254nm, UV-C)
 - 100 mJ/cm² for bacteria and fungi
 - 250 mJ/cm² for virus (pepinovirus 150 mJ/cm²)
- Membrane filtration (micro-, ultra- & reverse osmosis)
 - <1 micrometer
 - more in use for desalination



High pressure UV installation

- ➔ High investment, larger nurseries, good performance

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Physical disinfection methods (2)

■ Slow sand filtration

- grain size: 0.15-0.35 mm
- filtration rate: 100 - 300 l/m²/h
- filter media: sand, mineral wool, perlite, lava granulate
- size (m²) = 10x capacity (m³/h)
- Similar to bio-filtration

→ Reliable, low investment, smaller nurseries



Chemical methods, oxidizers (1)

- Reaction with all organic matter, as in pipelines (clogging + byproducts)
- Very fine prefiltration needed: 50-80 µm

■ Ozone (O₃ → O₂ + O·)

- 10g.h⁻¹.m³, exposure time 1 h, low pH
- High investment, strict rules for application
- On-site fabrication of ozone
- Reliable good performance

■ Hydrogen peroxide (H₂O₂ → H₂O + O·)

- 0.005% (pythium), 0.01% (fungi), 0.05% (virus)
- Activator needed (weak acid), pH drop
- Damage to plant roots (0.05%)
- In use against bio-fouling



Chemical methods, oxidizers (2)

■ Sodium hypochlorite (NaOCl → HOCl + NaOH- or OCl-)

- Household bleach (cheap)
- Decomposition into NaClO₃ (climate) → variable results
- Not effective against virus
- Na⁺ added to closed system
- Phytotoxic: >50ppm
- Corrosive to equipment

■ Chlorine dioxide (ClO₂)

- <5ppm, 10 min. exposure time, pH independent
- On-site fabrication (hydrochloric acid + sodium chlorite)
- Expensive
- Too little information about elimination plant pathogens



Other methods

■ Copper-silver ionisation

- Electrolysis: approx. 2 ppm
- Not very effective, only pythium, phytophthora

■ Active carbon adsorption

- Adsorption organic, non-polar substances
- Regeneration needed
- Not to be used for pathogen elimination



Disinfection other materials

■ Substrates

- Single year use
- Mobile steaming apparatus?

■ Drippers

- Annually soaked
- Filled with lye or acid

■ Plastic sheets

- Removed and renewed

→ Hygiene practices !



Discussion (1)

■ No open soilless system

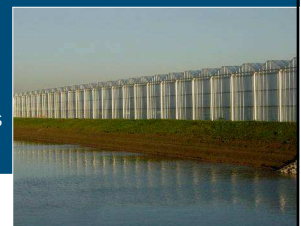
- NL: almost zero emission in 2027
- Closed systems: 10-40% leaching

■ Soil grown:

- Change to soilless
- Reuse drainage water

■ Open field production

- Lettuce, strawberry, leek
- Nursery stock, fruit & bulbs



Soilless: outside!



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Discussion (2)

	++	+	-	--
	Performance		Costs	
■ Heat treatment	++			-
■ UV radiation	++			-
■ Membrane filtration	++			--
■ Slow sand filtration	+			+
■ Ozone	++			--
■ Hydrogen peroxide	-			+
■ Sodium hypochlorite	--			++
■ Chlorine dioxide	-			-
■ Copper silver ionisation	--			-
■ Active carbon adsorption	-			-

■ No disinfection

-- -- -- +++
 -- bad performance -- high costs
 ++ good performance + low costs

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Conclusions

- EU WFD demands less emission
 - Change to soilless
 - Change from open to closed
 - Disease management becomes more important
- Disinfection
 - performance important : Heat treatment, UV radiation
 - costs are most important factor: Slow sand filtration
- Soilless culture alternative for chemicals in soil ?
 - Water shortage
 - In greenhouses and outside
 - Crops? <10 plants/m²

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Thank you for your attention

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