Emission to surface water from greenhouse drip and spray applications

Erik van Os, Tycho Vermeulen
erik.vanos@wur.nl, tycho.vermeulen@wur.nl

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The Food and Environment Research Agency

Wageningen UR Greenhouse Horticulture




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Introduction

- EU Water Framework Directive (2000)
  - Sound surface and groundwater by 2015
  - Horticultural industry: almost zero emission by 2027
- Measurements Water Boards in surface water
  - Many exceedings
- Present PPP package under pressure
  - Risk for less available PPP

➔ Emission should be minimized soon

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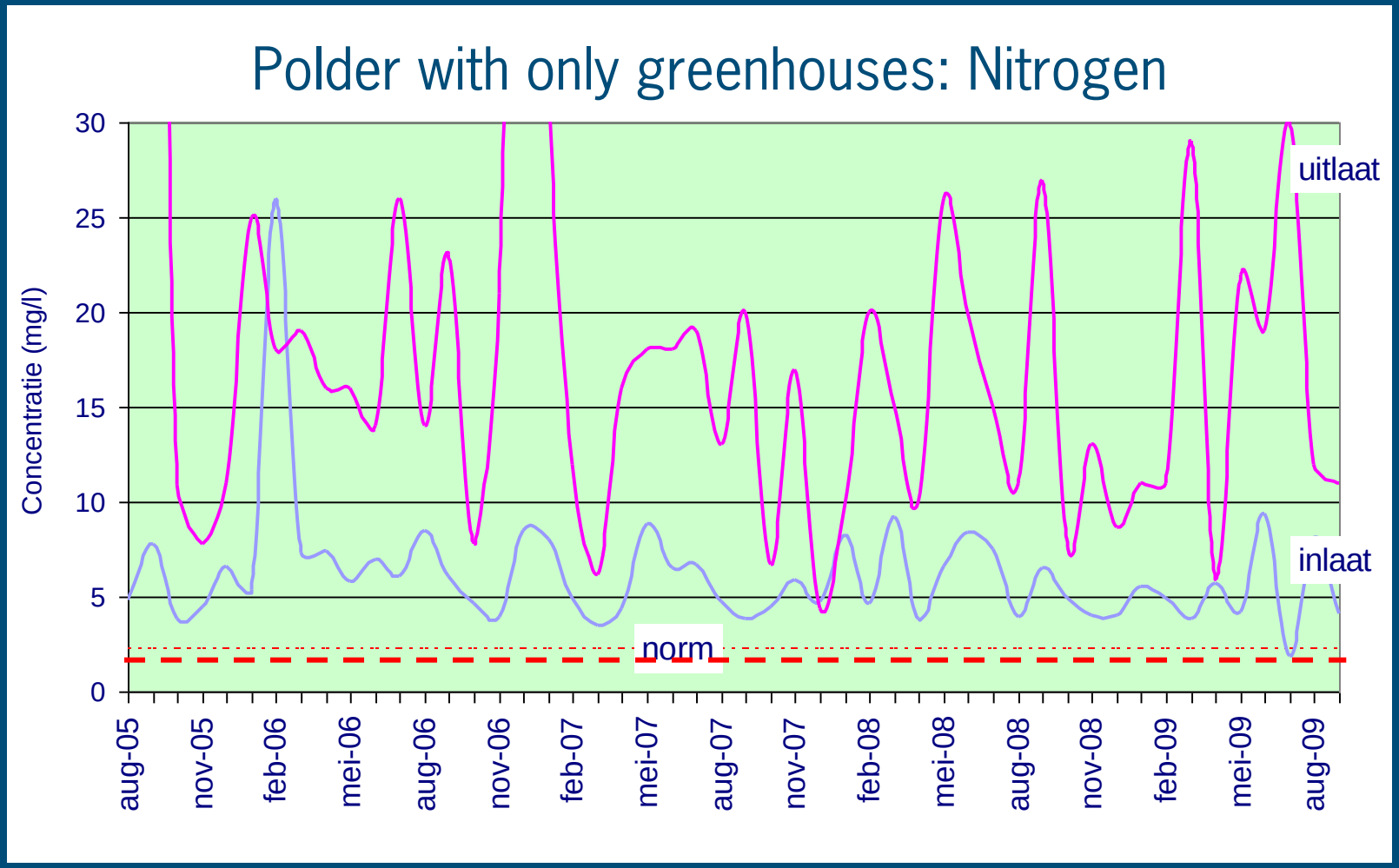
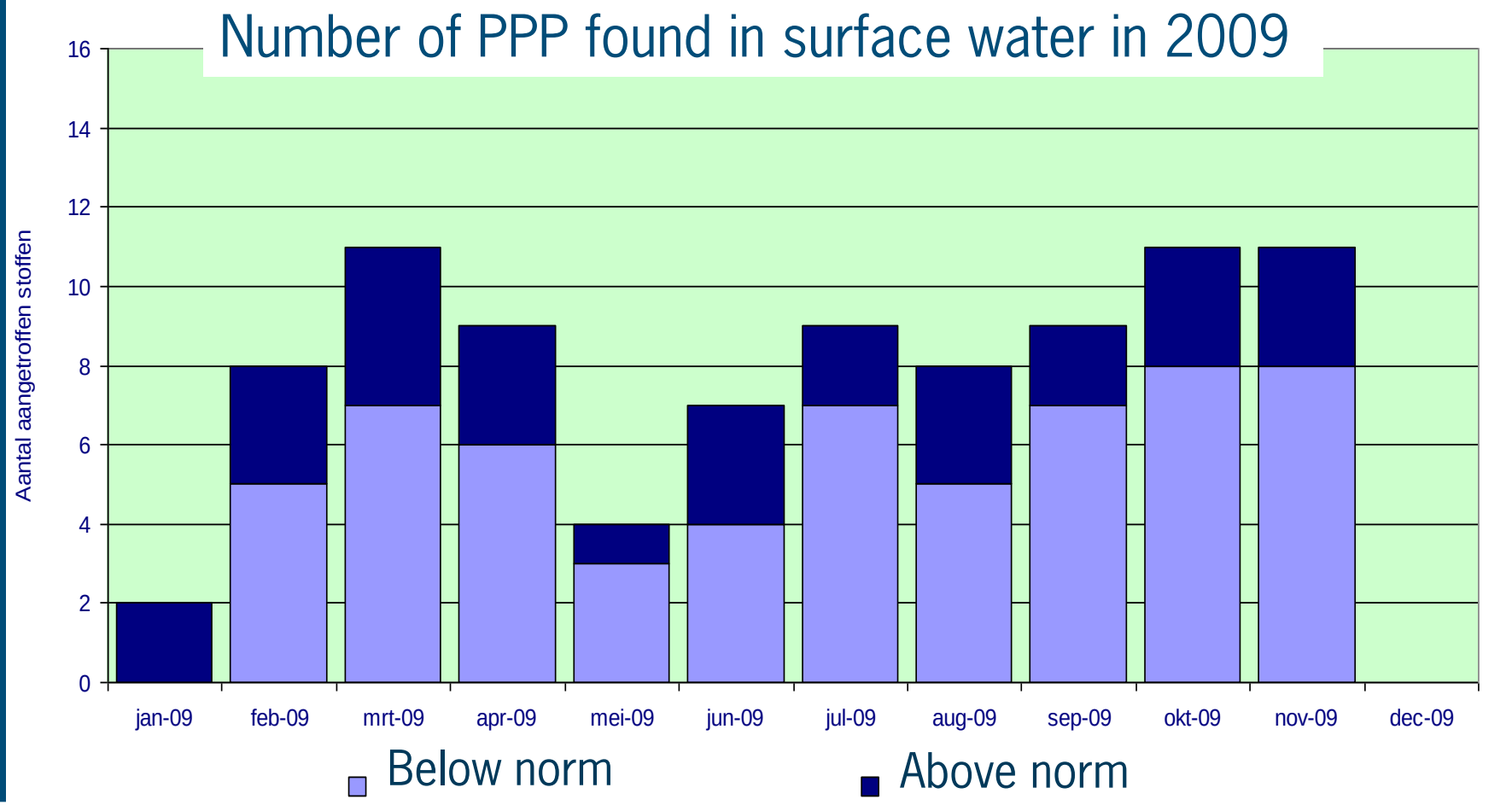
Problem nutrients



→ Similar for phosphate

Problem PPP

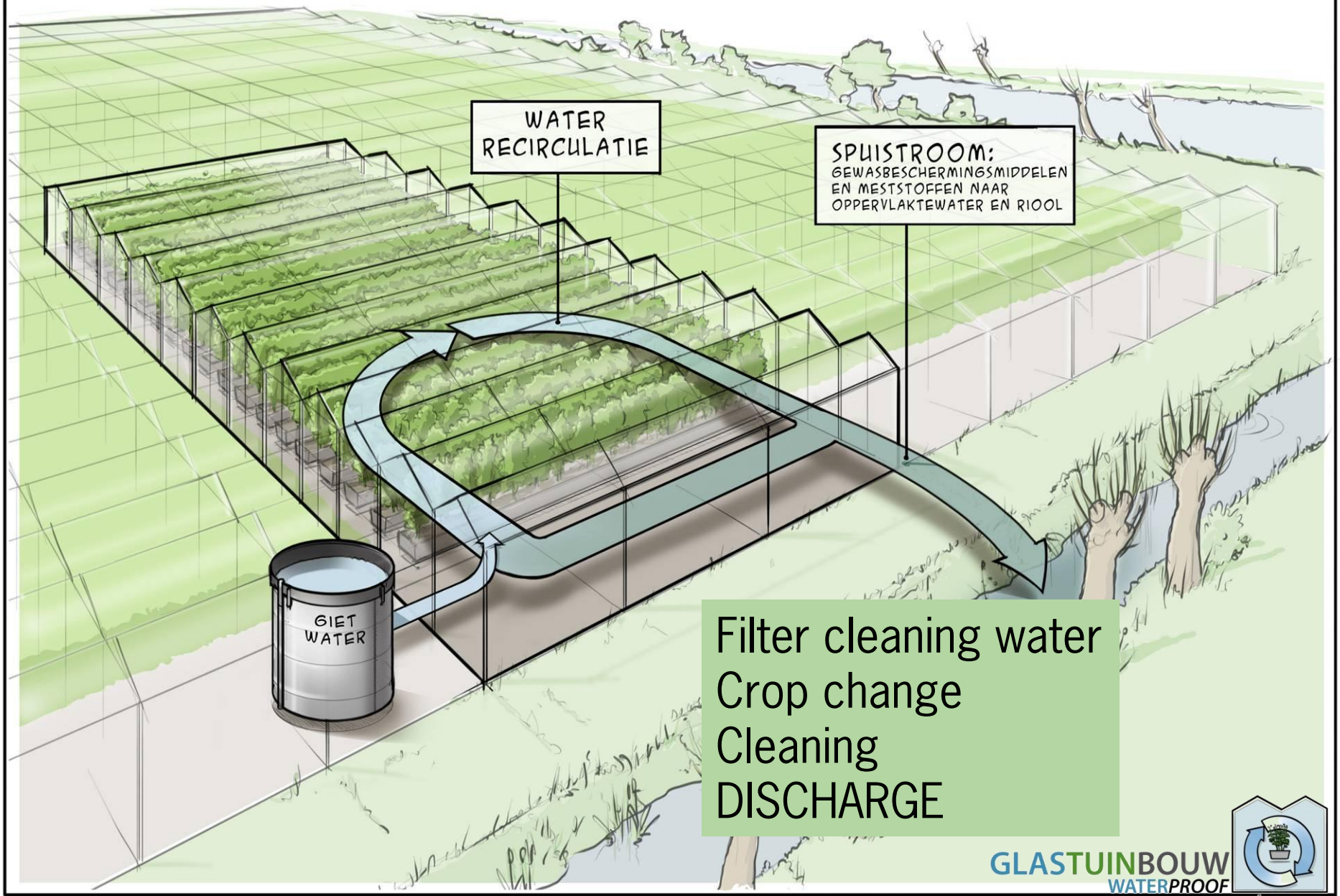
Polder with only Greenhouses



➔Variation per month

➔Variation per year

WATERKRINGLOOPSLUITING SUBSTRAATTEELTEN



Filter cleaning water
Crop change
Cleaning
DISCHARGE

GLASTUINBOUW
WATERPROOF
substraat

Reasons for discharge

- Accumulation of Sodium
  - in supply water
  - in fertilizers
- Growth inhibition
  - Root exudates
  - Accumulation of Plant Protection Products (PPP)
  - Microbial reactions
- Unbalanced nutrient composition
- Filter cleaning water
- Technical failures of equipment
- Other cultivation reasons

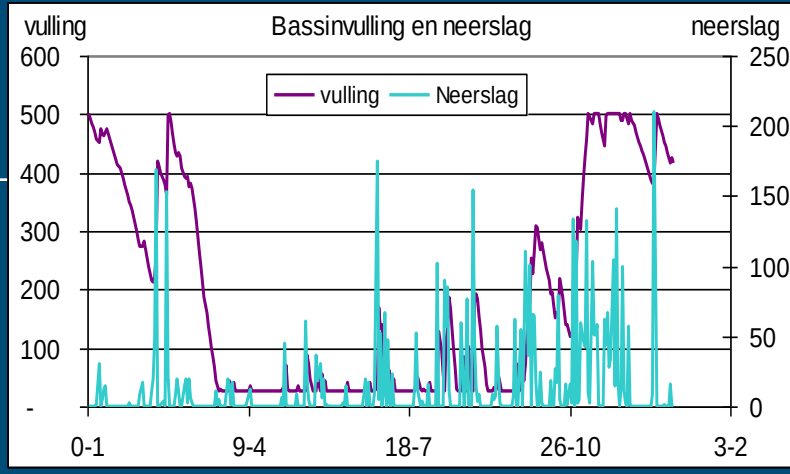
Reference rose

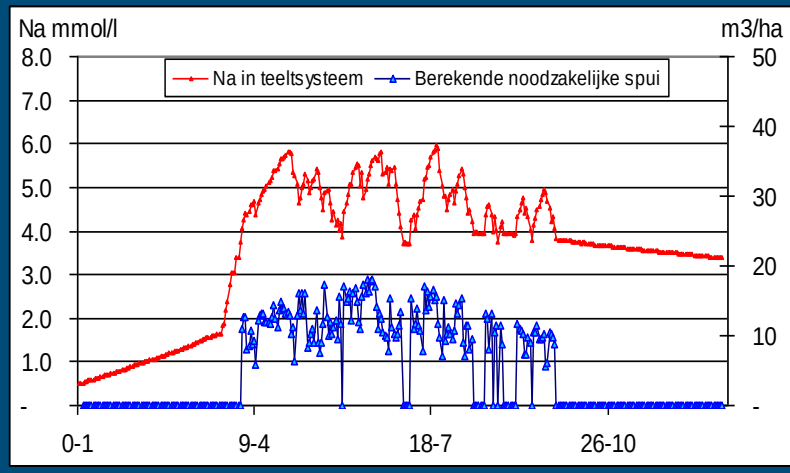
- Rainwater basin: 500 m^3/ha
- additional: tap water (1,8mmol/l)
- 25% drain
- Dry year (500mm rain)

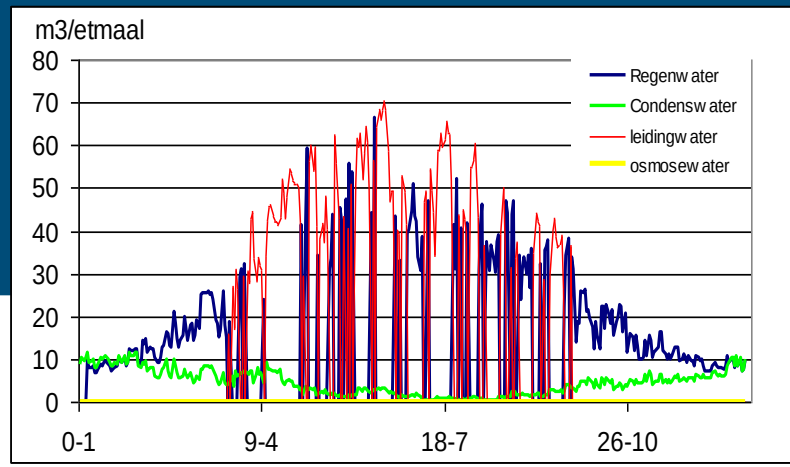
Water usage: 1223 mm

Discharge: 18% (2200 m^3/ha)

- [Na]> 4mmol/l
- 100 d each day drain: open system
- drain 15-20m^3/d







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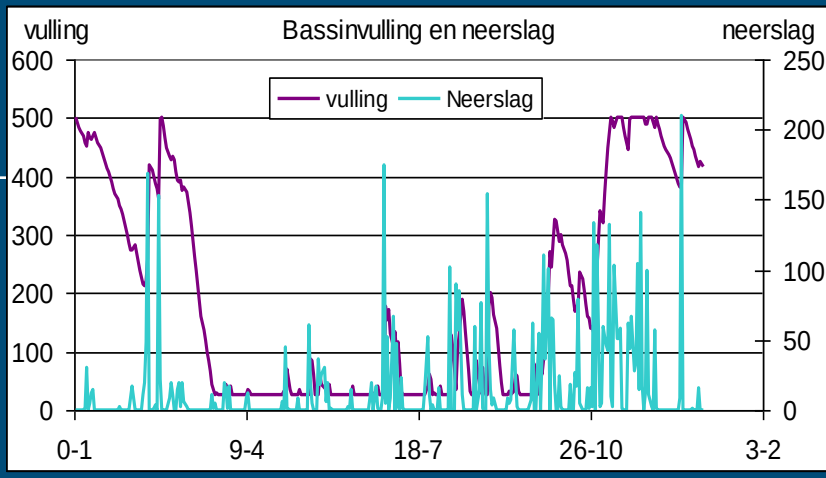
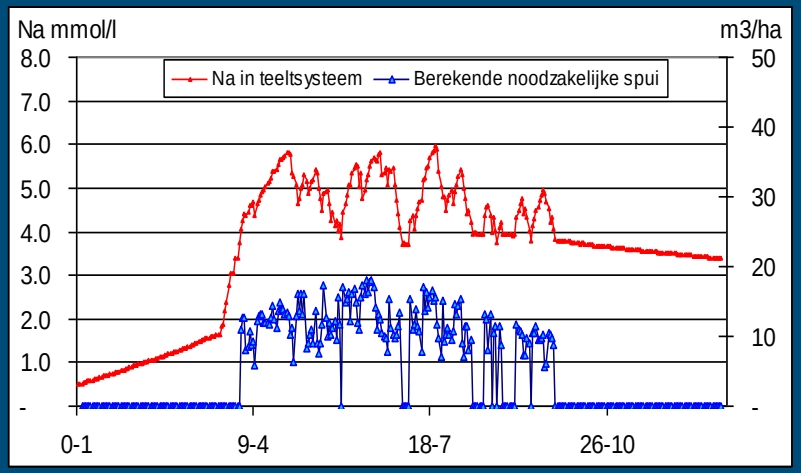
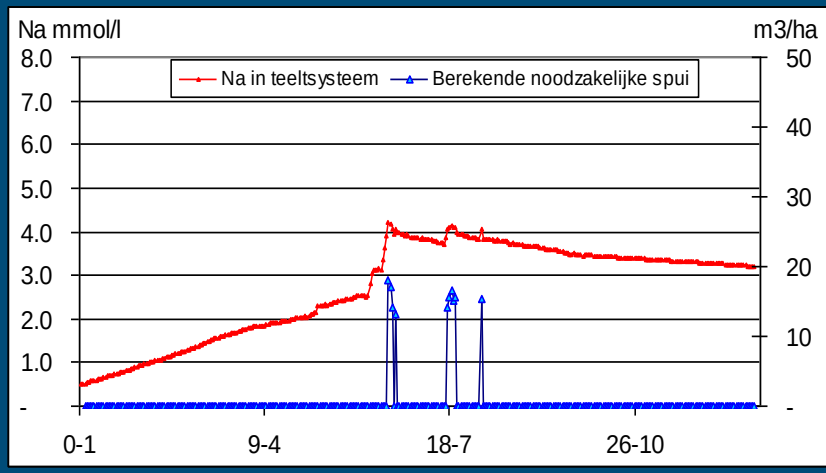
Use of osmosis water

Water usage: 1223 ➔ 1055 mm

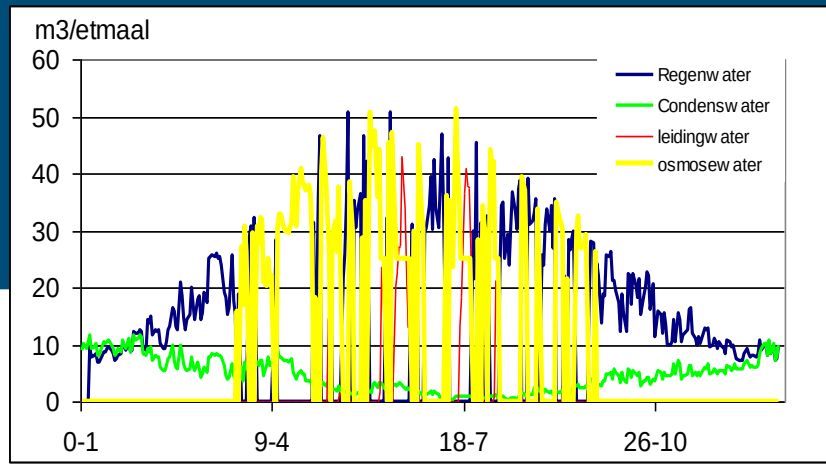
Discharge: 18% (2200 m^3/ha) ➔ 5%







- no Na into the system: little discharge



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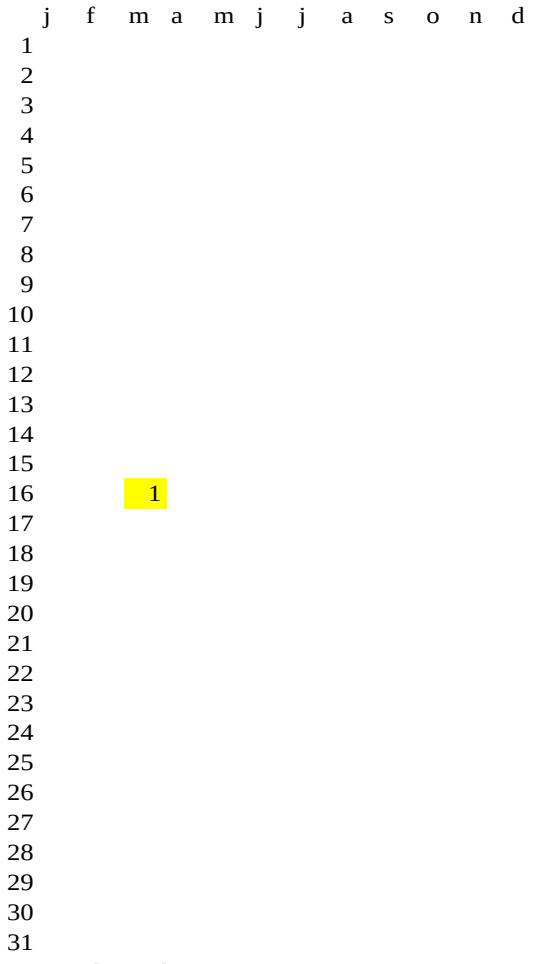
- Root application
- Spraying
  - Ca. 10% of applied product falls on the substrate

Spraying scheme rose (example)

Root pathogens

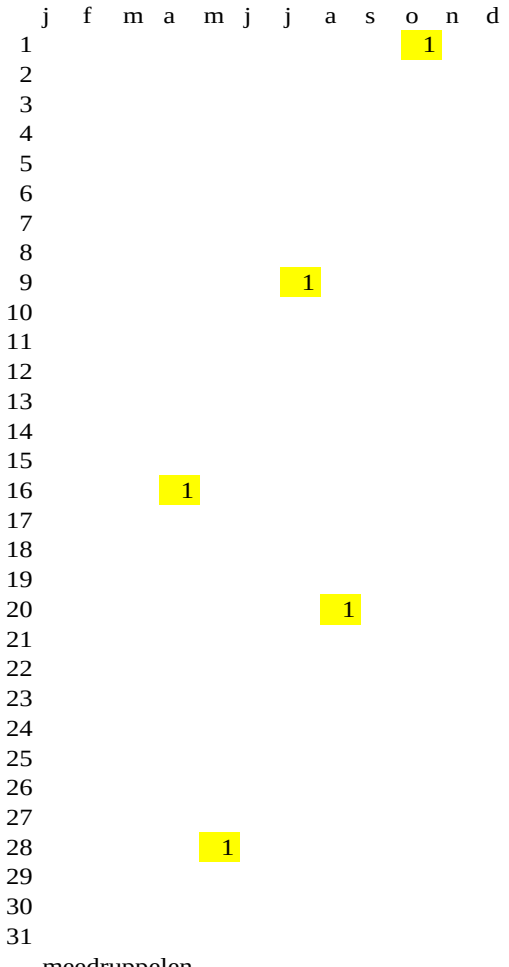


meedruppelen

1 propamocarb

eenmalig

Aphids

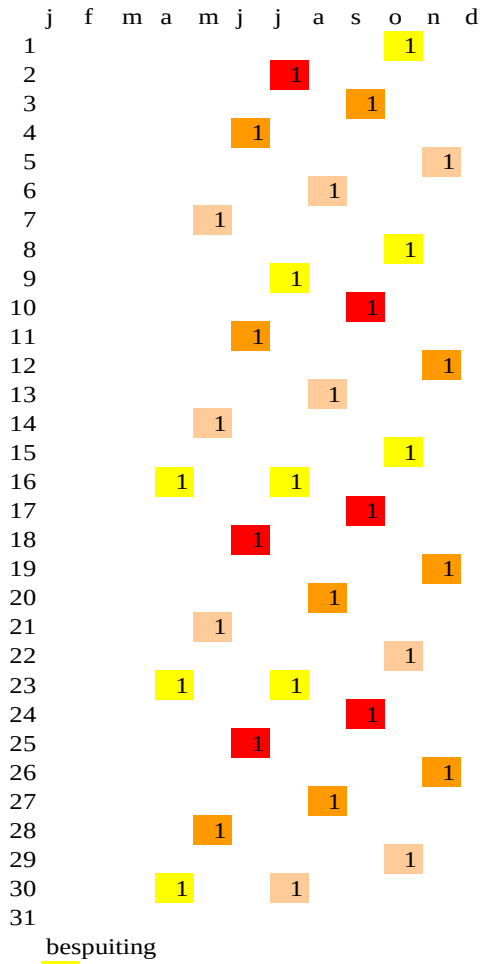


meedruppelen

1 imidacloprid

behandeling om de 6 weken

Mildew



bespuiting

1 bitertanol

1 dodemorph

1 penconazool

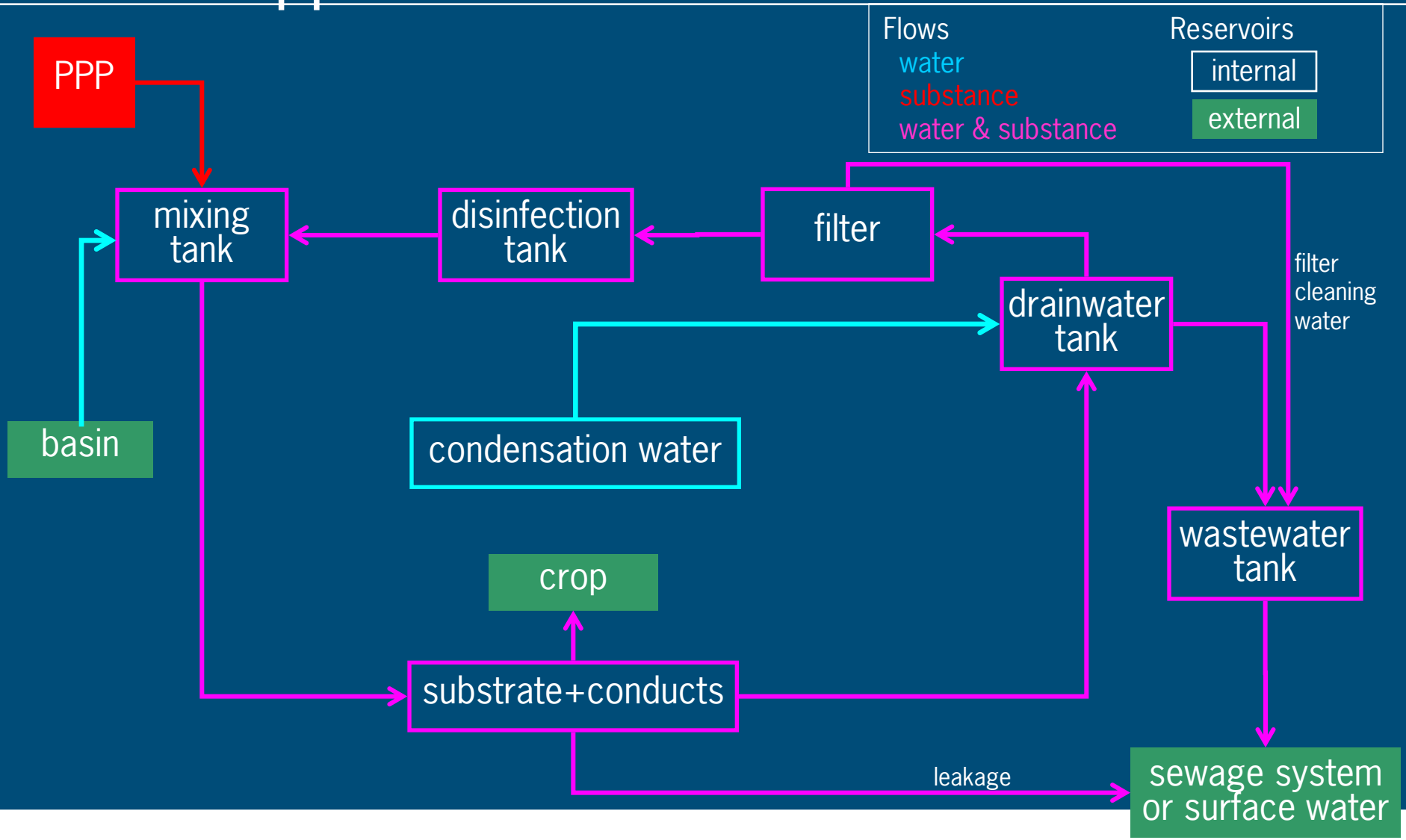
1 mepanipyrim

behandeling om de 7 dagen

blokken van 3 behandelingen met 1 stof

A: root application

Version 17/03/2009



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B: spray application

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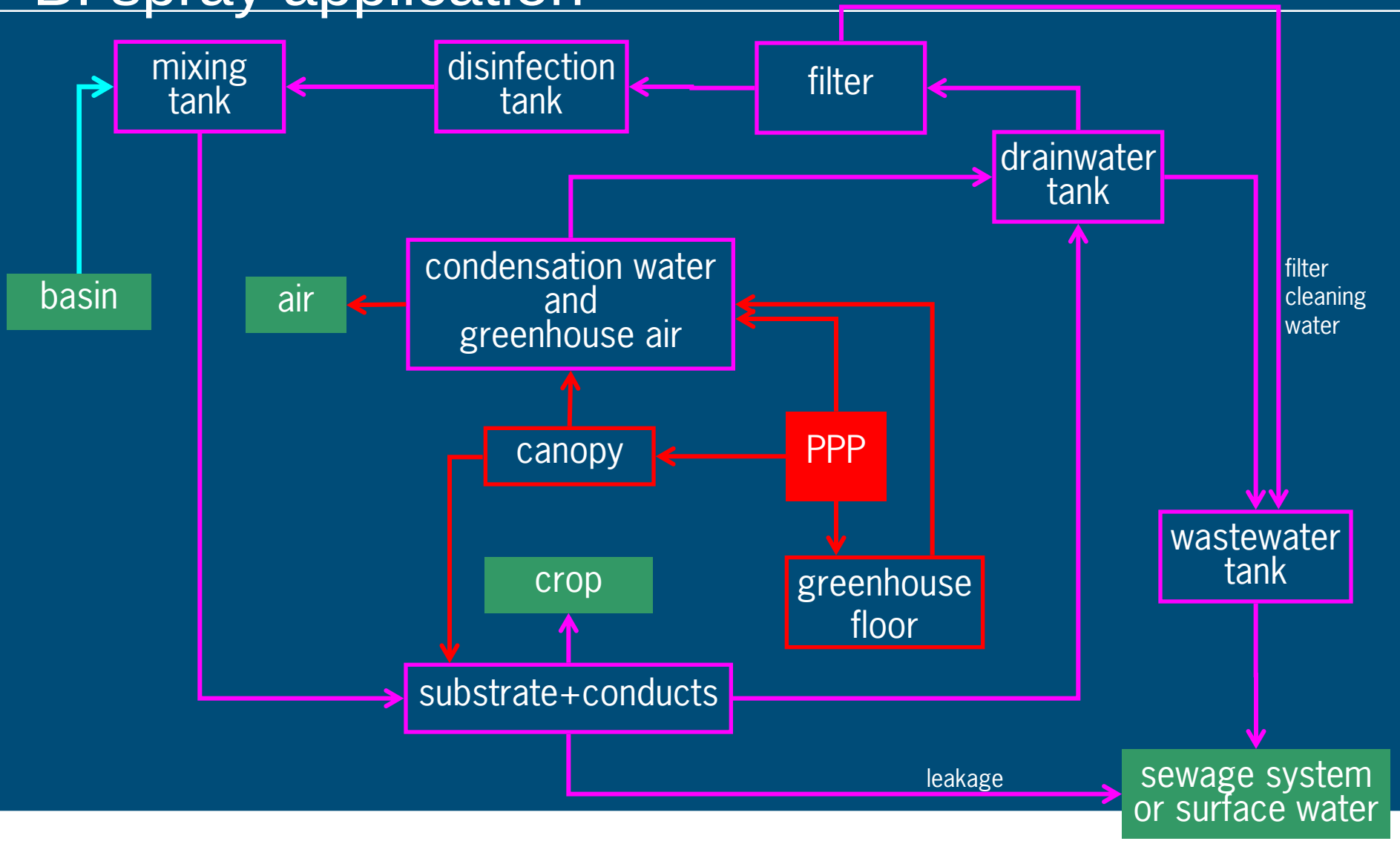

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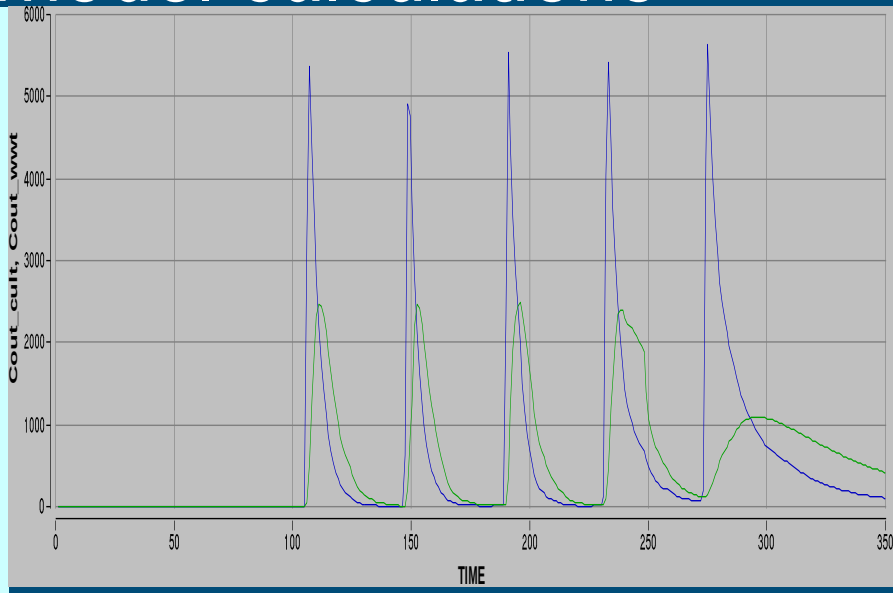
PPP substance emission, model calculations

	reference	osmosis
water use	1223	1055
% discharge	18	5
propamocarb		
crop uptake	78.2	81.3
degraded	16.1	16.7
discharge	4.6	0.9
leakage	1.1	1.1
imidacloprid		
crop uptake	63.0	80.7
degraded	8.4	11.2
discharge	26.3	5.2
leakage	1.7	2.2
mepanipyrim		
crop uptake	73.6	74.2
degraded	22.5	22.4
discharge	1.1	0.5
leakage	0.2	0.3



Imidacloprid, 5 applications

Bl= recirculation water

Gr= waste water tank

Estimated extremes in emission of PPP

Fate model	Calculated for model crop	Low end of emission (% of application)	High end of emission (% of application)
Application via nutrient solution	cucumber	0.03	11
	pepper	0.02	10
	rose	0.11	16
Crop application by spraying	cucumber	0.01	0.5
Crop application in ebb/flow system	ficus	0.01	0.5

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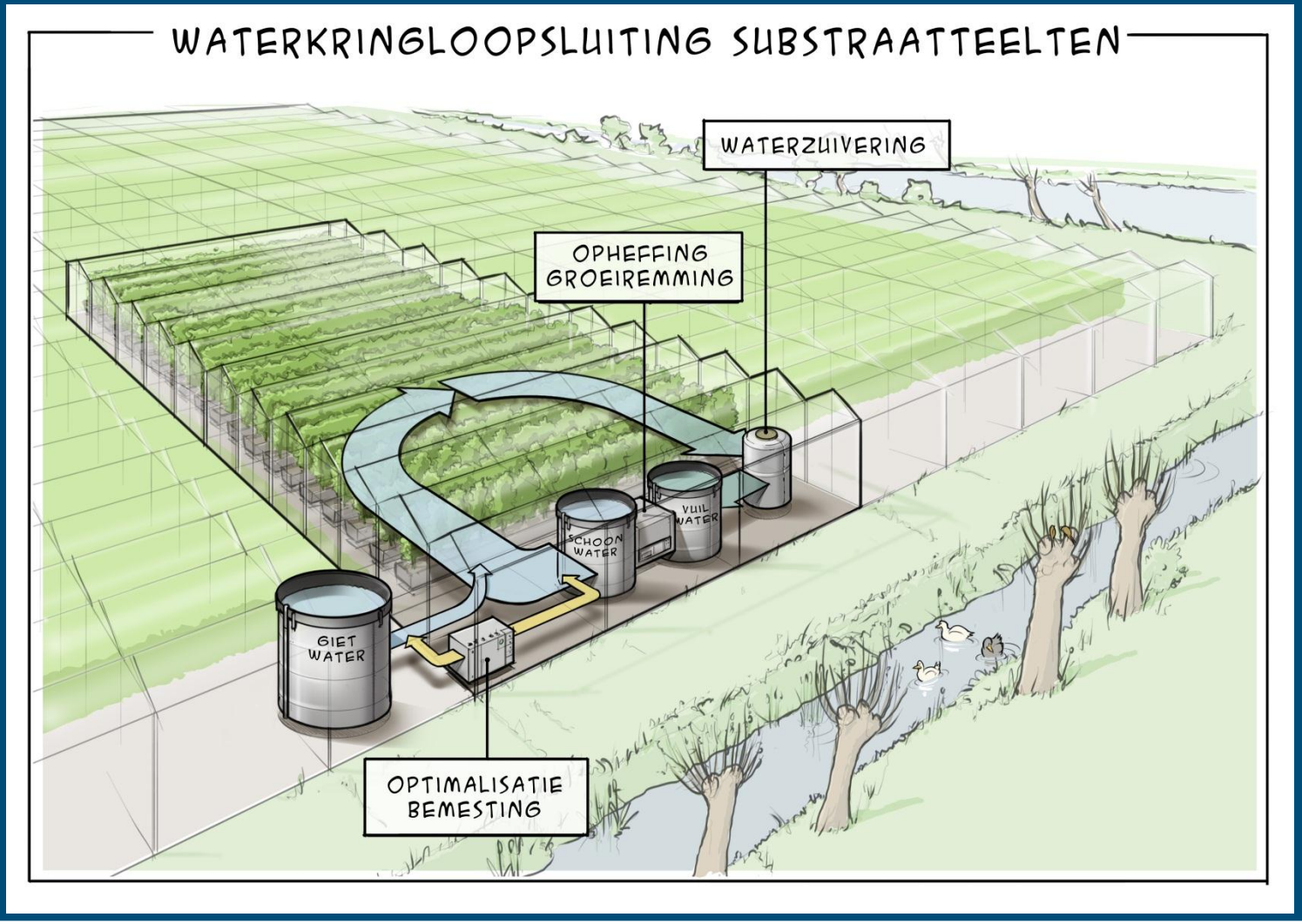
- Multi year analysis: emission depends on moment of application and discharge
- Emission to air is significant and so far not addressed

Closing the water cycle, concept 1



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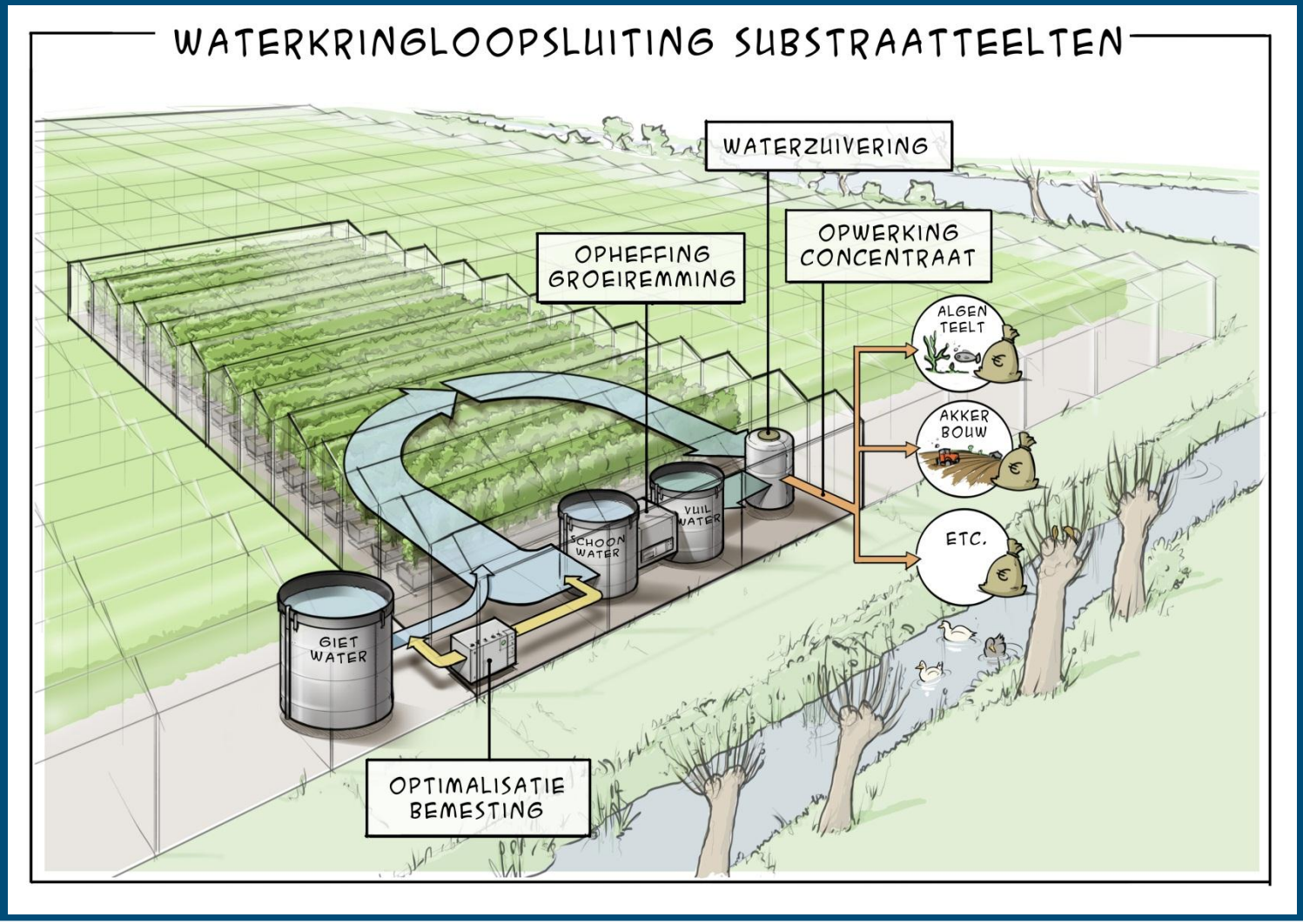
GLASTUINBOUW WATERPROOF substraat

Closing the water cycle, concept 2



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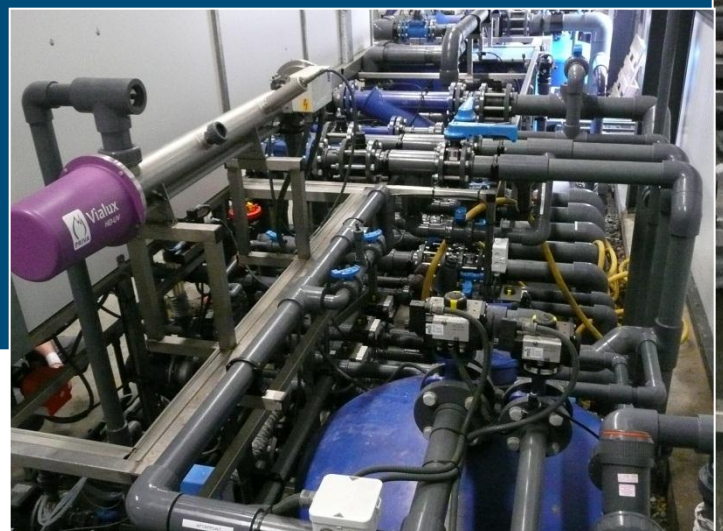
GLASTUINBOUW WATERPROOF substraat

Principles of purification

- Chemical/physical
  - H_2O_2, Ozone, UV
- Adsorbtion
  - carbon filter
- Filters
  - reversed osmosis, membrane distillation, bio-membranes
- Biological activity
  - constructed wetlands

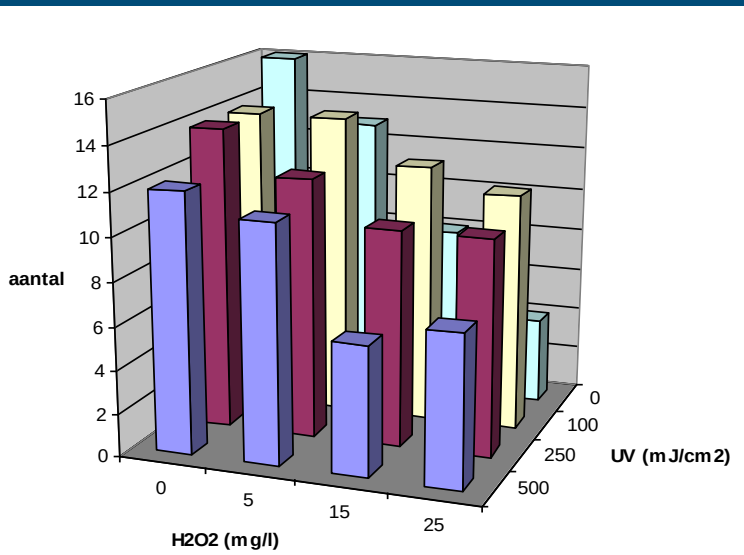
Advanced oxidation

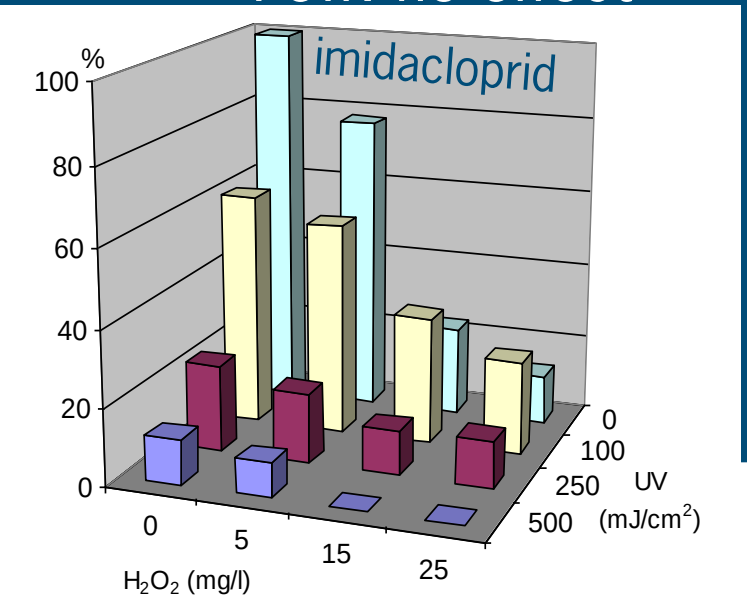
- Commercial grower with UV disinfection equipment
  - Additional H_2O_2 dosing applied to get advanced oxidation
- Tests on degradation of PPP
  - H_2O_2: 0-25 mg/l
  - UV-C (200-280nm): 0-1000 mJ/cm^2

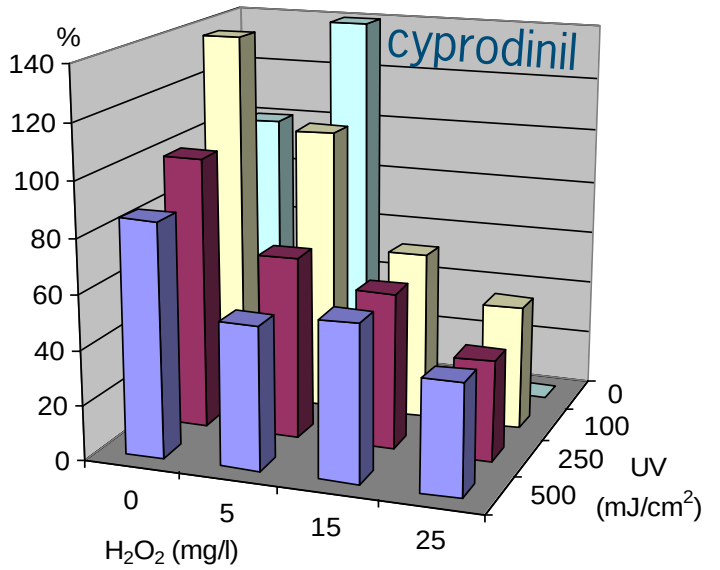


Effect of H_2O_2 + UV-C on PPPs

- Drainwater (before) compared with treatments (after)
  - 9-14 PPPs found in drainwater
  - 30% of originally found PPPs disappeared
  - Others decreased by 60-100%
  - Few: no effect







Goals for greenhouse horticulture

- Reuse as long as possible
  - Water sources without [Na]
  - No discharge on sewage system or surface water
  - Reduction in costs for nutrients and water
- If discharge is needed, then purification
  - Removal of PPP, nutrients (advanced oxidation, others in development)
- *Adaptation of application techniques*
  - *More predators and integrated approach / resilience*
  - *Improved spraying techniques (lower volumes and pressures)*

Thanks

for your attention !

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