

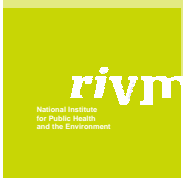


Emissions of plant protection products from hydroponic cultivation systems to surface water.

Ton van der Linden

Dutch work group

- *Ton van der Linden, RIVM*
- *Roel Kruijne, Alterra*
- *Rik de Werd, Applied Plant Research*
- *Rob Meijer, Greenhouse Horticulture*
- *Erik van Os, Greenhouse Horticulture*
- *Marieke van der Staay, Greenhouse Horticulture*
- *Tycho Vermeulen, Greenhouse Horticulture*
- *Jan Huijsmans, Plant Research International*
- *Ynze Stienstra, Ctgb*
- *Erwin Roex, Deltares*
- *Theo Cuijpers, Water Board Schieland and Krimpenerwaard*



Outline

- Introduction
- Schematic representation of a hydroponic system
- Concepts
- Example simulations
- Results
- Possibilities for scenario development
- Conclusions

Remit of Dutch work group

To estimate emissions of plant protection products from glasshouses to surface water.

To develop assessment methods for use in Dutch authorisation.

To exchange knowledge with EFSA

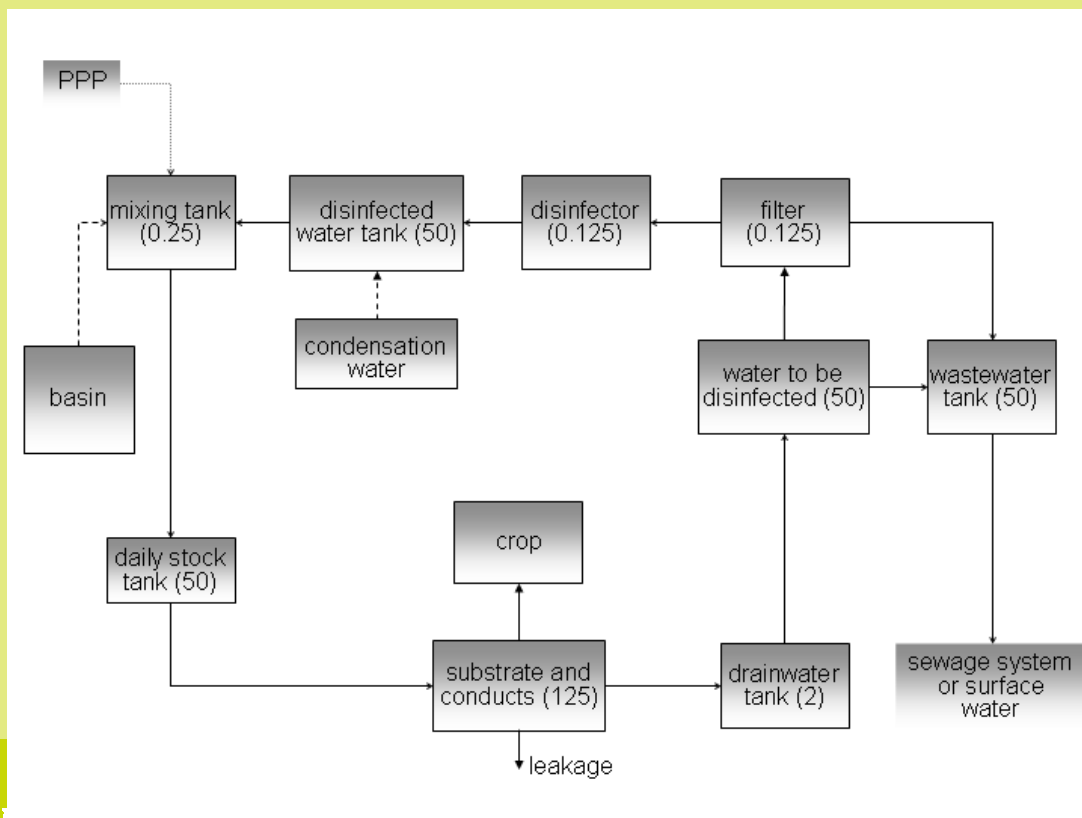
Background

- Current emission in authorisation procedure: 0.1%
- Monitoring in surface water in glasshouse horticultural areas:
 - frequently concentrations above Environmental Quality Standards
 - possibly 0.1% emission is an underestimation

limitation

- This presentation is limited to applications with the nutrient solution
 - hydroponic system (substrate cultivation)
 - no spraying / fogging

Scheme of hydroponic growing system



Concepts (1)

Three models:

1. model for calculating crop water requirement
2. model for calculating water flows and accumulation of a.o. salts in the system, based on crop water requirement, available water sources and their sodium contents
3. model for calculating substance fate

Example results of water models

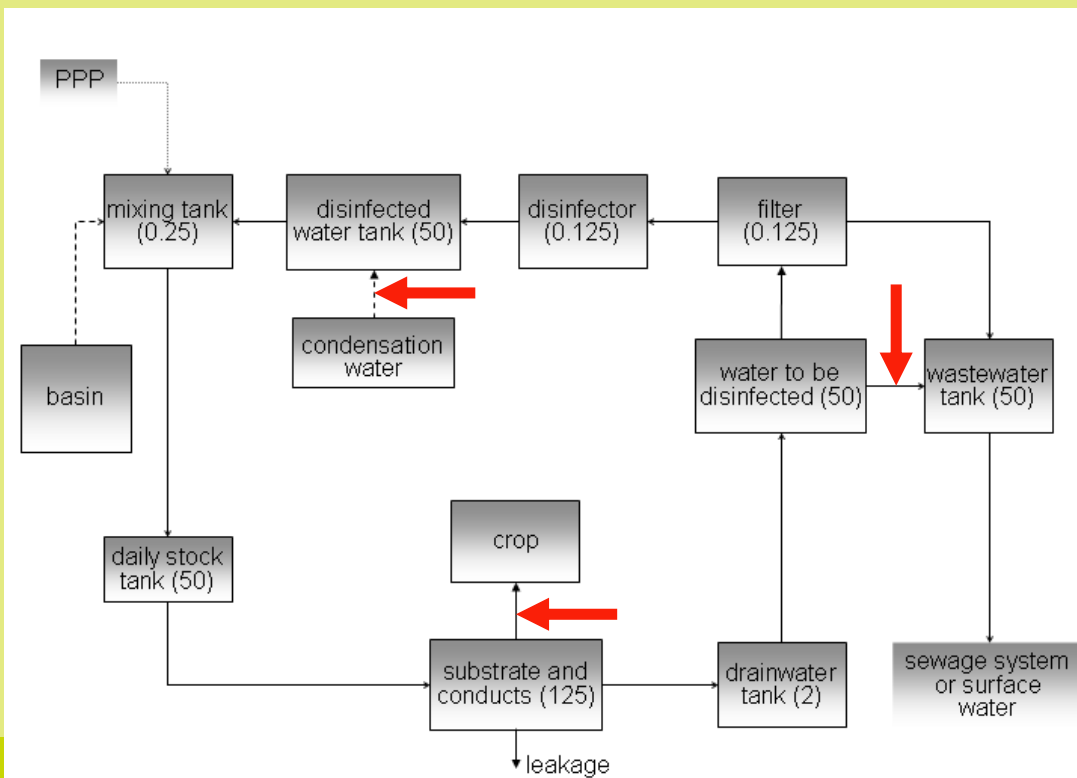
Conditions: wet year, basin 1500 m³ ha⁻¹, tap water

	volume (m ³ ha ⁻¹ yr ⁻¹)	
	rose	sweet pepper
Water supply to crop	13000	10500
Condensation	1500	1000
Drainwater	3250	2500
Discharge	100	350

Water flows on daily basis



Input (↓) from water model to fate model



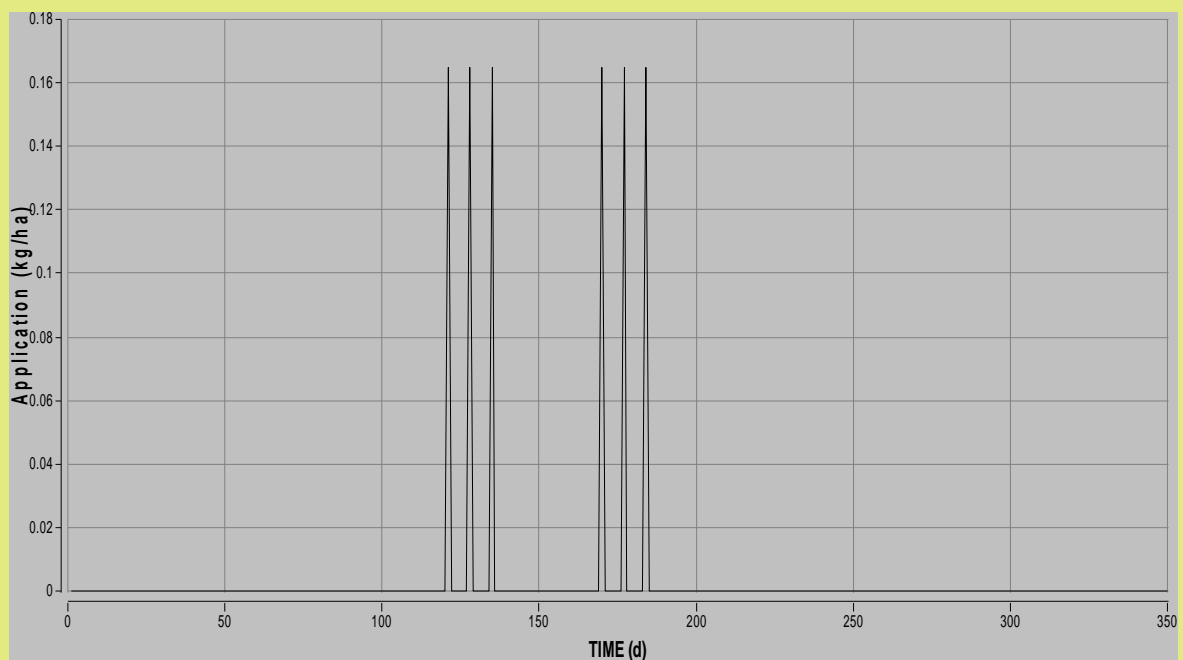
Concepts fate model

- water in tanks is assumed to be perfectly mixed
- first order transformation in water / nutrient solution
- crop uptake based on octanol/water partitioning
 - transpiration stream concentration factor $\sim \log(K_{ow})$
- no interaction with substrate

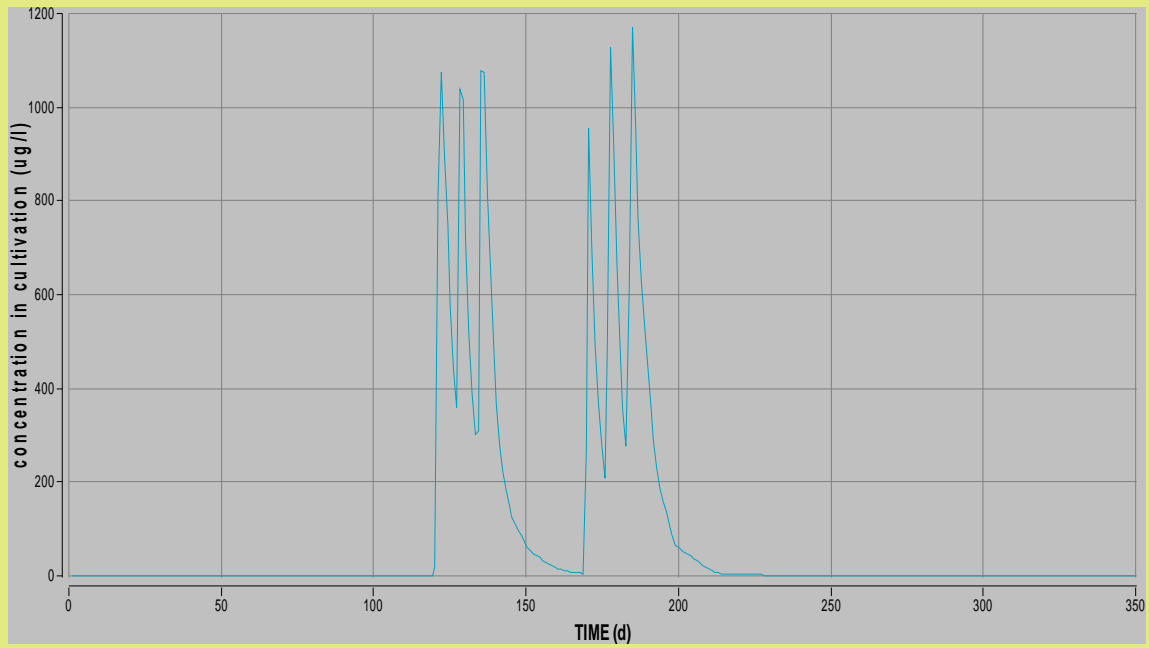
Example calculations

- 6 applications of 0.165 kg ha^{-1}
- DegT_{50} in water is 10 days
- TSCF is 0.5

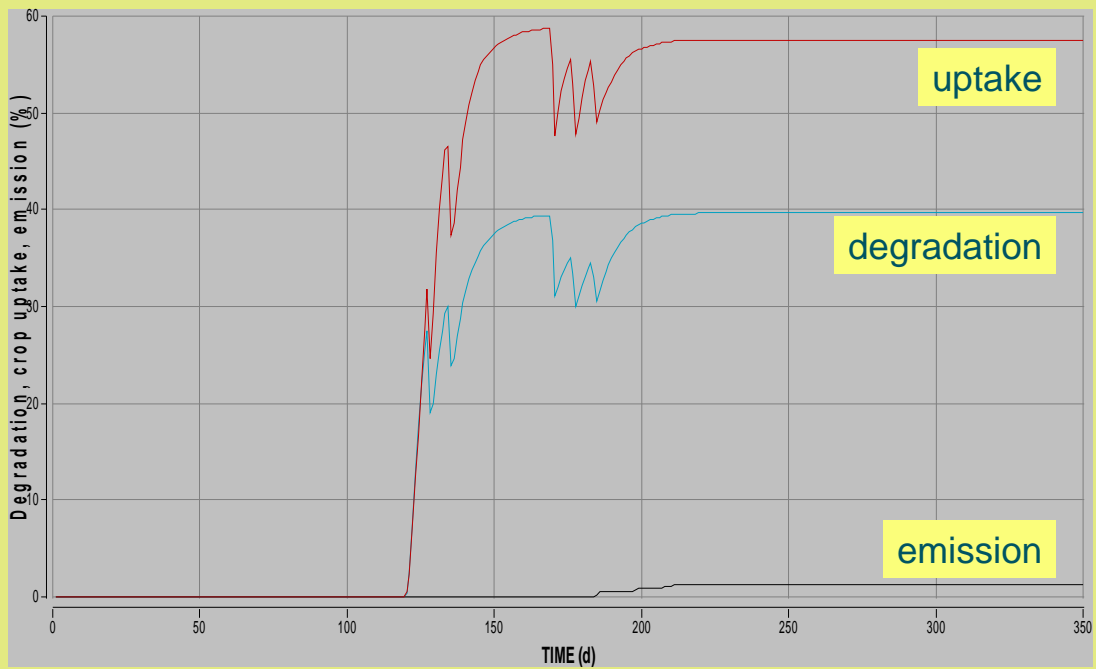
Application



Concentration in system



Fate of substance



Results for cucumber (1)

year	basin	[Na] source 1	[Na] source 2	deg.	crop uptake	surface water
	m ³	(mmol dm ⁻³)			%	
wet	500	0	1.8	36.30	57.24	4.97
wet	1500	0	1.8	39.70	57.53	1.27
wet	3000	0	1.8	40.16	58.29	0.03
dry	500	0	1.8	38.94	48.83	10.97
dry	1500	0	1.8	40.91	50.50	7.27
dry	3000	0	1.8	43.46	53.35	1.80

Results for cucumber (2)

year	basin	[Na] source 1	[Na] source 2	deg.	crop uptake	surface water
	m ³	(mmol dm ⁻³)			%	
warm	1500	0	1.8	37.74	54.46	6.39
normal	1500	0	1.8	39.38	54.03	5.19
cold	1500	0	1.8	40.91	50.50	7.27
wet	1500	0	0.1	40.16	58.29	0.03
dry	1500	0	0.1	44.07	54.48	0.03
normal	1500	0	0.1	41.65	56.84	0.03

Important factors

- water
 - availability of high quality water
 - size of basin
 - quality of suppletion water (low $[Na^+]$)
- substance
 - uptake by crop
 - $DegT_{50}$ in water / nutrient solution

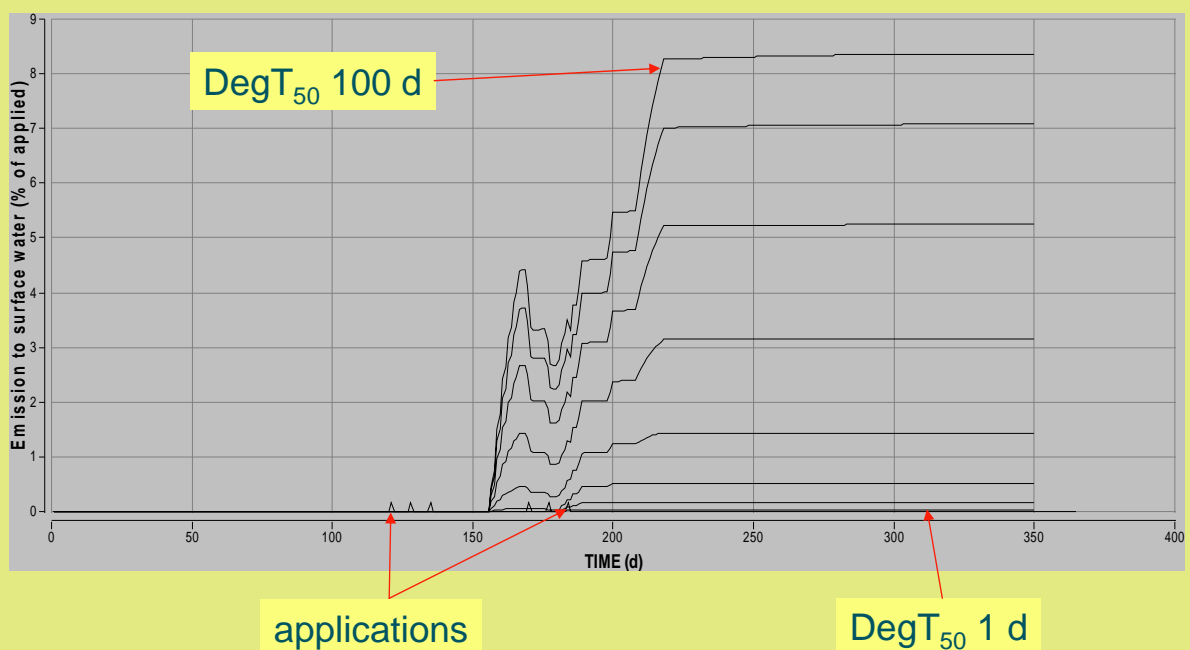
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National Institute
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and the Environment

Emission from glasshouses

York, September 2009

Influence of substance half-life



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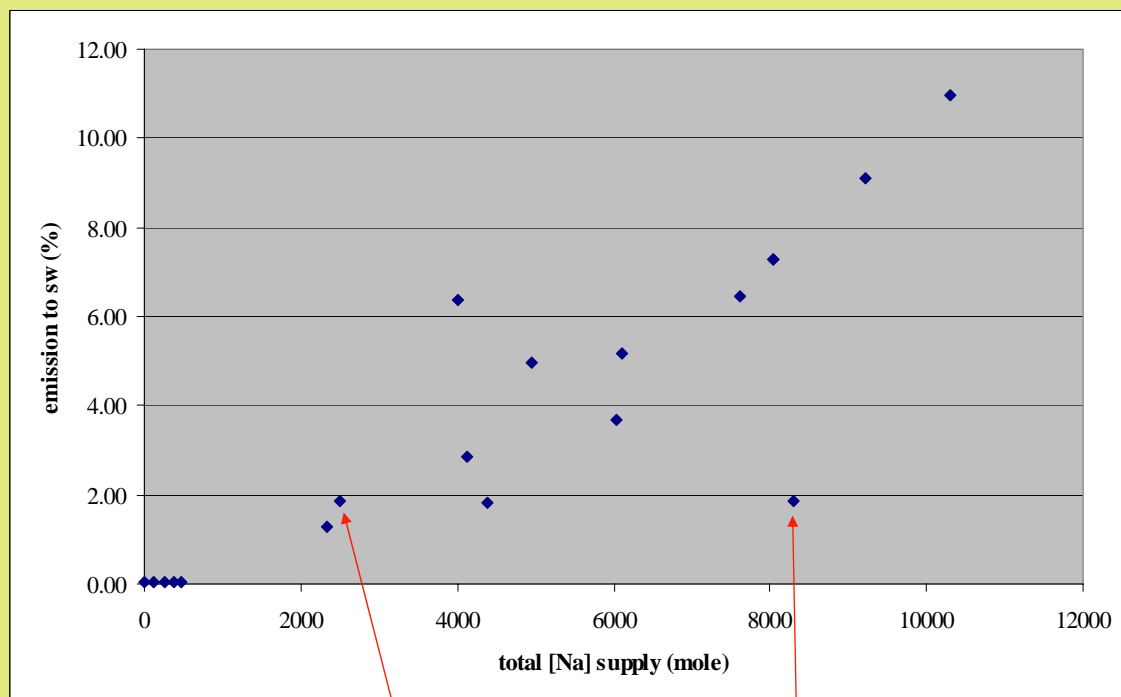
Emission from glasshouses

York, September 2009

Possibilities for scenario development (1)

- authorisation procedures use realistic worst case scenarios but at the moment insufficient information on
 - basin volumes ($500 \text{ m}^3 \text{ ha}^{-1}$ is compulsory, but larger basins exist)
 - water sources for suppletion water (reverse osmosis water, groundwater, tap water, surface water)
 - discharge strategies with respect to sodium accumulation
 - other factors influencing discharge
- no weighted 90th percentile situation can be derived at the moment

Possibilities for scenario development (2)



Possibilities for scenario development (3)

Correlation with Na supply but also influence of application time. Emission only when discharge is necessary.

Conclusions (1)

- Emissions may be higher than assumed up till now in authorisation procedure. Generic 0.1% is too low to cover glasshouse horticulture as a whole.
- Emissions dependent on
 - scenario aspects
 - climatic conditions
 - Na concentration in water sources
 - substance properties
 - crop uptake
 - DegT50 in water

Conclusions (2)

- DegT_{50,w} in dossier possibly not representative of half-life in hydroponic systems
- Insufficient information available on
 - basin volumes
 - water sources
 - discharge strategiesto establish realistic worst case scenario
- more information is required

Thank you for your attention