

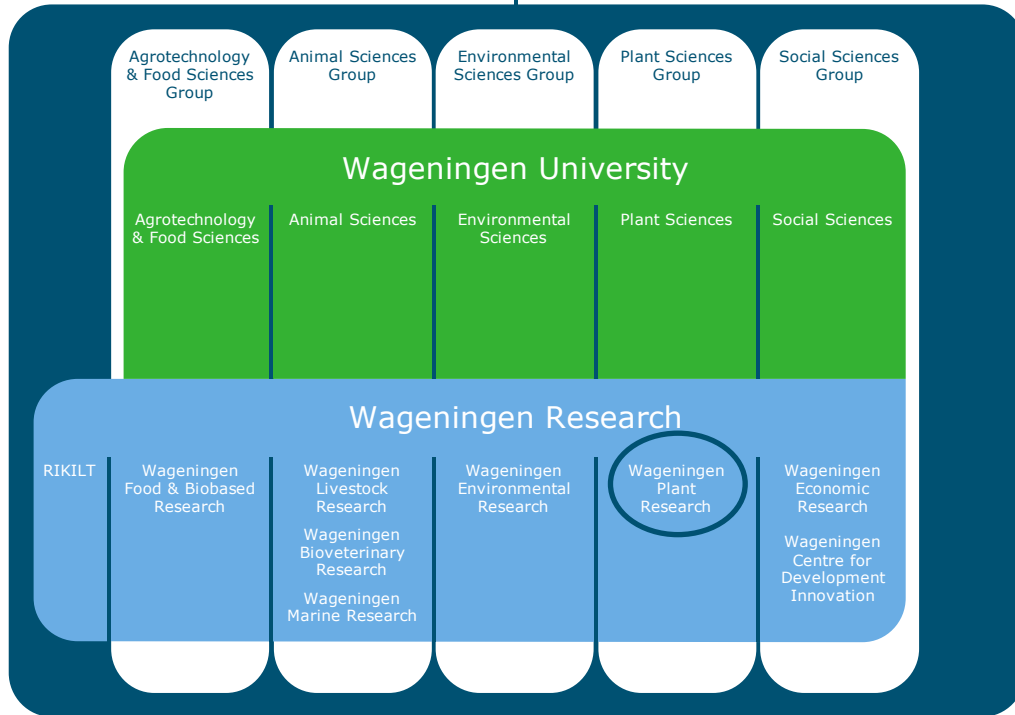
# Strategies for drain water re-use in berries soilless culture

Wageningen University & Research – Greenhouse Horticulture Business Unit

15-11-2022 | Tommaso Barbagli (tommaso.Barbagli@wur.nl)



# Wageningen University and Research – Greenhouse Horticulture Business Unit



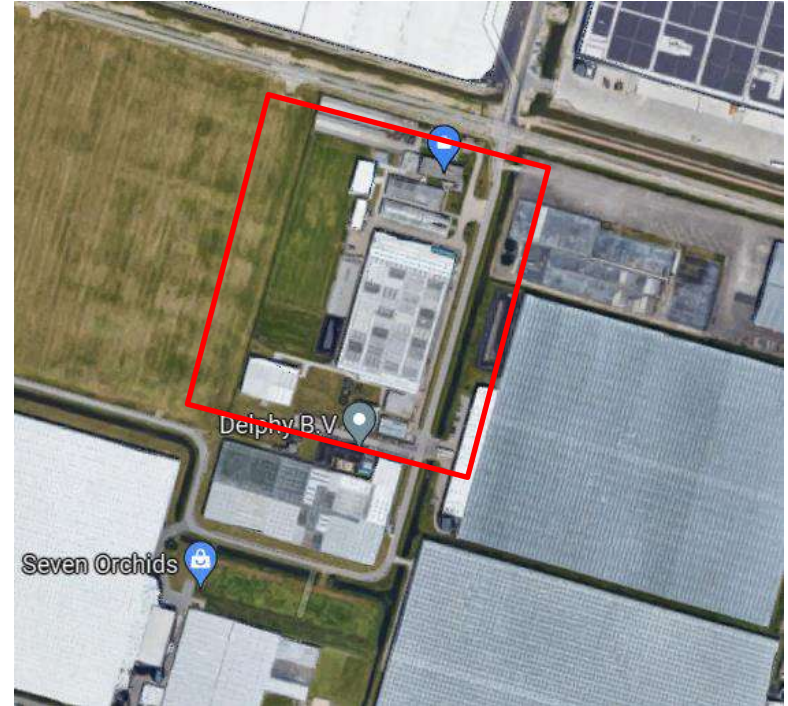
## 7 Business Units:

- Biointeractions & Plant Health
- Agrosystems Research
- Biometrics
- Bioscience
- Greenhouse Horticulture
- Field crops
- Plant breeding

## 6 Teams:

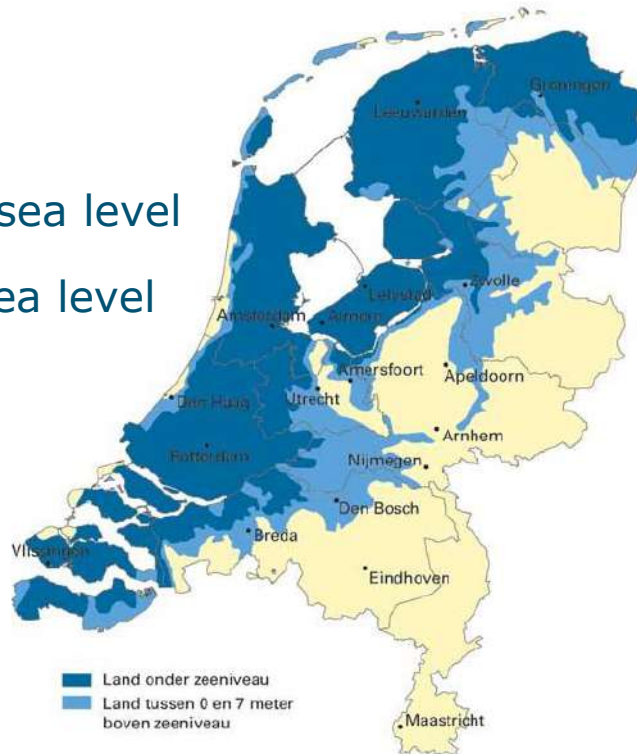
- Energy and climate
- Advanced systems
- **Water and emissions**
- Sustainable crop protection
- Quality of crop and product
- Added value crops

# Wageningen University and Research – Greenhouse Horticulture Business Unit

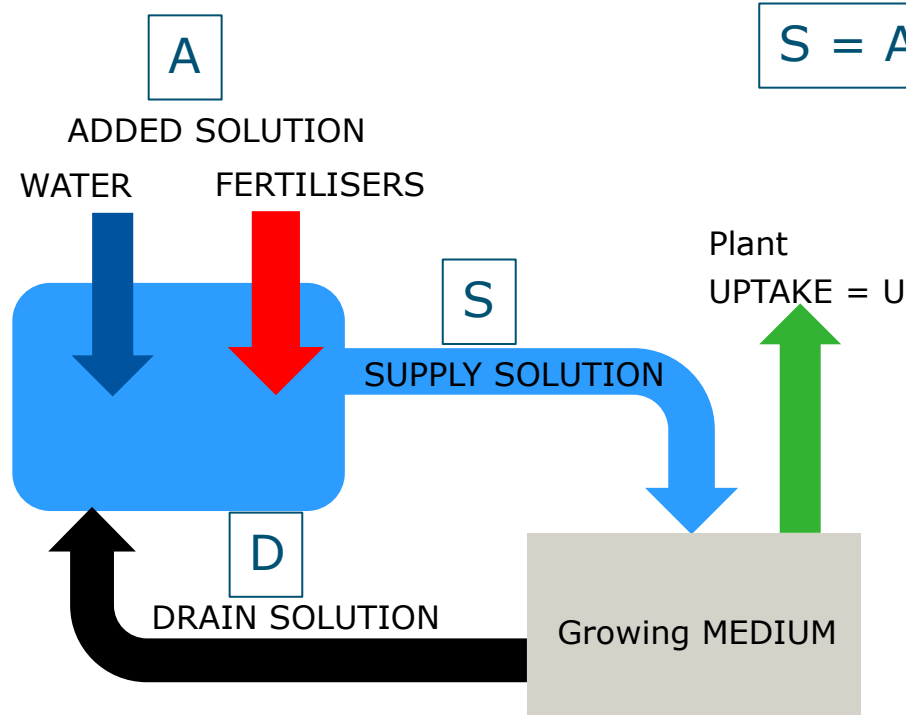


# The Netherlands

50 % around sea level  
20 % below sea level



# Closed-loop irrigation system



$$S = A + D$$

In closed-loop system, the **input (A)** should **equal** the **output (U)**

$$A = U$$

When  $A > U$   
accumulation occurs

When  $A < U$   
depletion occurs

# Drain re-use in berries



# Closed-loop irrigation system

## **Pros:**

- Save water & fertilisers
- Avoid emissions

## **Cons:**

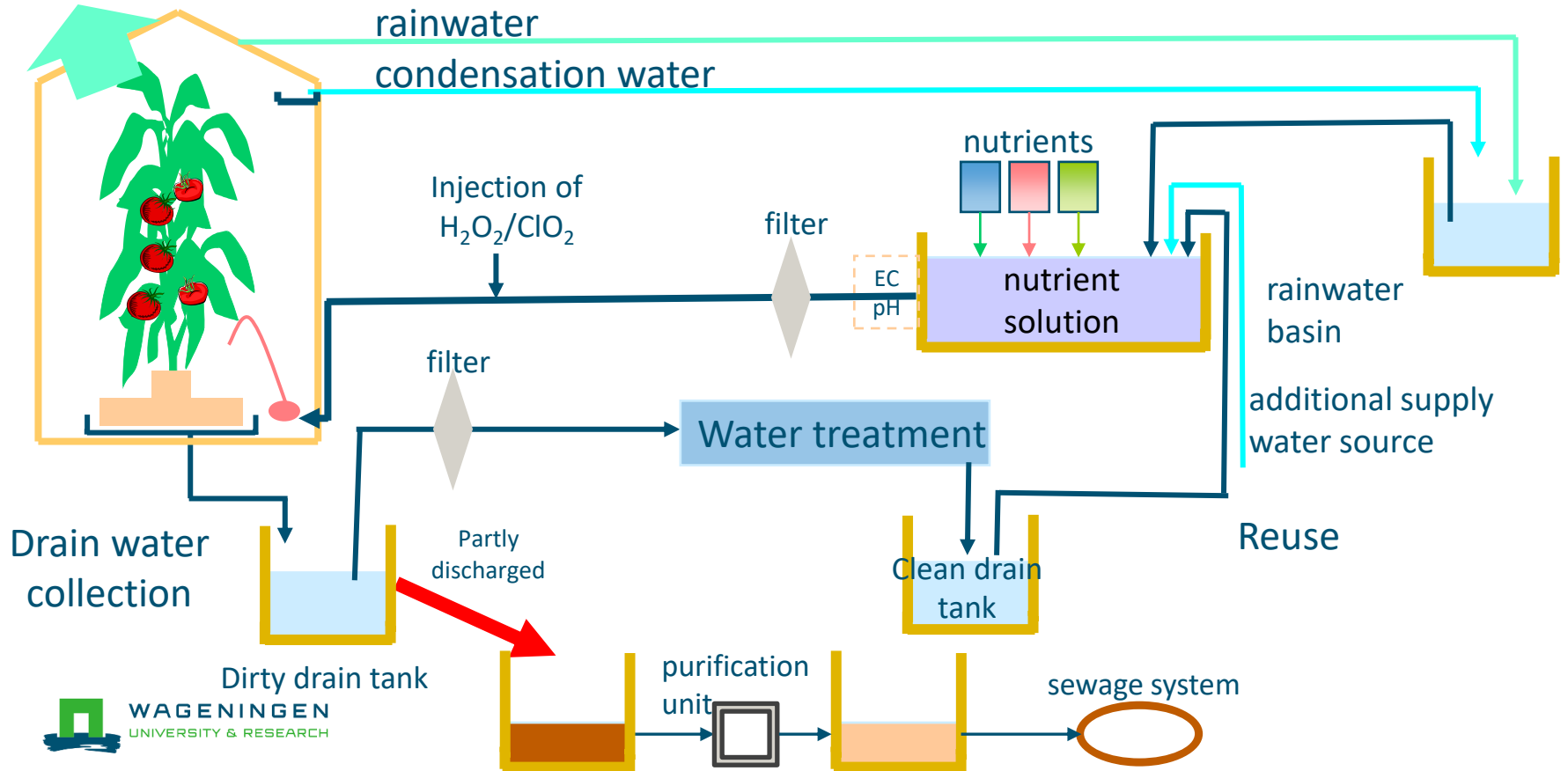
- More complex
- Susceptible to accumulations/depletions



## **Important:**

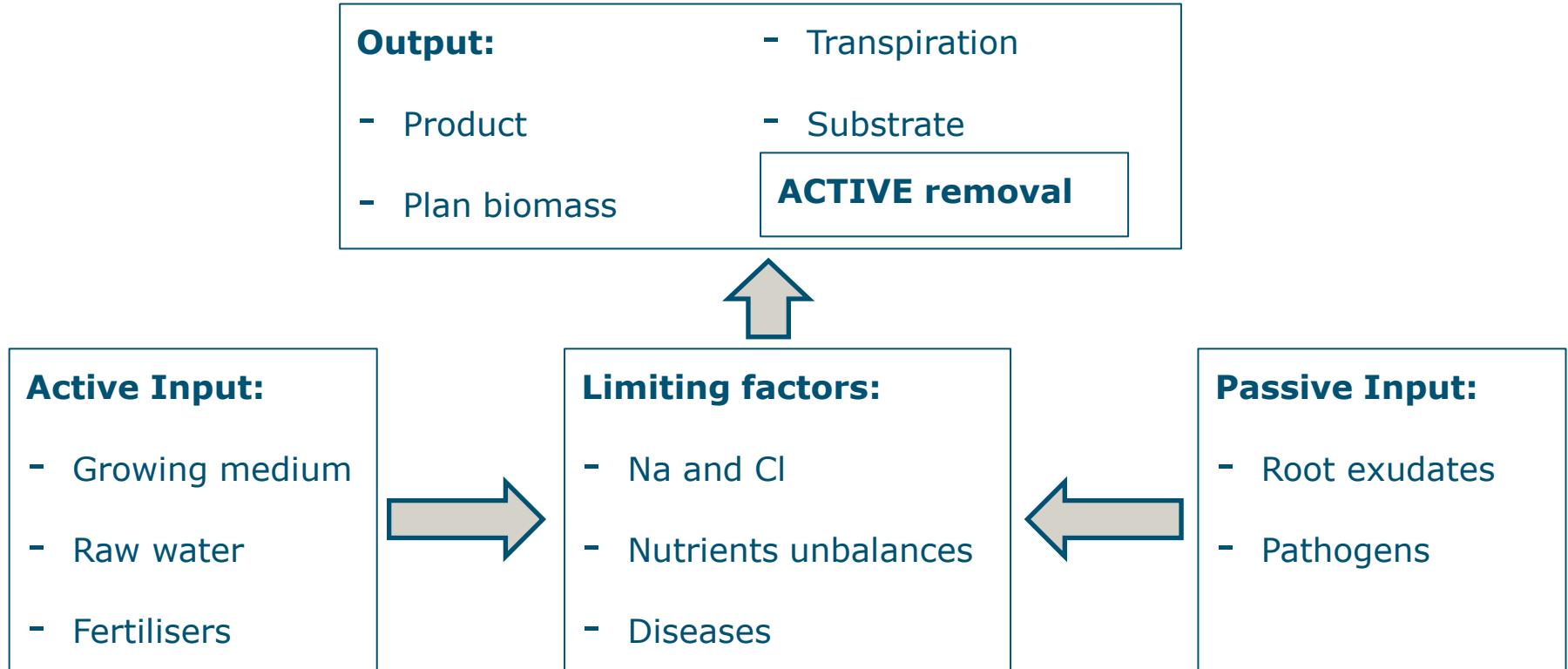
- High quality input
- Drain filtration and disinfection
- Nutrients management

# Examples of the complexity





# High quality input - irrigation



# Filtration and Disinfection

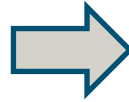
Disinfection methods	effect	costs
Heat Treatment	++	-
UV lighting	++	-
Ozone	++	--
Membrane filtration	++	--
Slow sand filtration	+	+
Anodic oxidation (ECA)	-	+
Hydrogen Peroxide	-	+
Sodium Hypochlorite	--	++
Chlorine dioxide	-	++
Copper silver ionisation	-	--
<b>NO DISINFECTION</b>	<b>---</b>	<b>+++</b>

**TAILORED MADE SOLUTION LOCATION-SPECIFIC WORKS ALWAYS THE BEST**

# Growing media

## Several options:

- Peat
- Cocos
- Artificial Media
- Other waste stream



## When needed, must be pre treated

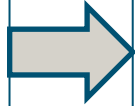
- Limed
- Saturation of CEC
- Remove salts (Na)
- Free from pathogens



# Raw Water

## Several options:

- HCO<sub>3</sub> concentration
- Salts concentration



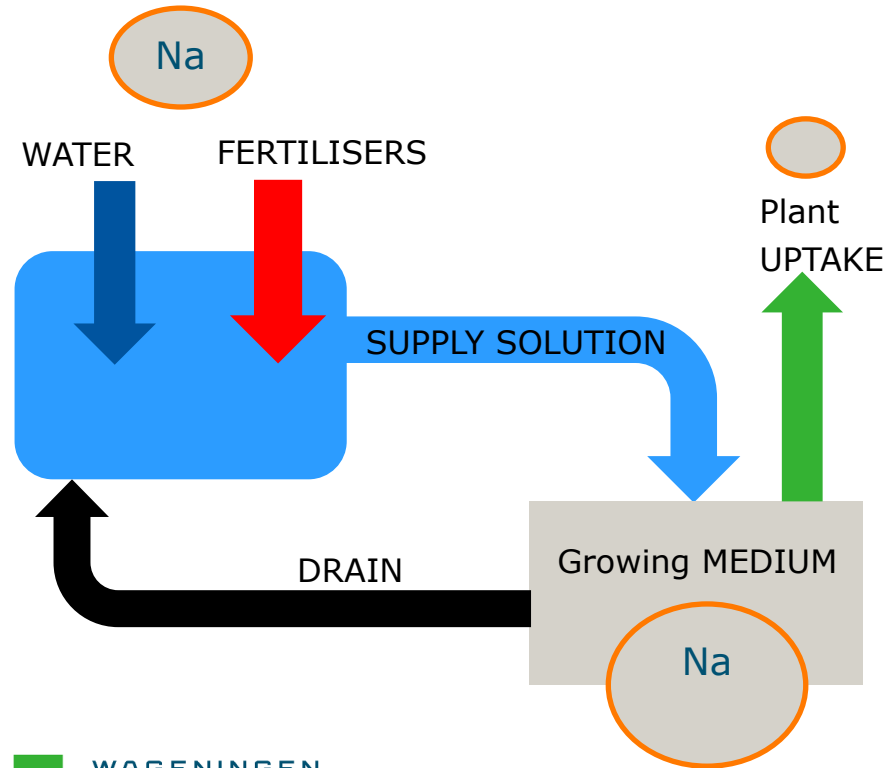
## When needed, must be pre-treated

- Active correction/through nutrient solution
- Rule of thumb are:



<b>Ms/cm</b>	<b>Mmol/l</b>	<b>Recommendation</b>
EC > 1.5	Na > 5.0	Not suitable for soilless
EC 1.0 < 1.5	Na 3.0 < 5.0	Soilless open system
EC < 1.0	Na 3.0 < 1.5	Soilless closed (hybrid)
	Na < 1.5	Soilless closed-loop 100%

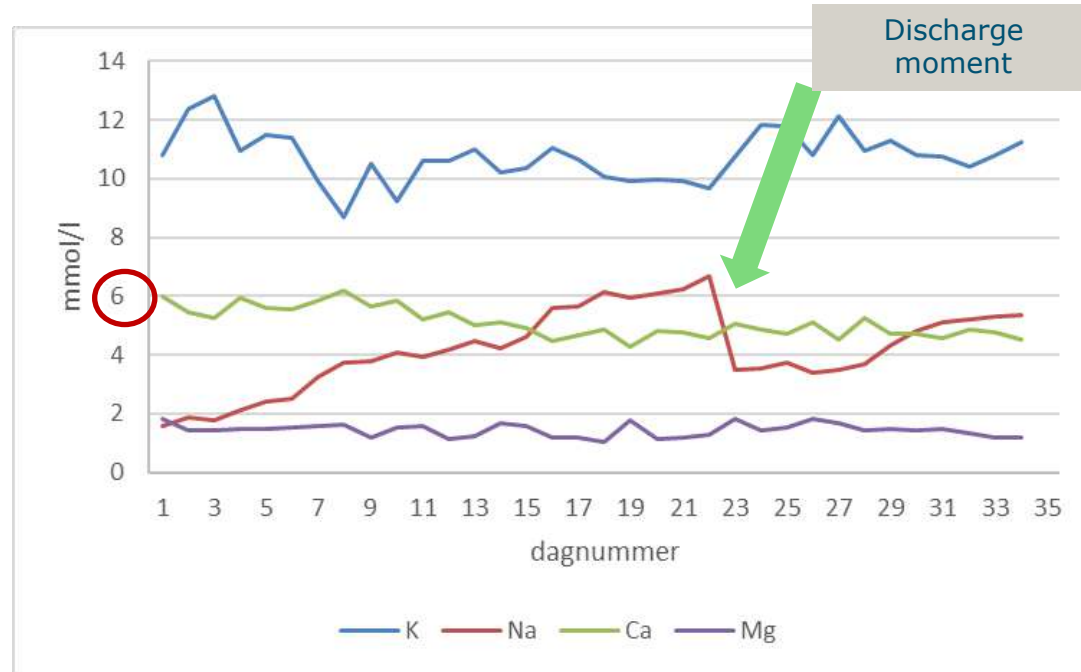
# Closed-loop irrigation system - Sodium



When Input > Output  
accumulation occurs

# What happens in a closed loop system

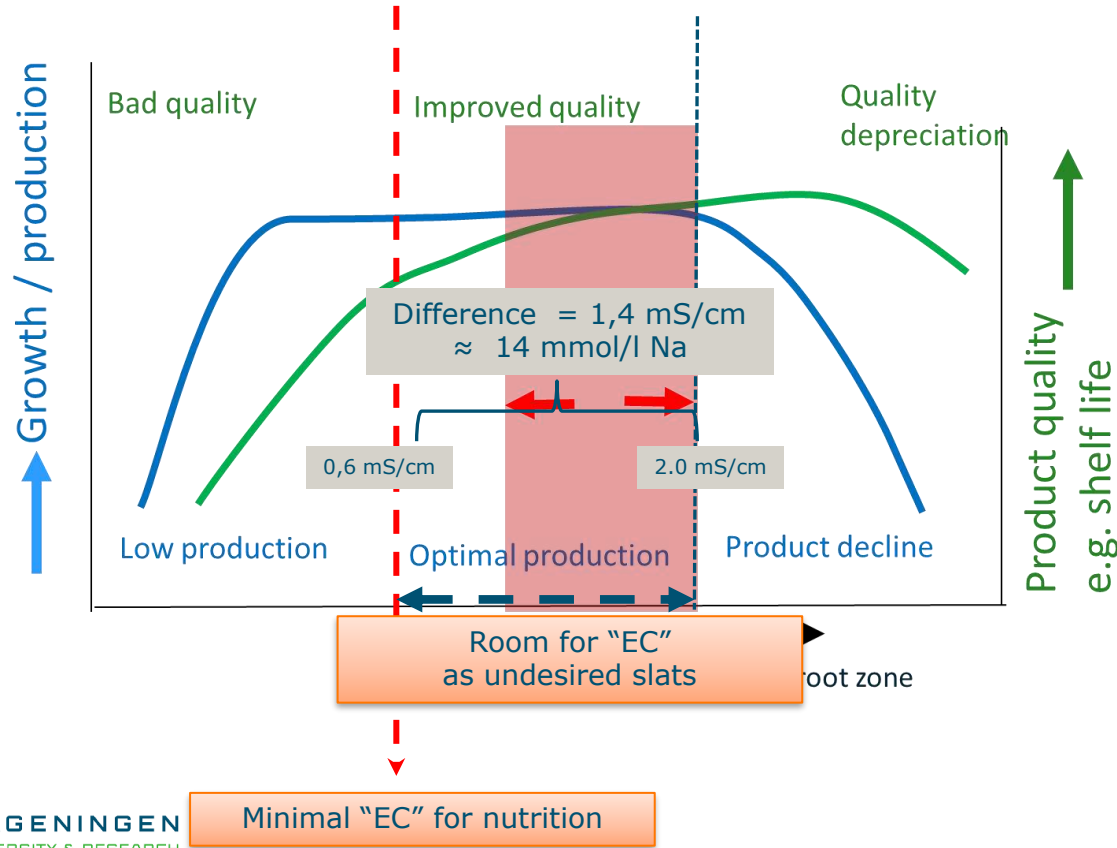
- Gradual Na accumulation, EC kept at target level -> nutrient reduction



# Maximum acceptable concentration of Na in the drain are far to be known for many crops

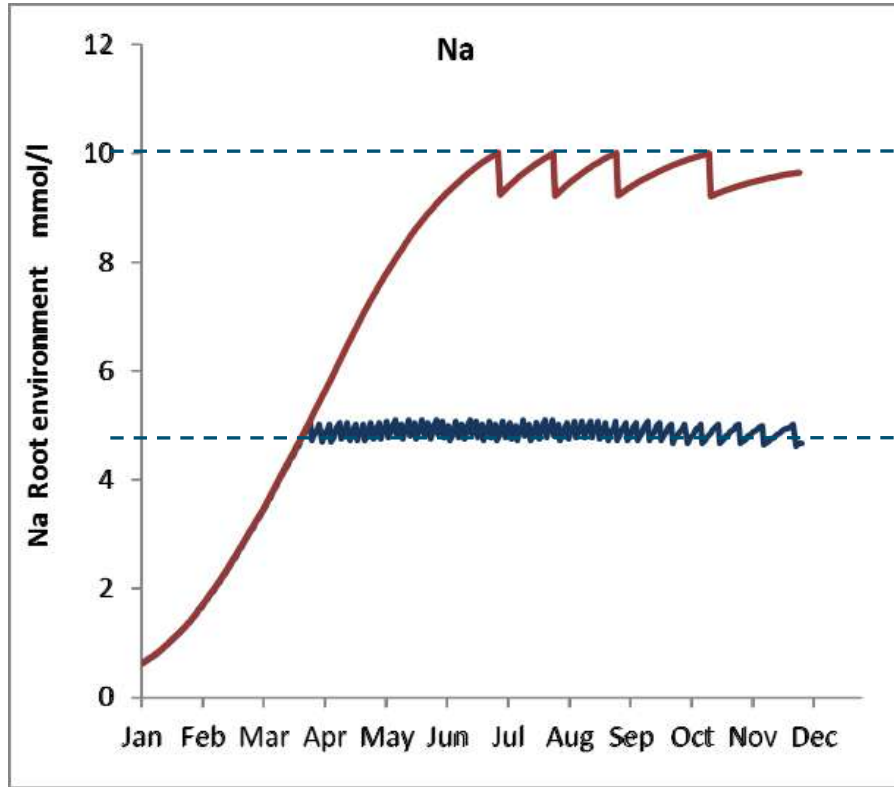
<b>Crop</b>	<b>Max Na (mmol/l) 90's data</b>
Tomatoes	10
Roses	6
Phalaenopsis	-
Strawberries	-
Blackberries	-
Raspberries	-
Blueberries	-

# What determines Na maximum acceptable concentration ?





# Increase $\text{Na}_{\text{max}}$ root environment



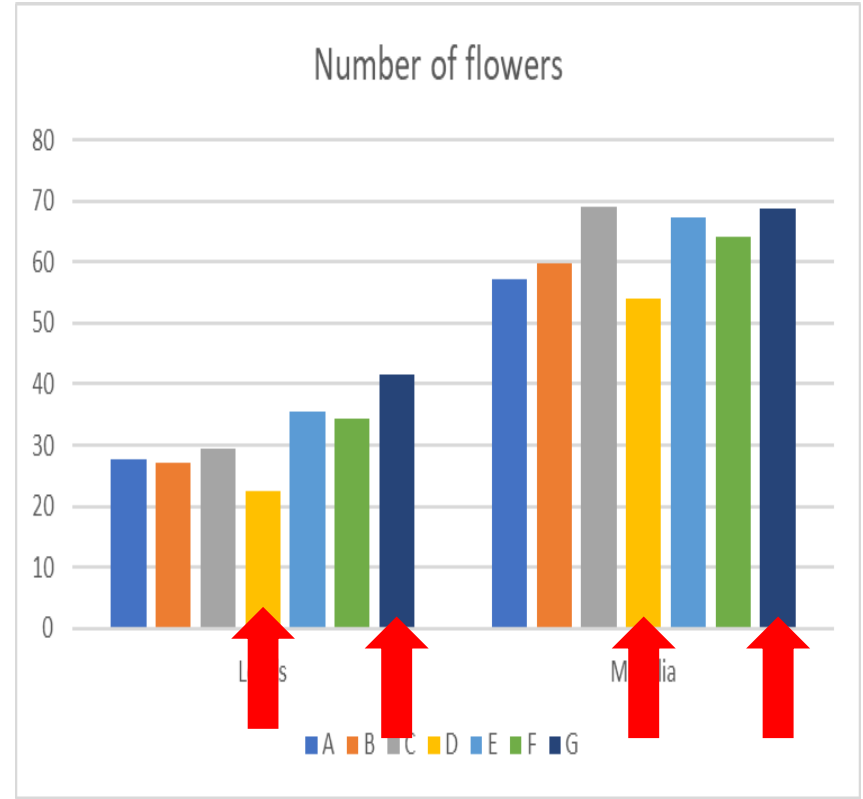
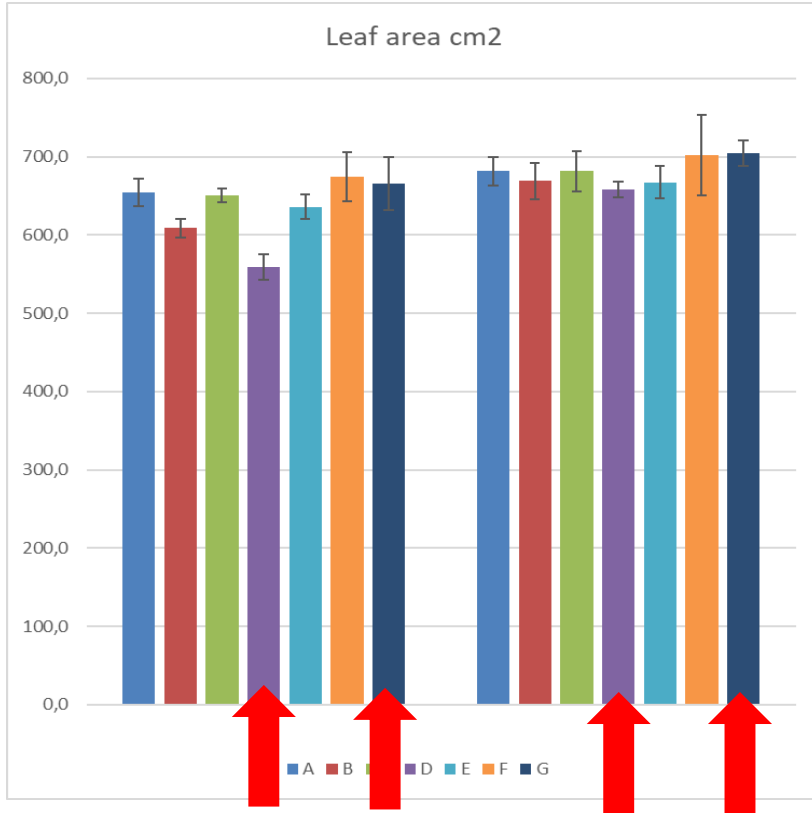
$[\text{Na}]_{\text{max}}$  10 mmol/l  
40 m<sup>3</sup>/ha discharge  
needed

$[\text{Na}]_{\text{max}}$  5 mmol/l  
530 m<sup>3</sup>/ha discharge  
needed

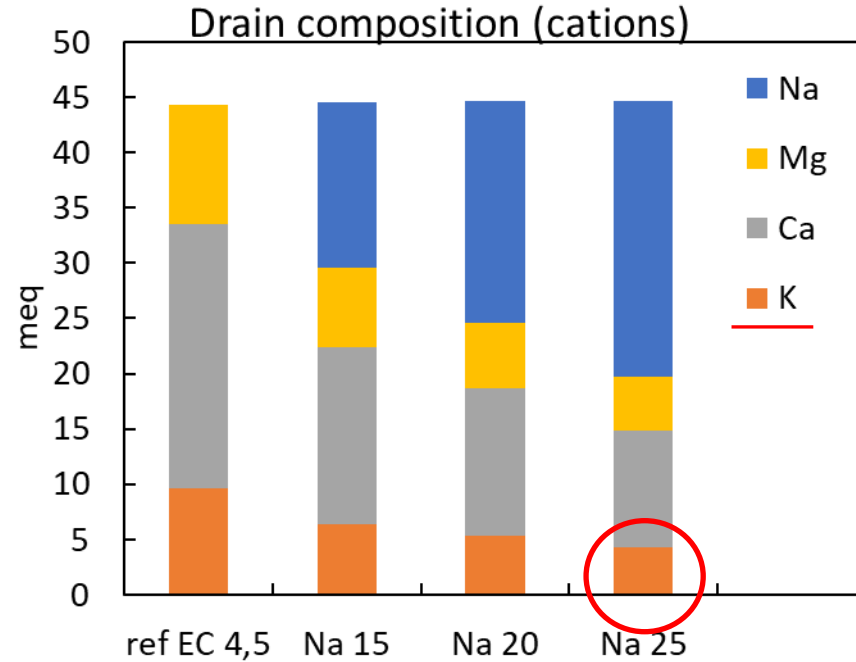
# Phalaenopsis data 2021

treatment	EC	K	Na	Ca	Mg
A	1,5	3,5	0,1	1,6	0,5
B	1,5	3,2	2,5	1,4	0,4
C	1,5	2,3	5,1	1,0	0,3
D	1,5	1,3	8,3	0,6	0,1
E	1,8	4,0	2,5	1,7	0,7
F	2,2	4,0	5,2	1,8	0,6
G	2,6	4,2	8,2	1,8	0,7

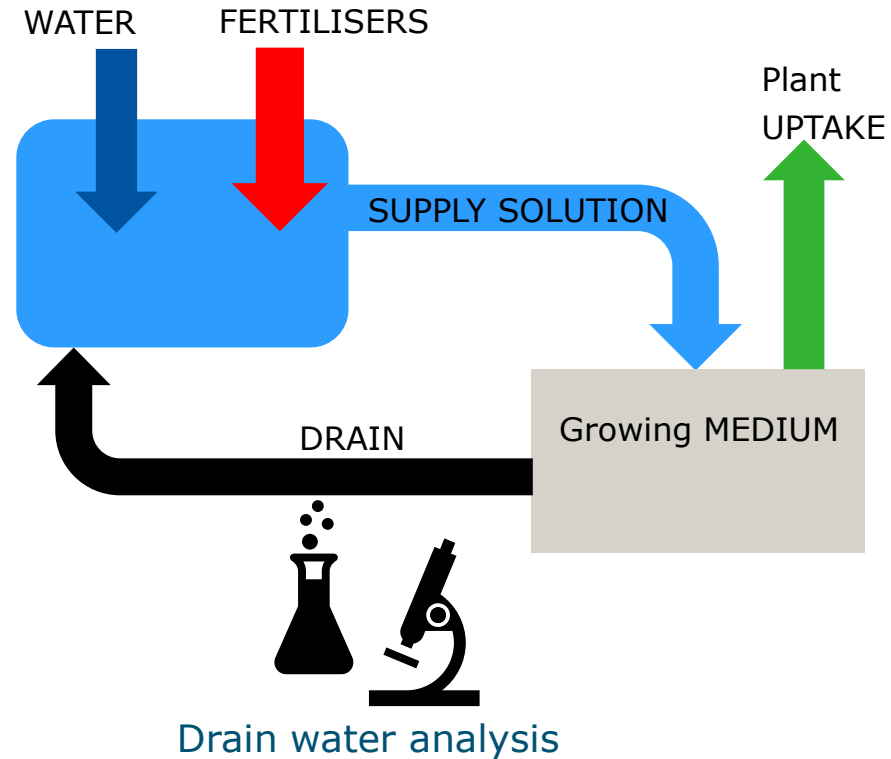
# Phalaenopsis 2021



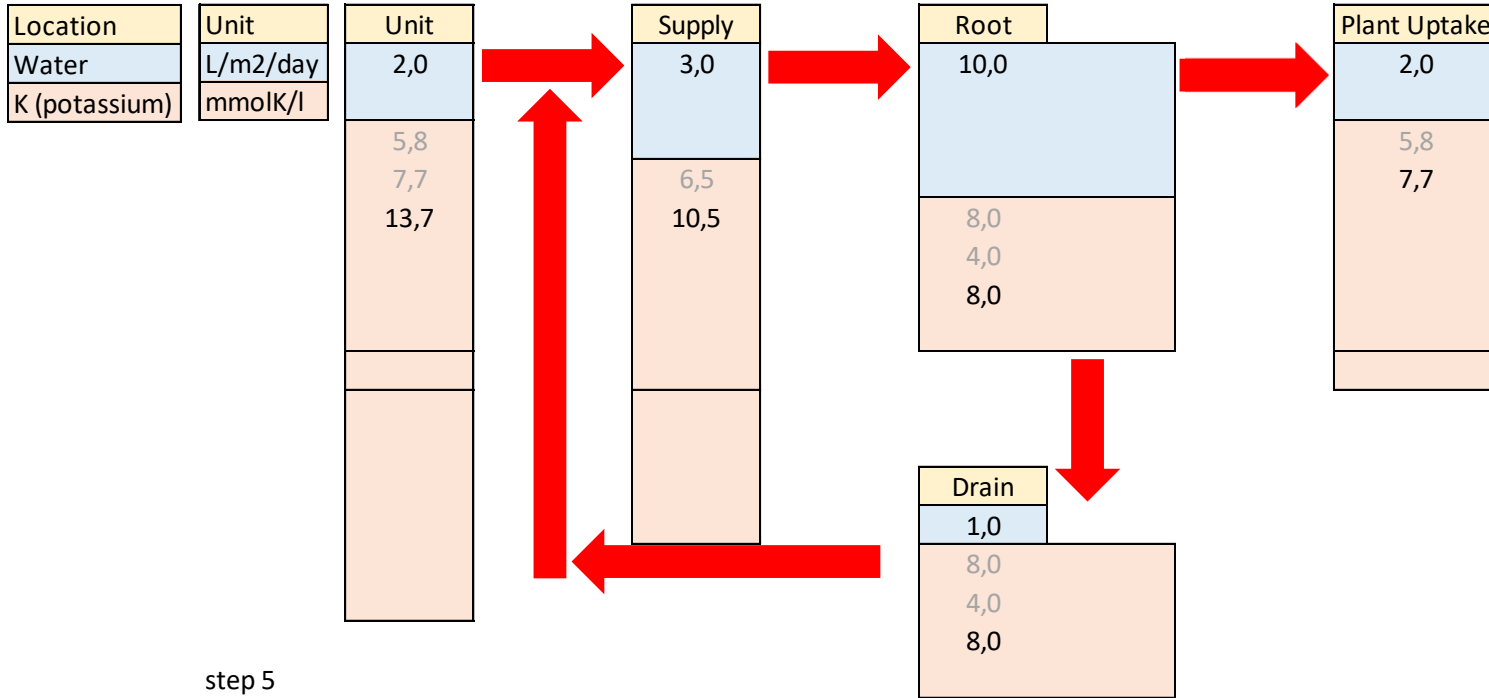
# Closed-loop irrigation system - Sodium



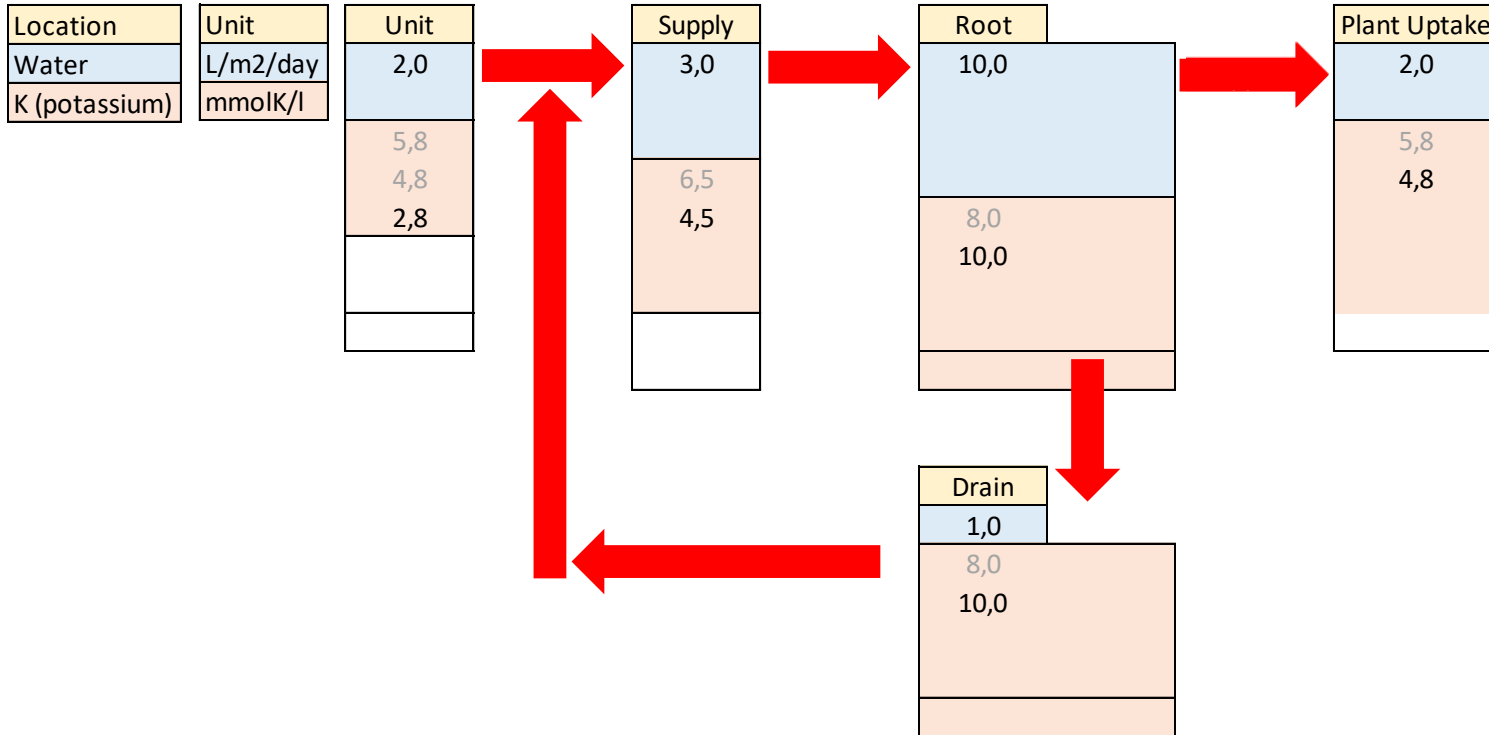
# Closed-loop irrigation system – Nutrients



# Nutrient recommendation system - depletion



# Nutrient recommendation system - accumulation



# Example of nutrients management - strawberries

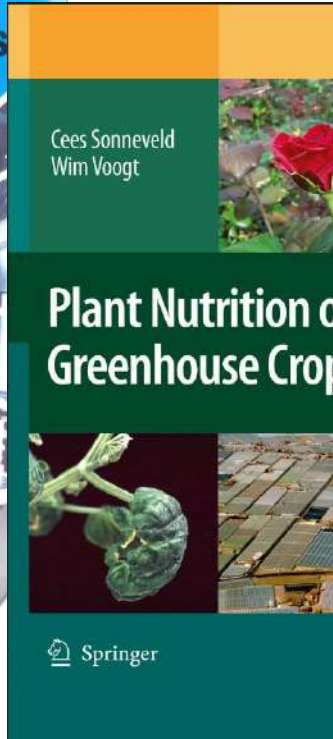
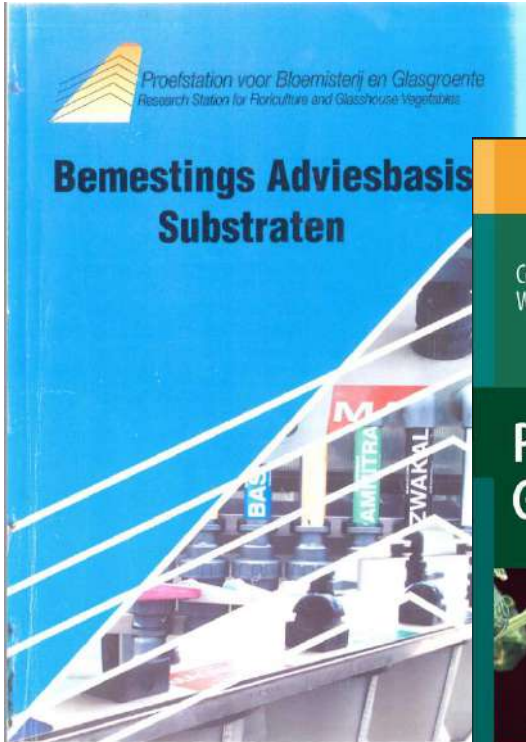
A. B. C. D. E. F. G. H. I. Recipe adjusted v3

step	EC	pH	NH4	K	Na	Ca	Mg	Si	NO3	Cl	SO4	HCO3	P	Fe	Mn	Zn	B	Cu	Mo
A	0,7					3,3	0,7		0,8		1,5	2,7			4				
B									2,7										
C=A+B	0,7					3,3	0,7		3,5		1,5	0			4				
D	1,7		1,0	5,5		3,3	1,3		11,5		1,5		1,0	20	10	3,5	20	0,8	0,5
E=D-C	1		1,0	5,5		0	0,6		8,0		0,0		1,0	20	6	3,5	20	0,8	0,5
F				8															
G <sup>1</sup>				-1															
H=E-G			1,0	4,5		0	0,6		8,0		0,0		1,0	20	6	3,5	20	0,8	0,5
I			1,0	5,2			0,7		6,8				0,9	20	6	3,5	20	0,8	0,5

<sup>1</sup>Also: pH, K:Ca, physiological stage.



# Nutrient recommendation systems



Bemestingsadviesmodel

digreenhouse.wur.nl/fertilizeradvice/#/substraatteelt

Gmail YouTube Maps Translate Drive LinkedIn MyLetsGrow Google Scholar WhatsApp Acta Horticulturae

### Bemestingsadviesmodel substraatteelt

Gewas: -- maak een keuze --

Gewasstadium: -- selecteer eerst een gewas --

Hergebruik drainwater ⓘ

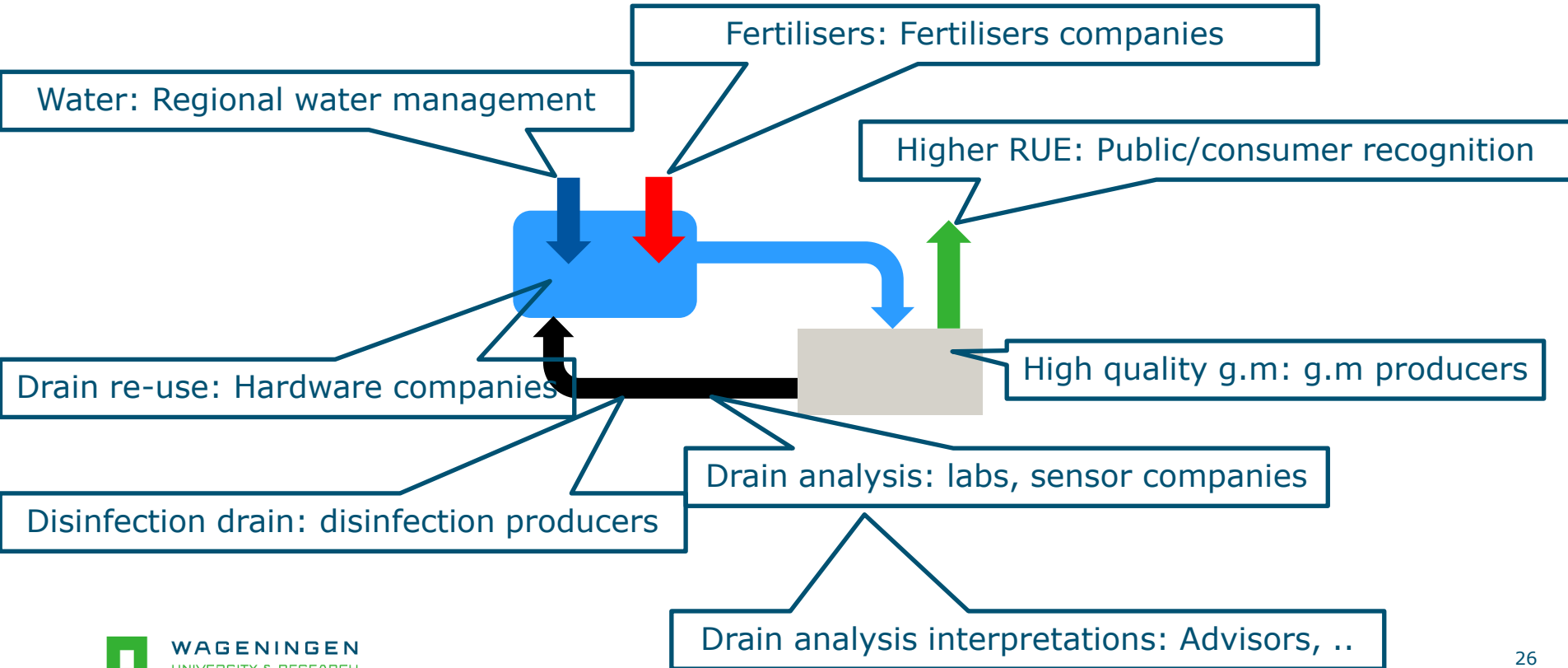
Chloride gebruik

EC druppelwater:  dS/m

**RUN**

	Schoonwateranalyse	Drainanalyse
EC	<input type="text"/>	<input type="text"/>
pH	<input type="text"/>	<input type="text"/>
NH4	<input type="text"/>	<input type="text"/>
K	<input type="text"/>	<input type="text"/>
Na	<input type="text"/>	<input type="text"/>
Ca	<input type="text"/>	<input type="text"/>
Mg	<input type="text"/>	<input type="text"/>
NO3	<input type="text"/>	<input type="text"/>
Cl	<input type="text"/>	<input type="text"/>
SO4	<input type="text"/>	<input type="text"/>
H2PO4	<input type="text"/>	<input type="text"/>
HCO3	<input type="text"/>	<input type="text"/>
Fe	<input type="text"/>	<input type="text"/>
Mn	<input type="text"/>	<input type="text"/>
Zn	<input type="text"/>	<input type="text"/>
B	<input type="text"/>	<input type="text"/>
Cu	<input type="text"/>	<input type="text"/>
Mo	<input type="text"/>	<input type="text"/>

# To take off drain re-use collaboration is the key!



# Thank you for attention

Questions?



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