

Fertilization in nursery stock production

15 February 2013 Henk van Reuler

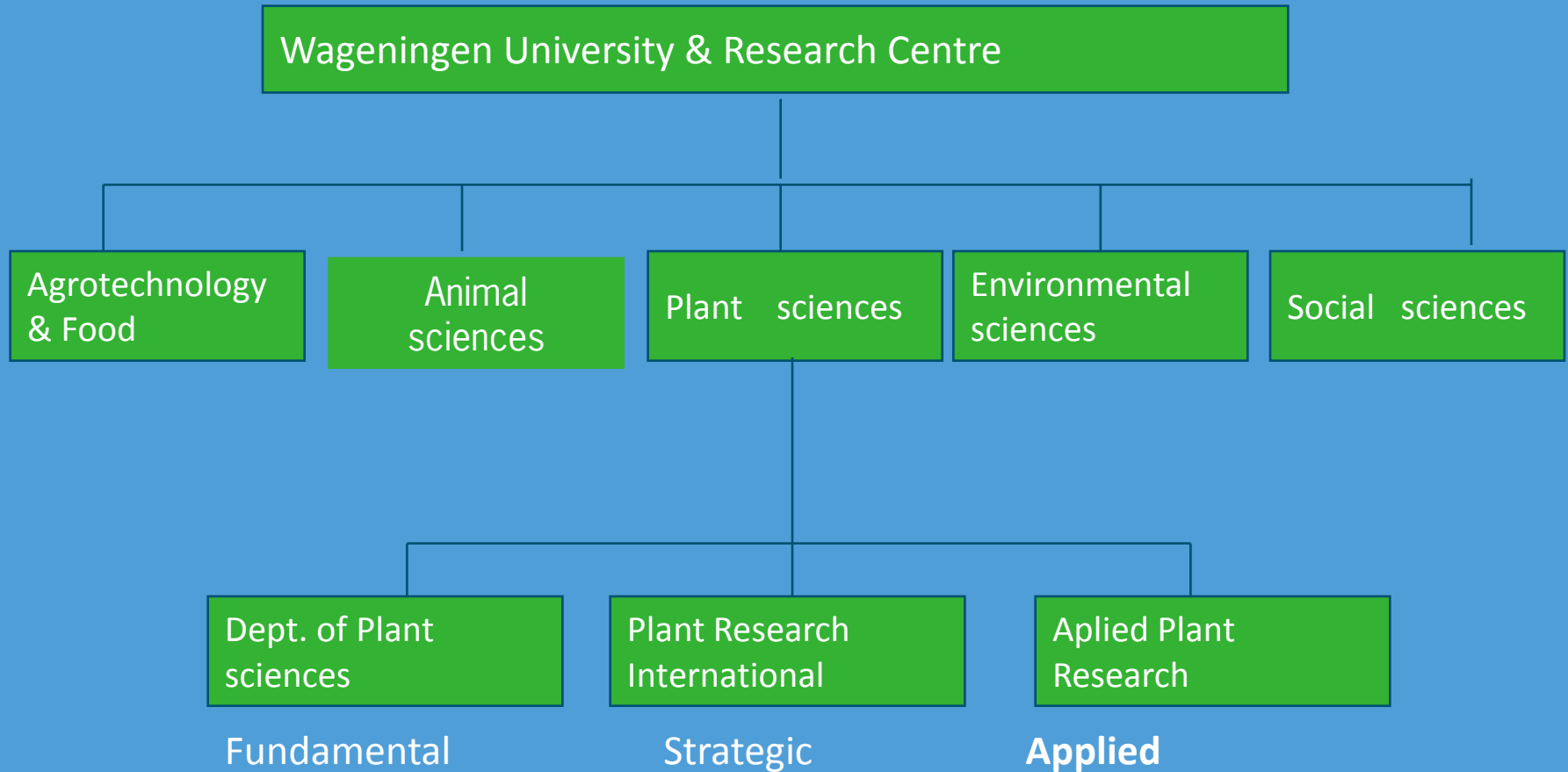


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Organization



Introduction

■ Nursery stock in the Netherlands

In total 17.000 ha Nursery stock

(a.o. perennials, street trees, shrubs, roses, conifers)

- 1.000 ha Container cultivation

WUR - Applied Plant Research

- EU, (Regional) Government
- Product Board for Horticulture
- Companies

Shift from on-station to on-farm research

Introduction

The Netherlands

Nursery stock centres

- Boskoop
- Opheusden
- Zundert
- Central Brabant
- N. Limburg



Introduction

- Plants need nutrients

- Macro nutrients
- Micro nutrients
- Natural soil fertility

N, P, K, Ca, Mg, S
B, Zn, Fe, Cu,
soil organic matter

- Mineral and/or organic fertilizers

- Grower good quality production at competitive prices

- Government environmental regulations

European legislation

- Groundwater
 - Nitrate Directive < 50 mg NO₃/l
- Water Framework Directive
 - Groundwater
 - Surface water
 - Nutrients and crop protection chemicals



Fertilization

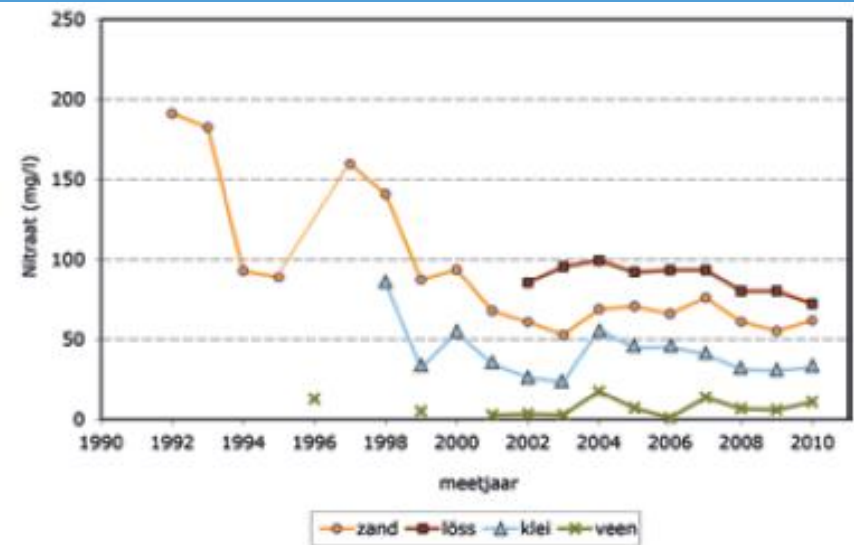
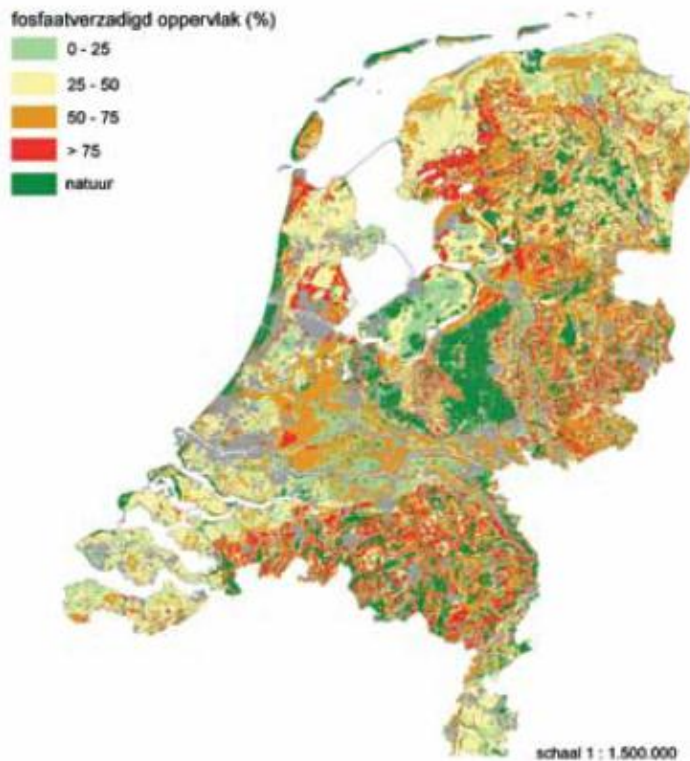
Nutrient	Range in uptake kg/ha	Range in nutrient content g/100 g
N	90 – 200	1.7 – 3.5
P ₂ O ₅	15 – 35	0.2 – 0.45
K ₂ O	75 – 165	1.1 – 2.6
Mg	20 – 42	0.2 – 0.6
Ca	60 – 140	0.5 – 1.9



Open field production

P saturation

NO₃ content



Open field production

Use standards for

- Nitrogen crop, soil type
- Phosphate soil phosphorus status (Pw)
- Animal manure maximally 170 kg total-N
and 85 kg P_2O_5 /ha



Open field production

Nitrate is easily leached

Balance method

$$\begin{aligned} &\text{N in rainwater} + \text{mineralization} + \text{fertilizers} \\ &= \\ &\text{N export with crops} + \text{surplus} \end{aligned}$$

Surplus:

Sandy soils < 78 kg NO₃/ha

Clay soils < 136 kg NO₃/ha

Open field production

■ Soil organic matter (SOM)

- Physical fertility
- Chemical //
- Biological //

Natural decomposition 2 – 8 %

soil type, age of SOM,
temperature, moisture content

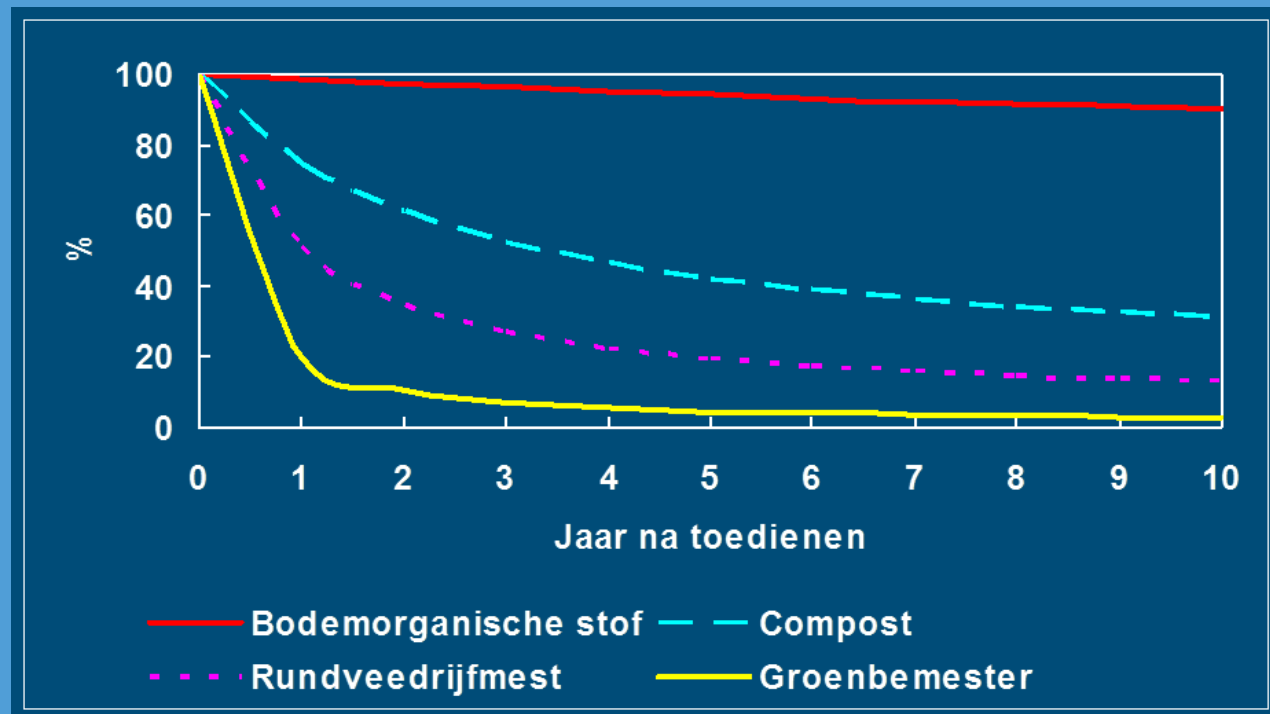


Open field production



Open field production

- Maintenance of SOM organic fertilizers, crop residues, green manure



Container cultivation

- Limited volume
- Substrate chemically poor
- Irrigation and fertilization is necessary

Fertilization

- Macro and micro nutrients
- Controlled release fertilizers
- Liquid fertilizers
 - **kg/ha** → mmol/l
 - **obligation to recycle drainwater**



Container cultivation

- Basic fertilization 0.5–1.5 kg Pg mix+ micronutrients/m³
- Liming if required
- CRF: composition, release period

Container cultivation

Target values for the salt content of substrate

Crop salt sensitivity	EC mS/cm	Na	Cl	S
		mmol/l		
Sensitive	< 0.9	< 1.7	< 1.7	< 2.0
Moderate sensitive	< 1.2	< 2.5	< 2.5	< 3.0
Tolerant	< 1.6	< 3.5	< 3.5	< 4.0



Container cultivation

Target values for nutrient content of substrate
(mmol/l 1: 1.5 volume extract)

Crop nutrient demand	N	P	K	Mg	Ca	S
Low	2.5	0.4	1.0	0.5	1.5	0.5
Normal	3	0.5	1.4	0.7	1.8	0.7
High	3.5	0.5	1.8	0.9	2.1	0.9



Container cultivation

Evaluation nutrient content of substrates (mmol/l) of crops with a normal nutrient demand

	N	P	K	Mg	Ca	S
1	< 1.7	< 0.2	< 0.7	< 0.3	< 0.8	< 0.6
2	1.7 - 2.4	0.2 - 0.4	0.7 - 1.0	0.3 - 0.4	0.8 - 1.3	0.6 - 0.9
3	2.5 - 3.5	0.41 - 0.6	1.1 - 1.7	0,5 - 0,9	1,4 - 2,2	1,0 - 1,4
4	3.6 - 4.2	0.61 - 0.75	1.8 - 2.1	1.0 - 1.3	2.3 - 2.8	1.5 - 1.9
5	> 4.2	> 0.75	> 2.1	> 1.3	> 2.8	> 1.9

Adjustment (mmol/l)

	N	P	K	Mg	Ca	S
1	+3.0	+0.25	+1.0	+0.375	+1.0	+0.50
2	+1.5	+0.125	+0.5	+0.25	+0.5	+0.25
3	-	-	-	-	-	-
4	-1.5	-0.125	-0.5	-0.25	-0.5	-0.375
5	-3.0	-0.25	-1.0	-0.375	-1.0	-0.75



Irrigation

Ways of irrigation

- Overhead
 - Eb and flow
 - Drip
-
- Efficiency
 - Legislation



Water quality

Water quality of irrigation water for different types of nursery stock (Knowledge and Innovation Impulse, 2011)

	Propagation Greenhouse – sensitive crops	Recirculation Outdoor – sensitive crops Greenhouse – tolerant crops	Outdoor – not sensitive crops
pH	6.5 – 7.5	6.5 – 8.5	6.5 – 8.5
EC mS/cm	< 0.5	< 0.8	< 1.2
Cl mmol/l	< 1.0	< 2.5	< 5.0
Na mmol/l	< 0.5	< 2.5	< 5.0
HCO ₃ mmol/l	< 1.0	< 2.0	< 4.0
SO ₄ mmol/l	< 1.0	< 1.5	< 2.5



Soilless culture

Soilless culture

- Aim development of profitable systems with minimal emissions
- All horticultural crops
- Nursery stock



New developments

Soilless culture

- Soilless culture is not new
- There are new systems developed
 - Pot-in-pot
 - 'Hanging' containers
 - Dutch airpot U system
 - Big containers



Pot-in-pot ('Verstraelen' system)



Pot-in-pot ('Verstraelen' system)

- Pot-in-pot again in the spotlights

Advantages

- Plants do not fall
- Temperature buffering
- Easy and fast harvesting
- Efficient water and nutrient use
- No damage by rabbits



'Hanging' containers



'Hanging' containers



Dutch U system



Harvest



Results

Rootsystem of Ulmus

open field

U system



Results

	Open field	U system	
		2009	2010
Insecticides	373	782	233
Fungicides	354	95	17
Herbicides	2753	610	839
Total	3479	1487	1089



Results

White clover – reduction of herbicide use



Results

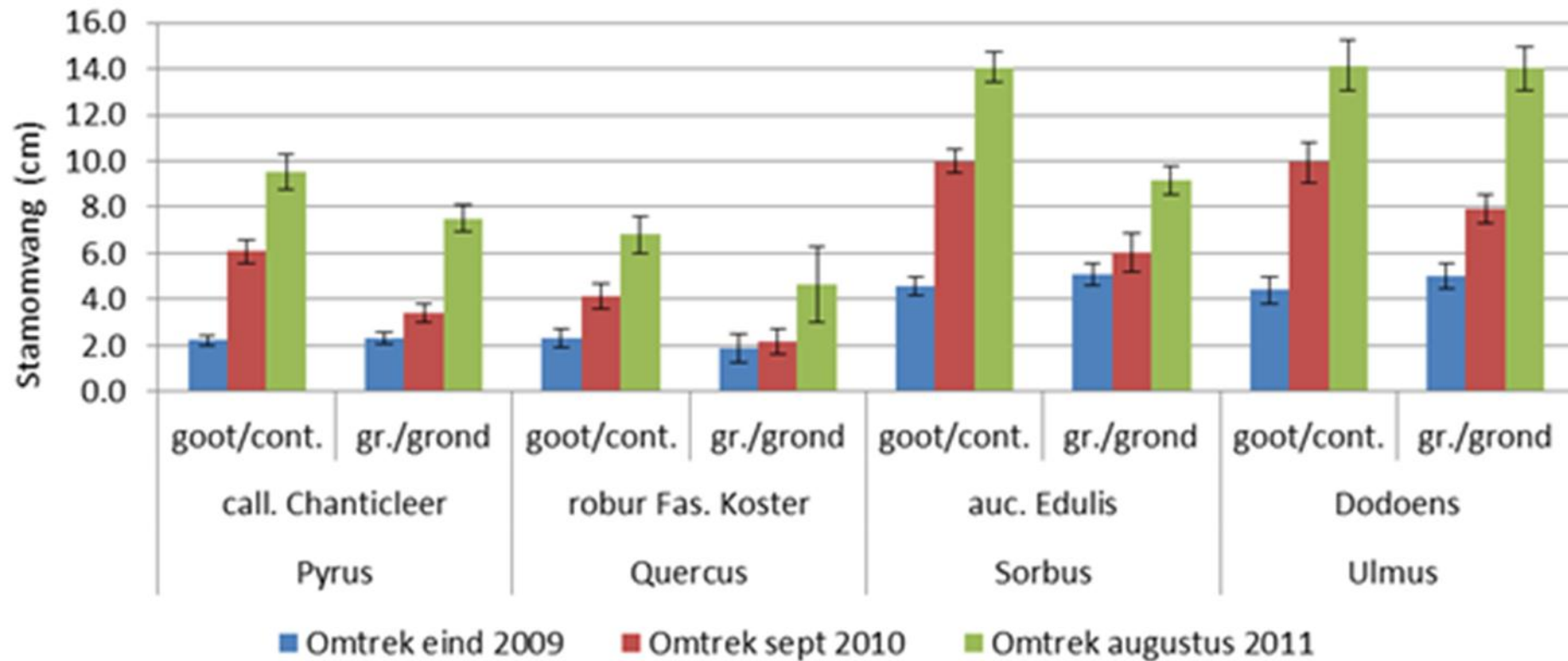
ADVANTAGES	DISADVANTAGES
Free of soil related diseases	Investment costs
Flexible harvesting	Harvest of all plants at one time
Improved labour conditions	Fixed dimensions
Spreading labour	Sometimes problems with Country planning
Growth regulation through water and nutrients	Winter hardiness
Intensive land use	Not suitable for all species
Less use of crop chemicals	
Minimal emission of nutrients and crop chemicals	
High success rate	



Street trees in big containers



Results



Future

- Recirculating drainage water
- Country planning
- Sustainability aspects
 - Alternative substrate
- Winterhardiness



New systems

- Economics
- High success rate of plants
- Some advantages are difficult to evaluate
- Company specific solutions
- Growers are actively involved
- www.teeltdegronduit.nl



Concluding remarks

- European legislation necessitates accurate fertilization
- Open field production – SOM management
- Container cultivation: kg/ha → mmol/l
 - Crop type
 - Container size and type
 - Length of cultivation period
 - Nutrient application method
 - Irrigation method
 - Water quality
 - Regular substrate analysis
 - Development of new systems



Thank you for your attention