A review of 12 years work on balancing the nutrition of nitrogen and potassium for the pear cultivar 'Conference'

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Balanced nutrition on 'Conference'-pears

- Most important elements:
  - Nitrogen
  - Potassium
  - But also calcium, magnesium,…
- Uptake is influenced by:
  - weather
  - soil temperature,
  - soil humidity,
  - type of rootstock
  - …


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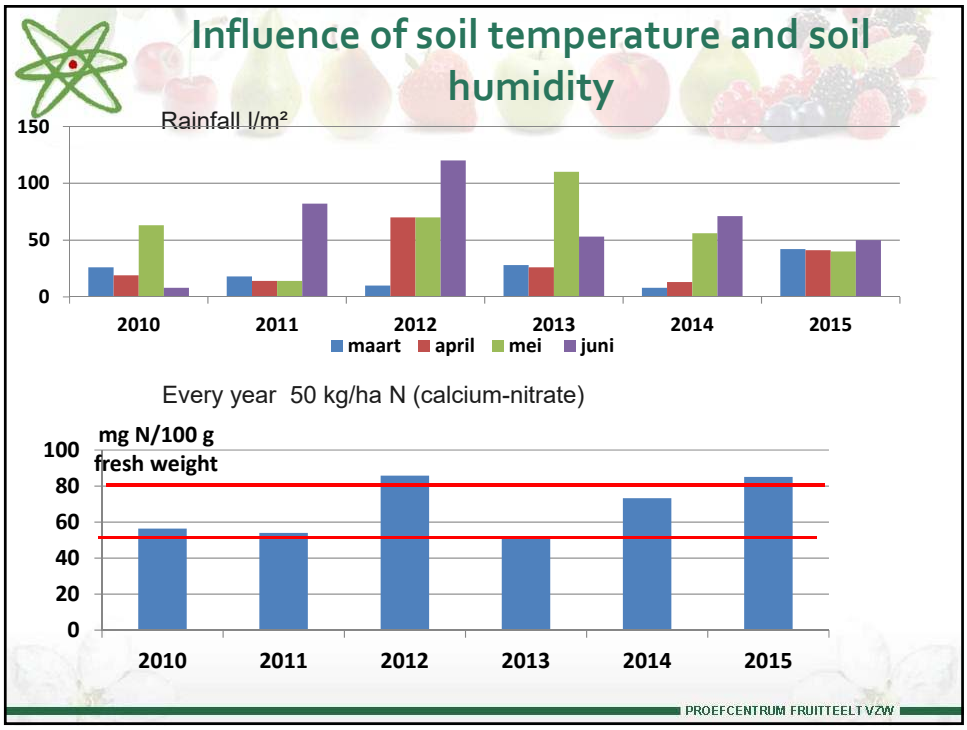
Nitrogen


Influence of soil temperature and soil humidity
Rainfall l/m²
150
100
50
0
2010
2011
2012
2013
2014
2015
maart
april
mei
juni
Every year 50 kg/ha N (calcium-nitrate)
mg N/100 g fresh weight
100
80
60
40
20
0
2010
2011
2012
2013
2014
2015
PROEFCENTRUM FRUITTEELT VZW

Big difference in uptake between years

40 kg N/ha in March (calcium nitrate)

Mineral content in the leaves	N	P	K	Ca
2012	2,3	0,16	0,7	2,2
2013	1,9	0,13	1,3	1,6
Optimal level	**2,2-2,5**	**>0,14**	**>0,9**	**>1,5**

Mineral content in the fruits	N	P	K	Ca	K/Ca
2012	67	12,9	136	6,4	21
2013	47	9,7	107	7,3	15
Optimal level	**50-80**	**9-13**	**100-150**	**5,5-8**	**15-25**

- Under dry soil conditions the uptake of N, P en K is less
- The uptake of Ca is better because there is less antagonistic effect between K en Ca

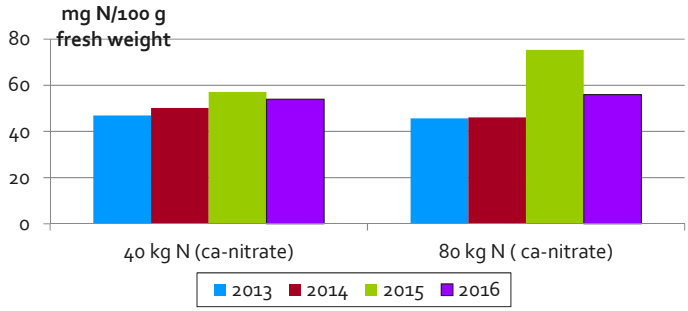
Increasing the dose of Nitrogen?

- 'Conference'
- Planting year : 2002
- Rootstock : Quince C
- Planting distance : 3.50 x 1.50 m
- Trial started in 2013
- 3 replications of 5 trees
- Same objects on the same trees.

	2013	2014	2015	2016
N low	40 kg/ha	40 kg/ha (+20 kg/ha)°	40 kg/ha	40 kg/ha
N high	80 Kg/ha	80 kg/ha (+20 kg/ha)°	80 kg/ha	80 kg/ha

° during summer

Increasing the dose of Nitrogen?



- Higher dose of fertilization is no guarantee for high mineral contents in the fruits
- There was no difference in quality at harvest or after storage
- The higher dose of N leads to more vigour

Potassium

Trial with different potassium-levels of soil nutrition

- 'Conference'
- Planting year : 2002
- Rootstock : Quince C
- Planting distance : 3.50 x 1.50 m
- Trial started in 2005
- 4 replications of 5 trees
- Same objects on the same trees.

Trial 2005-2013

Object	Treatment	N (kg/ha)	P_2O_5(kg/ha)	K_2O (kg/ha)	MgO
1	Control	40	20	-	-
2	50 E K_2O	40	20	50	-
3	100 E K_2O	40	20	100	-
4	150 E K_2O	40	20	150	-

Build-up a reserve of potassium in the soil

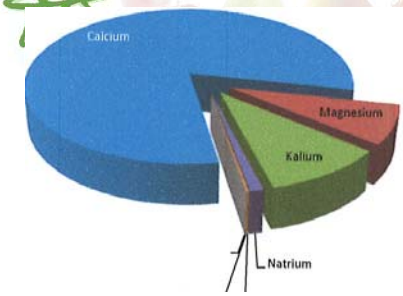
Trial started in 2005
Soil-analysis of 2013

Spurway- soilanalysis in June 2013 (kg/ha)

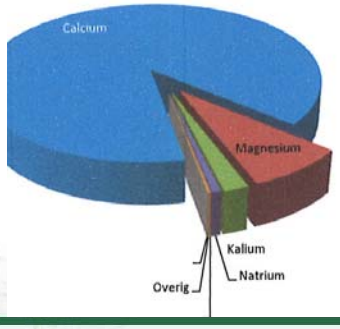
	optimum	Control		150 kg/ha K_2O	
		analyse	Soil supply (kg/ha)	analyse	Soil supply (kg/ha)
Potassium	**75-100**	**22**	**65**	**323**	**972**
Magnesium	50-75	56	231	54	225
Calcium	300-2700	822	2055	696	1740

After 9 years, there is a important difference in soil supply

Influence on the soil structure



	Bezetting	Laag	Goed	Hoog
Calcium (Ca^{2+})	81 %			
Magnesium (Mg^{2+})	7.7 %			
Kalium (K^{+})	10 %			
Natrium (Na^{+})	1.1 %			
Waterstof (H^{+})	< 0.1 %			
Overig (o.a. Al^{3+}, Fe^{2+})	0.2 %			



	Bezetting	Laag	Goed	Hoog
Calcium (Ca^{2+})	89 %			
Magnesium (Mg^{2+})	8.0 %			
Kalium (K^{+})	1.9 %			
Natrium (Na^{+})	0.7 %			
Waterstof (H^{+})	< 0.1 %			
Overig (o.a. Al^{3+}, Fe^{2+})	0.2 %			

- After 9 years the first year with K-deficiency in het leaves

Influence of potassium on the production

- In het first years there was no effect on the production
- Since 2013 the fruit size on the 'untreated' trees was smaller
- Yellow leaves on the untreated trees

Production in 2013: first year with negative effect on the fruit size

Object	# Flower buds	Kg/tree	# fruits	Fruit weight (g)
Control	121 a	25.9 b	209 a	**129** b
50 kg/ha K_2O	106 a	32.4 a	219 a	150 ab
100 kg/ha K_2O	92 a	31.8 a	204 a	157 a
150 kg/ha K_2O	110 a	34.2 a	230 a	149 ab

Trial with different potassium-levels of soil nutrition

Since 2014 the control gets every year 100 E K_2O

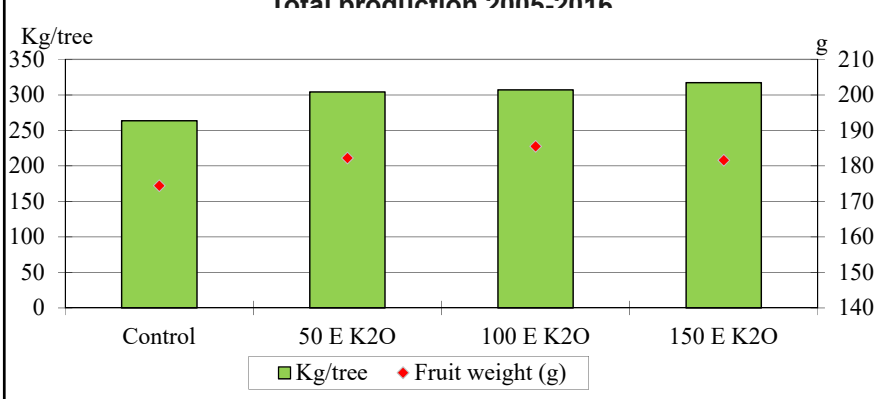
Object	Treatment	K_2O (kg/ha) 2005-2013	K_2O (kg/ha) 2014-2016
1	Controle	-	100
2	50 E K_2O	50	50
3	100 E K_2O	100	100
4	150 E K_2O	150	150

Total fruit set 2005-2016

Object	# Flower buds/tree Total (2005-2016)	%	# fruits/tree Total (2005-2016)	%	Fruits/100 flower buds
Control	1346	**100**	1984	**100**	147
50 kg/ha K_2O	1394	**104**	2196	**109**	157
100 kg/ha K_2O	1304	**97**	2174	**109**	167
150 kg/ha K_2O	1362	**101**	2340	**121**	172

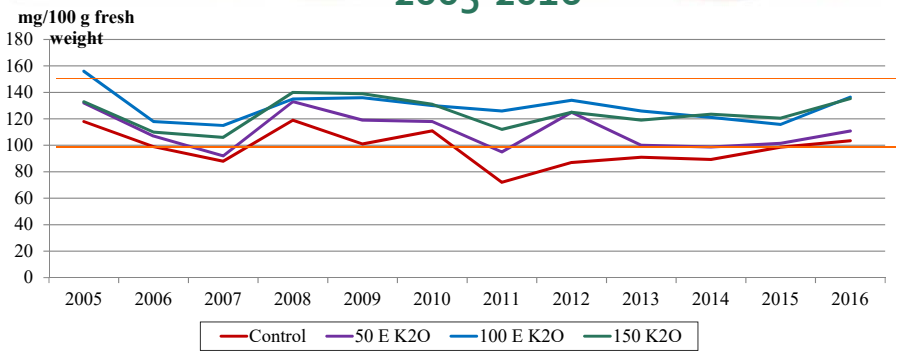
- Until 1013 there was no influence on the number of flower buds
- Last years there was a tendency to a lower fruit set on the 'control'
  ⟹ Weaker flower bud quality

Influence of potassium on production of Conference



Smaller fruit size leads to lower production volume

Potassium content in the fruits at harvest 2005-2016



- After 6 years, K- content of the control was always below the optimal level
- Since 2014 the control gets every year 100 E K_2O : the K-amount in the fruits slowely increases
- No big difference between 100 and 150 E K_2O
- No irrigation on this parcel, so no excessive uptake

What on soils with high K-level ?

- Trial started in 2012
- 'Conference'

Control (without irrigation)	Fertigation since 2012
50 E - calcium nitrate (15.5 % N) 20 E P_2O_5 - tripelsuperphosphate (45 % P_2O_5) 50 E MgO - kieserite (26 % MgO) 20 E N - potasium nitrate (13 % N - 45 % K_2O)	50 E N + 97 E CaO Ca-nitrate fertigation in spring 20 E N + 39 E CaO Ca-nitrate fertigation in summer

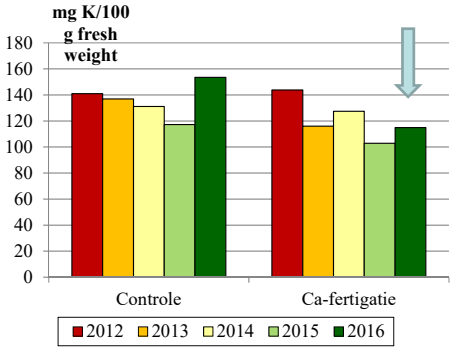
Mineral content of the fruits in 2016

Leaf analyses		mg/100 g fresh weight				
		N	P	K	Ca	Mg
1	Ca-nitrate	2.4	0.14	0.78	2.56	0.51
2	Ca-nitrate fert.	2.4	0.14	0.64	2.71	0.63
Optimal level		**2.0- 2.5**	**> 0.14**	**> 0.90**	**> 1.50**	**> 0.23**

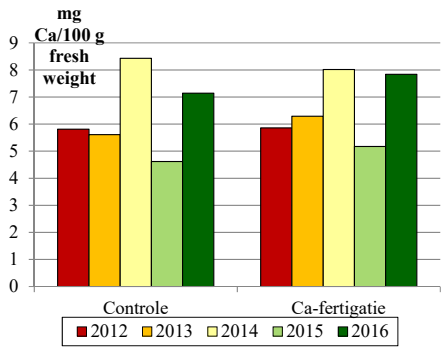
Fruit analyses		mg/100 g fresh weight							
		% DS	N	P	K	Ca	Mg	Mn	K/Ca
1	Ca-nitrate	13.2	60.9	13.9	153	7.1	6.6	0.08	21
2	Ca-nitrate fert.	13.5	52.7	12.6	115	7.8	6.8	0.06	14
Optimal level		**-**	**50-80**	**9-13**	**100-150**	**5.5-8**	**5.5-8**	**0.07-0.15**	**15-25**

It took 5 years to see the first differences !

Evolution of the K and Ca-content in the fruits



Evolution K-content 2012-2016



Evolution Ca-content 2012-2016

2016 : 1st year with lower K-content

Conclusions on Potassium nutrition in pear cv. Conference

- On loamy, non K-fixating soils, excessive doses of potassium are not needed
- High doses of potassium will create a soil reserve
- Potassium will not leach from the upper soil levels
- It takes several years to go from an excessive level to a normal soil level
- High doses of potassium will be antagonistic to the uptake of calcium.
- A shortage of calcium in the fruits might cause serious storage problems.
- The uptake of potassium is highly dependent on the soil humidity in spring

A moderate K-gift is necessary but

exaggerating leads also to poor fruit quality