



 **pcfruit**  
PROEFCENTRUM FRUITTEELT VZW

# **Sustainable fruit production: thinning, and water&nutrients**

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# Overview

1. **Thinning** with Brevis in apple **2016**: application time trial & dose response trials
2. **Thinning advice 2017**: impact of the frost damage
3. Extensions of **PWARO service system** for irrigation&fertigation
4. **Nitrogen reduction** project in **pear**
5. Fertigation and irrigation in **strawberry**
6. Strengthening of **blackberry** fruit skin by adjusting fertigation



# Thinning with Brevis in 'Golden Delicious': application time trial 2016

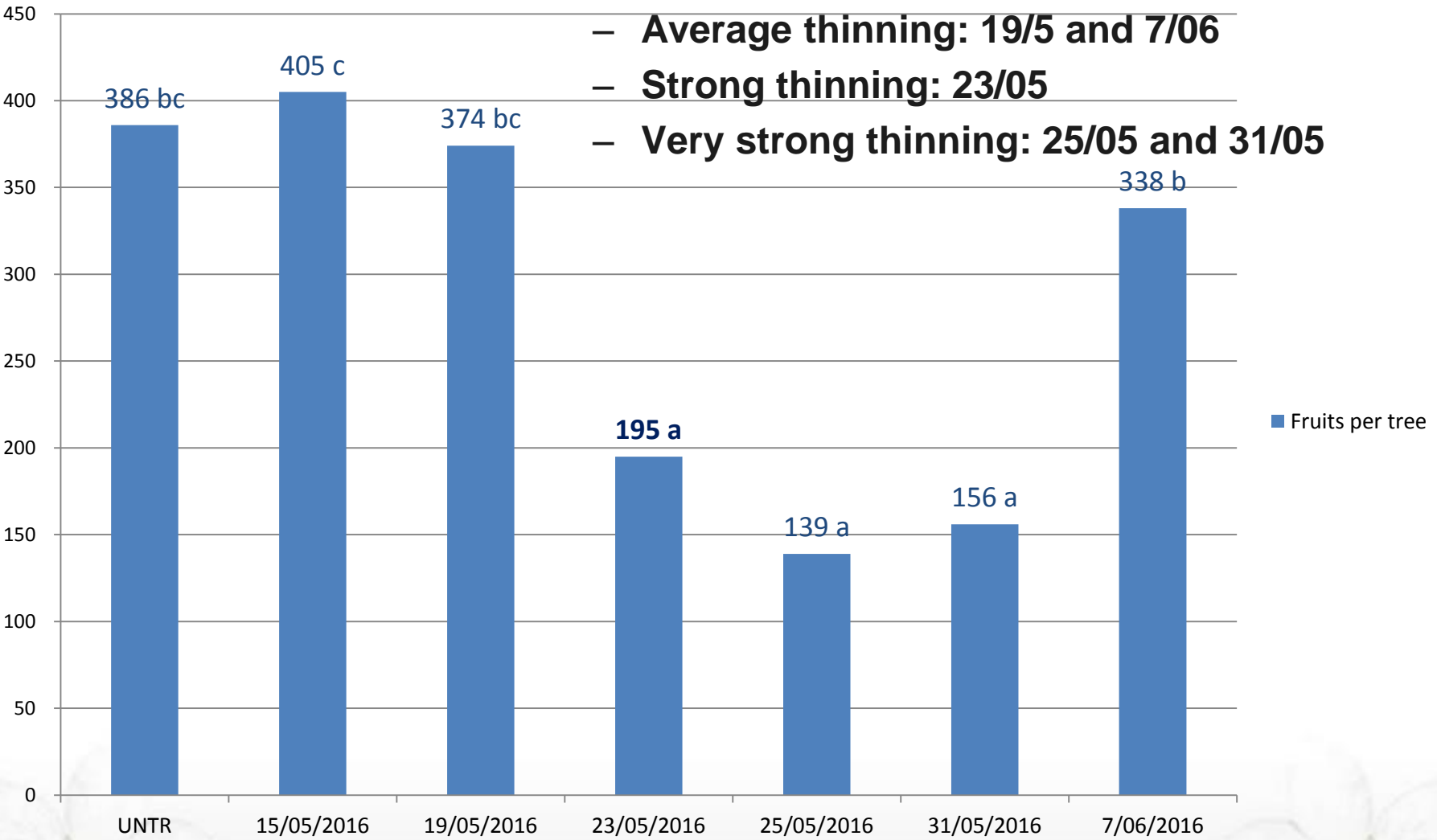
Object ('Golden Delicious')						
Application time	15/5	19/5	23/5	25/5	31/5	7/6
Brevis dose (kg/ha)	1,65	1,65	1,65	1,65	1,65	1,65
Actual fruitlet diameter (mm) 2 yow (diameter range)	7,1 (6-8)	9,1 (8-10)	11 (10-12)	12,2 (12-14)	15,4 (14-16)	18,7 (16-18)

- 11 years old trees; 3,5 x 1,5 m; tree height of 3,2 m
- No pollinator
- Number of flower clusters 2016 : 250-300 per tree
- 1000 L water/ha
- 4 replicates of 6 trees (4 netto trees), 7 objects incl. untreated control



# Thinning with Brevis in 'Golden Delicious': application time trial 2016

- Weak thinning: 15/5
- Average thinning: 19/5 and 7/06
- Strong thinning: 23/05
- Very strong thinning: 25/05 and 31/05





# Dose response trials with Brevis

- 'Gala', 'Elstar', 'Fuji', 'Braeburn', 'Pink Lady'
- 3,5 x 1,5 m; tree height of 2,8 m
- Pollinators (12 varieties)
- 1000 L water/ha
- 4 replicates of 2 trees, 5 objects (1,1 kg; 1,65 kg and 2,2 kg/ha standard orchard at 8 mm; 2,2 kg/ha SO at 12-14 mm; untreated control)

	'Pink Lady'	'Braeburn'	'Gala'	'Elstar'	'Fuji'
8 mm	15/05/2016	17/05/2016	19/05/2016	19/05/2016	19/05/2016
12-14 mm	25/05/2016	25/05/2016	25/05/2016	25/05/2016	25/05/2016



# Dose response trials with Brevis

- **All cultivars show a clear dose response:** number of fruits per tree and kg per tree decrease whereas average fruit weight increases with increasing Brevis dose
- **All cultivars except 'Elstar' show overthinning using 2,2 kg /ha on 25/05/2016** (12-14 mm)
- Effect of fruit size at time of application (2 year old wood)
  - **In most years strongest thinning occurs at 12-14 mm** (depending on climatological conditions): probably the naturally occurring carbon deficiency in the tree is strongest at this fruit size (natural June drop involves mainly fruits of 12-16 mm)
  - **Broad range of application between 8 and 16 mm** fruit size, sometimes even later, but risk of no effect in some years
  - **Earlier applications at 8 mm** are usually **not successful** for thinning





# Thinning advice for 2017

- Taking frost damage and effect of gibberellins into account: **no Brevis** because it has a stronger effect on fruits without seeds (parthenocarpic)
- **Pear**: no chemical thinning unless 6-BA (8-10 mm) for weak thinning if fruit set is good and temperature sufficient for application (min 18°C), has positive effect on number of flower clusters next year
- **Apple**: no thinning unless diploid cultivars and fruit set is good; use 6-BA
- **Await the end of June drop** and if necessary apply (quality) hand thinning



# PWARO service system for irrigation and fertigation



- Individual irrigation/fertigation advise (minimal input of water and nutrients)
- **For pear and sweet cherry** (first extension since 2017) growers
- At orchard level
- Demonstration : [www.pwaro.be](http://www.pwaro.be)







# PWARO advise



## MEASUREMENTS

- **Soil samples:** volumetric water content together with pF curve
- **Water potential** measurements of the **leaf**

## INPUT soil water balance model

- Info on soil and crop
- Weather forecast
- Weather observations (temperature – min & max, radiance – hrs of sunshine and of degree clouding, relative humidity, wind velocity, topographic height – latitude)
- Precipitation and amount of irrigation
- Evapotranspiration based on  $ET_0$  or reference evapotranspiration [mm/dag] (the maximum evapotranspiration of a healthy lawn (grass) of 12 cm high , optimal water and nutrients) and a crop factor



# Example calculation PWARO advise



- $ET_0 = 3,5 \text{ mm/m}^2/\text{day}$
  - Tree =  $\pm 3 \text{ m}^2$
  - Evapotranspiration per tree =  $3,5 * 3 = 10,5 \text{ mm}$  or l/day/tree
  - Irrigation, amount of water per drip point = 2 l/h
  - Distance between drip points = 0,5 m
  - Distance in the row = 1,25 m
- } 2,5 drip points/tree } 5 l/tree/h

 Irrigate for  $\pm 2 \text{ h}$

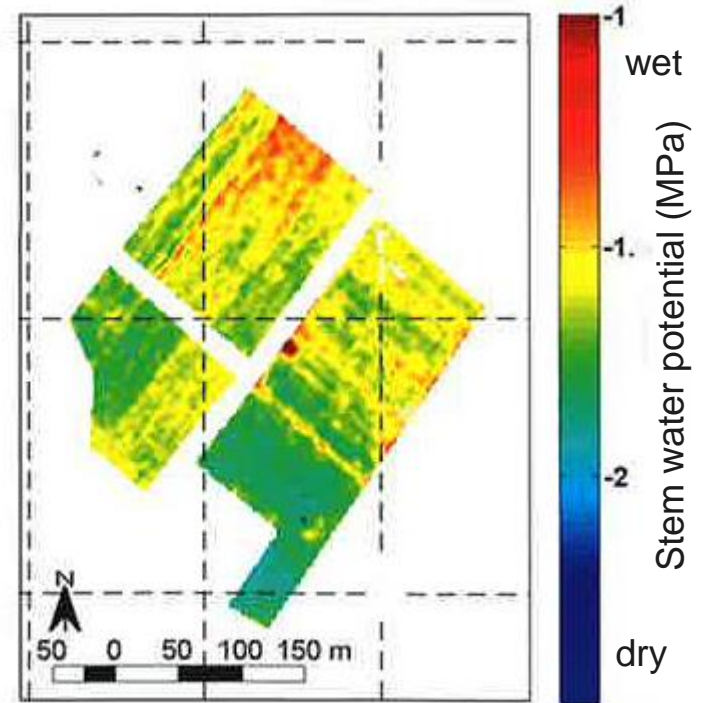


# PWARO support by satellite image analysis (second extension)



- **PWARO**: soil samples for measuring volumetric water content are taken in one **central reference zone** of the orchard, but often large variation in soil and trees within an orchard
- Past research: **satellite image** (Worldview) analysis can reveal **water status in the orchard**
- And water status is strongly **linked with pear size**

- Optimal reference zone
- Variable irrigation
- Better planning of root pruning





# PWARO support by satellite image analysis for irrigation management



- **Sentinel-2 satellite** images (ESA): resolution 10 m, image every 5 days, large archive of historic images
- **NDVI** index → variation in biomass
- **ReNDVI** (Red Edge) index: strong correlation with stem water potential and thus with drought stress



**Careful interpretation** together with the grower to verify possible causes of the variations seen in the satellite images!



# Nitrogen reduction project in pear



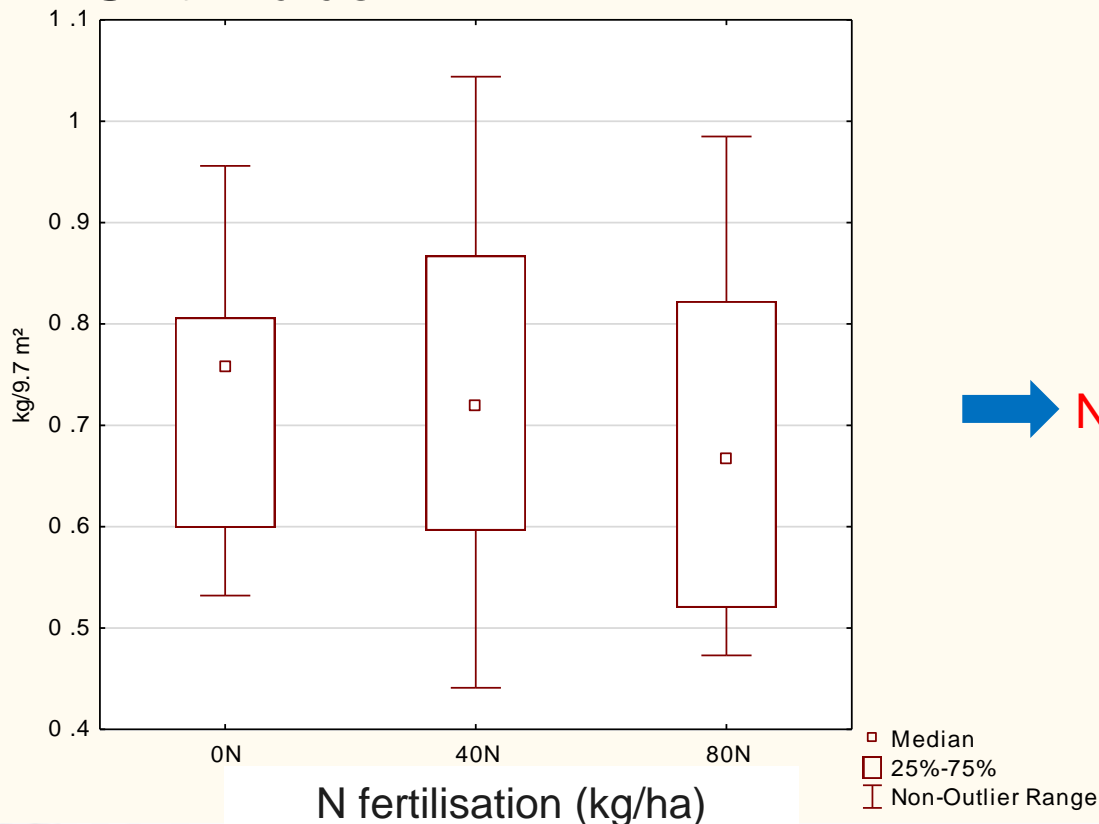
- **Leaching of nitrogen** (N) into surface and ground water remains above the limit (50 mg/L) in some measuring points in Belgium despite efforts by the farmers
- **Goal** project (2017-2019)? **Reduction of N fertilisation** in pear by more controlled fertilisation using fertigation and a reduction of the total amount of N, but maintaining yield and fruit quality
- **Demonstration project** in grower's orchards, two orchards (one in sandy loam soil and other in loam soil in the province Limburg)
- Three objects: (i) standard N fertilisation scheme of the grower, (ii) **20% less** N fertilisation and (iii) **40% less** N fertilisation whereby in the last two objects controlled fertigation (RDI) is done in the summer to achieve the reduced amounts
- **Measure** yield, grading, fruit quality (firmness, brix, starch, acidity)





# Fertigation and irrigation in strawberry

- How important is nitrogen (N) fertilisation for strawberry production?
- 'Elsanta' trial 2014 (planting) – 2015 (3 different N fertigation levels) in Sint-Truiden:



➔ No response to N fertilisation





# Fertigation and irrigation in strawberry

Can **N mineralisation** in the soil explain the lack of response to N fertilisation?

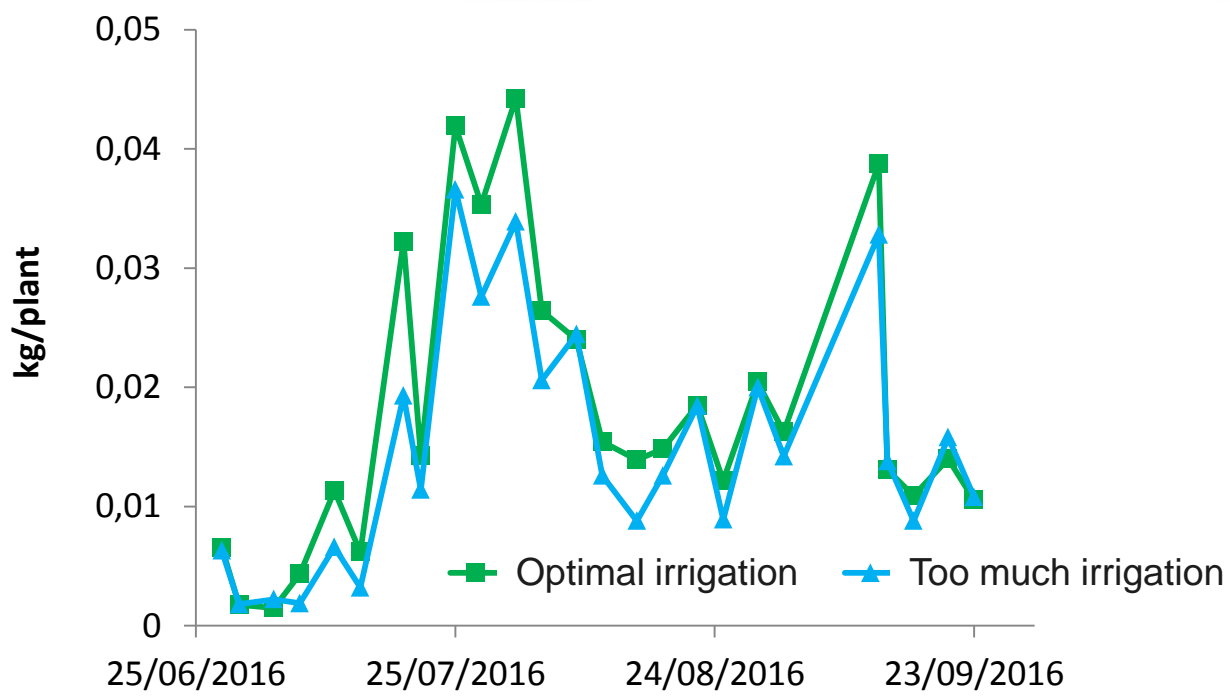
**Everbearer trial: 'Portola' in Sint-Truiden 2016 (planted mid April)**

*NO<sub>3</sub><sup>-</sup> N level measured (no plants; irrigated)*

<b>Date sampling</b>	<b>NO<sub>3</sub><sup>-</sup>N (0-30 cm) (kg/ha)</b>
<b>18/04/2016</b>	47
<b>13/05/2016</b>	77
<b>15/06/2016</b>	129
<b>1/08/2016</b>	79
<b>21/09/2016</b>	75



# Fertigation and irrigation in strawberry



- ➔ Excessive irrigation does not result in higher yield!
- ➔ Similar to PWARO for pears, a service system for irrigation and fertigation in strawberry is set up by Research Station for Fruit (pcfruit), Soil Service Belgium, Research Station for Strawberry Hoogstraten and University of Leuven



# Adjusting blackberry fruit skin by modification of fertigation

- **Blackberry fruit skin ruptures easily**
- **Hypothesis:** weak cell walls due to low Ca level
- **Solution?** Increase Ca level in berries by increasing Ca concentration in fertigation solution
- **Trials:** 'Kwanza' in pots in greenhouse





# Near harvest

**K/Ca  
higher**

	<b>EC</b>	1.6
	<b>pH</b>	5.5
mM	<b>NH<sub>4</sub></b>	0.0
mM	<b>K</b>	4.2
mM	<b>Ca</b>	3.7
mM	<b>Mg</b>	2.2
mM	<b>NO<sub>3</sub></b>	11.5
mM	<b>Cl</b>	0.0
mM	<b>SO<sub>4</sub></b>	1.5
mM	<b>P</b>	1.5
mM	<b>Si</b>	0.0
	<b>Ca/K</b>	0.88
	<b>Ca/Mg</b>	1.68
	<b>K/Ca</b>	1.14

V ^ V

V

**K/Ca  
lower**

	<b>EC</b>	1.6
	<b>pH</b>	5.5
mM	<b>NH<sub>4</sub></b>	0.0
mM	<b>K</b>	3.5
mM	<b>Ca</b>	4.5
mM	<b>Mg</b>	1.75
mM	<b>NO<sub>3</sub></b>	11.75
mM	<b>Cl</b>	0.0
mM	<b>SO<sub>4</sub></b>	1.5
mM	<b>P</b>	1.25
mM	<b>Si</b>	0.0
	<b>Ca/K</b>	1.29
	<b>Ca/Mg</b>	2.57
	<b>K/Ca</b>	0.78



# Leaf mineral analysis

		% DM					
		N	P	K	Ca	Mg	S
K/Ca higher		3.37	0.371	2.27	1.20	0.451	0.11
K/Ca lower		3.28	0.328	2.13	1.12	0.425	0.13

**➔ No differences in leaf mineral composition**



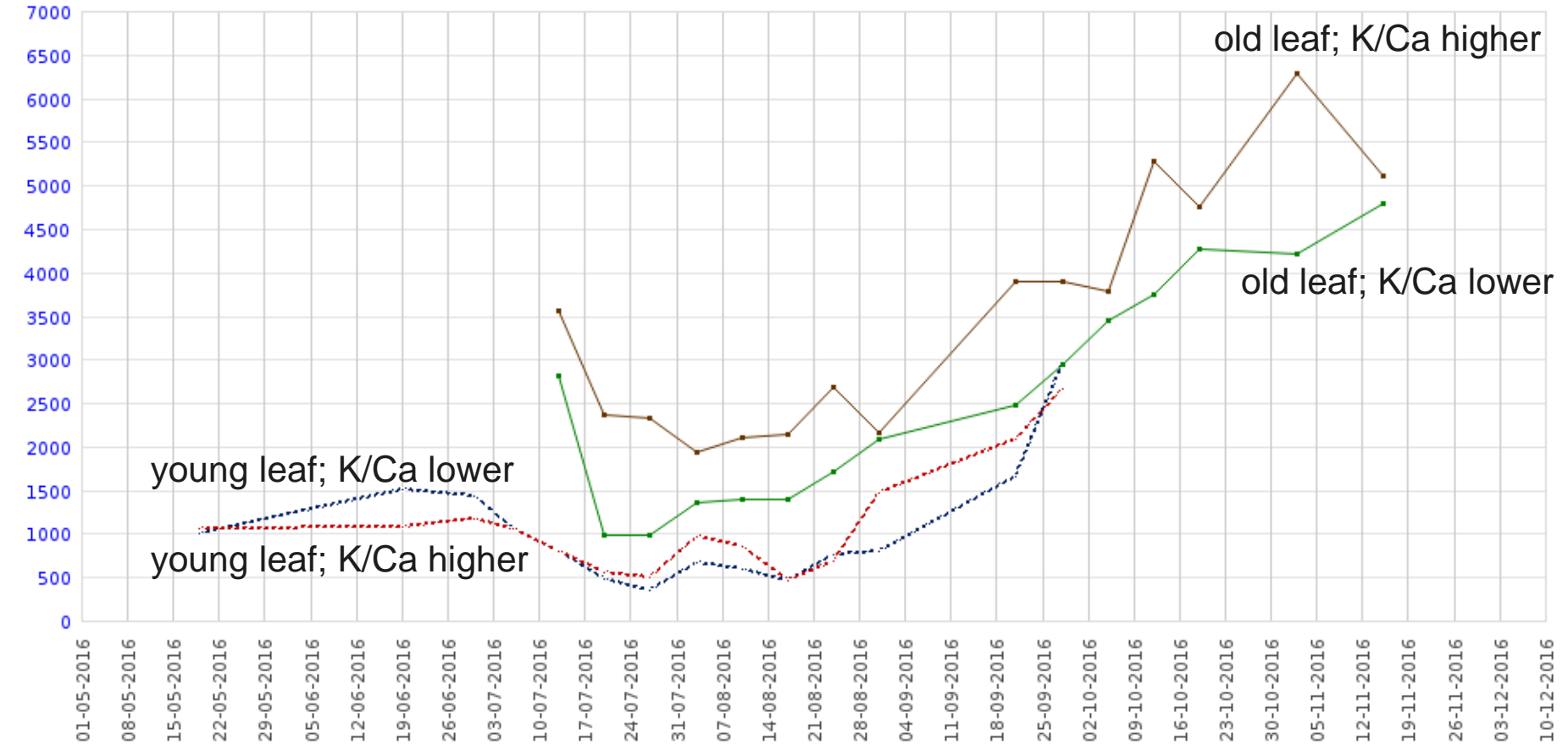


# Time course study of minerals by sap analysis

## Calcium

- 1 - HFB Kwanza Obj 1 - Plantsap - Blad (jong) - Ca - Calciu...
- 1 - HFB Kwanza Obj 1 - Plantsap - Blad (oud) - Ca - Calciu...
- 1 - HFB Kwanza Obj 8 - Plantsap - Blad (jong) - Ca - Calciu...
- 1 - HFB Kwanza Obj 8 - Plantsap - Blad (oud) - Ca - Calciu...

ppm



➡ **Difficult to interpret**



# Thank you for your attention! Contact Information

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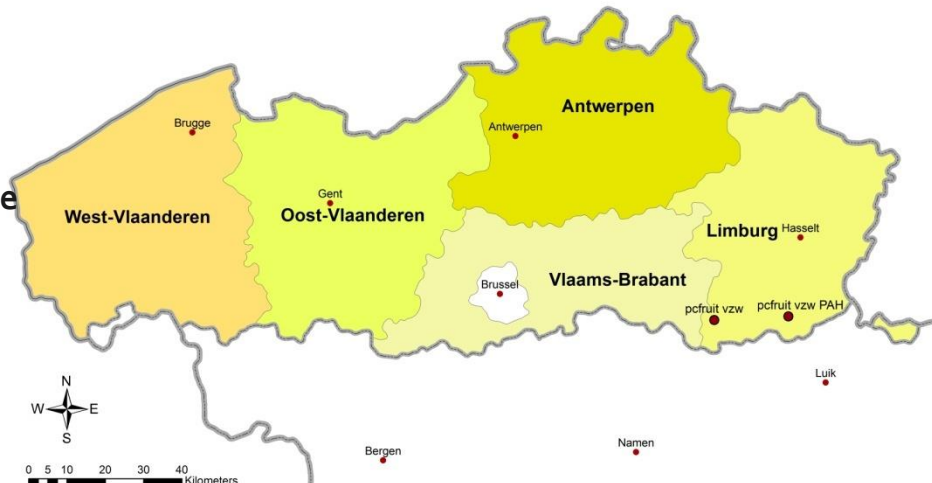
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