Energy and nutrients in a short-rotation coppice

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POPFULL

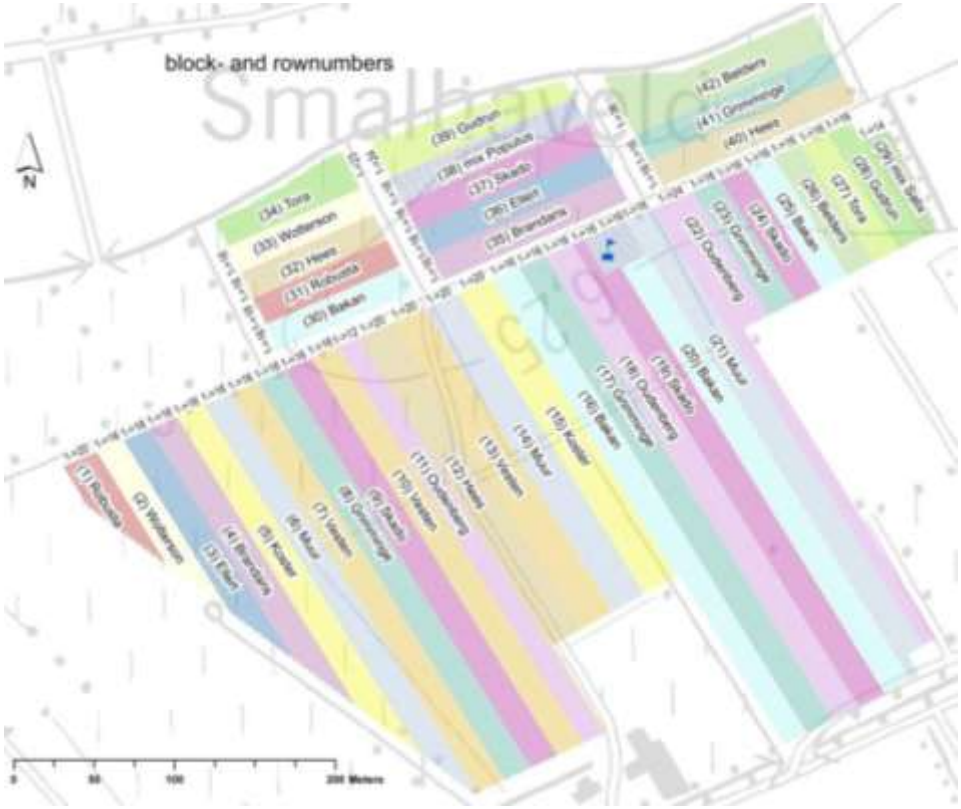
Aim & scope

- Research questions:
  - How many nutrients are recycled with leaf fall?
  - How many nutrients are minimally removed with the harvest?
- Important for fertiliser requirements
- Compare energy and nutrient concentrations in
  - Fresh litter
  - Terminal leader of the current-year shoot

The POPFULL project

A short-rotation coppice culture

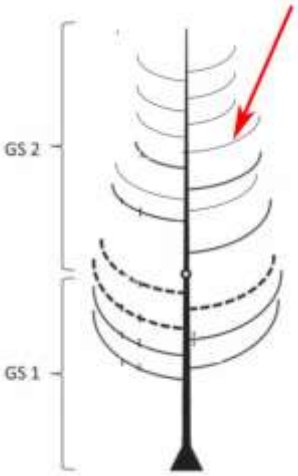
- 18.4 ha
- No irrigation, no fertilisation
- Former agricultural land



Measurements

1. Energy & nutrient concentrations

- 1 sylleptic branch per tree & 10 trees per genotype
- 25 freshly fallen leaves per genotype

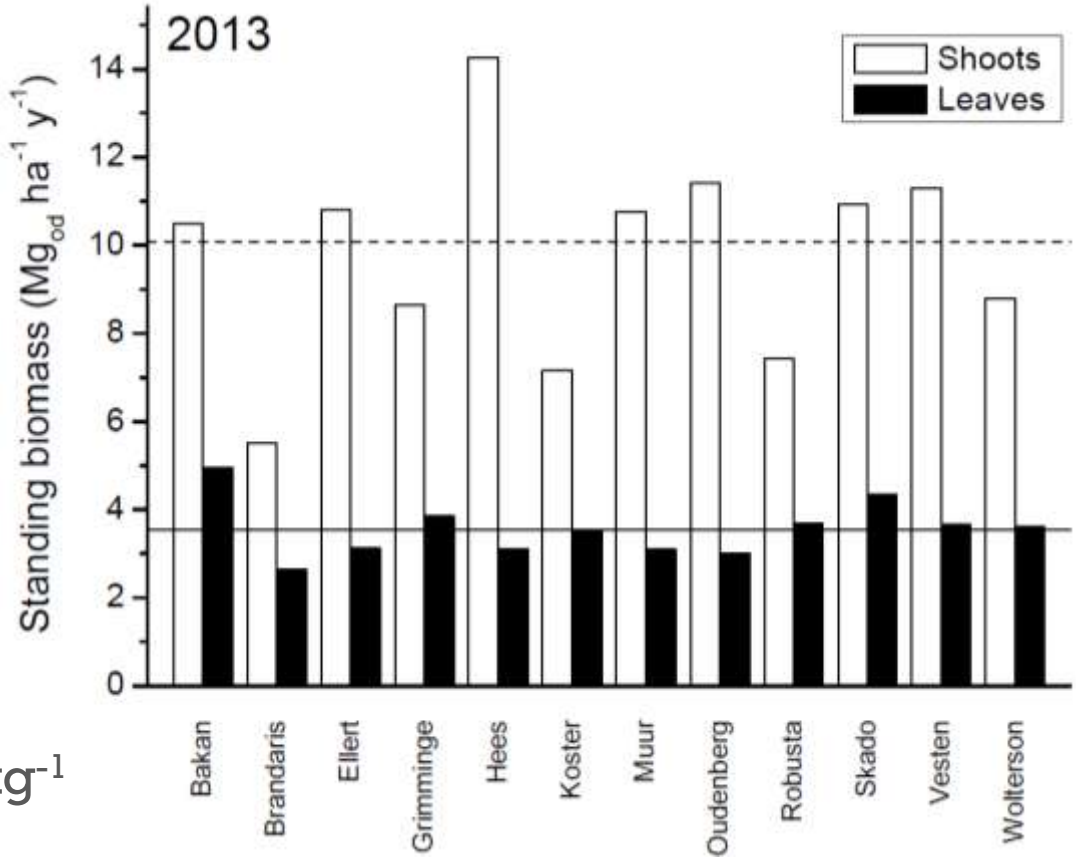


- Gross calorific value of shoots & leaves
- N, P, K, Ca & Mg concentration in shoots & leaves

Measurements

2. Biomass production

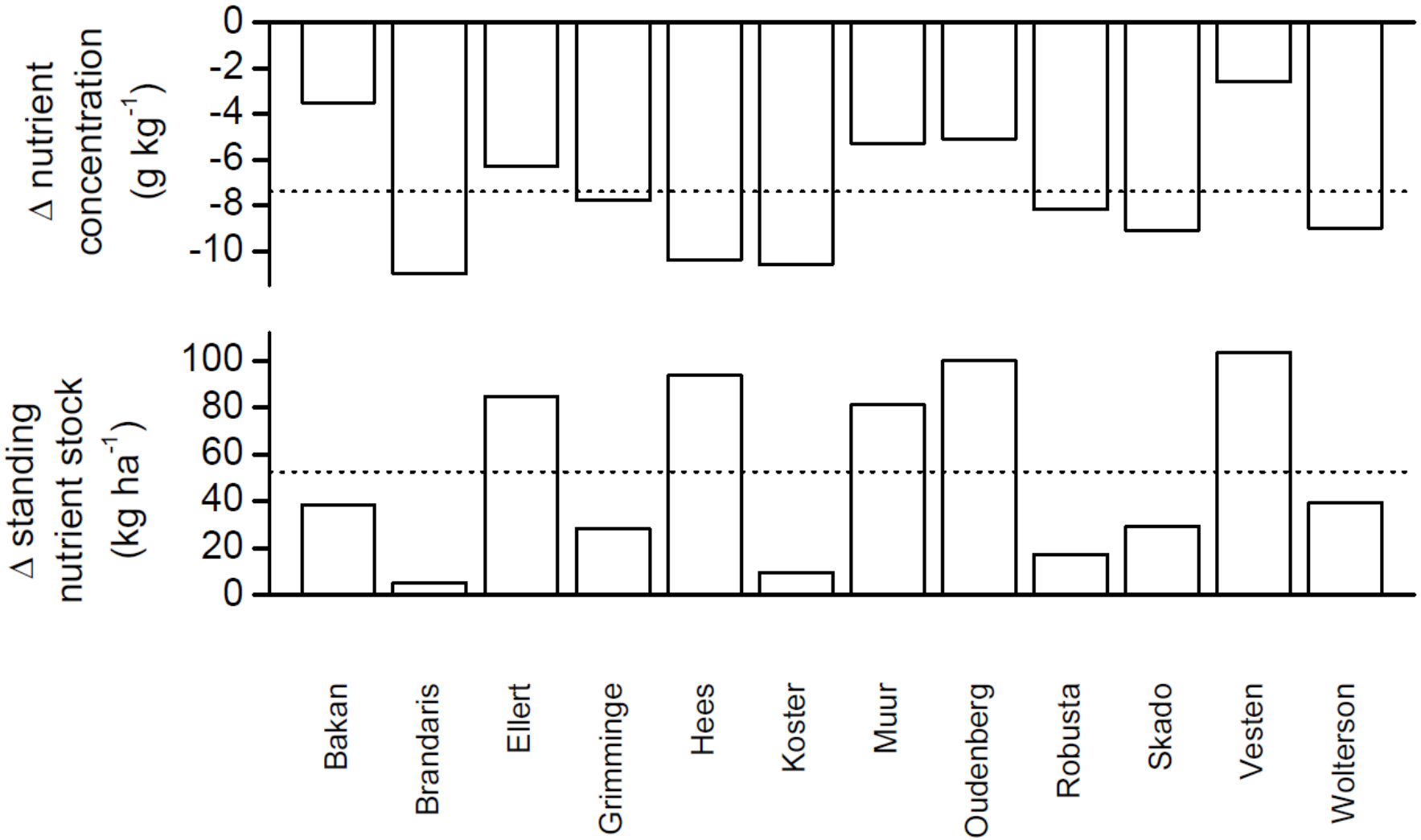
- 8.000 plants ha^{-1} → > 100.000 plants
- 2x 2 year rotations
- 12 *Populus* genotypes



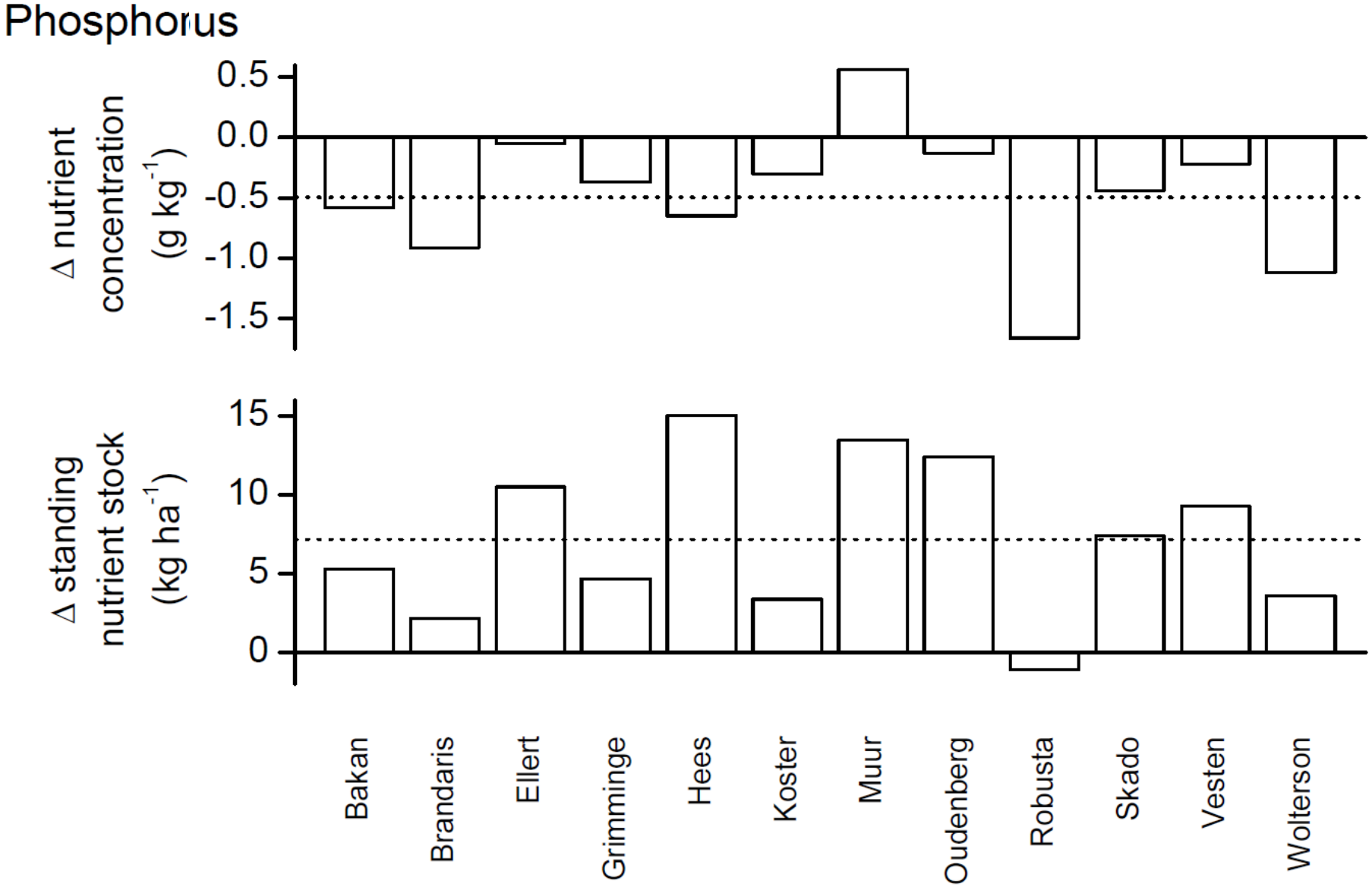
- GCV_{shoots} 18.36 ± 0.39 MJ kg^{-1}
- GCV_{leaves} 18.16 ± 0.37 MJ kg^{-1}

Results

Nitrogen

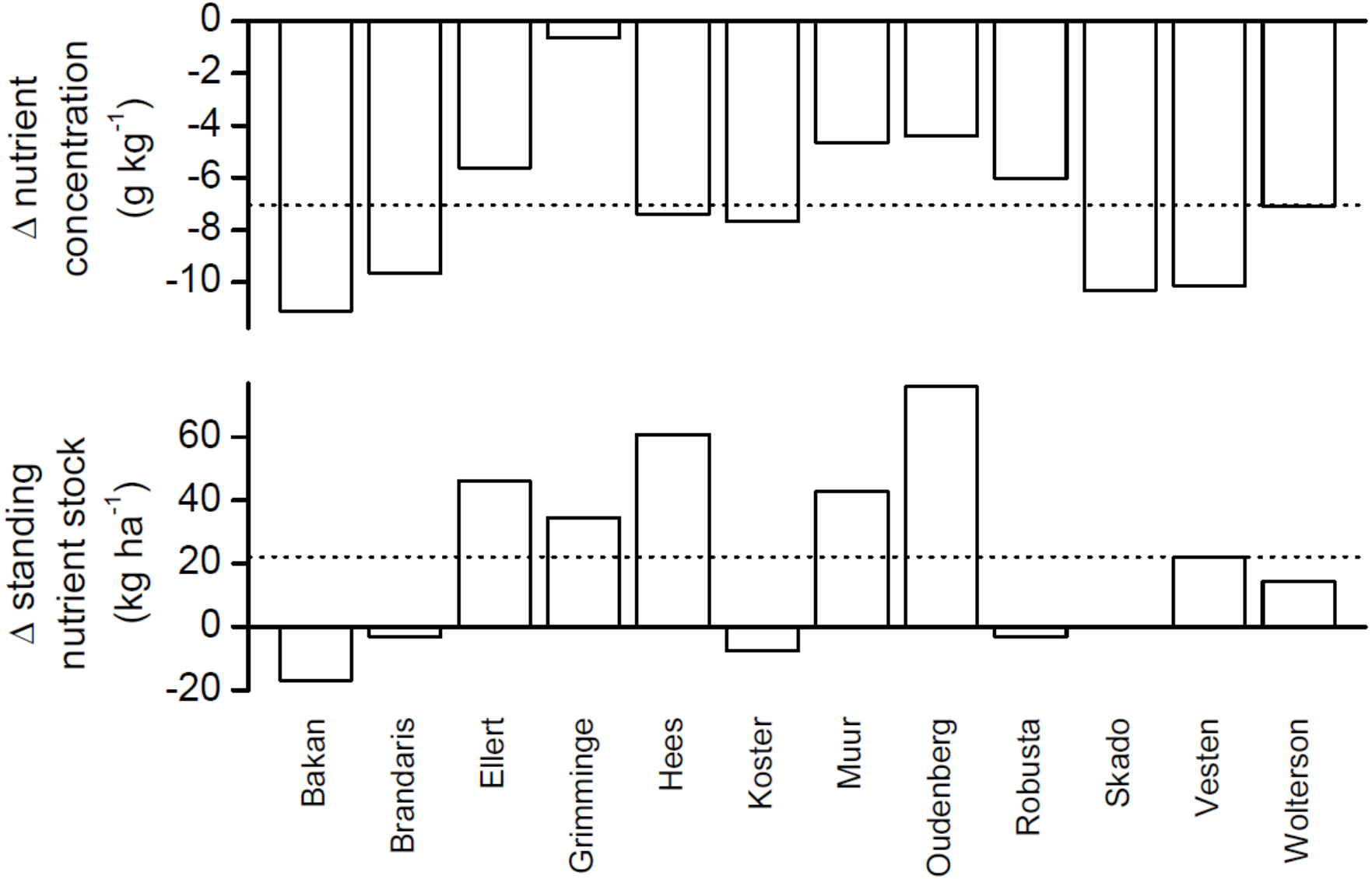


Results


Phosphorus
Δ nutrient concentration (g kg-1)
0.5
0.0
-0.5
-1.0
-1.5
Δ standing nutrient stock (kg ha-1)
15
10
5
0
Bakan
Brandaris
Ellert
Grimminge
Hees
Koster
Muur
Oudenberg
Robusta
Skado
Vesten
Wolterson

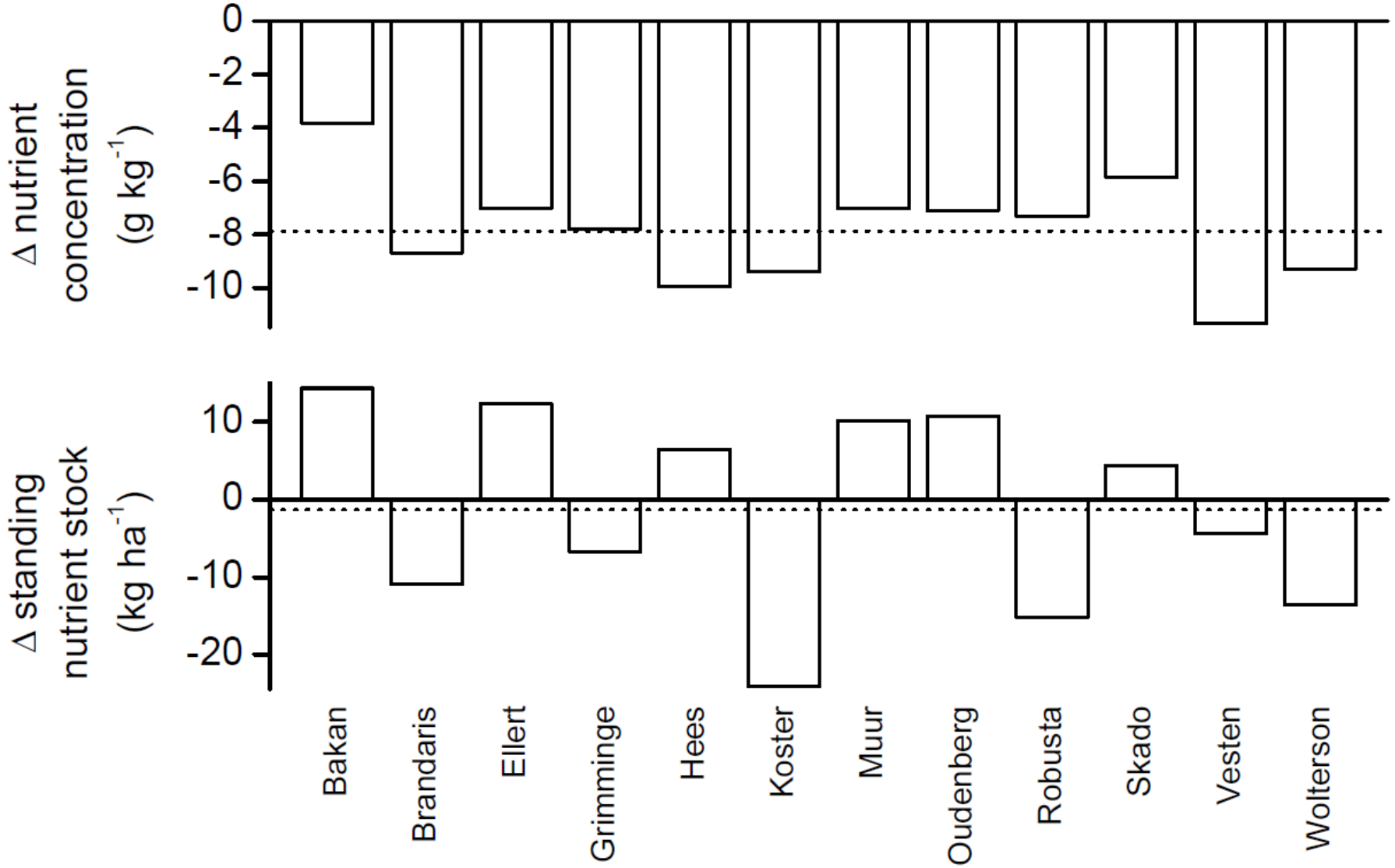
Results

Potassium

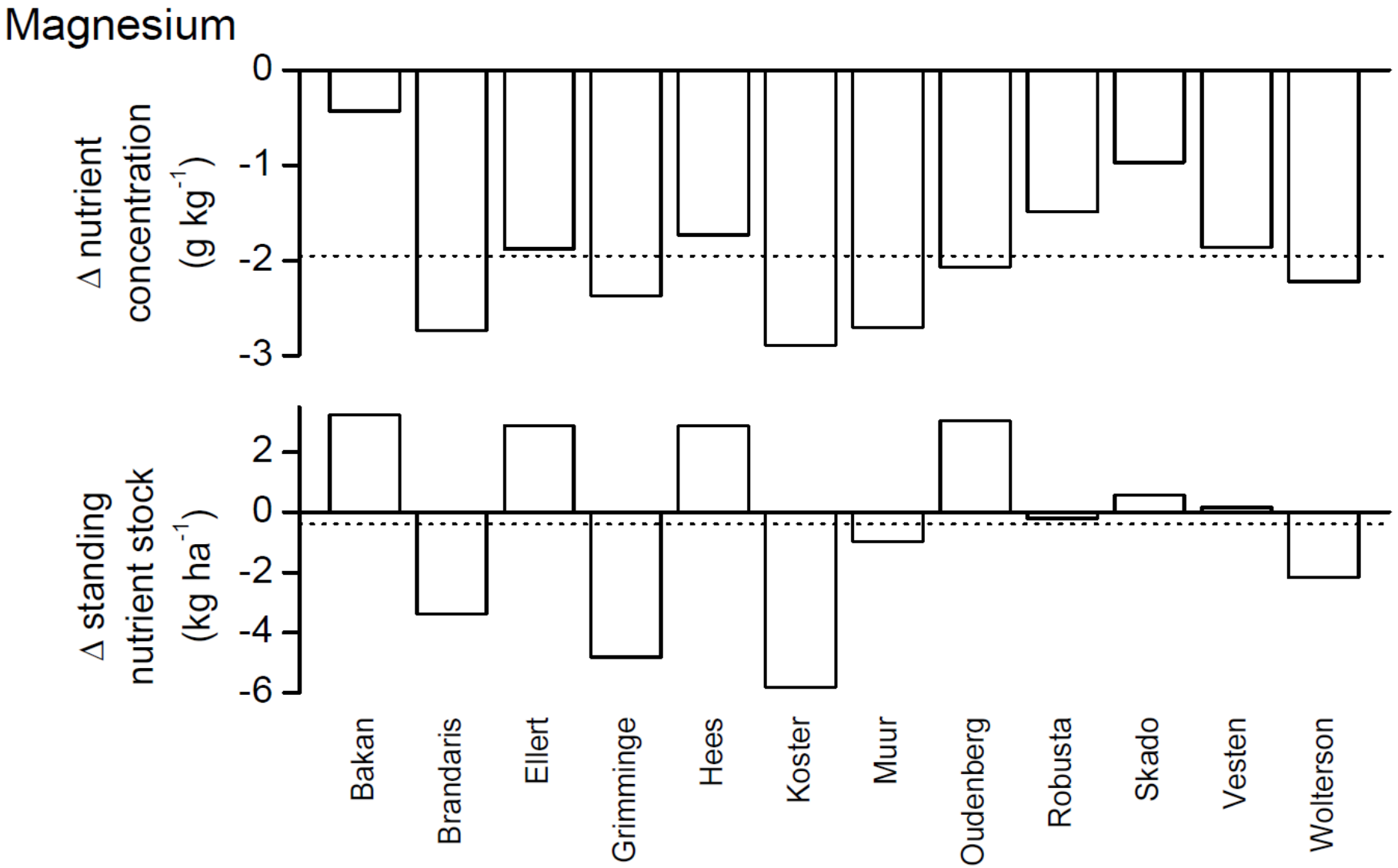


Results

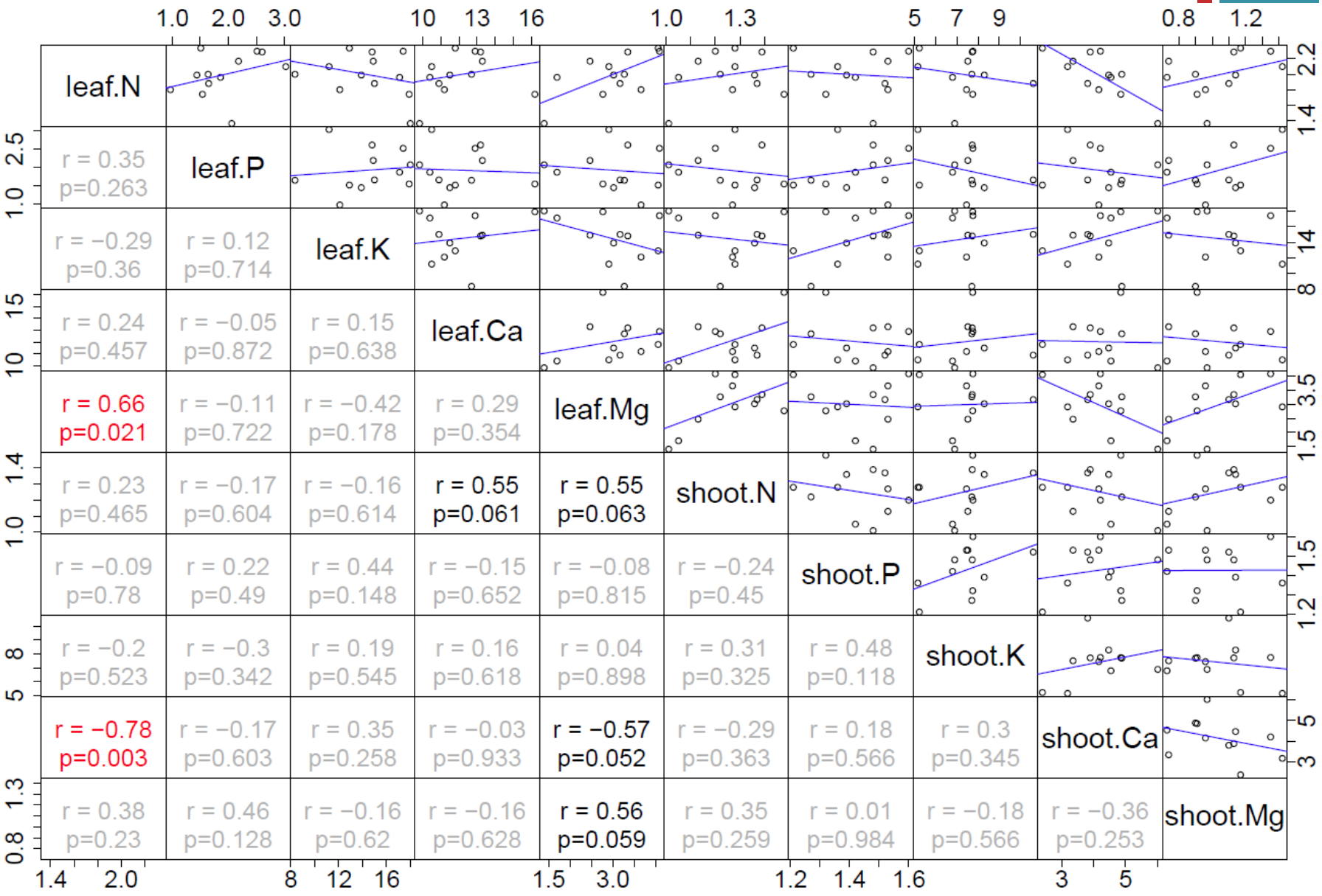
Calcium



Results


Magnesium
Δ nutrient concentration (g kg-1)
0
-1
-2
-3
Δ standing nutrient stock (kg ha-1)
2
0
-2
-4
-6
Bakan
Brandaris
Ellert
Grimminge
Hees
Koster
Muur
Oudenberg
Robusta
Skado
Vesten
Wolterson

Results


leaf.N
leaf.P
leaf.K
leaf.Ca
leaf.Mg
shoot.N
shoot.P
shoot.K
shoot.Ca
shoot.Mg
r = 0.35 p=0.263
r = −0.29 p=0.36
r = 0.12 p=0.714
r = 0.24 p=0.457
r = −0.05 p=0.872
r = 0.15 p=0.638
r = 0.66 p=0.021
r = −0.11 p=0.722
r = −0.42 p=0.178
r = 0.29 p=0.354
r = 0.23 p=0.465
r = −0.17 p=0.604
r = −0.16 p=0.614
r = 0.55 p=0.061
r = 0.55 p=0.063
r = −0.09 p=0.78
r = 0.22 p=0.49
r = 0.44 p=0.148
r = −0.15 p=0.652
r = −0.08 p=0.815
r = −0.24 p=0.45
r = −0.2 p=0.523
r = −0.3 p=0.342
r = 0.19 p=0.545
r = 0.16 p=0.618
r = 0.04 p=0.898
r = 0.31 p=0.325
r = 0.48 p=0.118
r = −0.78 p=0.003
r = −0.17 p=0.603
r = 0.35 p=0.258
r = −0.03 p=0.933
r = −0.57 p=0.052
r = −0.29 p=0.363
r = 0.18 p=0.566
r = 0.3 p=0.345
r = 0.38 p=0.23
r = 0.46 p=0.128
r = −0.16 p=0.62
r = −0.16 p=0.628
r = 0.56 p=0.059
r = 0.35 p=0.259
r = 0.01 p=0.984
r = −0.18 p=0.566
r = −0.36 p=0.253
1.0 2.0 3.0
10 13 16
1.0 1.3
5 7 9
0.8 1.2
1.0 2.5
10 15
1.0 1.4
5 8
0.8 1.3
1.4 2.0
8 12 16
1.5 3.0
1.2 1.4 1.6
3 5

Results

- Concentrations within the range reported in literature
- But…
  - Compartimentalisation
  - Current-year wood as stem or as branch?
  - Height
  - Age
  - Season
  - Abiotic factors
  - Genotype
  - Genotype x Environment

Soil nutrient concentrations

- N, P, K, Ca & Mg
  - Pre-establishment vs 4 year old coppice (2 harvests)
  - Genotype Koster vs Genotype Skado
  - 0-30 cm vs 30-60 cm

mg kg^{-1} (± stdev)	Koster 2010	Koster 2014	Skado 2010	Skado 2014
nitrogen (N)				
0-30 cm	13.44 (3.3)	14.71 (4.0)	12.81 (2.1)	13.82 (1.8)
30-60 cm	6.02 (2.0)	11.37 (4.0)	6.09 (1.9)	11.37 (2.2)
phosphorous (P)				
0-30 cm	215.00 (102.1)	285.00 (50.1)	275.71 (117.2)	7.52 (0.9)
30-60 cm	60.00 (29.4)		94.29 (84.8)	1.96 (0.6)
potassium (K)				
0-30 cm	92.50 (51.2)	150.63 (26.2)	125.71 (71.3)	12.60 (1.0)
30-60 cm	52.50 (28.8)		113.33 (85.0)	12.48 (2.0)
calcium (Ca)				
0-30 cm	815.00 (167.0)	785.00 (70.1)	1222.86 (423.5)	14.66 (0.6)
30-60 cm	762.50 (213.9)		1202.86 (439.5)	14.70 (1.5)
magnesium (Mg)				
0-30 cm	135.00 (23.8)	113.13 (15.1)	124.29 (28.2)	7.67 (0.7)
30-60 cm	107.50 (28.8)		130.00 (71.4)	8.43 (1.5)

Acknowledgements

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Thank you! Questions?

http://uahost.uantwerpen.be/popfull

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