Measuring P deficiency in maize leaves:
comparing spectral and wet chemical measurements under tropical conditions

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Introduction

- P essential non-renewable plant nutrient
- Efficient use of P
- Destructive measurements costly & time consuming
- Non-destructive assessment in the field → Spectracrop Plant Vitality and P tester

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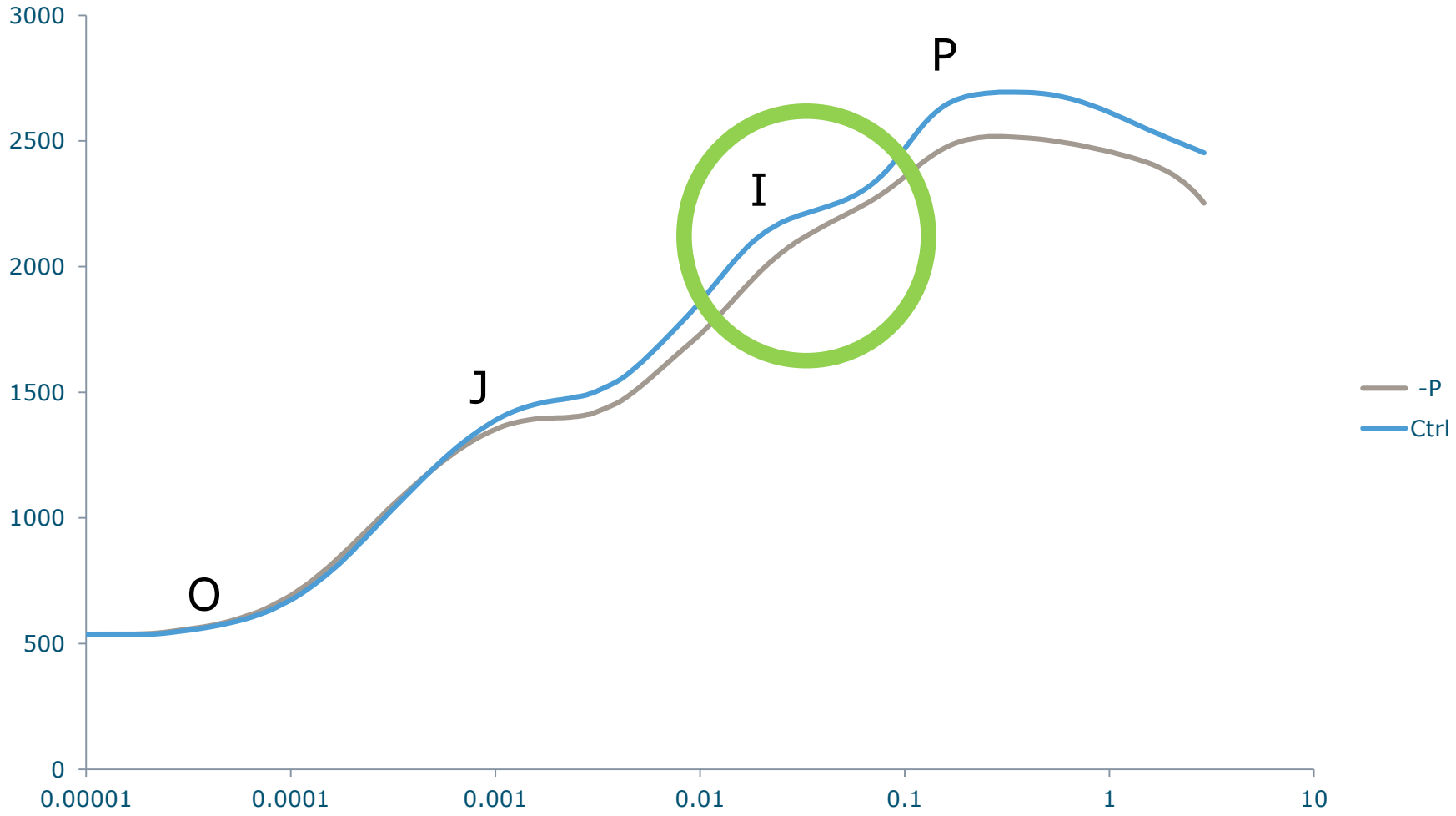
Chlorophyll-a fluorescence – OJIP transient



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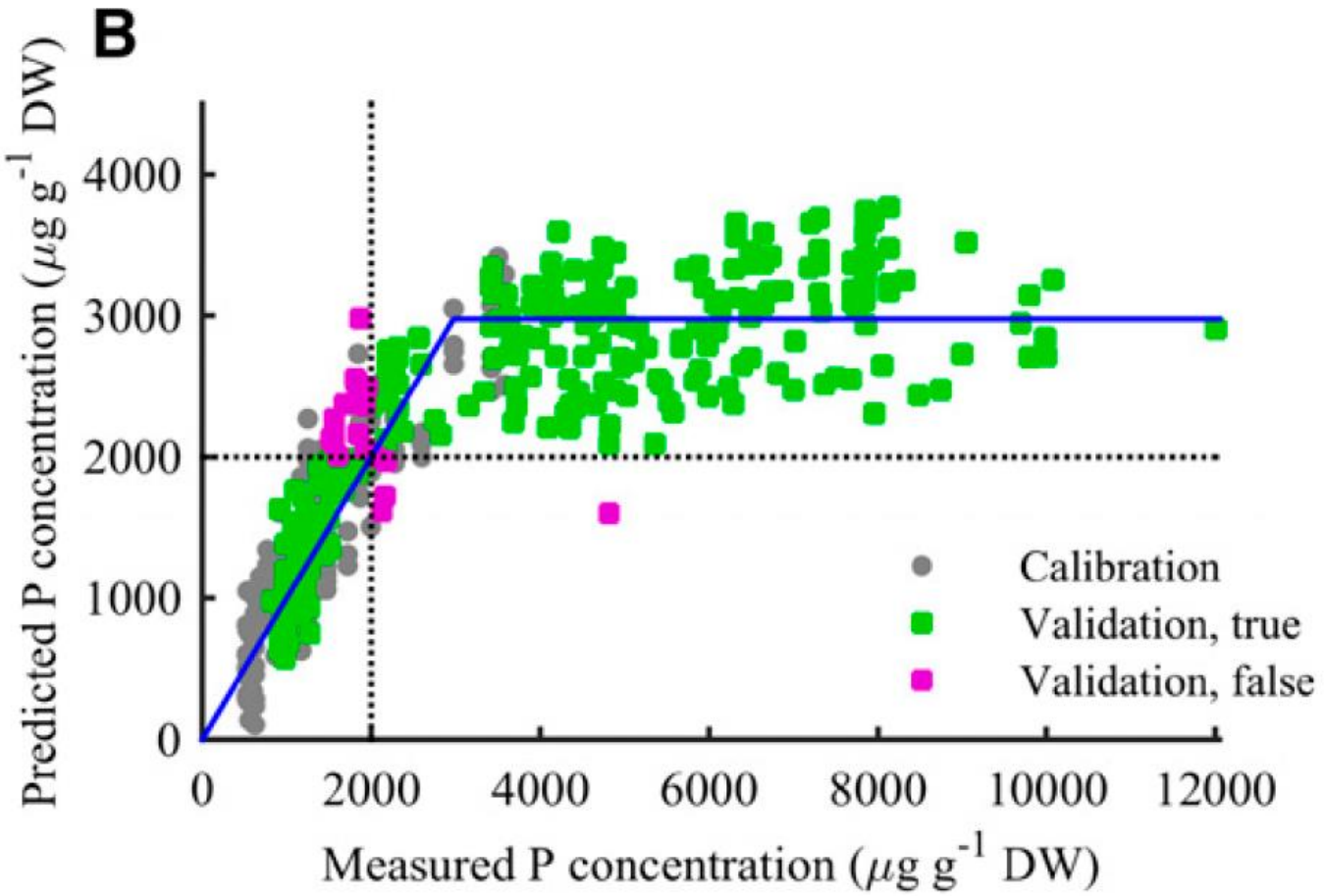
An example with barley

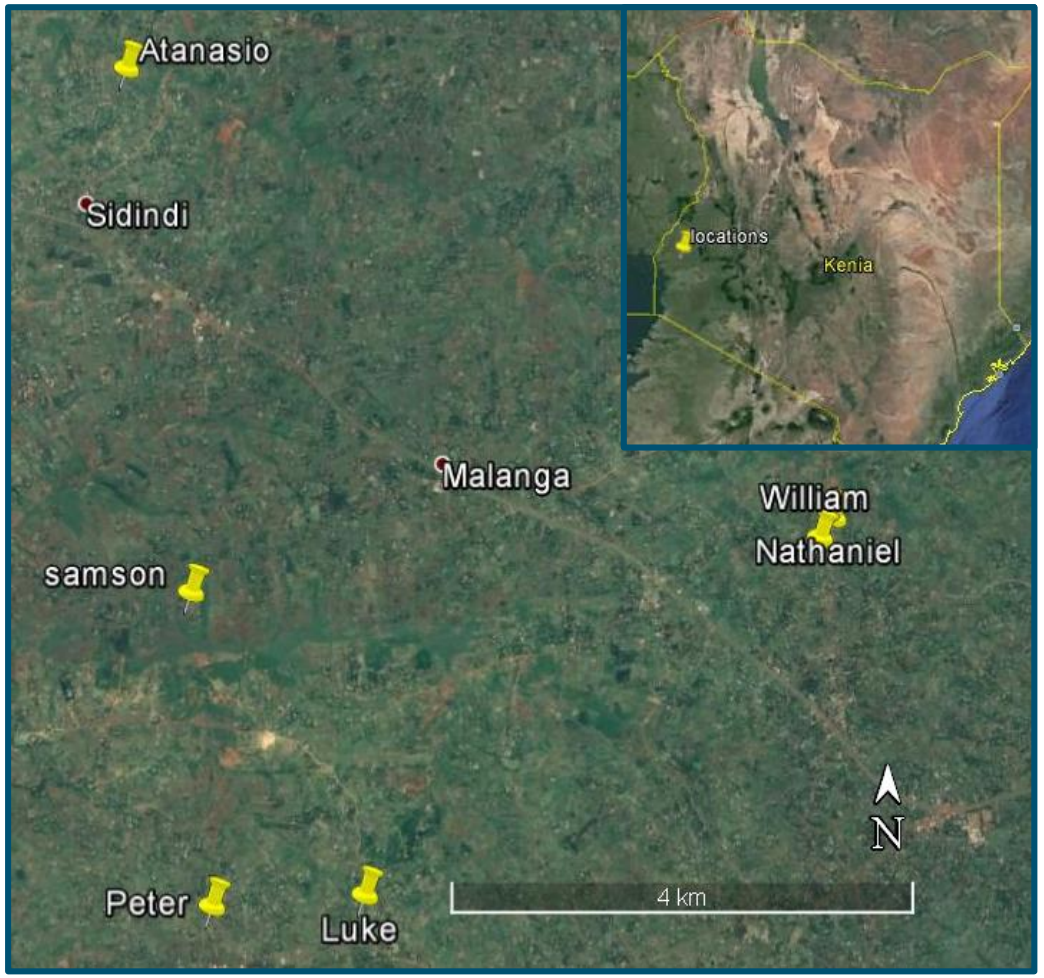


Frydenvang et al. 2015

Methodology

Methodology – 1/2

- Western Kenya
- 6 locations
- Nutrient omission trial
    - Control, full, PK, NK, NP
- After 6 seasons sub divisions of plots with new treatments
- Measuring at 4 & 7 weeks of 9th season
- 4-6 leaves per plot



Experimental design

Old treatment	Old treatment	Old treatment	Old treatment	Old treatment
Control	PK	NK	NP	NPK

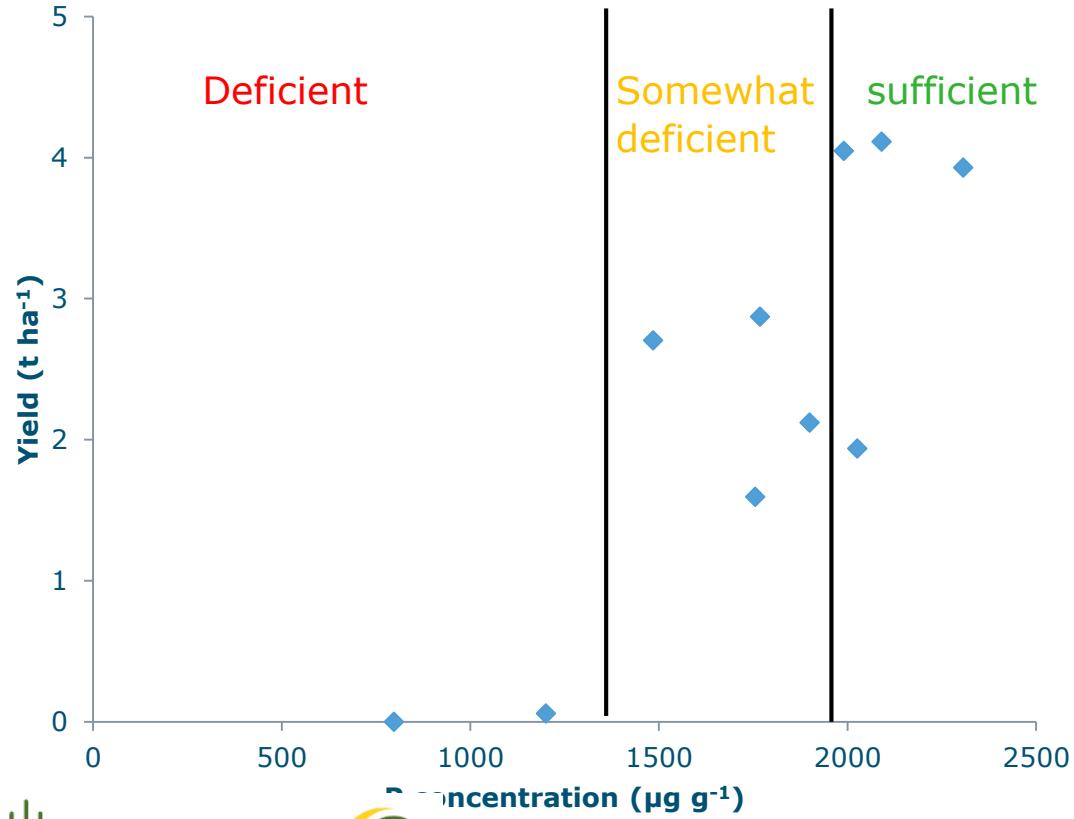
New treatments		New treatments		New treatments		New treatments		New treatments	
PK	NK	PK	NK	PK	NK	PK	NK	PK	NK
NP	NPK	NP	NPK	NP	NPK	NP	NPK	NP	NPK

Some examples

- Variation in plant (P) nutritional status

Methodology – 2/2

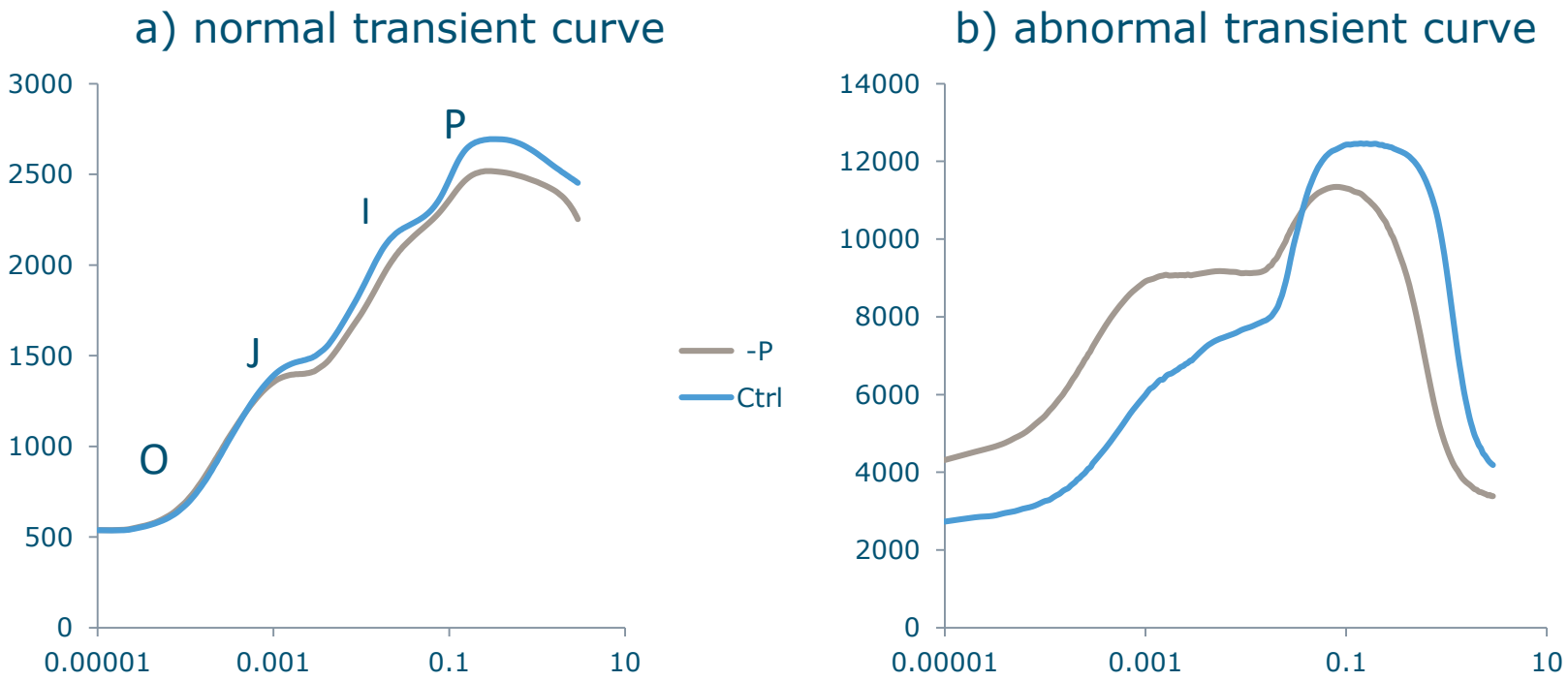
- Comparing spectral measurement with wet chemical measurement (for 1 location)
- Spectral measurements:
  - Sufficient (A)
  - Somewhat deficient (B)
  - Deficient (C)
- Wet chemical measurements divided in same classes to compare with P tester measurements



t chemical P concentration (in µg g^{-1})

Results

Results – 4 WAP



- Measuring too late in the day
- Plants heat / or light stressed

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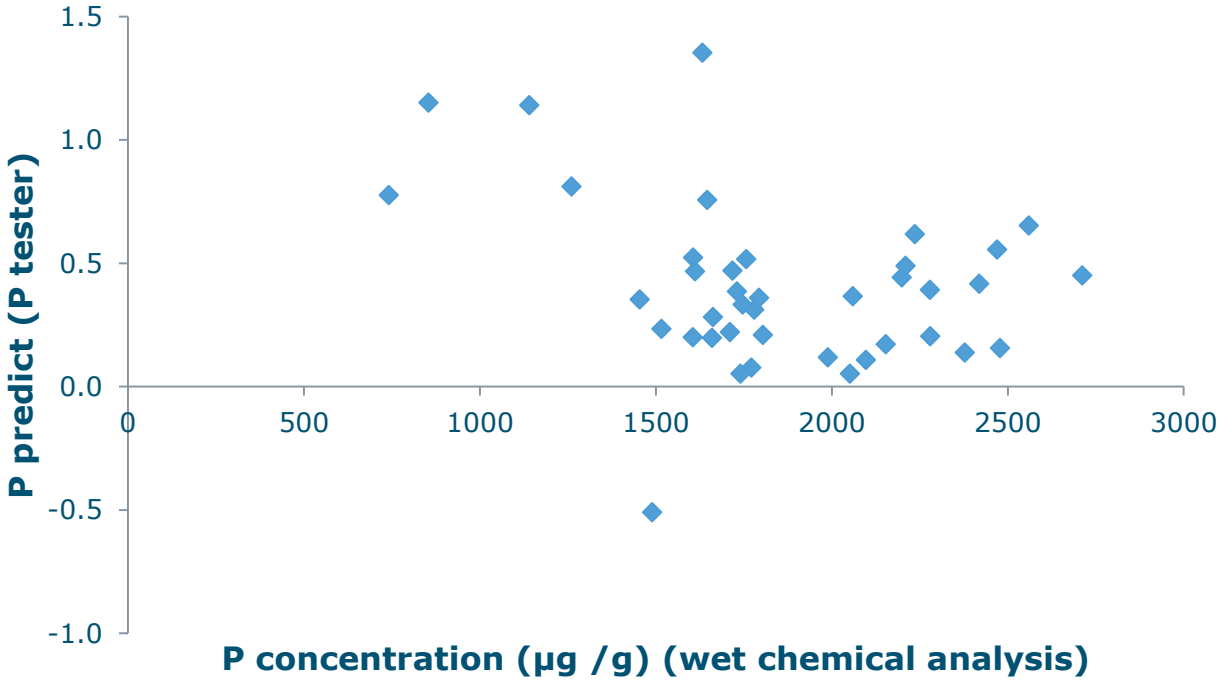
Results – 7 WAP

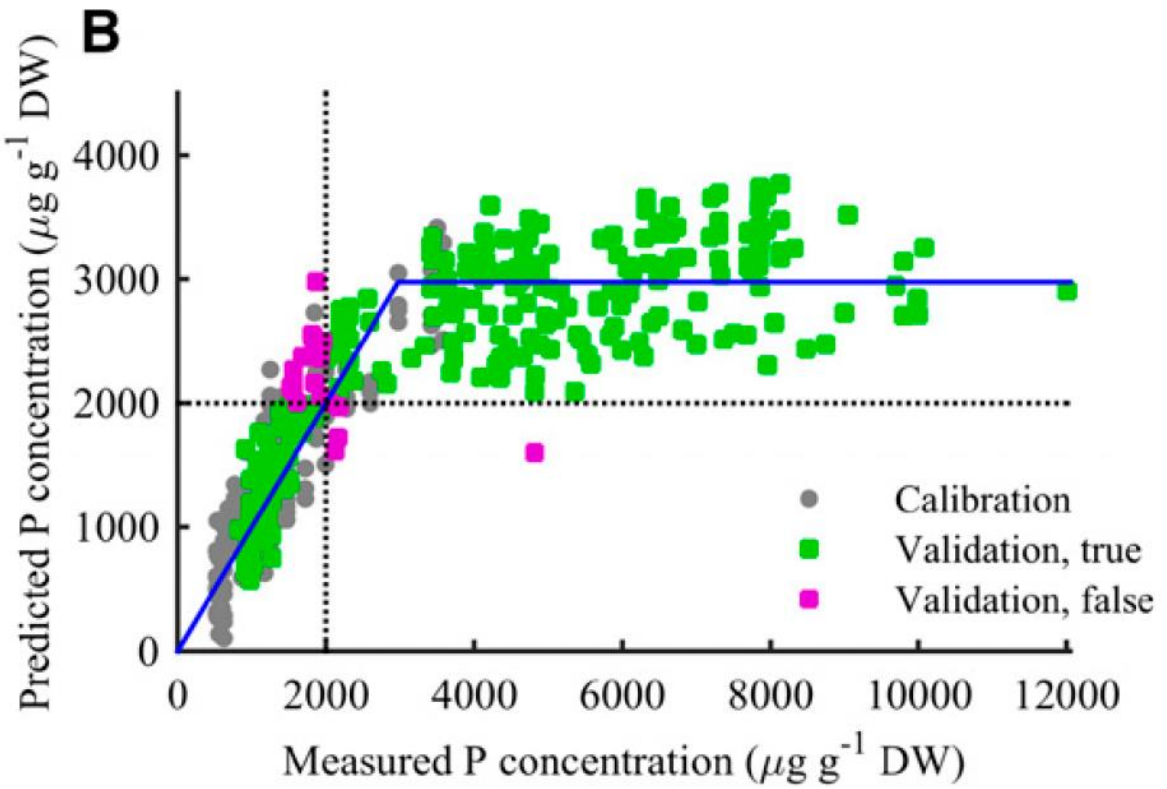
- No match between wet chemical and spectral measurements

Treatment old	Treatment new	Expected	P (µg / g) wet chemical	Spectral measurement
control	PK	B	2109	C
control	NK	C	797	A
control	NP	B	2238	B
control	NPK	B	2025	A
PK	PK	A	1899	C
PK	NK	B	1899	B
PK	NP	A	2595	B
PK	NPK	A	1990	B
NK	PK	B	1634	C
NK	NK	C	1200	A
NK	NP	B	1705	C
NK	NPK	B	1768	B
NP	PK	A	1550	C
NP	NK	B	1755	B
NP	NP	A	1859	C
NP	NPK	A	2307	A
NPK	PK	A	1918	B
NPK	NK	B	1484	C
NPK	NP	A	2169	C
NPK	NPK	A	2090	B

Results in figures



Comparison spectral and wet chemical P



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Discussion & Conclusion

Discussion

- Variation in plant nutritional status observed
- Wet chemical measurements coherent with expectations
- Spectracrop plant vitality and P tester was unable to measure P deficiency
- High temperature and light intensity is a challenge
- P fixing soils?
- Calibration of transient curves for tropical conditions

Conclusion

- High potential to assess P deficiency
- Not suitable to assess P deficiency (yet)
- Improvements needed on interpretation of OJIP transients

- Practical limitations in the tropics remain

Thank you

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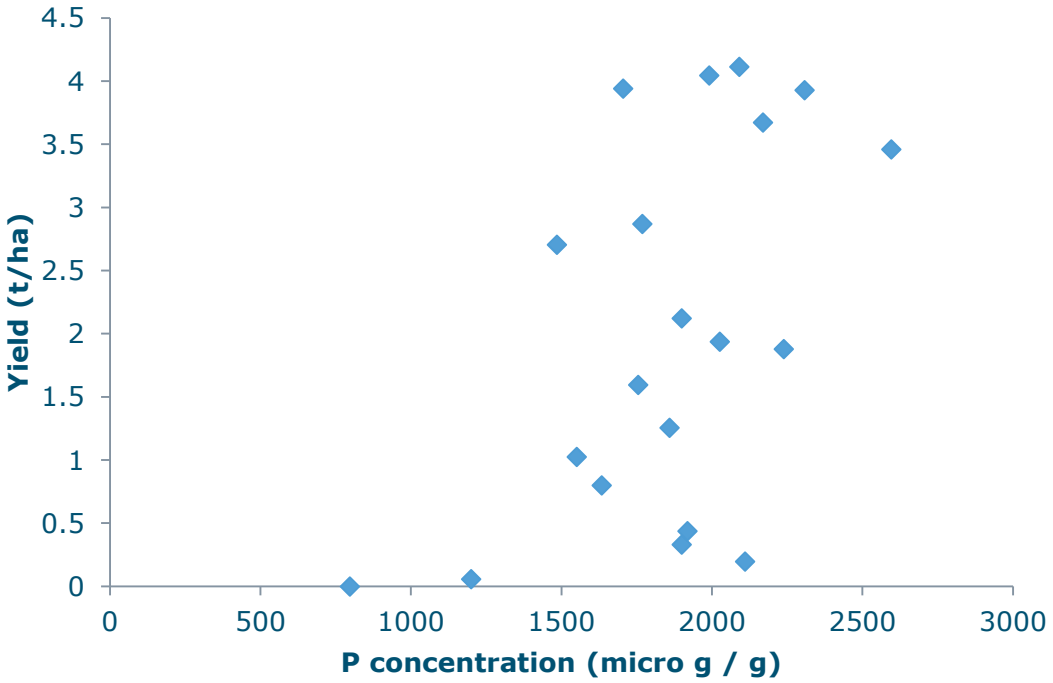
Yield and P concentration



Old treatment	New treatment	Yield (t/ha)	P concentration (micro g /g)
Control	PK	0.2	2109
Control	NK	0	797
Control	NP	1.9	2238
Control	NPK	1.9	2025
PK	PK	0.3	1898
PK	NK	2.1	1899
PK	NP	3.5	2594
PK	NPK	4.0	1990
NK	PK	0.8	1633
NK	NK	0.1	1199
NK	NP	3.9	1704
NK	NPK	2.9	1768
NP	PK	1	1550
NP	NK	1.6	1754
NP	NP	1.3	1859
NP	NPK	3.9	2306
NPK	PK	0.4	1918
NPK	NK	2.7	1484
NPK	NP	3.7	2169
NPK	NPK	4.1	2090