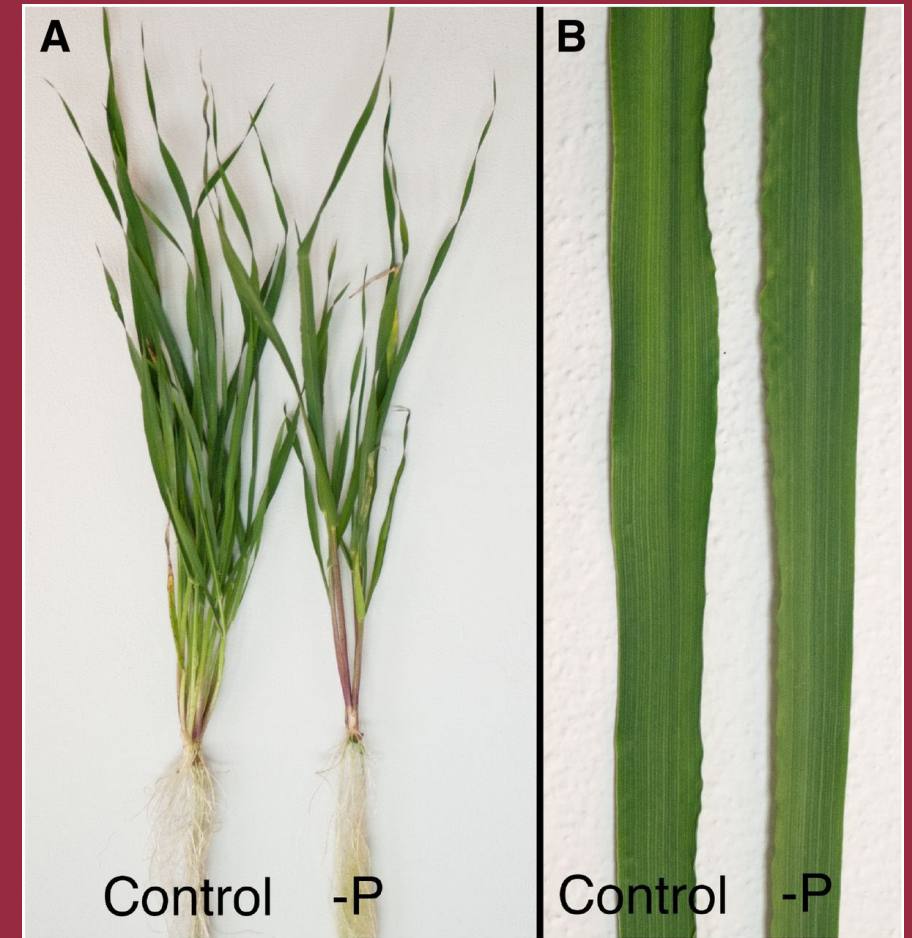


Innovationscenter
for Økologisk Landbrug

Nyt og gammelt om fosfor

01-10-23 ORD

Morten W. Vestenaa



Promilleafgiftsfonden for landbrug



Hvordan optager planter fosfor fra jord?

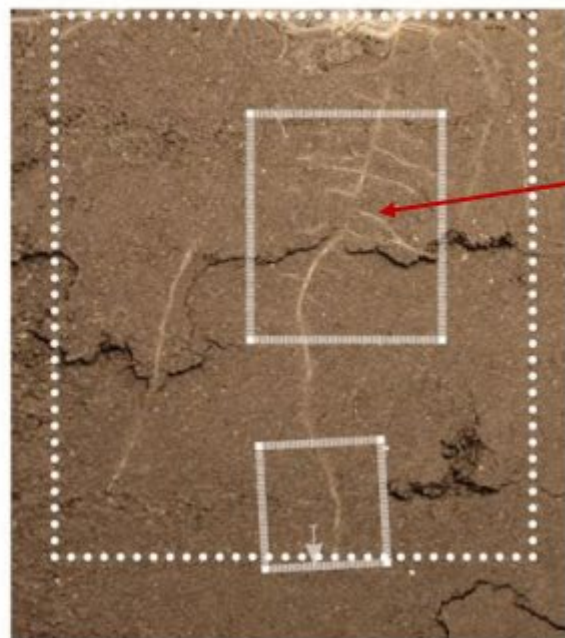
Hvorfor er jordekstraktioner dårlige til at forudsige planters fosforstatus?

Findes der alternativer til jordekstraktioner?

Studie: P-testeren

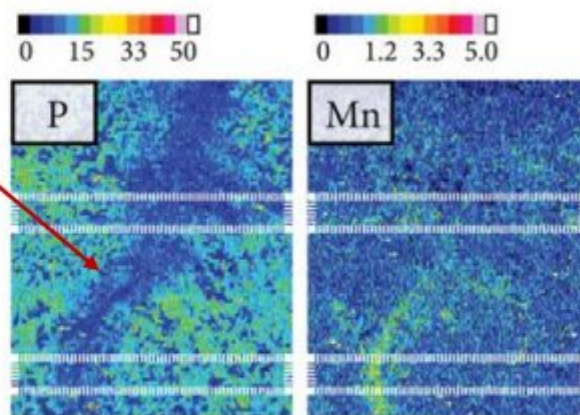
Struvit





Boghvederod

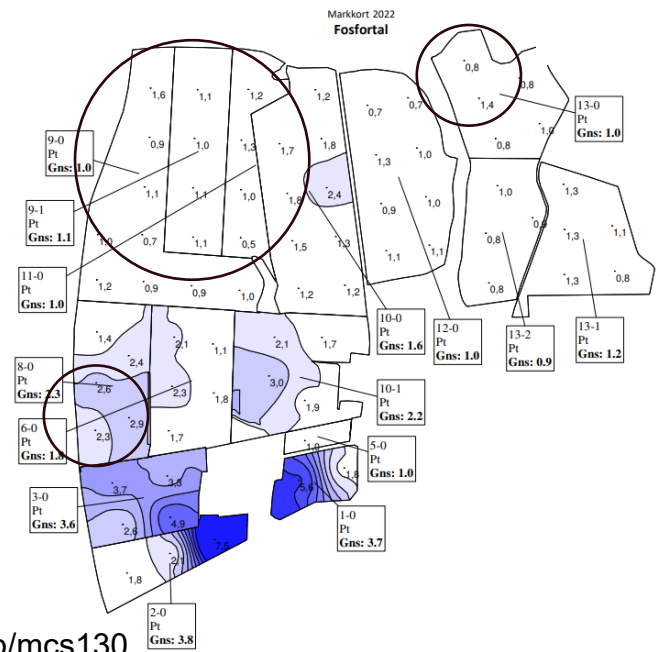
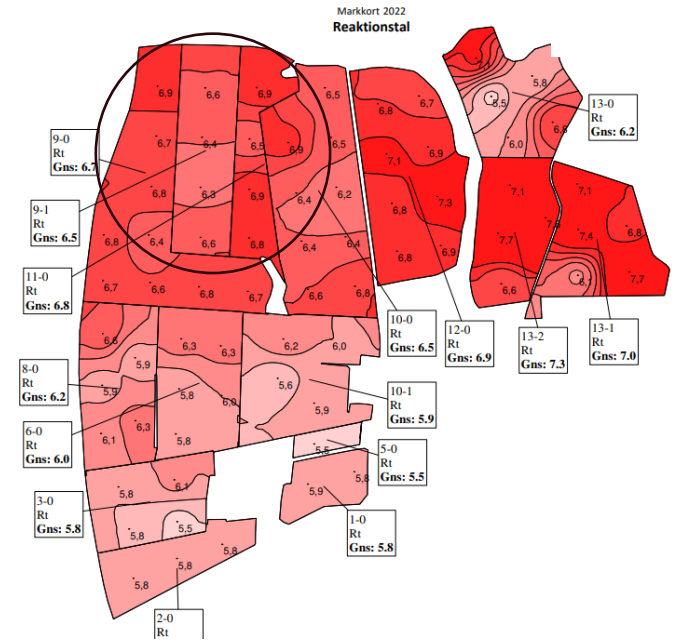
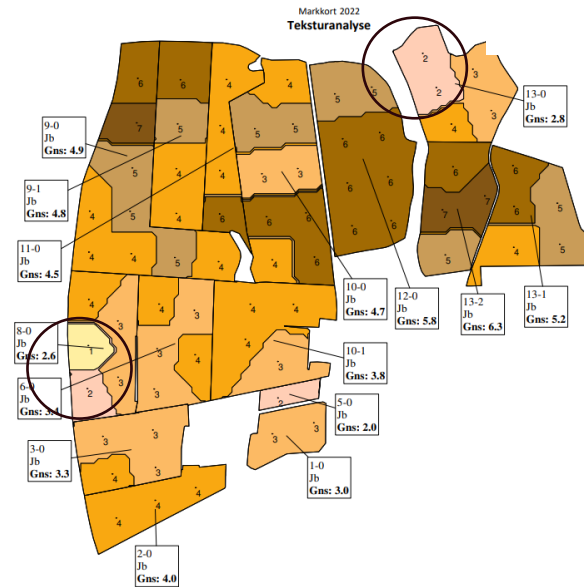
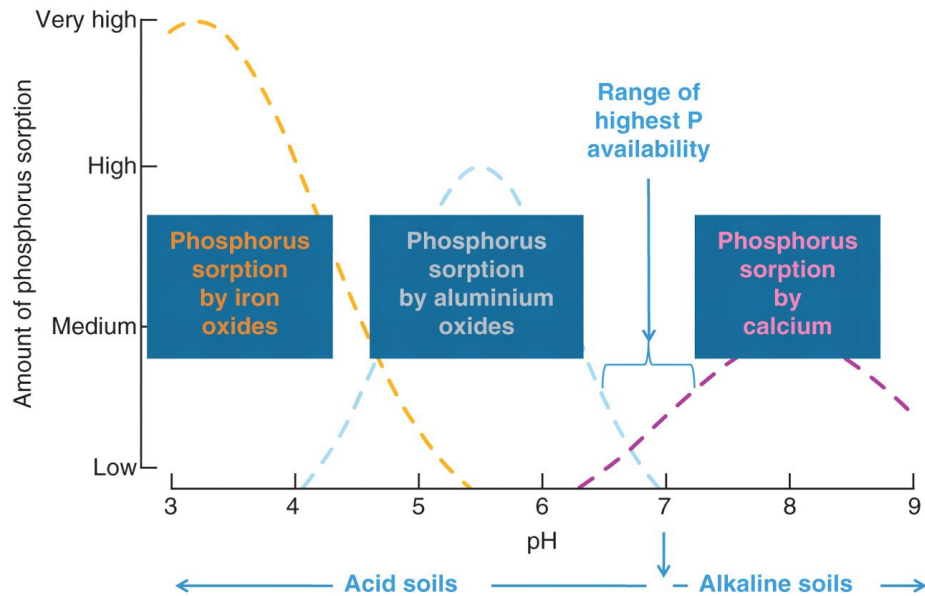
Roden udtømmer området omkring roden for fosfor



Hvorfor?

1. Lav P opløselig i jord
2. Højt P behov for vækst
3. Lav P diffusionskoefficient

pH har indflydelse på fosfors binding i jord



$$Rt = 0,5 + pH \text{ målt i } 0,01 \text{ M } CaCl_2$$



Hvordan optager planter fosfor fra jord?

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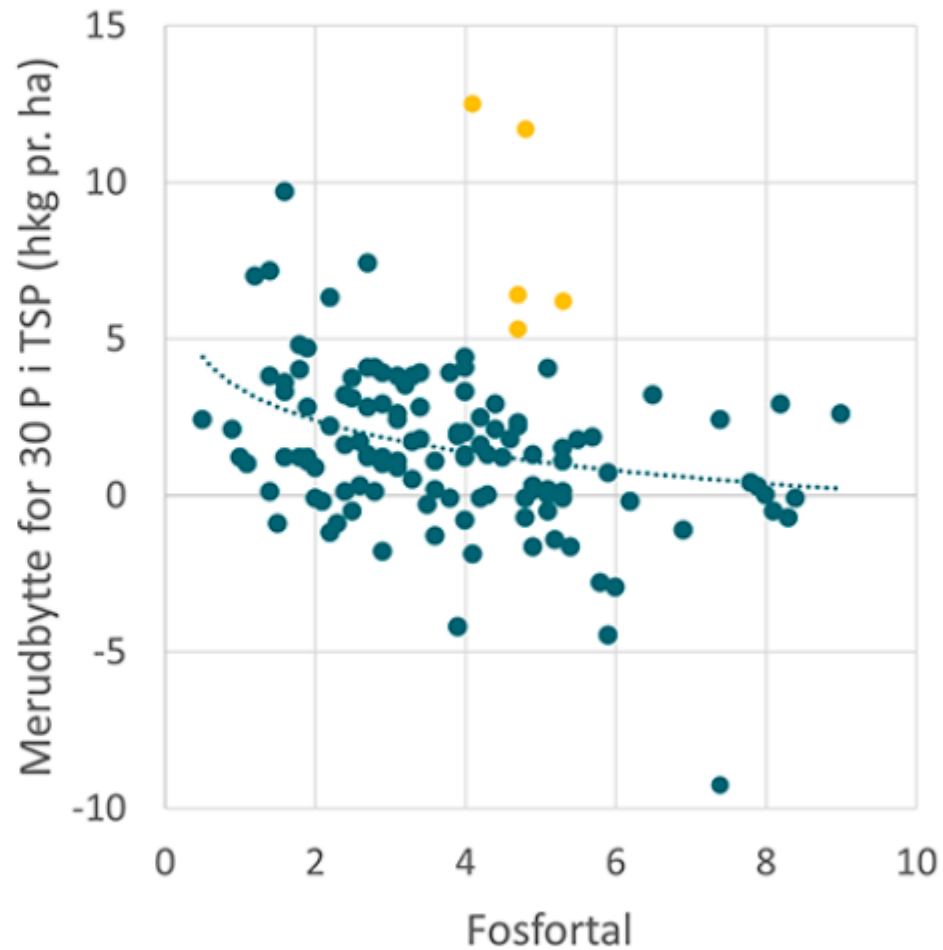
Struvit

Olsen P



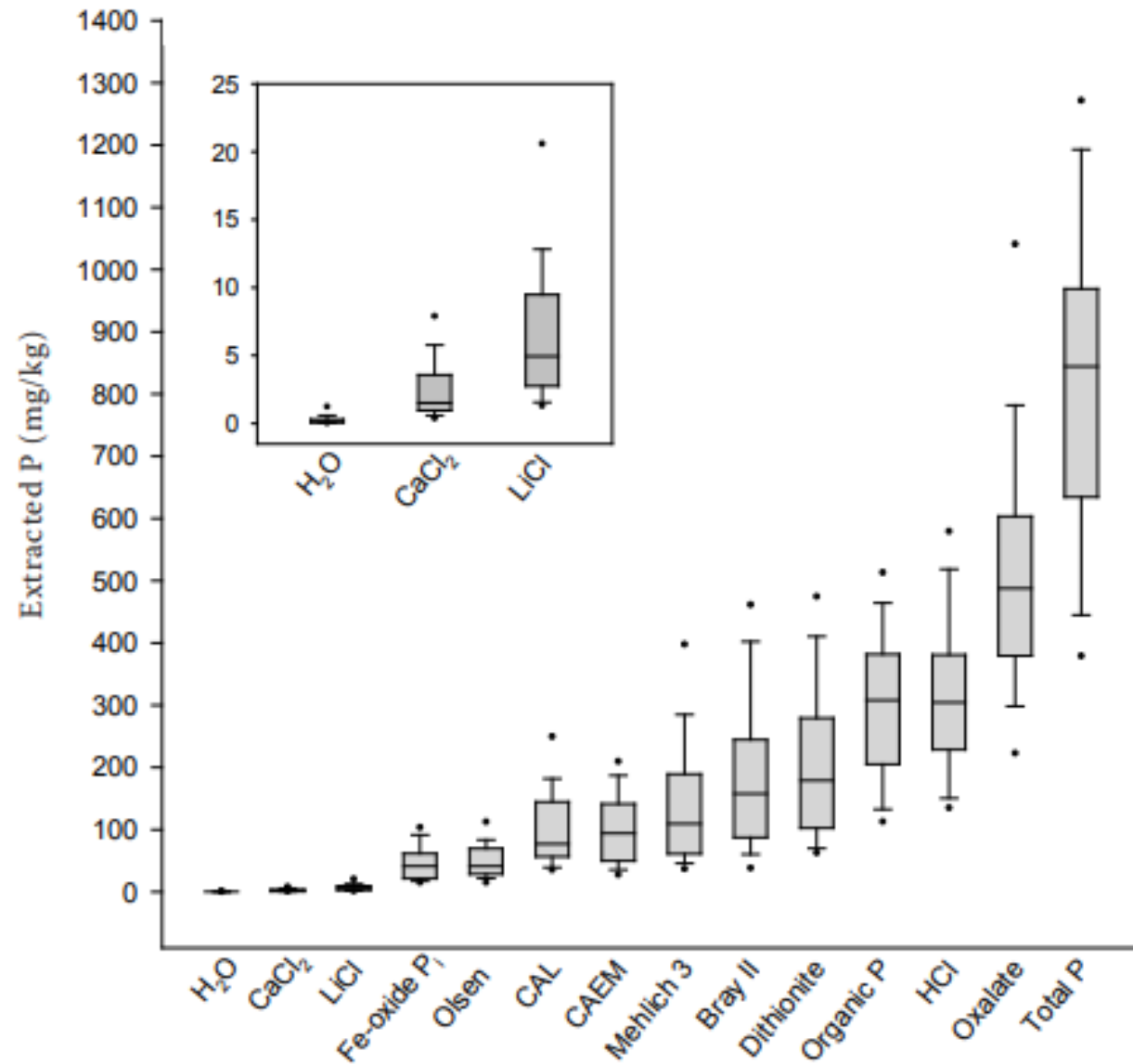
Lang historie
Etableret analyse
Relativ lav ekstraktionsstyrke

Forudser P optag og udbytterespons dårligt



Landbrugsinfo 2022: Arealer med overset fosforbehov: Forsøg og baggrund
Camilla Lemming, [Arealer med overset fosforbehov: Forsøg og baggrund \(landbrugsinfo.dk\)](https://landbrugsinfo.dk)

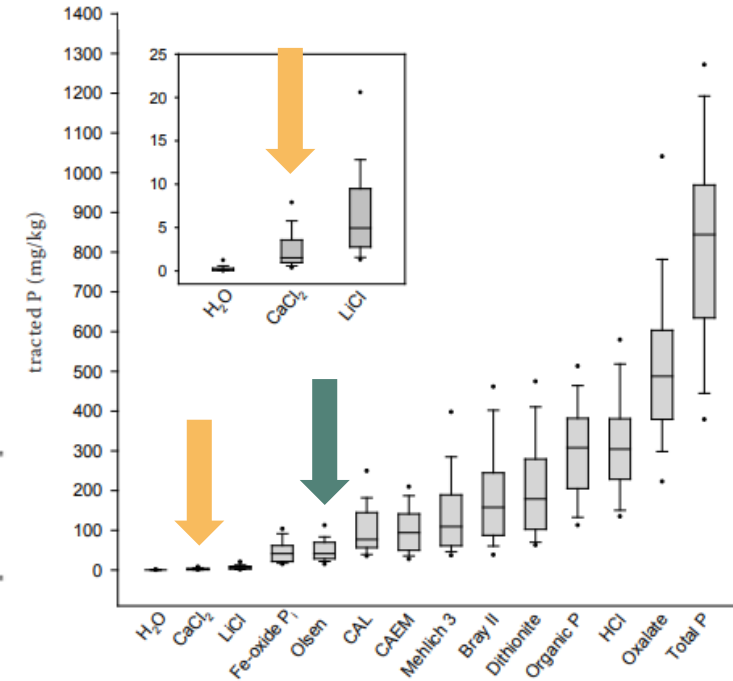




Hvad bruger vi nu?

- I mindre grad CaCl_2
- I meget høj grad Olsen-P (0.5M NaHCO_3 , pH 8,5)

	Enhed	Resultat	Optimalt niveau	lav	lidt lav	god	lidt høj	høj
N-total jordlager	kg N/ha	4550	2980 - 4170	[Bar chart showing N-total is in the 'lidt høj' category]				
C/N forhold		13	13 - 17	[Bar chart showing C/N is in the 'god' category]				
N-leverings evne	kg N/ha	70	95 - 145	[Bar chart showing N-leverings evne is in the 'lidt lav' category]				
S-plante tilgængelig	kg S/ha	16	20 - 30	[Bar chart showing S-plante tilgængelig is in the 'lidt lav' category]				
S-total jordlager	kg S/ha	995	595 - 950	[Bar chart showing S-total is in the 'lidt høj' category]				
C/S forhold		61	50 - 75	[Bar chart showing C/S is in the 'god' category]				
S-leverings evne	kg S/ha	16	20 - 30	[Bar chart showing S-leverings evne is in the 'lidt lav' category]				
P-plante tilgængelig	kg P/ha	3,0	5,4 - 8,9	[Bar chart showing P-plante tilgængelig is in the 'lav' category]				
P-afgrøde lager	kg P/ha	300	260 - 405	[Bar chart showing P-afgrøde lager is in the 'god' category]				

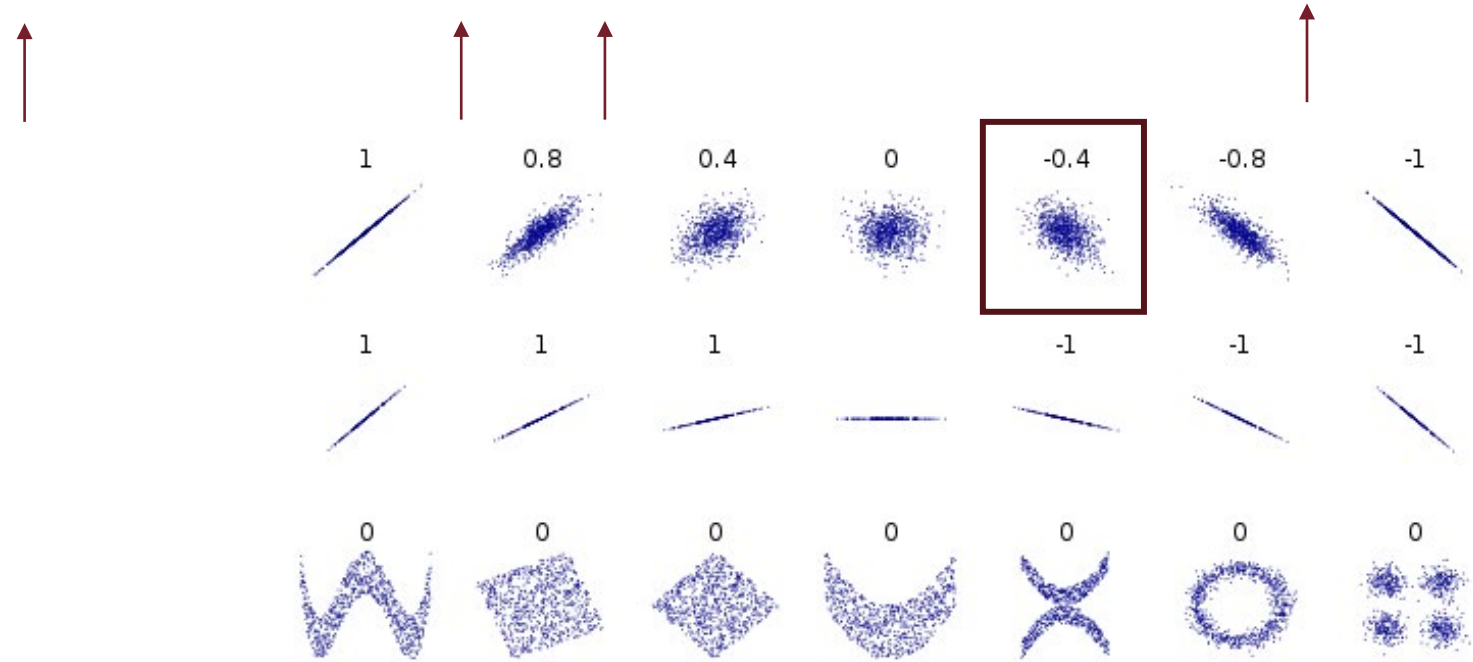


Jordanalyser: Poul Christensen

Table 4. Pearson correlation coefficients between soil P extraction methods and soil properties ($n = 50$; * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$)

	pH (KCl)	EC	C _{org}	CaCO ₃	C/N (molar)	Clay	Silt	Sand	CEC _{pot}	BS	Fe _o	Fe _d	Fe _o /Fe _d	P _o /Fe _o (molar)
H ₂ O	-0.111	0.154	-0.089	-0.234	0.062	-0.011	-0.161	0.119	-0.020	-0.129	0.051	0.010	0.199	-0.005
CaCl ₂	-0.348*	0.387**	-0.223	-0.341*	0.452***	-0.422**	-0.462***	0.500***	-0.312*	-0.379**	-0.074	-0.106	0.232	0.122
LiCl	0.024	0.407**	-0.067	-0.238	0.184	-0.237	-0.291*	0.301*	-0.205	-0.040	-0.044	-0.091	0.196	0.174
Olsen	-0.319*	0.219	0.076	-0.363**	0.268	-0.242	-0.463***	0.427**	0.070	-0.402**	0.307*	0.146	0.627***	0.091

Clay, silt and sand content
 pH
 Texture
 Carbonate content
 Iron oxide content and crystallinity



Hvordan optager planter fosfor fra jord?

Hvorfor er jordekstraktioner dårlige til at forudsige planter fosforstatus?

Findes der alternativer til jordekstraktioner?

Studie: P-testeren

Struvit

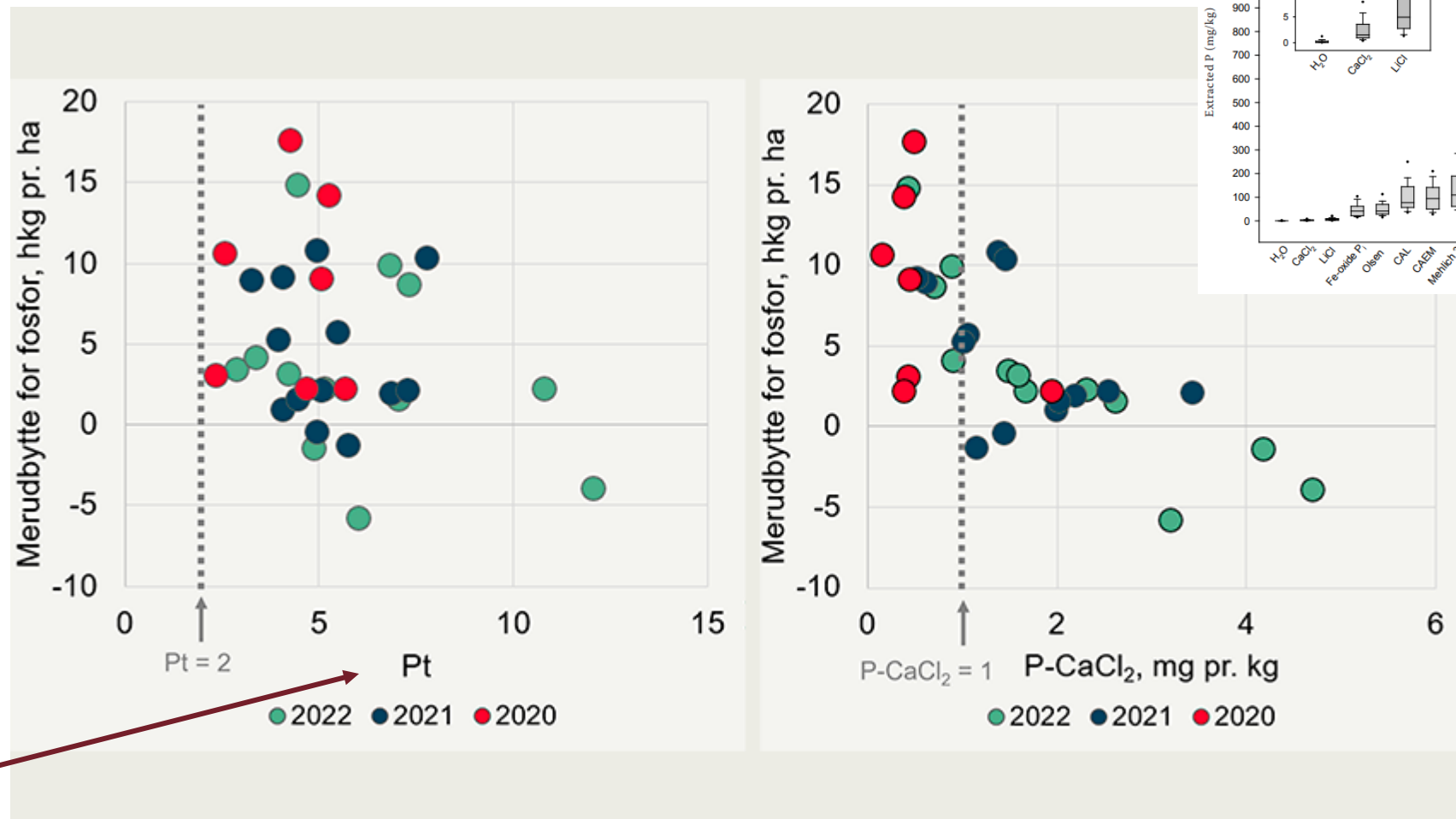


Ja

Planteanalyse

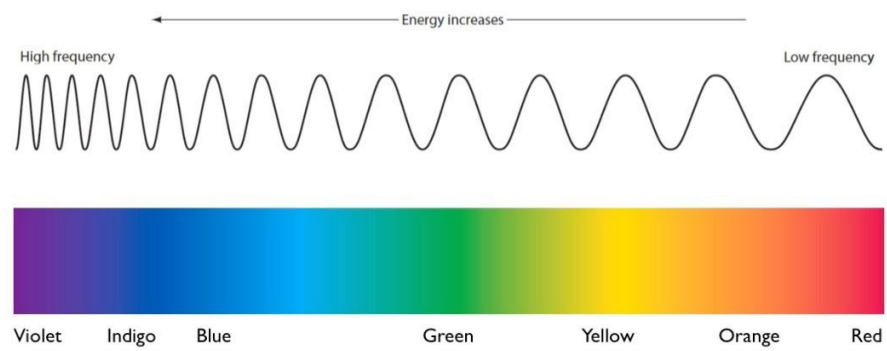
Meget milde jordekstartioner

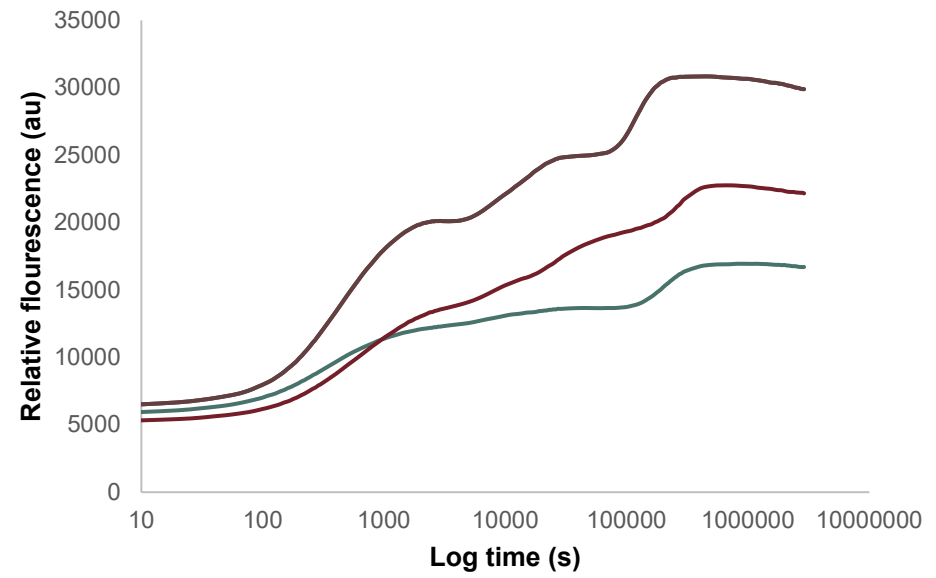
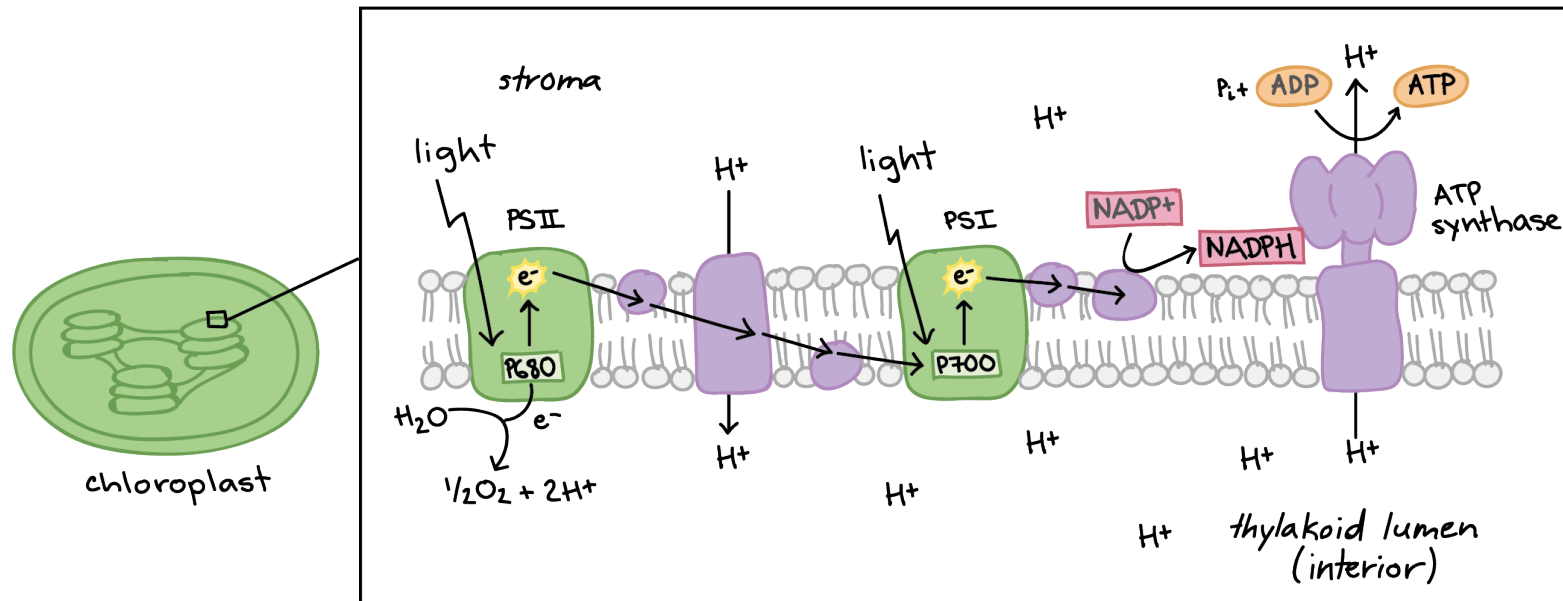
Olsen P



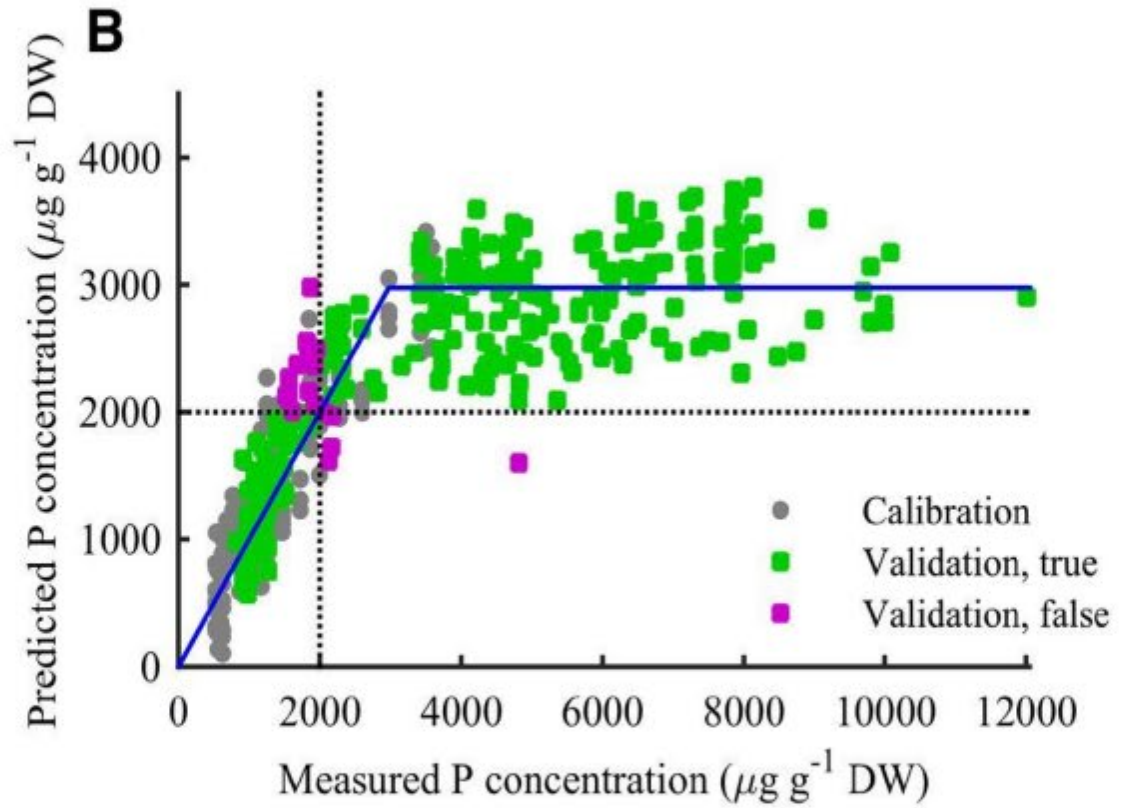
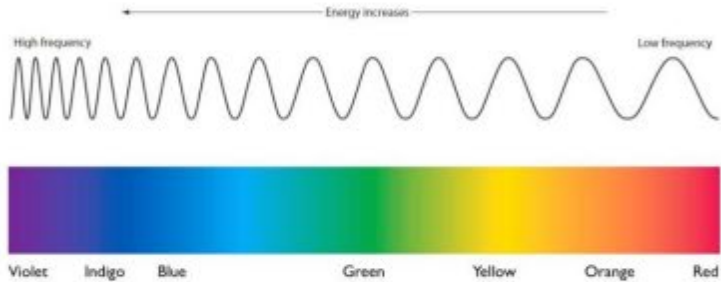
Figur 5. Sammenhæng mellem merudbytter for 60 kg fosfor pr. ha og henholdsvis fosfortallet (Pt, venstre), og P-CaCl₂ (højre). De stiplede linjer viser den øvre grænse for, hvornår der kan forventes merudbytte. For P-CaCl₂ er der tale om en foreløbig grænse vurderet af Pedersen og Rubæk 2022.

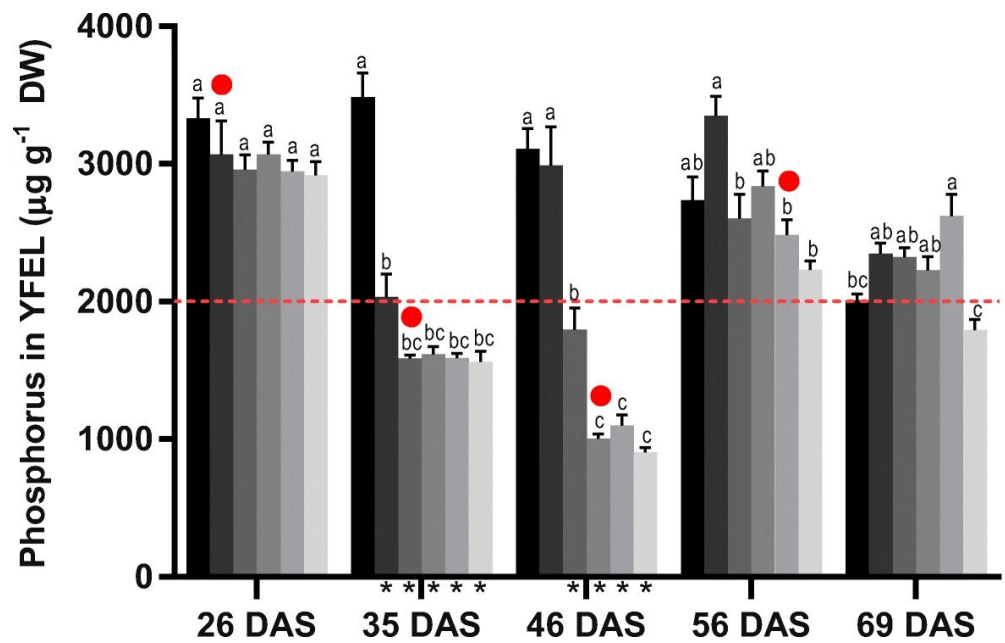
Visible part of the Electromagnetic Spectrum



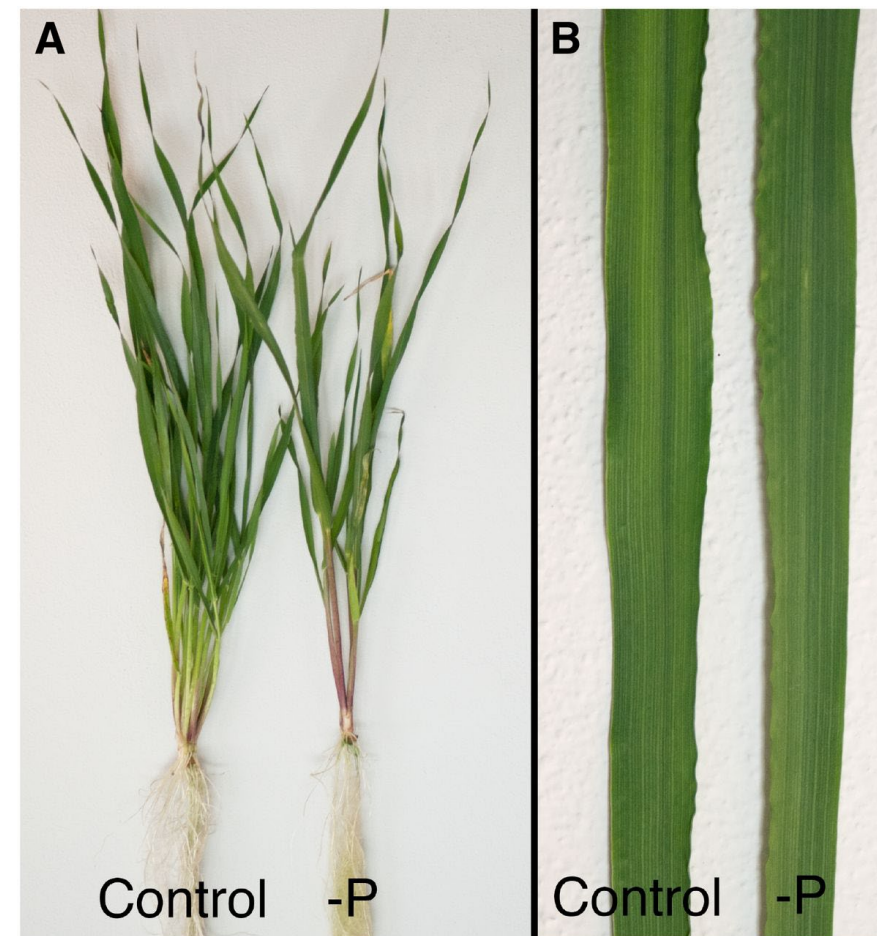


Visible part of the Electromagnetic Spectrum





- P+ 0 DAS
- P+ 26 DAS
- P+ 35 DAS
- P+ 46 DAS
- P+ 56 DAS
- P-
- P fertilization
- * Diagnosed P deficient using OJIP transients



Hvordan optager planter fosfor fra jord?

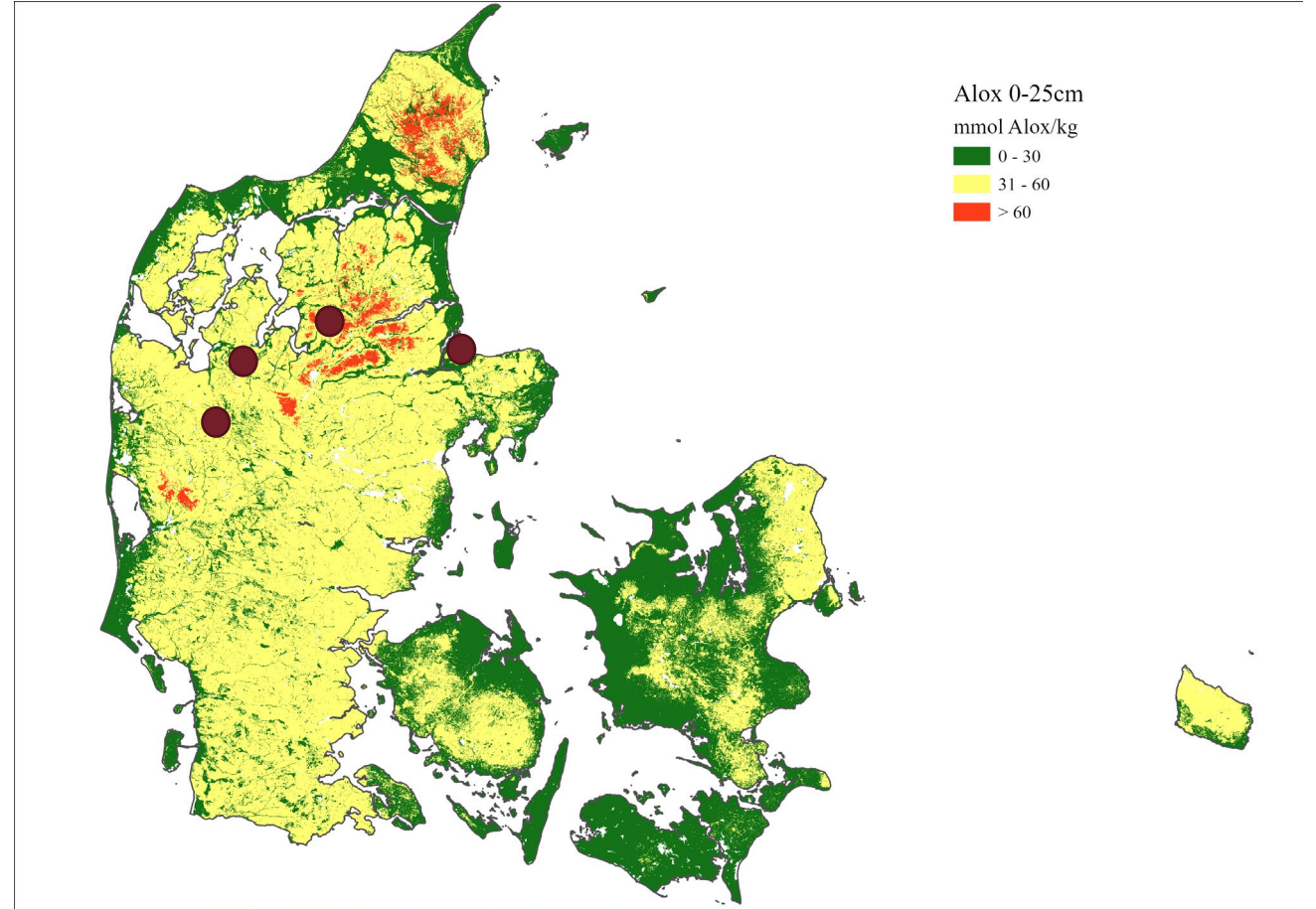
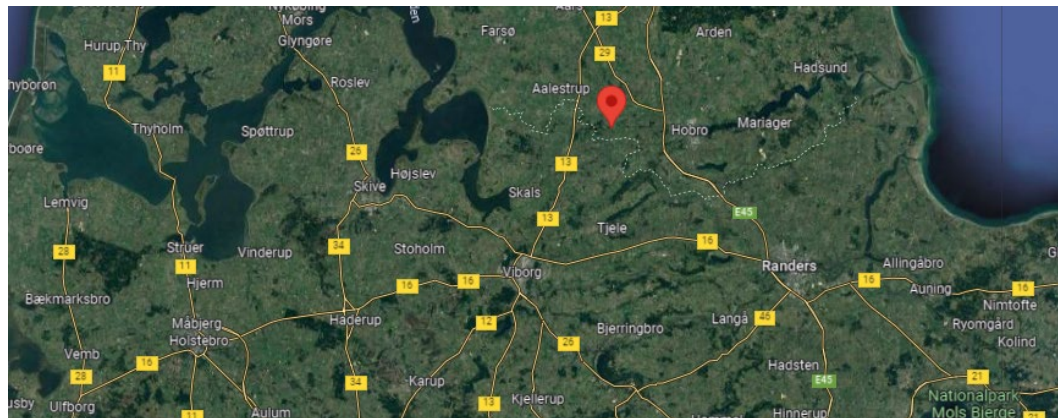
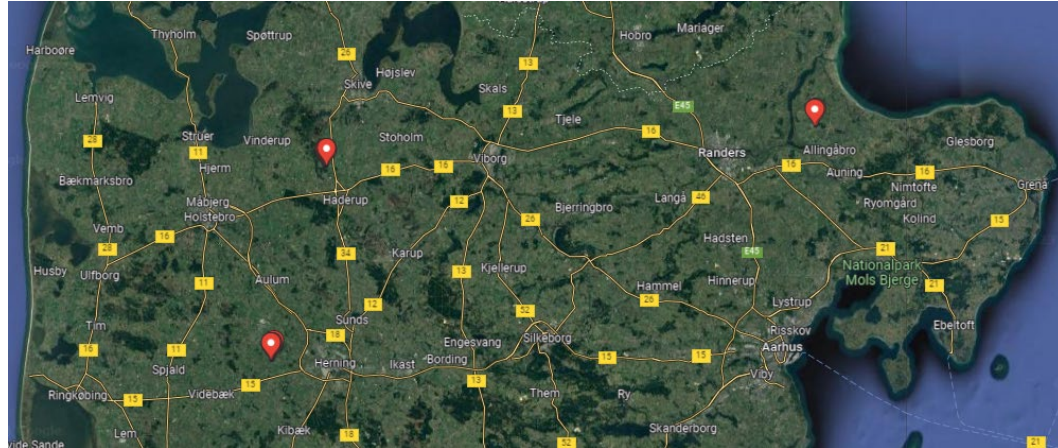
Hvorfor er jordekstraktioner dårlige til at forudsige planters fosforstatus?

Findes der alternativer til jordekstraktioner?

Studie: P-testeren

Struvit

Forsøgsmarker



Study setup

Analysis:

Chl a fluorescence by P-tester

Soil analysis: Pt, Kt, Mg, Rt and Alox

Plant Analysis: "Essentiel" elements

Protocol:

10 sample sites

At each sample site:

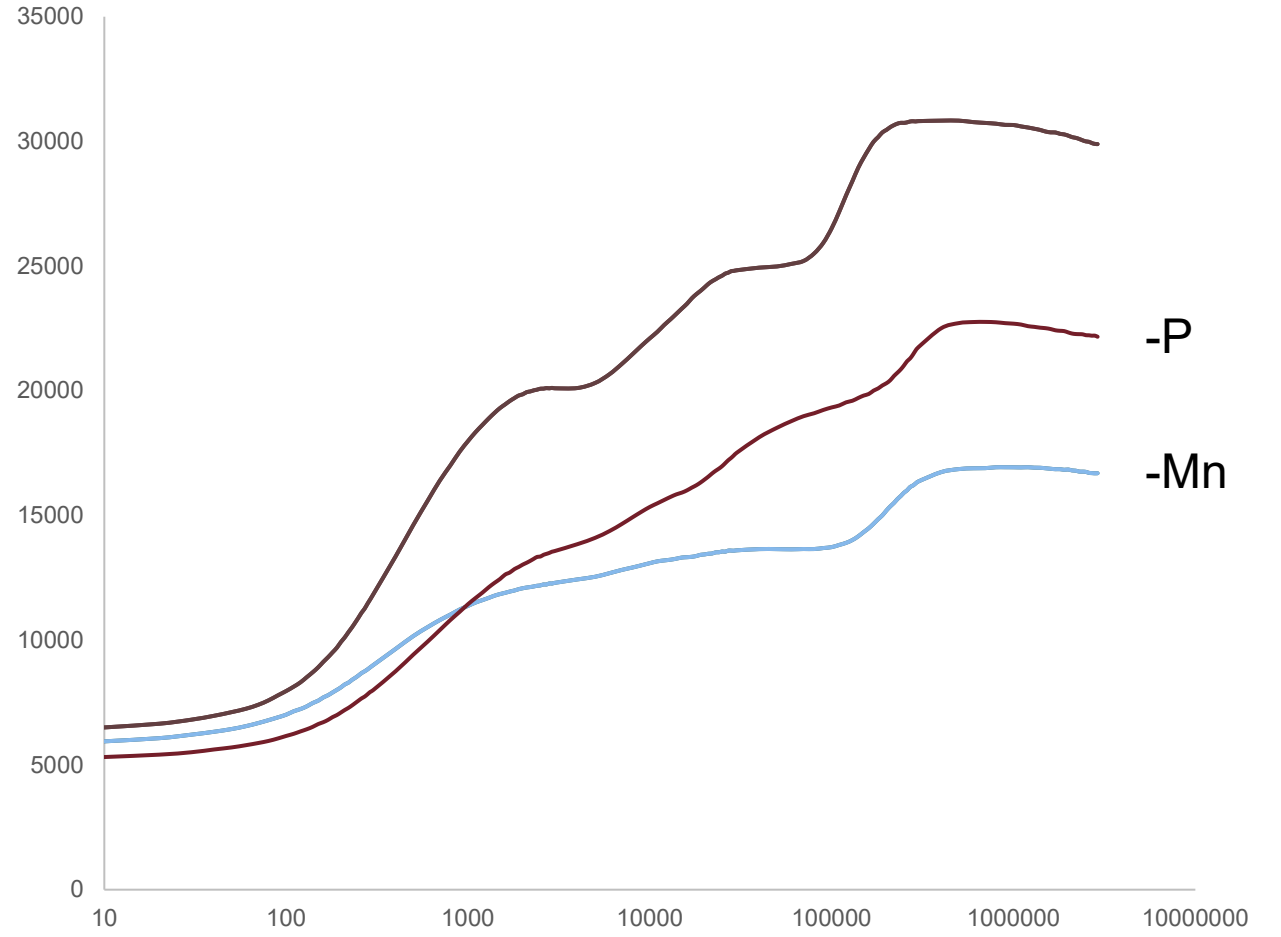
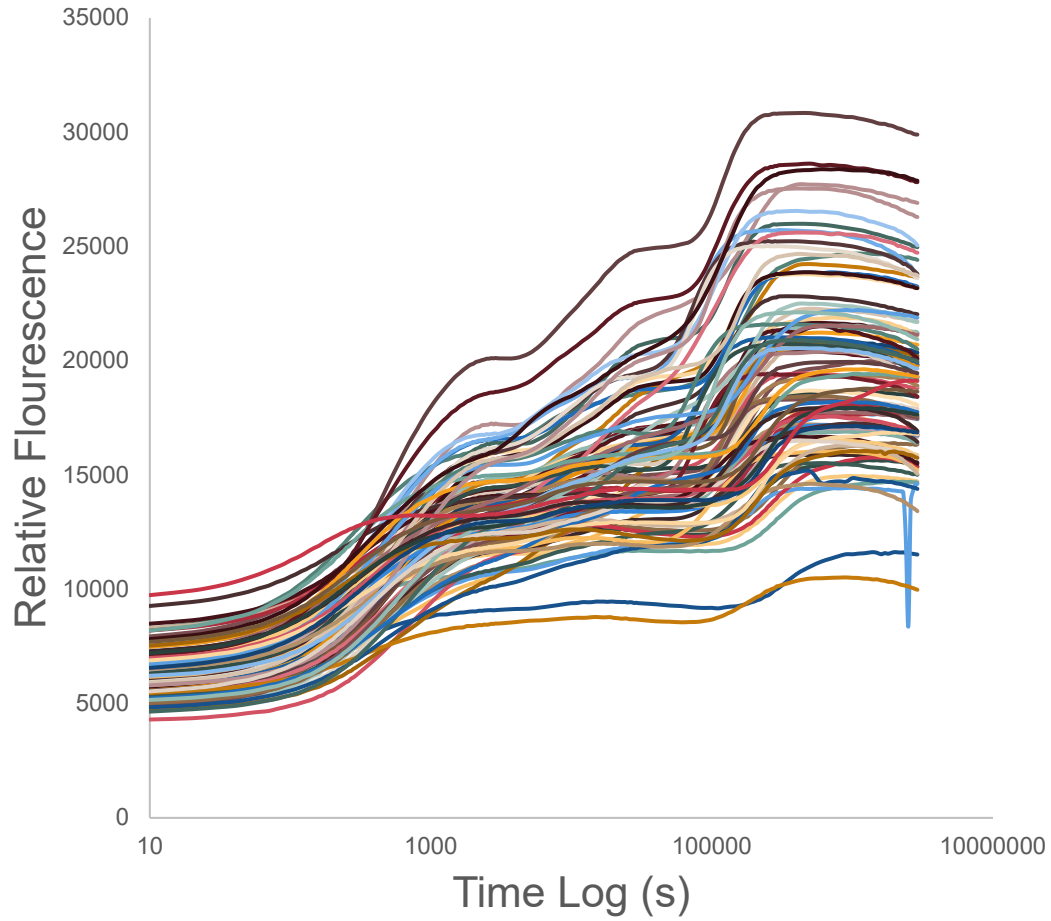
10 chl a samples

1 plant sample (accumulated)

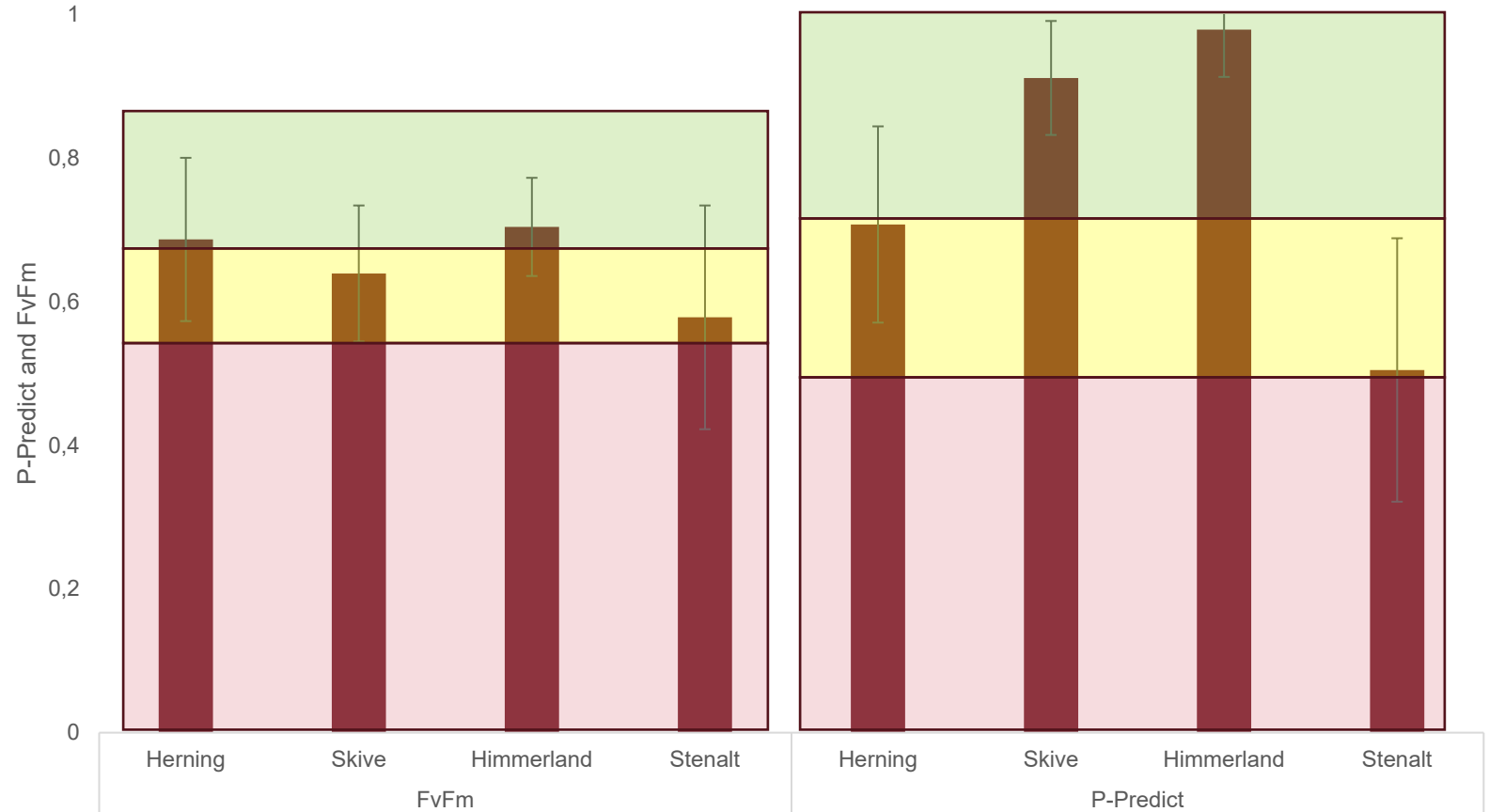
1 soil sample (accumulated)

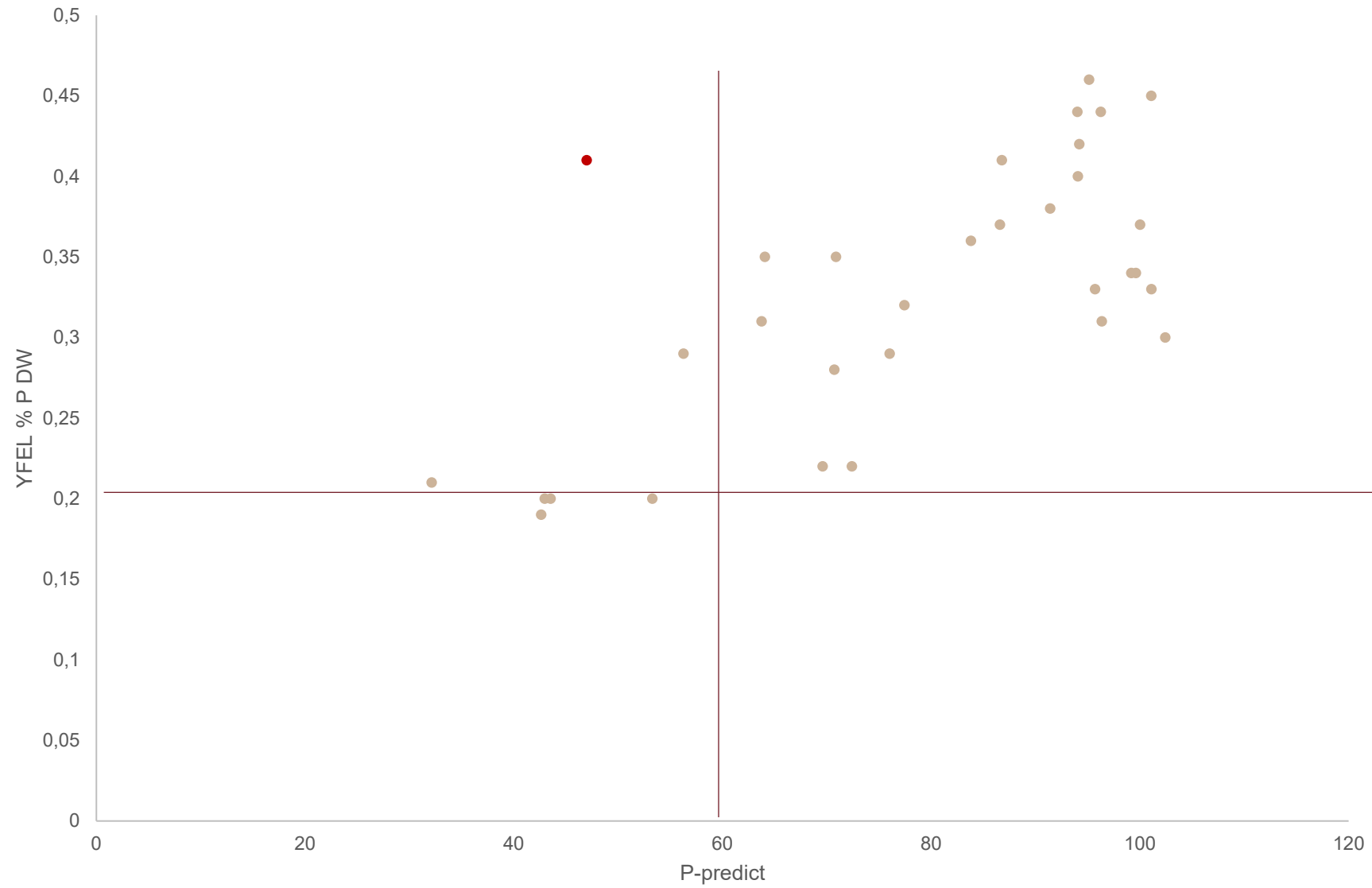


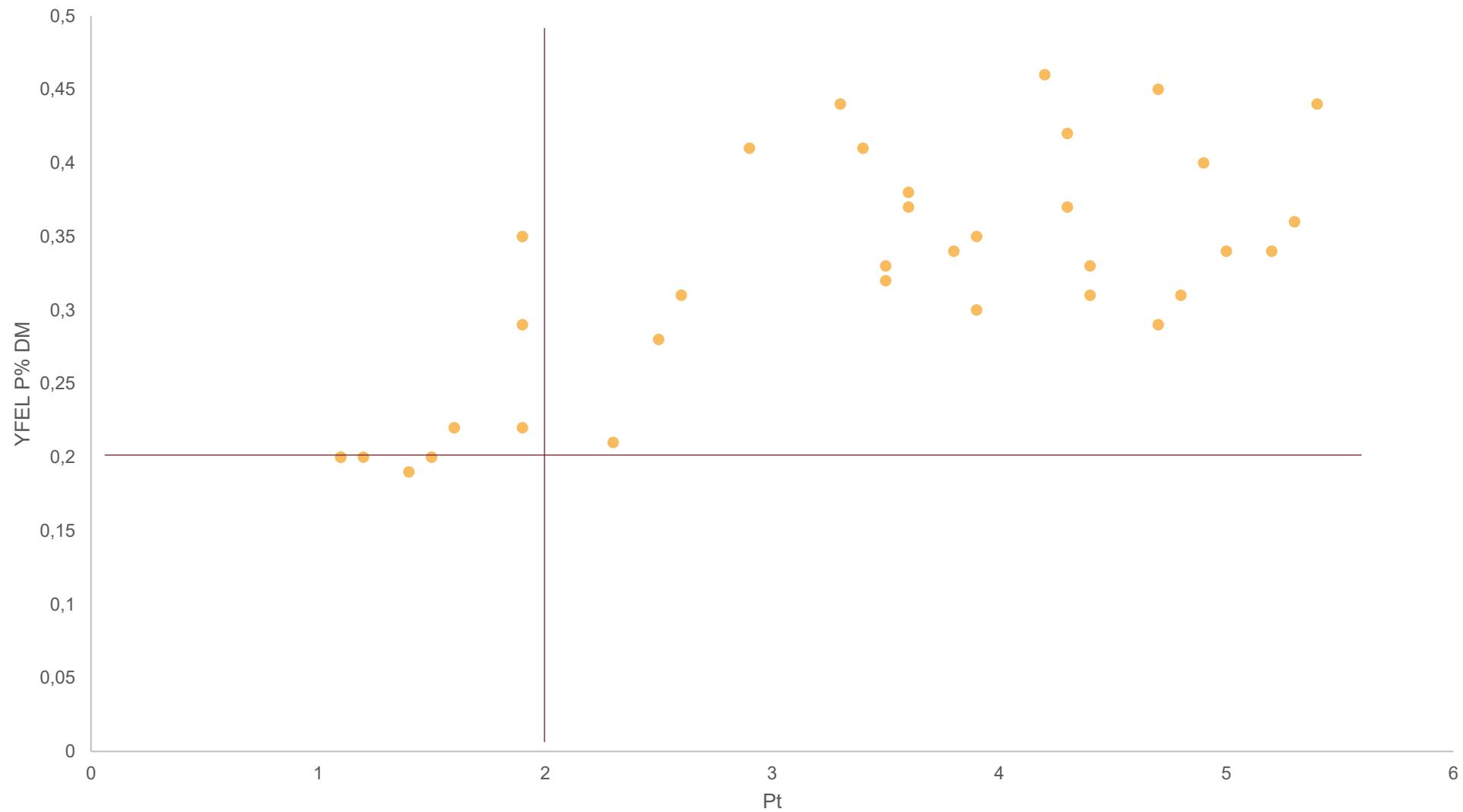
n= 360

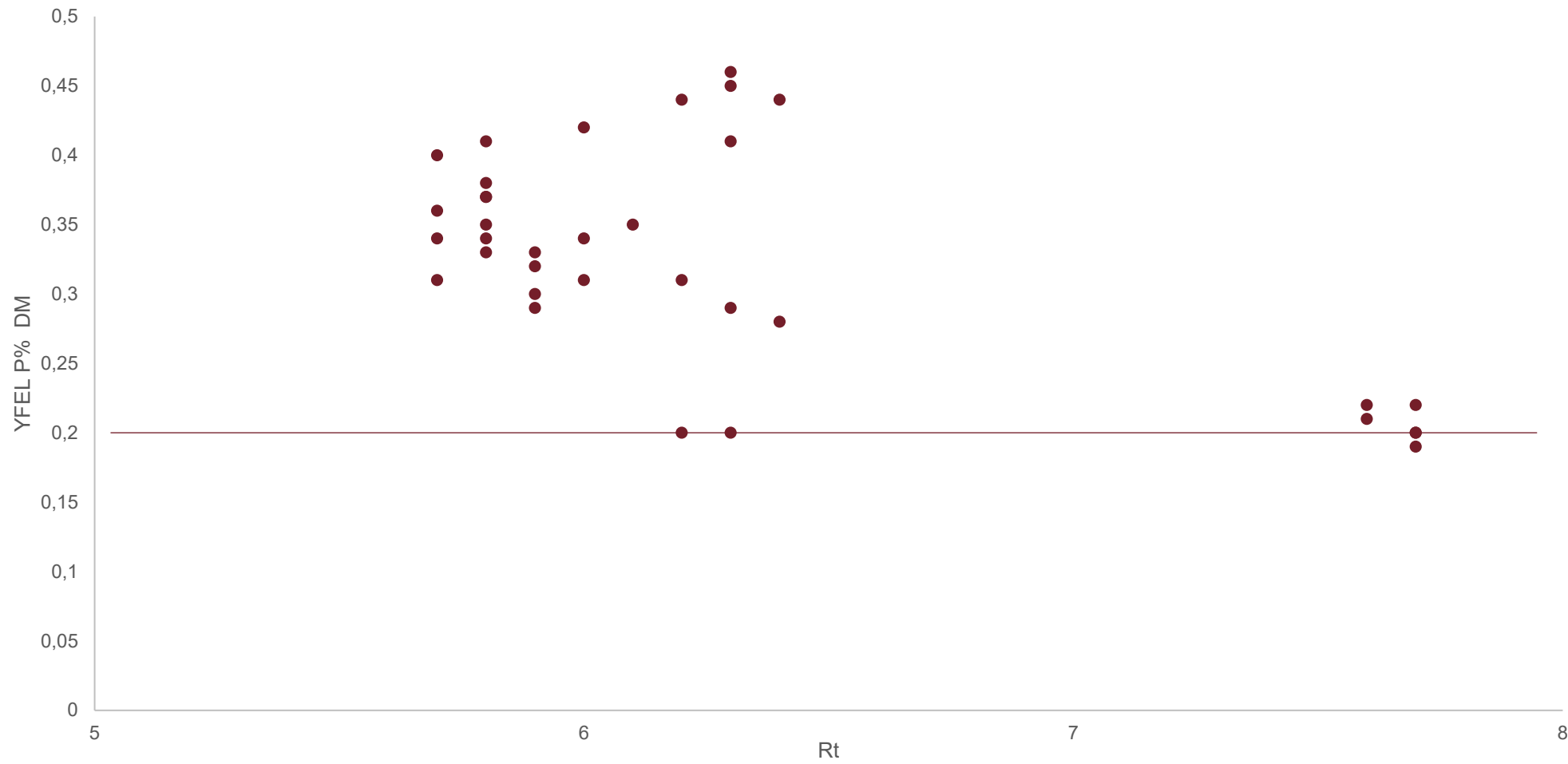


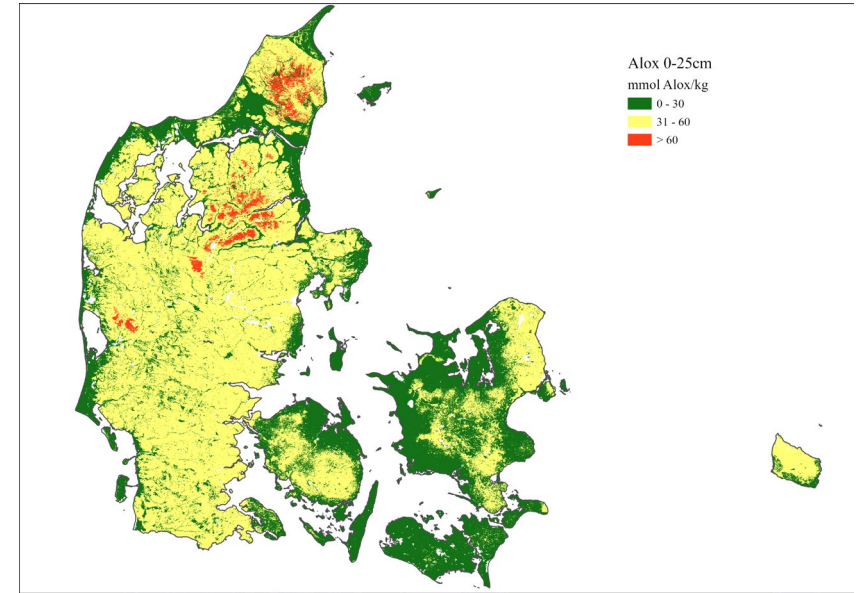
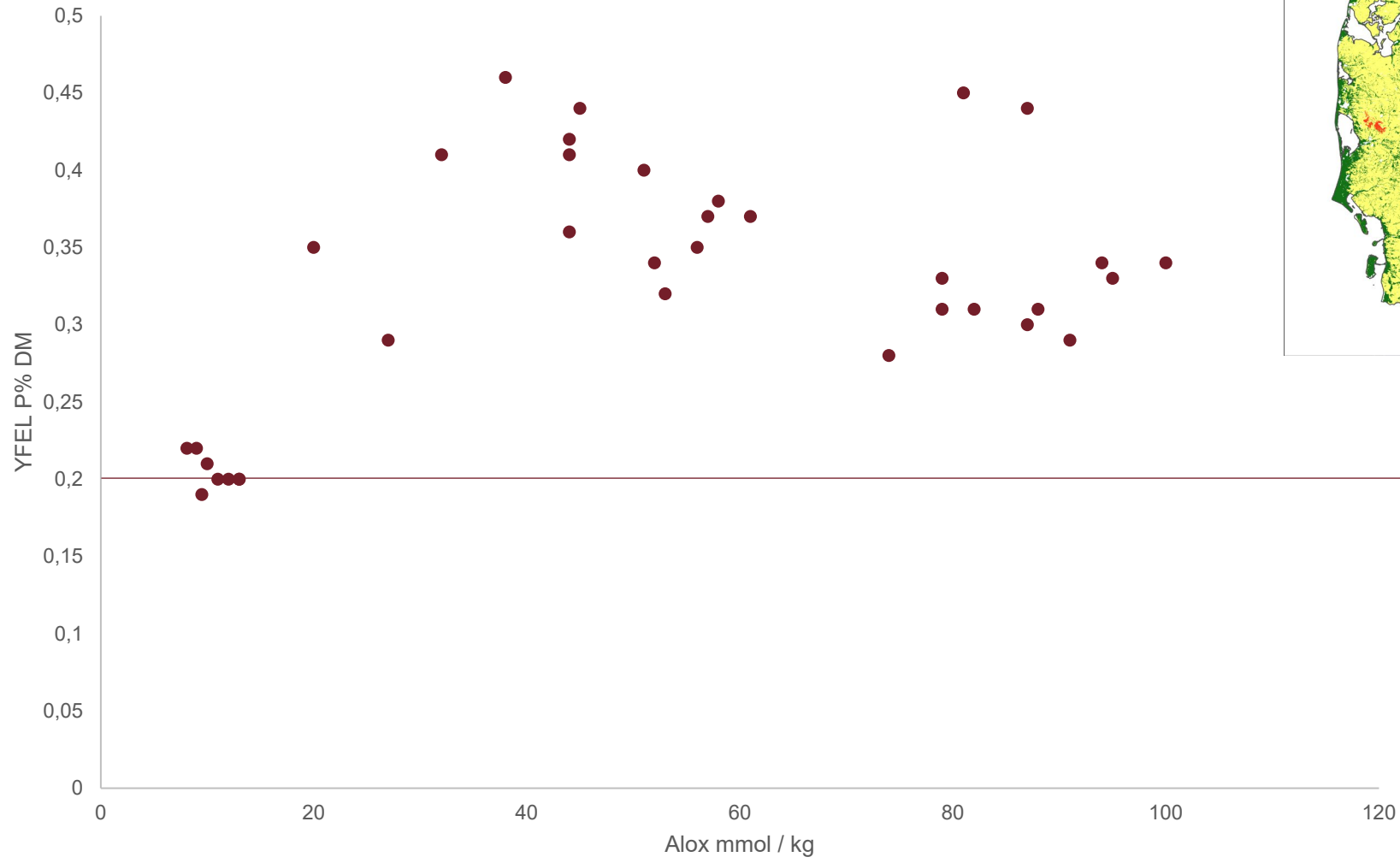
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	Quality Check: ok		
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	Quality Check: ok		
11-05-2023 11:32:47			
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	Mn-predict: 87	P-predict: 109	
	Quality Check: ok		
11-05-2023 11:32:30			
<input type="checkbox"/>	Fv/Fm: 0,78	PI: 1,79	
	Mn-predict: 92	P-predict: 95	
	Quality Check: ok		
11-05-2023 11:32:17			
<input type="checkbox"/>	Fv/Fm: 0,70	PI: 1,01	
	Mn-predict: 82	P-predict: 107	
	Quality Check: ok		
11-05-2023 11:32:02			
<input type="checkbox"/>	Fv/Fm: 0,72	PI: 1,16	
	Mn-predict: 84	P-predict: 97	
	Quality Check: ok		











Hvordan optager planter fosfor fra jord?

Hvorfor er jordekstraktioner dårlige til at forudsige planters fosforstatus?

Findes der alternativer til jordekstraktioner?

Studie: P-testeren

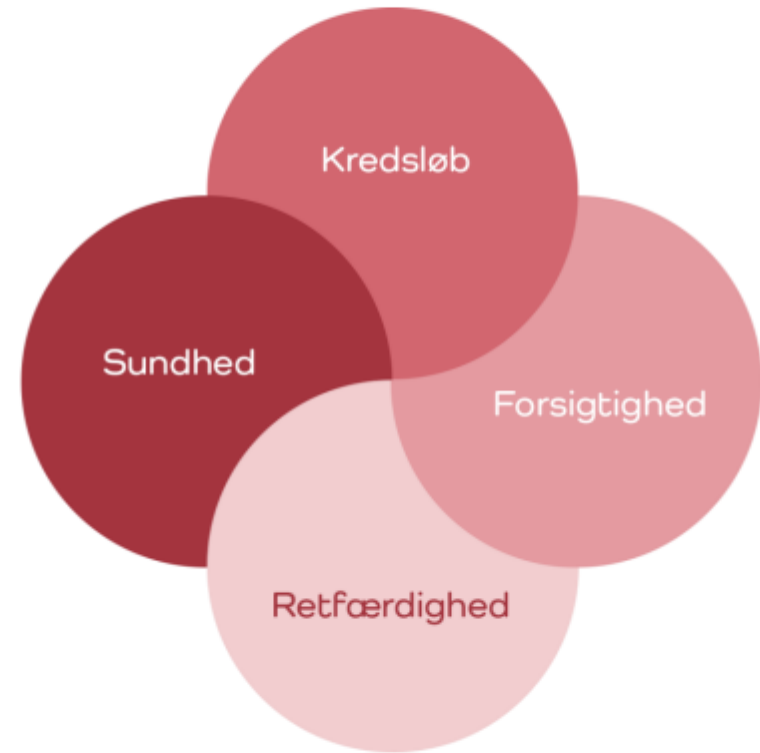
Struvit

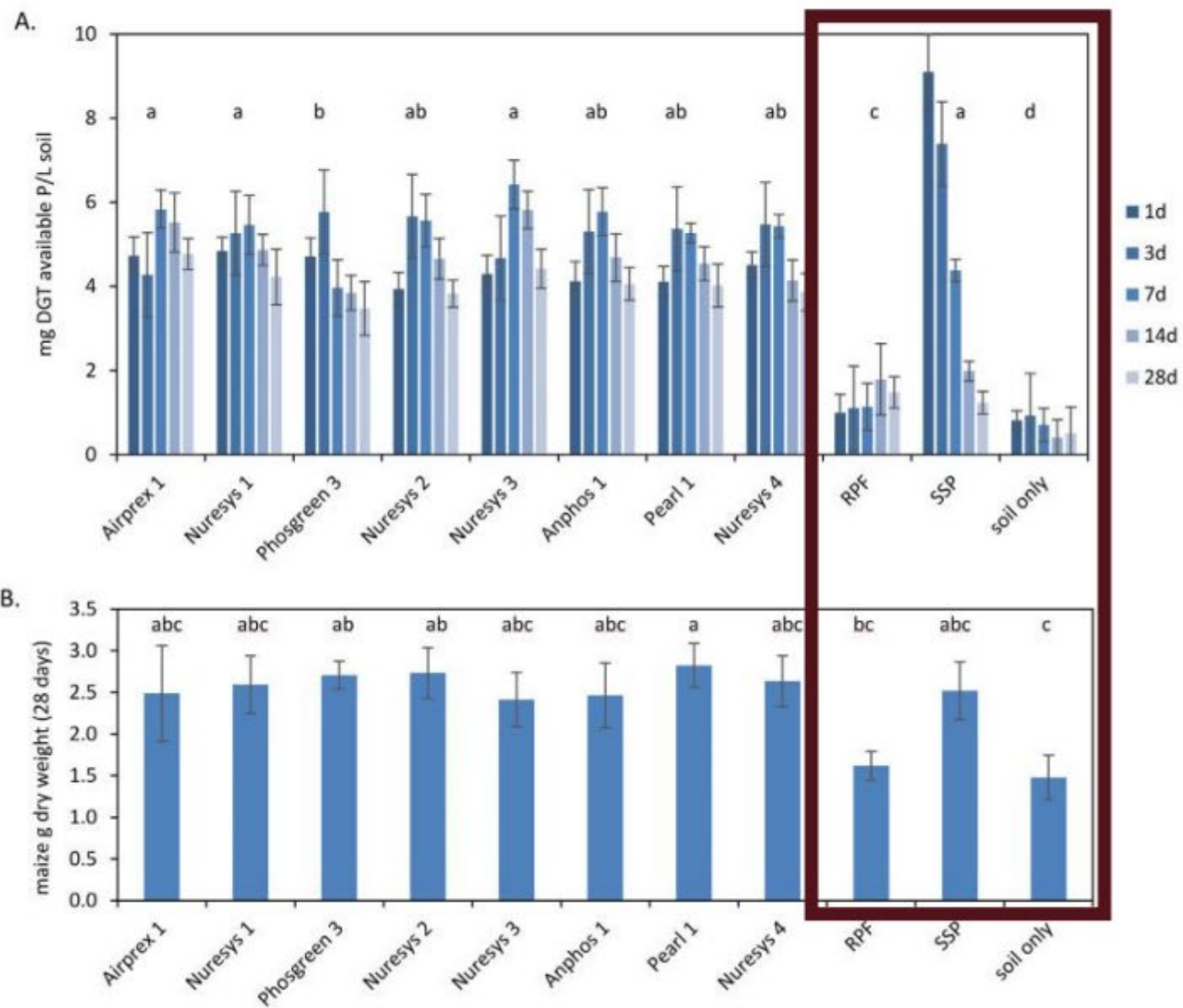
Struvit

Problematiske stoffer?

Relevante mængder?

Agronomisk værdi? ←





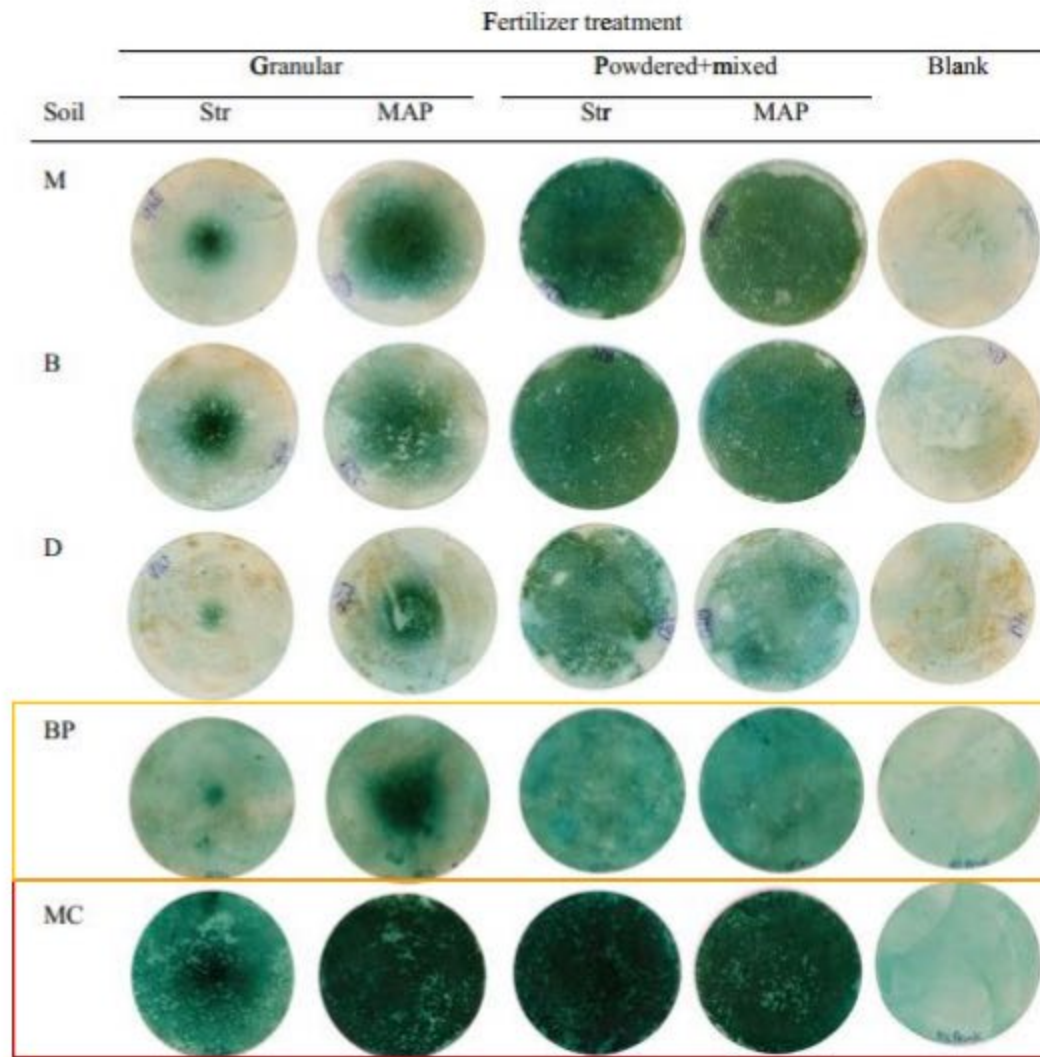


Table 1 Selected soil characteristics

Soil	Monarto (M)	Bordertown (B)	Doonen (D)	Mt Compass (MC)	Black Point (BP)
pH (water)	7.5	6.1	8.1	5.9	8.5

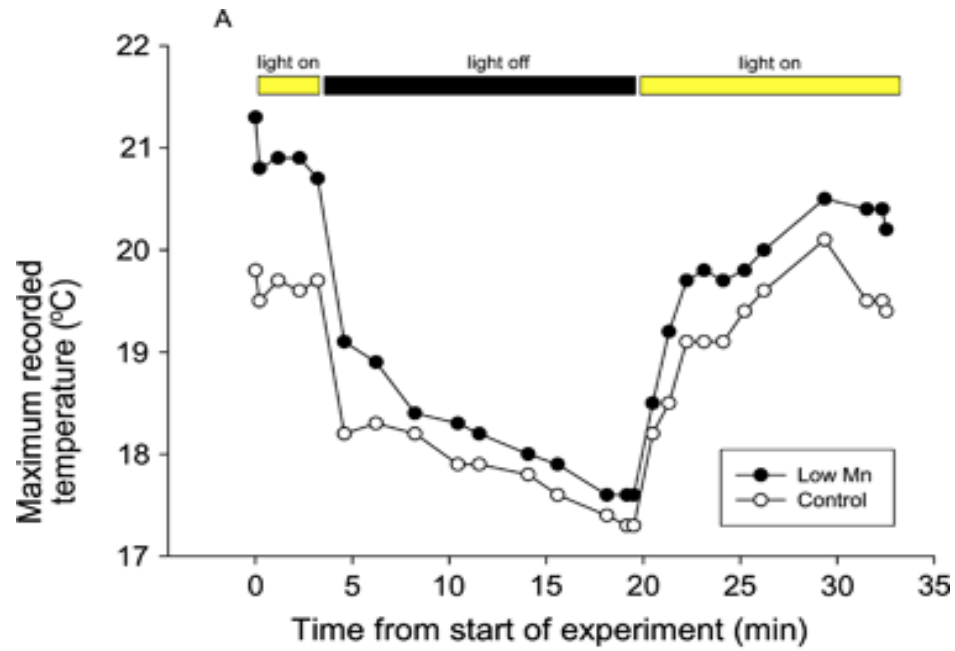
Hvordan optager planter fosfor fra jord?

Hvorfor er jordekstraktioner ikke gode til at forudsige planters fosforstatus?

Findes der alternativer til jordekstraktioner?

Studie: P-testeren

Struvit



~ 0.5

Fv/Fm

~ 0.5

