

Soil and plant phosphorus status and crop yields after 41 years of mineral P fertilization

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Goal

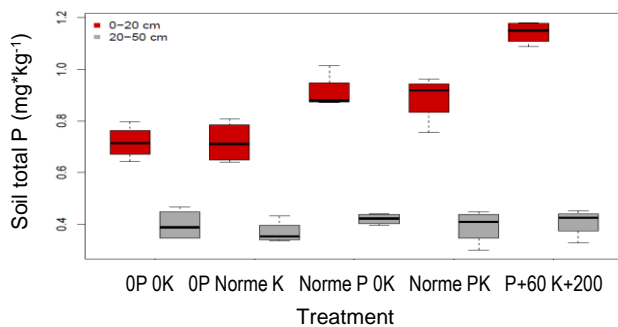
To study long-term effects of P fertilization on (i) soil and plant P status (ii) crop yields.

Material and methods

- Long-term trial (1971), pH 6.7, clay 52%, OM 5%, crop rotation : winter wheat/ maize/ winter wheat/ rapeseed
- 5 PK treatments (0P 0K; 0P Norm K; Norm P 0K; Norm PK; Norm P+60 Norm K+200 kg*ha⁻¹)
- Total soil and plant P [1]; Soil available P for crops: (i) chemical extraction (P-CO₂, P-Olsen) [1], (ii) isotopic exchange (C_p, E_{1min} & R/r_{1min}) [2]; Critical P dilution curve [3].
- Yields

Results

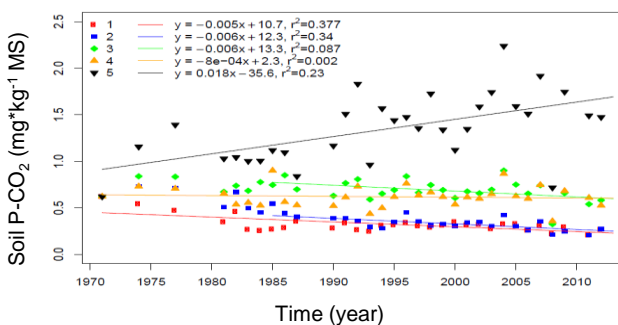
Soil total P in 2012



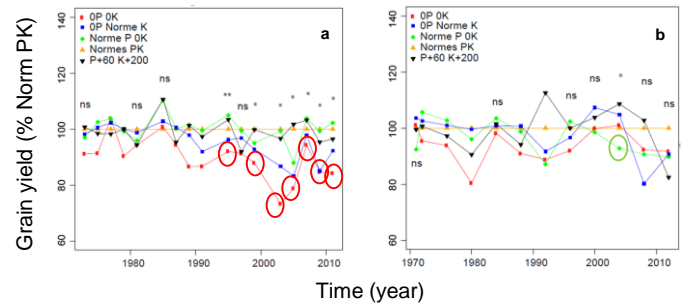
Soil available P in 2012

Depth cm	Treatment	C _p mg/l ⁻¹	R/r _{1min}	P-CO ₂		P-Olsen	
				A	B	A	A
0-20	0P 0K	0.062	8.0	0.27	9.70	A	A
	0P Norm K	0.072	7.8	0.27	10.46	A	A
	Norm P 0K	0.237	4.6	0.58	27.36	B	B
	Norm PK	0.198	5.0	0.53	26.81	B	B
	P+60 K+200	0.754	2.9	1.47	60.71	C	C
20-50	0P 0K	0.005	22.6	0.09	3.49	A	A
	0P Norm K	0.005	24.7	0.09	2.91	A	A
	Norm P 0K	0.006	24.2	0.09	4.14	A	A
	Norm PK	0.006	23.3	0.08	3.60	A	A
	P+60 K+200	0.008	19.4	0.10	7.52	B	B

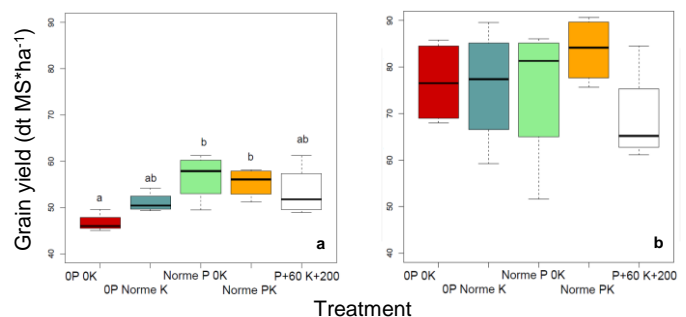
Soil P-CO₂ : evolution during the trial



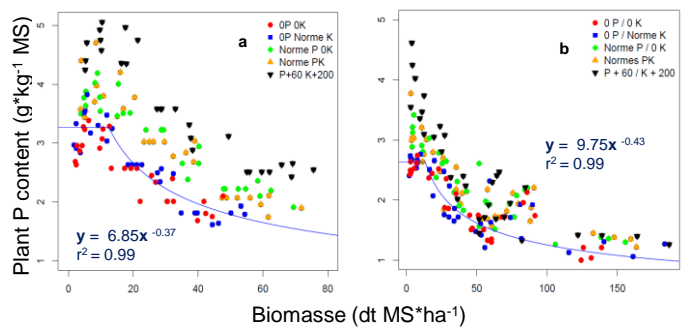
Yields: Wheat (a) and maize (b) evolution during the trial



Yields: Wheat 2011 (a) and maize 2012 (b)



Critical P dilution curves: Wheat 2011 (a) and maize 2012 (b)



Conclusion

- After 41 years of no fertilization: slight decrease of soil P content (all methods used), but no significant yield decrease, except for wheat in treatment 0P 0K
- After 41 years of over-fertilization: P enrichment of surface horizon, plant « luxury consumption » of P, but no impact on final grain yields.
- This study highlights the interest of plant-based diagnostic methods alongside soil analyses for the optimization of P fertilization practices for croplands in Switzerland.

References

- 1 Agroscope FAL, FAW, RAC, 1996. Schweizerische Referenzmethoden für eidgenössischen landwirtschaftlichen Forschungsanstalten Agroscope, vol. 1
- 2 Frossard E., S. Sinaj, 1997. Isotopes in Environ. Health Stud. Vol 33, 61-77.
- 3 Ziadi N., G. Bélanger, A. Claessens, L. Lefebvre, A.N. Cambouris, N. Tremblay, M.C Nolin, L.E. Parent, 2010. Agronomy Journal 102, 241-250