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Exhaustion Land

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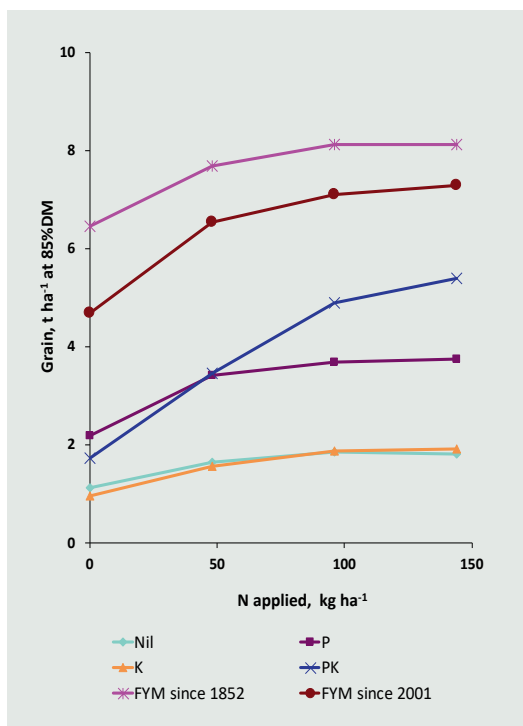


Fig. 8 Hoosfield; mean yields of spring barley grain (cv. Tipple), 2008-2015.

treated soils will be released at a time when it *cannot* be used by the crop and much will be lost by leaching as nitrate.

Sodium silicate, both as a fresh application and as a residue, continued to give substantial yield increases in the period 2008-15 on plots lacking P or K but had little effect on plots receiving these nutrients (Table 7). The mechanism for this is still not fully understood but is thought to be a soil rather than a crop effect.

Table 7. Hoosfield; effects of silicate on the mean yield of spring barley, 2008-15

Treatment ⁽¹⁾	(-)	(Si)-	(-)Si	(Si)Si
Mean yields of grain, t ha ⁻¹ at 85% DM				
N3	2.26	2.60	3.07	3.21
N3 K	2.07	3.41	3.18	3.84
N3P	4.43	4.94	4.51	4.32
N3PK	6.15	6.57	6.46	6.43

⁽¹⁾ See Table 6 for details

Exhaustion Land

Unlike some Classical experiments, which have been modified without losing the continuity of many of their treatments, this experiment has had several distinct phases since it started in 1856.

From 1856 to 1901 annual dressings of N, P, K or FYM (from 1876 only) were applied, initially to wheat (1856-1875) then to potatoes (1876-1901). There were 10 plots from 1876 to 1901.

From 1902 to 1939 no fertilisers or manures were applied and, with a few exceptions, cereals were grown. Yields were recorded in some years; residual effects of the previous treatments were very small in the absence of fresh N fertiliser.

From 1940, fertiliser N was applied to all plots. Nitrogen not only increased yields, but also demonstrated the value of P and K residues remaining in the soil from the first period of the experiment. From 1940 to 1985, spring barley was grown and N fertiliser applied to all plots every year, initially at a single rate, but in 1976 the 10 main plots were divided to test four rates of N. The residual effects of the P and K were initially large but declined as amounts of available P in the soil declined. However, even in recent years (1992-2012) residues from P applied in FYM or as fertiliser more than 100 years ago, still supply more than twice as much P as the soil that has received no P input since 1856 (Table 8).

In 1986, after a long period when the P residues, in particular, were being “exhausted” it was decided to see how quickly this decline in soil fertility could be reversed. Annual, cumulative dressings of 0 v 44 v 87 v 131 kg P ha⁻¹, as triple superphosphate, were tested on five of the original plots (each divided into four sub-plots). Basal N and K were

Table 8. Exhaustion Land; phosphorus removed from 1856 to 2012 by arable crops growing on soils without P since 1856 or on soils with residues of P applied as fertiliser from 1856-1901 or in FYM from 1876-1901 and none since.

Period	Crop	Amounts of P removed, kg ha ⁻¹					
		Plots 1 & 5 No P since 1856		Plots 7 & 9 Residues of P fertiliser 1856-1901		Plot 3 Residues of FYM 1876-1901	
		Total	per year	Total	per year	Total	per year
1856-75	W. wheat	80	4.0	121	6.0	66	3.3
1876-01	Potatoes	47	1.8	138	5.3	159	6.1
1902-40 ⁽¹⁾	S. barley	102	2.6	207	5.3	200	5.1
1941-85 ⁽²⁾	S. barley	189	4.2	394	8.8	478	10.6
1986-91 ⁽³⁾	S. barley	28	4.7	51	8.5	60	10.1
1992-2012 ⁽⁴⁾	W. wheat	75	3.6	175	8.3	200	9.5

⁽¹⁾ Mainly spring barley grown during this period; no fertilisers or manure applied

⁽²⁾ Fertiliser N has been applied at various rates since 1941; fallow in 1967 and 1975

⁽³⁾ Basal K applied since 1986

⁽⁴⁾ Spring wheat in 2001

applied such that these nutrients did not limit yield. Responses to fresh P were rapid. After just three years, where P applications had increased available-P (Olsen P) above a critical level, a yield “plateau” was reached. Although further applications of fresh P increased soil P these did not increase yield. Applications of the three fixed rates of P were stopped after seven years and since 2000 were replaced by maintenance dressings, equivalent to offtakes by the crop. (not to the no-fresh-P sub-plots). Wheat has been grown since 1992. Typically, it showed the same response to available-P as spring barley *i.e.* above a critical level, *on this soil*, of about 10-14 mg kg⁻¹ there is no further increase in yield, even though that maximum yield may be quite different (Figure 9) (Poulton *et al.*, 2013). In autumn 2015, maintenance P dressings on plots previously given 44 kg P ha⁻¹ (see above) ceased.

On the other half of the experiment, the effects of K residues (in the presence of basal P and N) on yield are investigated (the “K Test” plots). Since 2007, annual cumulative applications of 0, 62.2 and 124.5 kg K ha⁻¹ as muriate of potash

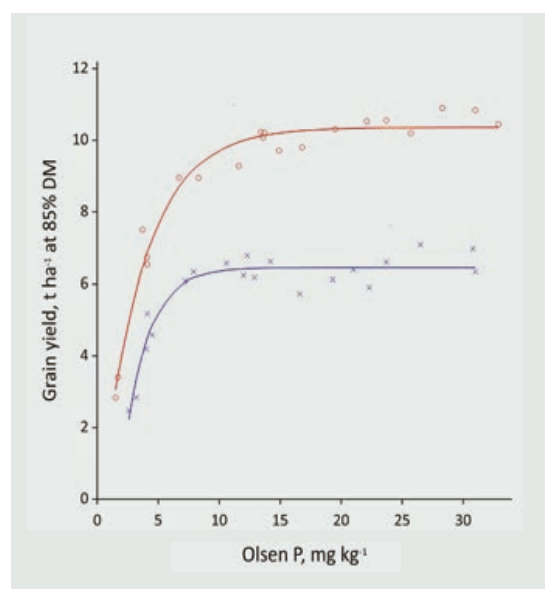


Fig. 9 Exhaustion Land; responses in the yield of wheat grain to concentrations of plant-available P (Olsen P) in the soil in contrasting years: 2003 (x) and 2008 (o).

have been applied (K0, K1 and K2). On average, grain yields are increased by 0.7 t ha⁻¹ with K1, but show little further benefit from additional K inputs and in some years there is no response to K fertiliser.