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The Long Term Experiments

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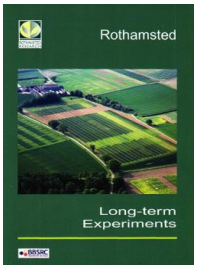

Hoosfield Spring Barley

Rothamsted Research

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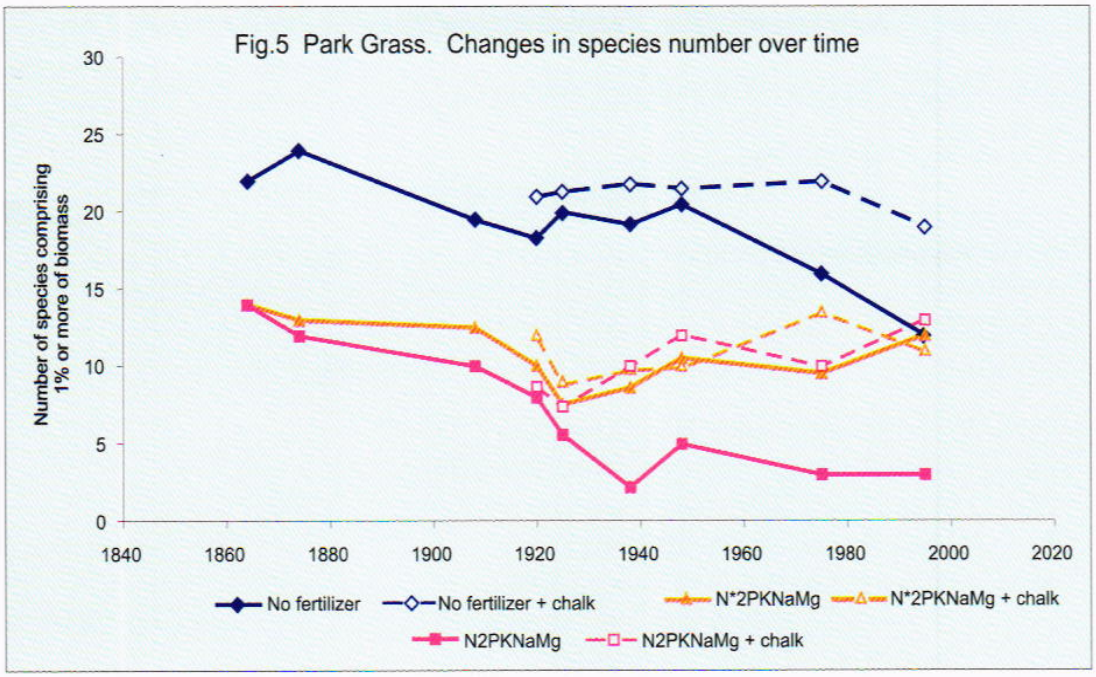

HOOSFIELD SPRING BARLEY

Spring barley has been grown continuously on this experiment since 1852. It offers interesting contrasts to Broadbalk; being spring-sown it has only needed to be fallowed four times to control weeds, and it tests not only nitrogen, minerals and FYM but also sodium silicate.

The design of the experiment is of a factorial nature with strips 1-4 (see plan), originally testing four combinations of nutrients: 0 v P v KMgNa v PKMgNa, crossed by four Series, originally testing no N or three forms of N, applied (usually) at 48 kg N ha^{-1} (Series 0, no N; Series A, ammonium sulphate; Series AA, sodium nitrate; Series C, rape cake, later castor meal).

The sodium nitrate series was divided in 1862 for a test of 0 v sodium silicate; this was modified in 1980 to test: 0 v silicate 1862-1979 v silicate since 1980 v silicate since 1862. Additional plots, on the south side, test: unmanured (plot 61); ashes, 1852-1932 (plot 62); residues of FYM applied 1852-71 (plot 71); FYM since 1852 (plot 72). Ashes were tested because in the early years of the experiment they were used to bulk up the different fertilisers to the same volume for ease of spreading. Thus, ashes alone were tested to ensure that no additional nutrients were being added. Two new plots, started in 2001, test: P2KMg (plot 63) and FYM (plot 73). Strip 5 tested various other combinations of N, P, K and Mg.

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Hoosfield Fertiliser and organic manure treatments

Treatments (per hectare per year unless indicated)

Nitrogen (applied in spring)
N -, 1, 2, 3 0, 48, 96, 144 kg N as calcium ammonium nitrate (Nitro-chalk)

Organics (applied before ploughing in autumn)
FYM 1852 Farmyard manure at 35 t since 1852
FYM 2001 Farmyard manure at 35 t since 2001
(FYM) 1852-71 Farmyard manure at 35 t, 1852-1871 only

Minerals (applied before ploughing in autumn)
P2 44 kg P as triple superphosphate since 2001
(P) 35 kg P until 2002 (to be reviewed for 2008)
K 90 kg K as potassium sulphate
K* 180 kg K, 2004-8 (450 kg K in 2003)
(Mg) 35 kg Mg as Kieserite every 3 years until 2002 (to be reviewed for 2008)
Mg 35 kg Mg as Kieserite since 2001
Si 450 kg sodium silicate since 1980
(Si) 450 kg sodium silicate 1862-1979
(Ashes) 1852-1932 Ashes, as added to minerals to aid spreading

Note: Na as sodium sulphate discontinued in 1974 (applied with K and Mg),
P, K and Mg last applied to Series C for 1979

Series treatments (last applied 1966; 1967 for parts of Series C)
0 None
A 48 kg N as ammonium sulphate
AA 48 kg N as sodium nitrate
C 48 kg N as castor bean meal

Short-strawed cultivars have been grown on the whole experiment since 1968 when most of the existing plots were divided and a four-level N test started, replacing the test of different forms of N. Growing barley in rotation with potatoes and beans was tested on parts of Series AA and C. The effects of the two-year break on the yield of barley were small, and barley has been grown each year on the whole experiment since 1979.

In 2003, several major changes were made to the experiment. On the "Main" plots (see Plan), the four-level N test continues but P and Mg are being withheld on some plots (and on parts of Series AA) until levels of plant-available P and Mg decline to more appropriate agronomic levels. Series C and Strip 5 are now used to test responses to plant-available P; basal N is applied and some plots receive K fertiliser to ensure that K is not limiting yield. The silicate test on Series AA has been simplified by stopping the four-level N test and applying basal N.

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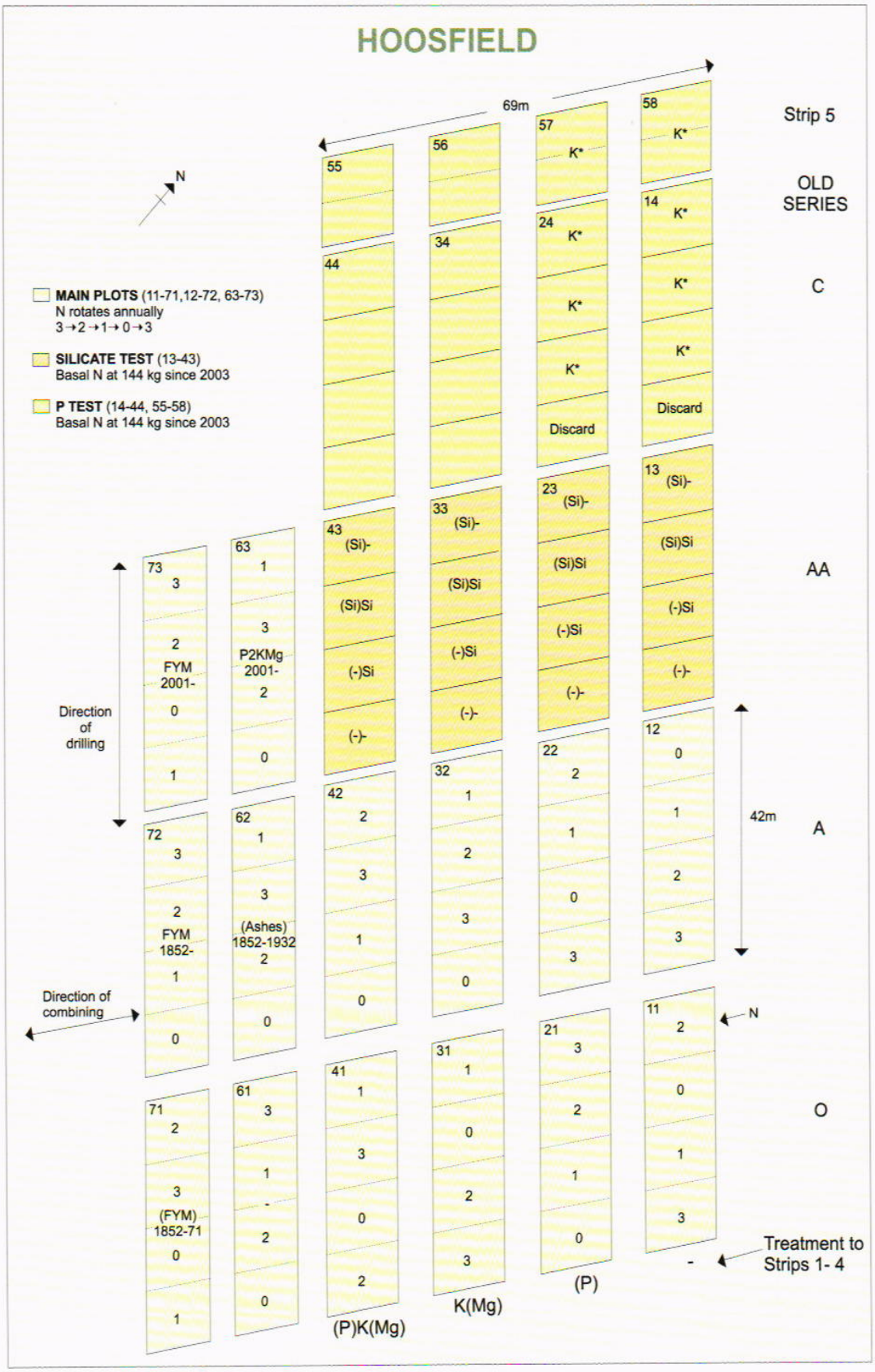

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Recent yields (Fig. 6) continue to show the great importance of P to spring-sown barley as well as large positive interactions between N, P and K. Until the 1980s, PK with appropriate amounts of N gave yields as large as those from FYM. More recently, yields have increased on the long-term FYM soil such that, on average, they are not now matched by fertilisers alone. However, much of the additional N mineralised from the extra SOM on the FYM soil 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 2002-5 on plots lacking P or K but had no effect on plots receiving these nutrients (Table 5). The mechanism for this is not fully understood but is thought to be a soil rather than a crop effect.

Fig.6 Hoosfield. Mean yield of barley grain, 2002-5

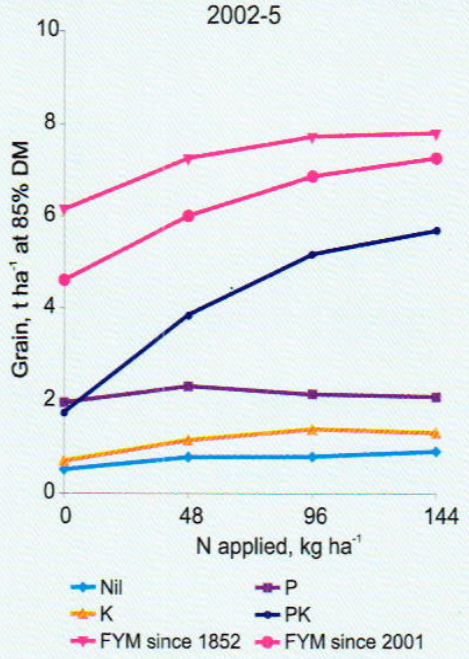

Table 5. Hoosfield; effects of silicate on mean yield of spring barley, 2002-5

Treatment[1]	(-)-	(Si)-	(-)Si	(Si)Si
	Mean yields of grain, t ha^{-1} at 85% dry matter			
N3 -	1.74	2.26	2.58	2.69
N3 K	1.59	3.40	2.98	3.58
N3P	3.11	3.70	4.46	3.79
N3PK	6.14	6.92	6.26	6.39

(1) See plan for details

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