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Rothamsted- the Classical Experiments

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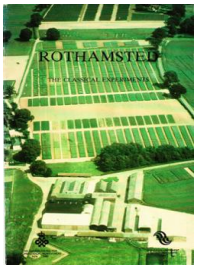

Agdell

Rothamsted Research

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previously acid plots and occasional plants of many other broad-leaved weeds also occur. Increasing the pH to 6 on sub-plots 9b, 11/1b and 11/2b has halved the amount of meadow foxtail but increased tall oat grass, especially on 11/1b.

(The botanical notes above were written in 1976 by Joan Thurston who has since retired.)

The distributions in the soil of nodule bacteria (*Rhizobium* spp.) for clover, *Lathyrus* and *Lotus* correspond closely to the distributions of their hosts in the different plots; neither medicks nor their nodule bacteria occur. Acid sub-plots contain no nodule bacteria and liming increases numbers. On limed sub-plots, N fertilizer has neither diminished the numbers nor altered the symbiotic effectiveness of the clover nodule bacteria.

BARNFIELD

Although less well-known than the other Classicals this was the first, having treatments applied in spring 1843 for a crop of turnips several months before the start of Broadbalk. However, the treatments and the cropping, although mainly roots, varied until 1876 when a period of continuous cropping with mangolds was started which lasted until 1959 (sugar beet were also grown from 1946).

As on Hoosfield Barley the treatments were applied in strips crossing at right angles. North–south strips tested minerals and FYM, including a test of FYM + PK, and these were crossed by strips comparing no nitrogen fertilizer with forms of nitrogen supplying 96 kg N ha^{-1}. Before 1968 this was the only Classical in which N was applied with both FYM and FYM + PK fertilizer.

Because yields of the continuous roots were declining, perhaps because of increasing amounts of cyst nematodes (*Heterodera schachtii*), the cropping has been progressively modified since 1959 and has included a range of arable crops with an increased range of N dressings and grass. Since 1977 the strip which had never received nitrogen fertilizer has been kept in fallow and since 1975 the remainder has been in grass.

A feature of the continuous roots and of recent arable crops has been the superiority of yields from plots given FYM even when a wide range of N dressings has been tested with the minerals. This may be because the extra organic matter has improved soil structure with greater effect on this field which is one of the most difficult to cultivate well. Yields of grass have also been larger on FYM-treated soils although FYM has not been applied since sowing the grass. This may be because more of the N applied to grass on fertilizer-treated soils is being used to increase soil organic matter. Accordingly a range of nitrogen dressings (75, 100, 125, 150 kg N per cut) has been tested on the grass since 1983.

AGDELL

This was the only Classical in which crops were grown in rotation. From 1848 to 1951 three different manurial combinations (none, PKNaMg and NPKNaMg plus rape cake/castor meal) were applied to the root crops of two four-course rotations. The rotations differed only in their third course – roots, barley, fallow or legume, wheat. There were only six plots and only one course of the rotation was present each year. The roots were turnips or swedes, the legume

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clover or beans. From 1920 club-root (*Plasmodiophora brassicae*) became progressively more damaging to the root crop especially on the NPKNaMg plots as a result of increasing acidity. By 1948 the produce was too small to weigh and the four-course rotation ceased in 1951. The soil acidity was subsequently corrected.

The six plots have since been divided, initially on one half grass was grown, on the other a range of arable crops. Both tested the value of the P and K residues accumulated during the rotations. For the arable crop the residues were evaluated in terms of fresh dressings which were applied to sub-plots.

Later, wide ranges of soil P and K were established, on both the grass and arable half plots, by further fresh dressings. The grass plots were then ploughed so that all amounts of soil P and K were present on soils with two amounts of organic matter. Arable crops have subsequently been grown to establish the relationship between yields, soil P and K and the response to fresh P and K for each amount in the soil. These tests are continuing, in winter wheat in 1984.

GARDEN CLOVER

The Garden Clover, pleasantly situated in the formal garden of the Manor House, has some claim to be the first micro-plot experiment. It is the simplest of the Classical Experiments, with (until 1956) only one plot, and that unmanured. Lawes, interested in the repeated growing of the same crop on the same land, found that red clover, however often resown on farmland, soon failed to give a useful yield. In 1854 he laid down this small plot in his garden. Yields were very large for the first 10 years averaging about 10 t dry matter ha^{-1}, probably because the soil was very rich in nutrients and because the soil-borne pests and diseases of clover were absent. Average crops were obtained over the next 30 years but thereafter yields showed a marked decline and there were several complete failures.

Between 1956 and 1972 the plot was sub-divided and a sequence of tests made of potassium, molybdenum, formalin, nitrogen and magnesium. N, K and Mg all increased yields, molybdenum and formalin did not. With N, P, K and Mg yields of about 6 t dry matter ha^{-1} were obtained in the year of sowing. The crop was usually severely damaged during the winter by clover-rot (*Sclerotinia trifoliorum*) and was resown each spring. From 1973 basal N, P, K and Mg were applied (corrective dressings were given to sub-plots which did not receive K and Mg in years of tests) and by 1975 the plot had returned to reasonable uniformity.

Between 1976 and 1978 aldicarb was tested (clover cyst nematode, *Heterodera trifolii*, was known to be present) and the variety Hungaropoly, believed resistant to clover-rot, was compared with the standard susceptible variety S.123. The combination of aldicarb with Hungaropoly gave yields up to 8 t dry matter ha^{-1} but winter survival remained poor.

The plot now grows Hungaropoly only, with basal aldicarb, and tests benomyl applied during autumn and winter. This treatment gave almost complete winter survival and a mean yield in 1980–82 of 16·6 t dry matter ha^{-1}, the largest yields in the history of the experiment.

Clover nodule bacteria and their bacteriophages are abundant. Nodule bacteria for *Vicia* are sparse and those for *Lotus* and medicks absent.

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