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# The Long Term Experiments

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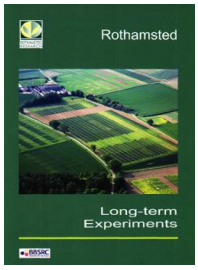


# Garden Clover

## Rothamsted Research

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The cultivar grown has usually been the same as on Broadbalk and the effects of fallowing may be roughly estimated by comparing yields of wheat on Hoosfield with continuous, unmanured wheat on Broadbalk. In the first 10 years of the experiment the one-year fallow gave an extra 0.6 t $ha^{-1}$ but over the next 60 years the difference was smaller at only 0.14 t $ha^{-1}$. With modern cultivars, and since its reversion to the original design in 1983, average yields of the wheat after a one-year fallow have been 1.7 t $ha^{-1}$. When expressed on the basis of the whole area (i.e. wheat plus fallow), the yield of 0.85 t $ha^{-1}$ is slightly less than the 1.0 t $ha^{-1}$ for continuous wheat on Broadbalk. It was in this experiment, in 1935, that symptoms caused by *Gibellina cerealis* were first recorded in the UK.

## GARDEN CLOVER

Garden Clover is the simplest of the Classical experiments, with (until 1956) only one, unmanured plot. Lawes and Gilbert were successful in growing wheat, barley and turnips each year on the same land but found that red clover, although a perennial, seldom survived through the winter when sown on farmland. Even when resown annually it soon failed to give an acceptable yield. To see whether red clover could be grown continuously on a "richer" soil, Lawes and Gilbert laid down this small plot in the Manor garden in 1854. Yields were very large for the first 10 years averaging about 10 t dry matter $ha^{-1}$, probably because the soil was rich in nutrients and because the soil-borne pests and diseases of clover were absent. Reasonable yields 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 K, molybdenum (Mo), formalin, N and Mg. N, K and Mg all increased yields, Mo 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. Since 1973 basal N, P, K, Mg and chalk have been applied.

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

The plot then grew Hungaropoly only, with basal aldicarb (until 1988), and tested the fungicide benomyl from 1980-90. Initially, there was a benefit from applying benomyl but averaged over the 11 years in which it was tested there was none. The cultivar was changed to Merviot in 1996. Between 1979 and 2006 the experiment has been resown seven times. A mean yield of 13t $ha^{-1}$ has been achieved in this period, with up to 20 t $ha^{-1}$ in some years.



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Clover nodule bacteria and their bacteriophages are abundant. Nodule bacteria for *Vicia* spp. are sparse and those for *Lotus* and medicks absent. Other than Park Grass, with its mixed herbage, this is the only remaining Classical site where only a non-graminaceous crop has been grown. In terms of microbial diversity, its soil provides a potentially valuable contrast with those of Broadbalk and Hoosfield.

The rich kitchen garden soil on which the experiment was established had received much FYM. In 1857, the 0-23cm soil layer contained 10.8 t N $ha^{-1}$; by 1983 this had declined to 4.5 t N $ha^{-1}$.

## BARNFIELD

This was the first of the "Classicals", with treatments applied in spring 1843 for a crop of turnips sown in July. The treatments and cropping, although mainly roots, differed until 1876 when a period of continuous cropping with mangolds was started that lasted until 1959 (sugar beet were also grown, on half-plots, from 1946).

Treatments during the first two years were on long narrow plots, as on Broadbalk. However, the design was modified in 1856 when strips testing minerals and FYM, including FYM + PK, were crossed at right angles by series comparing no N fertiliser with both inorganic and organic forms of N supplying 96 kg $ha^{-1}$. Before 1968 this was the only Classical in which N was applied with both FYM and FYM + PK fertiliser.

Because yields of continuous roots were declining, perhaps because of increasing numbers 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. From 1977 to 1983 the series that had never received N fertiliser was kept fallow. It was sown to a grass-clover ley in 1984. The remainder has been in grass since 1975.

A feature of the continuous roots and subsequent arable crops was the superiority of yield on soils given FYM, even where large amounts of N were applied in combination with the minerals. This may have been because the extra organic matter had improved soil structure with considerable effect on this field, which is one of the most difficult on the farm to cultivate. Yields of the grass, grown more recently, were also larger on FYM-treated soils, although no FYM was applied after sowing the grass. This was perhaps because more of the N applied to grass on minerals-treated soils was being used to increase soil organic matter. Accordingly, from 1983 to 2000 a range of N dressings (75, 100, 125, 150 kg N $ha^{-1}$ per cut) was tested on the grass. With optimum N, the yields with minerals nearly equalled those from FYM. With neither minerals nor FYM there was no benefit from increasing N above 75 kg $ha^{-1}$.

No treatments have been applied and no yields taken since 2001



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