ROTHAMSTED RESEARCH

Rothamsted - the Classical Experiments

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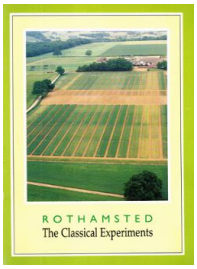

Broadbalk Wilderness

Rothamsted Research

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of NO_3-N in autumn flow in excess of current EEC limits where the amount of N applied exceeded that required for the yield potential of the cultivar then grown. A salutary lesson relevant to today's environmental concern. Phosphate, although applied in water-soluble form, was almost completely retained.

Some of the free-living nematodes of the Broadbalk soils are carried down in the water reaching the drains and can be caught on fine-mesh sieves at the outfalls. This has added to the knowledge gained more laboriously by taking soil samples and extracting the nematodes.

Other uses of Broadbalk

Broadbalk has for many years attracted the interest of scientists working in subjects that were unthought of by Lawes and Gilbert when they planned the experiment. Because the soil of each plot is now in a virtually stable condition and cultivations and husbandry are changed as little as practicable Broadbalk offers particularly good facilities for studying trends in yield and nutrients and fluctuations of pests, and diseases, etc., in relation to seasonal differences. The fluctuations in numbers of wheat blossom midges (*Contarinia tritici* and *Sitodiplosis mosellana*) were studied for nearly 40 years. The statistical analysis of the relation between rainfall and yields of the Broadbalk plots was one of the first tasks of R. A. (later Sir Ronald) Fisher.

Recent projects using Broadbalk have included:

(1) Growth analysis in relation to yield of wheat from season to season in standard soil conditions.

(2) Investigation of the uptake and losses of N fertilizer using ^{15}N as a tracer.

(3) Comparison of yields and nutrient responses of a modern short-strawed and older long-strawed variety.

(4) The residual benefit of nitrogen fertilizer used for many years.

(5) The effects of man's industrial activities on the accumulation of heavy metals, especially cadmium, polynuclear aromatic hydrocarbons and dioxins in soils and the effects of these pollutants on their concentration in the grain harvested from the field.

Material from the field can be provided for workers outside Rothamsted subject to acceptance of our regulations.

BROADBALK WILDERNESS

In 1882 about 0.2 ha of the wheat crop on land unmanured for many years was enclosed by a fence at the end of the Broadbalk Field nearest the present farm buildings, left unharvested and the land not cultivated. The wheat was left to compete with the weeds, and after only four years the few plants surviving were stunted and barely recognizable as cultivated wheat.

One half of the area has remained untouched; it is now woodland of mature trees over 20 m high, and leading species are ash, sycamore and oak. Hawthorn, now the understorey, is dying out. The ground is covered with ivy in the

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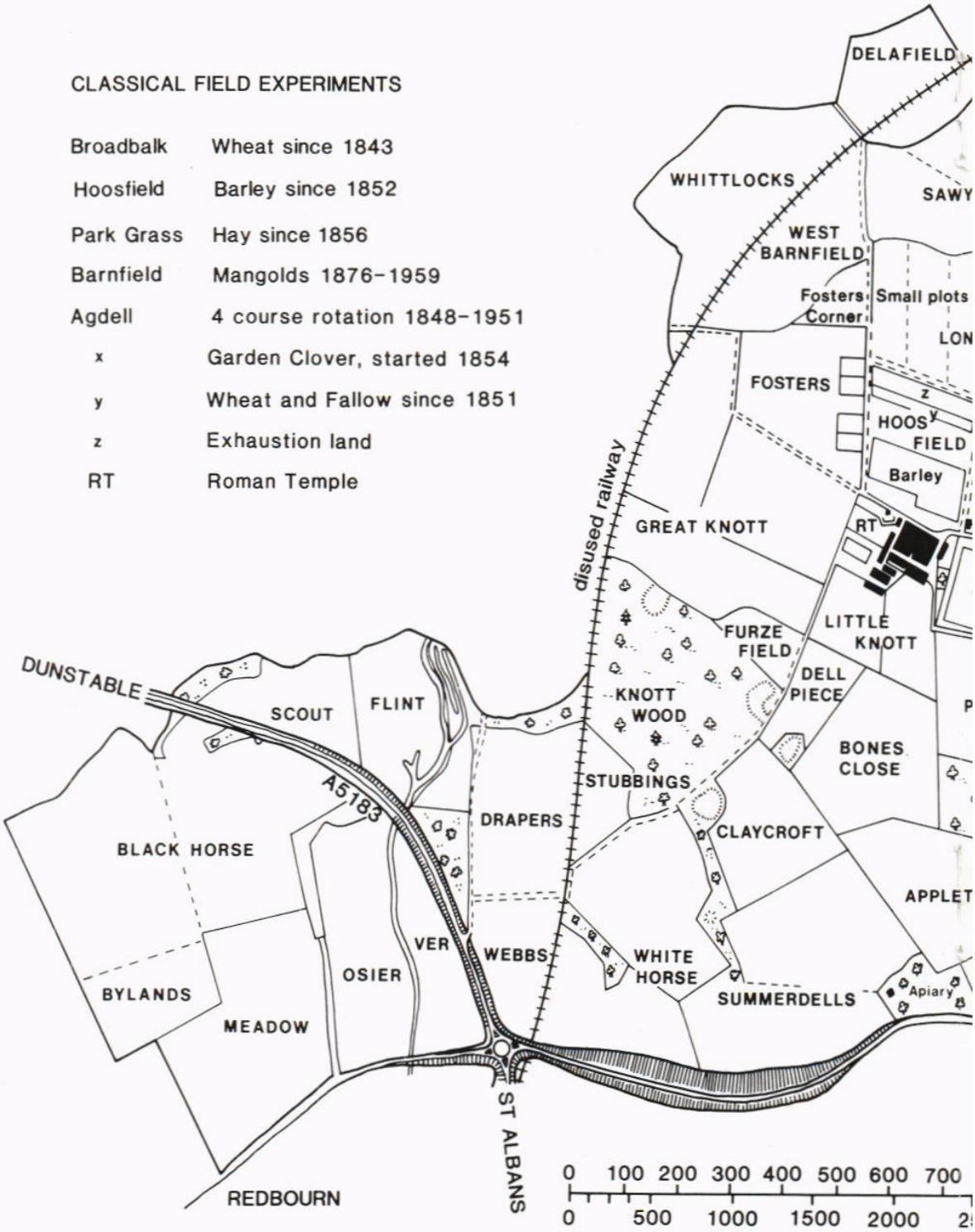
ROTHAMSTED EXPE



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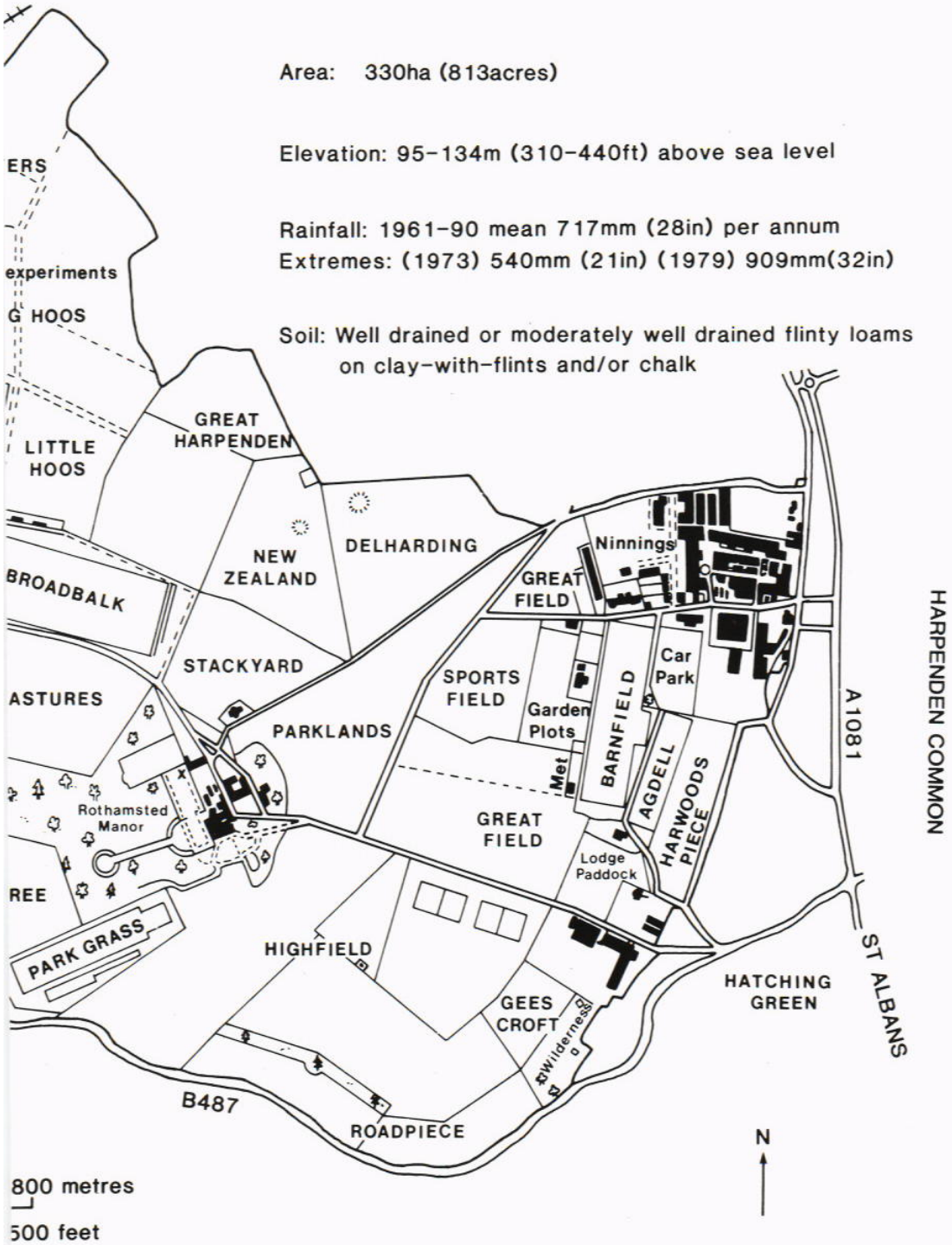
RIMENTAL STATION



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densest shade, and with dog's mercury, violet and blackberry in the lighter places. On the other half bushes have been hoed out (grubbed) annually to allow the open-ground vegetation to develop. This consists mainly of coarse grasses, hogweed, agrimony, willow-herb, nettles, knapweed and cow parsley, with many other species in smaller numbers. The bushes that appear are mostly hawthorn, dog-rose, wild plum, blackberry, with a few maple and oak.

In 1957 this grubbed section was divided into two parts, that farther from the woodland area has continued to be grubbed each year. The other part was mown several times during each of the next three growing seasons and the produce removed to encourage grasses as a preparation for grazing. Although the hogweed and cow parsley gave place to ground ivy, the grasses did not increase substantially until sheep were put in to graze. By 1962 perennial ryegrass and white clover had appeared, and they are now widely distributed. The ground ivy has almost gone, and the growth of the miscellaneous plants is much restricted. The unwelcome appearance of nettles in this area in 1986 has necessitated occasional applications of weedkillers.

The soil has gained much organic matter since the Wilderness was fenced off in 1882. Over the period 1883-1964, the net gain of nitrogen by the top 69 cm of soil from the grubbed part was 4.5 t ha^{-1}, and the corresponding gain of organic carbon 51 t ha^{-1}. The wooded and grubbed parts of the Wilderness accumulated carbon and nitrogen at almost exactly the same rates. By 1964, the Wilderness had gained more organic matter than the plot on Broadbalk receiving 35 t ha^{-1} of farmyard manure annually since 1843.

Legumes were absent from the grubbed section of the Wilderness until recently and the nitrogen gains (equivalent to 49 kg N ha^{-1} $year^{-1}$) appear to have come from rain, bird droppings, dry sorption of ammonia (13 kg N ha^{-1} $year^{-1}$) and from nitrogen fixation by bacteria in the rhizosphere of the perennial weeds. Acetylene reduction assays show that hogweed, hedge woundwort, ivy and ground ivy all support a nitrogen-fixing flora which can, under wet conditions, fix as much as 0.5 kg N ha^{-1} day^{-1}.

Nitrogen gains in the wooded section are as yet unexplained.

HOOSFIELD ALTERNATE WINTER WHEAT AND FALLOW

From 1856 to 1932 this area, which has been completely without manures since 1851, was divided into two strips which alternated wheat and fallow in successive years. From 1932 to 1982 a modification allowed a yearly comparison of a one-year and a three-year fallow but the effects were quite small (Table 3) and since 1983 the experiment has reverted to the original design.

The variety of wheat has always 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 (Table 3). In the first 10 years of the experiment the one-year fallow gave an extra 0.6 t ha^{-1}. Unlike Broadbalk the yield on Hoosfield has declined steadily during the experiment and in recent years the yield after one-year fallow has been similar to that of the continuous wheat.

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