ROTHAMSTED RESEARCH

The Long Term Experiments

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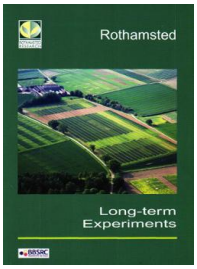

Broadbalk and Geescroft Wildernesses

Rothamsted Research

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BROADBALK AND GEESCROFT WILDERNESSES

Although not experiments in the usual sense, these two areas of regenerating woodland are of great value, especially now, when the sequestration of carbon in soils and vegetation is being debated. Both sites had grown arable crops for many years. The Broadbalk surface soil had been heavily chalked and is still calcareous (pH 7.7); Geescroft had not been so heavily chalked and soil pH fell from 7.1 in 1883 to 4.4 in 1999.

In 1882, at the west end of Broadbalk field, about 0.2 ha of the wheat crop on land unmanured for many years was left unharvested and the land was no longer cultivated. The wheat did not compete well with the weeds, and after only four years the few self-sown wheat plants that could be found were stunted and barely recognisable as cultivated wheat. One half of the area has remained untouched; it is now woodland dominated by ash, sycamore and hawthorn; the ground is covered with ivy in the densest shade, and with dog's mercury and other species present where shade is less dense. On the other half, woody species have been removed (stubbed) annually since about 1900 to allow open-ground vegetation to develop. This consists mainly of coarse grasses, hogweed, agrimony, willow-herb, nettles, knapweed and cow parsley, with smaller numbers of many other species.

In 1957, this stubbed section was divided into two parts; one part continues to be stubbed each year. On the other part, the herbage was mown several times during each of the next three years 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 the site was grazed by sheep. 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 other species is much restricted. The appearance of nettles in this area in 1986 has necessitated occasional applications of herbicides. Since 2001, this area has been mown, to simulate grazing.

The Geescroft Wilderness covers 1.3 ha. It is sited on part of what had been an experiment that grew beans from 1847 to 1878. After subsequent years in fallow and clover, the experimental site was abandoned in 1886 and the area of the wilderness-to-be left untouched. The area now has a relatively uniform stand of trees, dominated by oak and ash. An understorey of holly has become increasingly dense since the 1960s. Because the soil has become so acid, there are few ground cover species.

Developing woodland, Geescroft, 1933

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On both sites, much C has been sequestered in trees and soil since they were abandoned in the 1880s. Geescroft has gained, on average, 2.00 t C ha^{-1} yr^{-1} (0.38 t in litter and soil to a depth of 69cm, plus an estimated 1.62 t in trees, including their roots); corresponding gains of N were 22.2 kg N ha^{-1} yr^{-1} (15.2 kg in soil, plus 6.9 kg in trees). Broadbalk has gained 3.39 t C ha^{-1} yr^{-1} (0.54 t in soil, plus an estimated 2.85 t in trees), 49.6 kg N ha^{-1} yr^{-1} (36.8 kg in soil, plus 12.8 kg in trees). Much of the N required for plant growth will have come from inputs in rain and dry deposition. The faster accumulation of C and N in the wooded part of Broadbalk compared to Geescroft is probably because, as it is relatively narrow, there is a large edge effect and greater light interception per unit area, perhaps more scavenging of atmospheric N, and thus more growth. However, additional atmospheric N could have come from the covered yards across the road in which bullocks were housed during the winter.

PARK GRASS

Park Grass is the oldest experiment on permanent grassland in the world. Started by Lawes and Gilbert in 1856, its original purpose was to investigate ways of improving the yield of hay by the application of inorganic fertilisers and organic manure. Within 2-3 years it became clear that these treatments were having a dramatic effect on the species composition of what had been a uniform sward. The continuing effects on species diversity and on soil function of the original treatments, together with later tests of liming and interactions with atmospheric inputs and climate change, has meant that Park Grass has become increasingly important to ecologists, environmentalists and soil scientists.

Fritillaria meleagris *on Park Grass*

The experiment was established on *c.*2.8 ha of parkland that had been in permanent pasture for at least 100 years. The uniformity of the site was assessed in the five years prior to 1856. Treatments imposed in 1856 included controls (Nil - no fertiliser or manure), and various combinations of P, K, Mg, Na, with N applied as either sodium nitrate or ammonium salts. FYM was applied to two plots but was discontinued after eight years because, when applied annually to the surface in large amounts, it had adverse effects on the sward. FYM, applied every four years, was re-introduced on three plots in 1905.

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