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The Soil at Rothamsted

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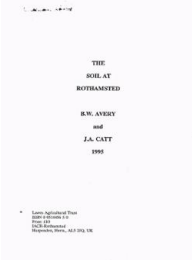

Soil Structure

Rothamsted Research

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150-250 t/ha, which was dug from infield 'bell-pits' or from 'dell-holes' on bordering slopes and spread by hand to improve the fertility and workability of the originally acid Batcombe and related soils; this eventually rendered them base-saturated and near-neutral in reaction to depths of 1.5 m or more. Grassland used for pasture or hay, as in Highfield and Park Grass (Fig. 1), was seldom chalked and hence remained at least moderately acid. By the 1950s, reserves of $CaCO_3$ remaining from earlier dressings had in places become exhausted by leaching and the soil had become acid, particularly in plots on Broadbalk and elsewhere receiving annual applications of ammonium sulphate. Except for areas deliberately kept acid, pH (H_2O) values on the cultivated land have since been maintained at around 7.0 by regular liming.

On Broadbalk, continuously cultivated since 1843 or earlier, organic carbon contents in the upper 23 cm of soil vary from around 0.8 per cent in the unmanured plot to around 2.2 per cent in the plot that has received farmyard manure annually. Profiles 19-27 in Broadbalk and Barnfield were located in inter-plot pathways and hence contain less topsoil organic C than adjacent plots. Corresponding values in profiles 18, 28-35, 41 and 42, all in fields not used for long-term experiments but cropped for varying periods before sampling, range from 1.4 to 2.8 per cent. Organic-carbon and pH data on a field-to-field basis, derived from a systematic survey in 1978-79, are given by Johnston *et al.* (1981).

Soil structure

Under woodland or old grassland, the structure of the topsoils is clearly influenced by organic matter content and base status. Thus the very dark coloured surface horizons of the soils that remain calcareous, either naturally or through the retention of added chalk as in Broadbalk Wilderness, are characterized by strongly developed granular or fine subangular blocky peds. In contrast those that are acid are more weakly structured and in extreme cases, typified by the unlimed Park Grass plots that have received regular applications of ammonium sulphate, organic matter has accumulated at the surface to form a discrete *mor* layer and the immediately underlying mineral soil is massive and structureless.

Despite the presence of $CaCO_3$ in varying amounts, structure is markedly weaker in the arable land than in the uncultivated calcareous soils. As a consequence the relatively impermanent aggregates produced by cultivation are apt to slake under the impact of rain, so reducing permeability and promoting the formation of a cap which can set hard and so delay the emergence of seedlings if dry weather follows. These effects are most evident in lighter soils, however, and are mitigated in the silty clay loam topsoils which predominate at Rothamsted by subsequent cultivation under favourable conditions, aided by the restorative action of periodic wetting, drying and freezing. There is accordingly no clear evidence that structural deterioration under continuous arable cultivation has influenced crop yields significantly (Boyd *et al.* 1962), though spring-sown crops may be adversely affected in unfavourable seasons as a result of failure to obtain a satisfactory seedbed.

Soil water regime

The Clay-with-flint subsoils of the Batcombe and Hornbeam series which underlie some 60 per cent of the estate are slowly permeable and hence are periodically saturated with

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