



The long-term effects of manures and fertilisers on soil productivity and quality: a review

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Received 20 October 2000; accepted in revised form 25 March 2002

Key words: Environment, Fertilisers, Manures, Organic, Productivity, Quality, Soils

Abstract

The results from 14 field trials comparing the long-term (20 to 120 years) effects of fertilisers and manures (farmyard manure, slurry, and green manure) on crop production and soil properties are reviewed. In total there were 24 paired comparisons of the effects of manure and fertiliser. Some of the trials also contained a control (no nutrient inputs) treatment. The input of nutrients as either fertilisers or manures had very large effects (150–1000%) on soil productivity as measured by crop yields. Manured soils had higher contents of organic matter and numbers of microfauna than fertilised soils, and were more enriched in P, K, Ca and Mg in topsoils and nitrate N, Ca and Mg in subsoils. Manured soils also had lower bulk density and higher porosity, hydraulic conductivity and aggregate stability, relative to fertilised soils. However, there was no significant difference ($P < 0.05$) between fertilisers and manures in their long-term effects on crop production. In the context of this set of international trials, the recent evidence from the Rothamsted classical long-term trials appears to be exceptional, due to the larger inputs of manures and larger accumulation of soil OM in these trials. It is suggested therefore that manures may only have a benefit on soil productivity, over and above their nutrient content, when large inputs are applied over many years. The evidence from these trials also shows that, because the ratio of nutrients in manures is different from the ratio of nutrients removed by common crops, excessive accumulation of some nutrients, and particularly P and N, can arise from the long-term use of manures, relative to the use of fertilisers. Under these conditions greater runoff of P, and leaching of N may result, and for soils with low P retention and/or in situations where organic P is leached, greater P leaching losses may occur. The use of manures, relative to fertilisers, may also contribute to poor water quality by increasing its chemical oxygen demand. It is concluded therefore that it cannot generally be assumed that the long-term use of manures will enhance soil quality – defined in terms of productivity and potential to adversely affect water quality – in the long term, relative to applying the same amounts of nutrients as fertiliser.