Assessing soil structure in organically farmed soils

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ABSTRACT

Soil structure was assessed in over 90 fields (organic and conventionally farmed) covering mixed, stockless and pasture farming systems. A combination of spade and an objective scoring system based on the degree of aggregation and porosity was able to detect differences between fields. On average, in the fields sampled, topsoil structure was slightly better on the organic farms though, even on the conventional fields, structure was unlikely to limit crop growth.

Keywords: soil structure; organic farming

INTRODUCTION

The link between soil structure and biological activity within a soil is such that good structure aids biological activity and *vice versa*. The scientific literature suggests that organic farming produces better soil structure (Reganold, 1995). This paper tests this hypothesis by reporting on soil structure from over 90 fields, comparing farm system, and rotational position and conventional versus organic fields.

MATERIALS AND METHODS

Thirty-three farms were visited during 1999/2000 in England. Most were mixed farms but the sample also included stockless and grassland farms. Three fields were sampled at each farm location, ensuring that soil texture was as similar as possible for the fields at each location. The fields were organically managed at the high (H) and at the low (L) fertility stages of the rotation and a conventionally managed field (C). This distinction between H and L fertility soils was not applicable on the predominantly grassland farms and in these cases, a single grass field was sampled on the organic farms (categorised as H). All organically farmed fields had been certified as organic for at least 6 years. For each field, an assessment was made of soil structure for 0-7 cm and 8-20 cm soil depths at 10 random points. Structure was assessed on a scale of 1 (poor) to 10 (good) (Anon., 1982). Dry bulk density was also determined on soil samples collected at three random points.

RESULTS AND DISCUSSION

Soil bulk density was highly negatively correlated with the organic matter content of the soil, but structural scores were unrelated to total soil organic matter content. The soil structure scores for the separate depths were combined to produce an average score for the topsoil (Table 1). Results show statistically significant effects for the stockless systems, with structure apparently better under the organic systems. Data from the mixed and pasture farms were less conclusive. However, for the mixed farms, this assessment was influenced by high fertility fields that were still in ley; it was observed that these fields had worse structure than ley fields that had just been ploughed, possibly due to animal poaching or machinery compaction. Once ploughed, the ley conveyed good structure to the soil.

Table 1. Topsoil structure score for each farm type and rotational position.

Farm type	Number	Rotational position[1]			*P*	SE
		H	L	C		
Mixed	23	6.4	6.2	6.1	0.18	0.14
Stockless	4	6.8	7.0	5.6	0.03	0.27
Pasture	6	6.8	-	6.3	0.17	0.31

[1] See text for details

Whereas there is a suite of complex, laboratory based physical measurements to assess soil physical condition (Anon., 1982), methods are time consuming, expensive and, often, do not reflect differences that can be seen in the field. We would argue that a combination of spade and objective scoring system based on aggregation and porosity is a valuable tool for assessing soil structure: this was able to determine differences between farming systems. However, on average, differences between systems were small and unlikely to limit crop production.

Whereas total SOM has a role in structural formation (through humic substances, for example), the young organic matter is especially important, providing a substrate for fungi and bacteria which in turn produce enmeshing hyphae and extracellular polysaccharides stabilising aggregates (Tisdall & Oades, 1982). Thus, to achieve aggregate stability and the advantages that this conveys, frequent input of fresh organic matter is required. Practices that increase SOM input are routinely used on organically farmed soils. We can therefore hypothesise that, because it is especially the 'light fraction' of SOM that is involved in soil structural development, structure will improve in a biologically active soil which continually turns over fresh residues. If so, this would suggest (and our data generally support) that there is greater potential for structural improvement in organic than in conventional soils. However, there must be a question whether these potential benefits produce measurable effects when organic matter inputs are similar between systems.

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