OSMO - a collaborative network testing knowledge and tools for resource-efficient soil health management

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**Implications**

Soil and knowledge are the most important resources for agriculture. In order to create new knowhow on managing soils, collaboration between research, advisory services, product development and farmers is necessary. The Finnish OSMO –project (2015-2018) has provided these opportunities in farmer learning groups, workshops and field trials (Mattila and Rajala, 2016). Based on the first year of results it is clear that soil health is a complex system, where different aspects interact. Many of the problems observed as nutrient deficiencies can be sourced to compaction from machinery or lack of drainage. On the other hand, deficiencies and excesses of nutrients may affect soil structure, especially in terms of the amounts of Ca and Mg (Dontsova and Norton, 2002).

The current hypothesis is that each field has its own set of problems. Soil health can be improved only by identifying the crop yield reducing factors, determining their causes and planning for effective ways to remedy them. Currently there are several methods for analyzing various properties of soil, but a lack in communicating the results and developing the findings into management options. Decision support tools for farmers and advisors could fill the gap between analysis results and management actions.

Identifying and remedying soil problems have a large potential for increasing the productivity of both organic and conventional agriculture.

**Background and objectives**

Agricultural soils are under increasing pressure globally. During the last decades crop rotations have become simplified, annual crop areas have increased and machinery has become heavier. At the same time the progress in crop yields has stagnated (FAO, 2017).

Compared to the potential yield productivity (solar radiation and water availability) (Sylvester-Bradley and Wiseman, 2005), crop yields are very low (FAO, 2017), especially in organic agriculture (LUKE, 2017). At the same time, variability between farms, fields and field parts is high. It is unclear why some fields have low yields while other adjacent fields have very good yields, although measurements such as water infiltration seem to give good correlations (de Paul Obade and Lal, 2016; Keller et al., 2012).

The concept of soil health is an emerging paradigm for looking at soil as a system. It appreciates the interconnections between components of soils and different views on problems (i.e. chemical, physical and biological)(Kibblewhite et al., 2008).

The objective of the OSMO -project is to apply new knowledge on soil quality and health and to test the applicability in practice on farms. This is done through improving knowledge on soil testing, farmer know-how on soil health management and developing tools and study materials. Methods for analyzing and repairing soil problems are tested on 8 experimental problem fields, with adjacent good fields serving as the reference. The approach has been problem-oriented, and analysis methods and tested techniques have been tailored to each problem field. The aim is to identify and overcome barriers to better productivity and soil health and to test how (and if) the approach works.

**Key results and discussion**

The project has been running since 2016 and most of the work is still ongoing. Final results for the test farms will be available in 2018. For now, five regional learning groups are running in western part of Finland, each with ca. 20 farms. These have included a six month intensive period of soil management education and application of skills to on-farm work. The separate tools for soil management have been assembled into a soil management planning toolbox, which is being refined based on user experience.

Several problems have been identified in the test farms and trials have been run to test for potential solutions. Soil structure has been improved through vetch based cover crop mixes and subsoiling. Gypsum applications have been targeted to remedy Ca:Mg ratio problems and manganese, potassium and boron fertilizers have been tested to remedy common nutrient deficiencies. In 2017, new methods for identifying and solving drainage and compaction issues are being tested.

The interaction between researchers and farmers has been valuable. In the intensive six month courses, researchers developed science based decision support spreadsheet tools and the farmers have applied them on their farms, providing valuable feedback. Receiving rapid feedback on their applicability and being able to redevelop them into tools has provided useful tools for soil management.

**How work was carried out?**

The core of the project was five learning groups with ca. 20 farms in each. The groups were mixed organic and conventional farmers. There were about 30-50 % organic farmers in each group.

Each group held regular meetings and online lectures on the main aspects of soil health (chemical, physical and biological). The participants also had access and guidance on using tools for managing soil fertility, compaction, drainage and crop rotations. The participants filled in an online soil management plan for their farm during the course and reported on their own trials and tested solutions for managing soil health. In addition, several in-depth work-shops were arranged on special topics. The scientific work focused on the 8 test fields. Their status was quantified through different soil tests (ammonium acetate extraction (Vuorinen and Mäkitie, 1955), Mehlich 3(Mehlich, 1984), Soil Health Tool (Haney et al., 2010)), physical soil evaluation (visual evaluation of soil structure (Ball and Munkholm, 2015), soil cover (Laflen et al., 1981), earthworm counts (Lawrence and Bowers, 2002), water infiltration (Burgy and Luthin, 1956)) and plant tissue nutrient testing.

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