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Abstract

Improving agriculture productivity through sustainable soil management (SUSVEG)

Definition of the research problem: Sustainability of agricultural production systems is highly dependent on maintaining soil productivity. This is a challenge under intensive agriculture in poorly structured, low fertility soils in climates with high temperatures and inadequate rainwater, such as Israel and large parts of Italy. Depletion of soil organic matter (SOM) is a common phenomenon in soils in both countries, leading to soils with reduced productivity due to low nutrient cycling rate, degraded physical stability, non-adequate hydraulic properties, and high incidence of soil-borne diseases. Compost application is becoming popular as a means of counteracting these effects. However, very high doses of composts are required to meet the nitrogen consumption requirements of crops, which results in surface water and groundwater contamination from compost-borne nutrients, as well as excess accumulation of some nutrients in the rhizosphere. Objectives: The goal of the proposed research is to find sustainable ways to reverse the process of SOM depletion and soil degradation by combining compost application with cover crop rotation, and by combining compost with biochar. These two agro-practices will be tested for their ability to reduce compost application rates and subsequent risks of pollution, while improving soil health and crops yield. Hypotheses: (i) Combining compost with cover crops is expected to improve availability of soil nutrients, especially nitrogen due to nutrient accumulation in the cover crops, and to improve soil structure and microbial activity, as a result of root associated processes. (ii) Biochar added together with compost is expected to have a synergetic effect on soil fertility and productivity due to its ability to retain nutrients and increase SOM stores and soil microbial activity. Proposed methodology: The research program is based mainly on field studies. In Israel compost dose and biochar dose will be investigated in a randomized block design with split plots. The main plots will include mineral fertilization as a control and three levels of compost, 10, 20 and 30 t dw ha-1. The lowest and highest compost treatments will be subdivided to three biochar treatments: 0, 1.5 and 3.0 t ha-1 applied together with the compost. In Italy two factors will be studied: compost dose (0, 15 and 30 t ha-1), and cover crop. In both countries the treatments will be applied to rotational crops (Israel: vetch, winter wheat, maize, chickpea, melon; Italy: vegetables). Field measurements will include: soil infiltration rate, penetration resistance, temporal changes in water content in the soil profile with time, physiological plant parameters (leaf photosynthesis, conductivity and transpiration rate) and biomass determinations. Laboratory analyses of soil samples (both from and below the root zone) will include determination of various properties [e.g. SOM content, potential nitrification (PN), available nitrogen, saturated hydraulic conductivity, bulk density and aggregate stability] and contaminating components (concentration of nutrients and salts below the root zone). In addition, nutrient content in plant tissues will be analysed. The RothC model will be used to predict long run SOC changes for various managements based on the field collected data. Finally, the impact of applying compost ± biochar on SDS will be measured in laboratory trials on Fusarium oxysporum f. sp. melonis (FOM) and Verticillium dahliae. Expected contribution: The project is expected to increase the sustainability and productivity of agriculture in Israel and Italy through the synergetic contribution of composts and biochar, or compost and cover crops to (i) improve SOM and soil fertility, (ii) reduce chemical fertilizer input, (iii) reduce environmental contamination, (iv) and (v) provide protection against soil-borne disease.