Improvement of physical, chemical and biochemical proprieties of a salt affect Alfisol by addition of biochar and gypsum

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Salinization is one of the major environmental problems threatening agricultural productivity. Soil salinization is defined as an excessive accumulation of salts within the soil profile. It negatively affects soil physical and chemical properties, as well as the biochemical ones. Reclamation of salt affected soils requires removal of soluble salts and Na^+ from the soil exchange sites. Subsequently, salts are leached out the root zone by irrigation water when available.

Gypsum ($CaSO_4 \cdot 2H_2O$) is the most commonly used chemical amendment for reclamation of salt affected soils since it provides Ca^{2+} that replaces Na^+ on the exchange sites and improves soil structure. Also organic amendments have been considered, but not extensively studied, for reclamation of salt affected soils. Recent studies have reported that biochar can be rich in nutrients like Ca^{2+} and Mg^{2+} and may enhance their availability in soil when added as amendment. Therefore, addition of biochar to a salt affected soil could aid in its remediation by supplying Ca^{2+} and $Mg^{2+,}$ and replacing Na^+, improving aggregate stability and hydraulic conductivity.

The objective of this study was to evaluate the effects of gypsum and biochar for the reclamation of a saline-sodic soil on some physical, chemical and biological properties.

The topsoil of an Alfisol, about fifty meters far from the foreshore in the Petrosino coast (Sicily, Italy), was used for this experiment. The soil was air-dried and sieved at 2 mm. The main physical and chemical properties of the soil were: pH 7.3, clay 23 %, total carbonates 50.9 %, electrical conductivity 0.81 dS m^{-1} (1:5, w/v), total organic C 11.0 g kg-^{1}, cation exchange capacity 24.8 $cmol_{(+)}$ kg^{-1}, exchangeable sodium percentage 35 %. Two doses of gypsum (2.6 and 5.1 g kg^{-1} of soil) and two doses of biochar (4.2 and 8.3 g kg^{-1}) were tested. The two doses of gypsum were calculated in order to decrease ESP from 35% to 25% and to 15%, respectively, whereas biochar was added in order to achieve an amount of 10 and 20 Mg ha^{-1}. Following addition of gypsum and biochar, either alone or in combination, 100 g of soil were incubated at room temperature in 150 mL plastic pots and maintained at 50% of soil water holding capacity during all the duration of the experiment (22 days). One week after the incubation, three horse-radish seeds were sown. Then, after 13 days, plants were removed, oven dried at 60°C for 48 hours and weighed. The soils were analyzed to determine porosity, CEC, ESP, ECe, microbial biomass C, soil respiration and microbial community structure. The experiment was carried out in octuplicate. In this work, the results are reported and discussed.