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COMPOST AND Fe OXIDES AS SOIL AMENDMENTS FOR MINE TAILING RECLAMATION: ORGANIC MATER MINERALIZATION AND NUTRIENT AVAILABILITY

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The application of amendments to improve soil properties often becomes an interesting alternative for mine tailing reclamation. One of the most relevant limitations for this type of soils is the low soil organic matter (OM) content. As OM contributes to improve soil physical and chemical properties, increasing soil OM generally leads to an increase in soil productivity. Due to the growing generation of urban sewage sludge in developed countries, its use as a soil amendment contributes to solve the problem of waste disposal and represents a cheap remediation alternative. Moreover, this type of waste supports nutrients to plants (N and P) and introduces OM into the soil. The exogenous OM applied to the soil yield to high mineralization rates, therefore addition of stabilization agents forming organo-mineral complexes will enhance soil reclamation. Particularly, iron oxides (FeOx) contribute to protect OM against attacks of microorganisms, decreasing mineralization rate and encouraging organic C sequestration into soil.
An evaluation of the OM mineralization process of a mine soil after addition of both an organic amendment and a stabilization agent was carried out. The experiment uses soil from an abandoned Fe mine tailing site in Southeast Spain (Alquífe, Granada). From a composite soil sample main properties were determined: sandy loam texture, pH 8, 0.2% organic C and 3 cmol+/kg CEC. Compost made from the mixture of sewage sludge and vegetable wastes (SVC) was used as organic amendment. Mine sludge, a by-product of the mining activity with 44% FeOx, was used as inorganic amendment. An incubation experiment was carried out with natural and amended soils to determine soil respiration and extractable ions (NH4+, NO3- and PO4-3). Measurements of extractable ions were determined weekly during a 60 days incubation period. The mixtures of soil and amendments were determined by generating a D-optimal design, assuming a quadratic model, in which experimental variables were: the amount of SVC (0-10%), mine sludge added to soil (0-30%), and the incubation time (t). Results indicated that incubation time and addition of SVC have a significant effect ($p < 0.05$) on the mineralization process, while soil amended with FeOx does not show any significant effect ($p > 0.05$). Daily production of CO2 in all cases was higher during the first week followed by a steady decline until the end of incubation. As regards to soil amended with SVC, the highest soil respiration rate was reached when compost was applied at 10%. Soluble NH4+, NO3- and PO4-3 concentrations from soil increased with increasing SVC. Moreover, PO4-3 content increased along the incubation time in both natural and amended soils due to an efficient mineralization. Conversely, NH4 + content decreased for amended soils due to N volatilization or immobilization. The amount of NO3- declines gradually with incubation time for amended soils, whereas NO3- content increases from day 14 of incubation for both control and inorganic amended soils. This pattern agrees with reported data related with the efficiency of nitrification in semiarid regions. As indicated by the results, organic amendments increase the available nutrients to plants but they could decrease N mineralization rate. Under the conditions tested in here, OM stabilization by addition of mining sludge does not achieve satisfactory results.