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Formulation of humic-based soil conditioners

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The goal of the study is to prepare soil conditioners (SC) able to carry out the following functions: (i) the chemical conditioning of soil mainly comprising the adjustment of pH, (ii) the balancing of inorganic nutrients, (iii) the physical conditioning of soil mainly comprising the improvement of water permeability, air permeability and water retention properties, and (iv) improvement of the ecological system concerning of useful microorganisms activity in the soil.
The SC was made of a mixture of inorganic ingredients, a chemical composition and physical and chemical properties of which promoted improvement of physical characteristic of soil and enrichment by its mineral nutritious elements. In addition to aforesaid ingredients, this soil conditioner contains agronomical-valued groups of microorganisms having the function promoting the growth of the crop. As organic component of SC humic acids (HA) was used. HA serve many major functions that result in better soil and plant health. In soil, HA can increase microbial and mycorrhizal activity while enhancing nutrient uptake by plant roots. HA work as a catalyst by stimulating root and plant growth, it may enhance enzymatic activity that in turn accelerates cell division which can lead to increased yields. HA can help to increase crop yields, seed germination, and much more. In short, humic acids helps keep healthy plants health.
The first stage goal was to evaluate mineral and organic ingredients for formulation of SC. Soil conditioners assessed included ash and slag. The use of slags has been largelly used in agriculture as a source of lime and phosphoric acid. The silicic acid of slags reduces Al-acitivity thus, promoting a better assimilation of P-fertilizer by plants. Additionally, silicic acid is also known to improve soil moisture capacity, thus enhancing soil water availability to plants. Physico-chemical characteristics of ash and slag were determined, as a total - about 20 samples. Results include: Chemical composition of (i) ash: 53-54% SiO2; 26-27% Al2O3; 3-5% Fe2O3; 1.7-2.9% CaO; 1.3-2.3% MgO; 0.5-0.8% Na2O; 1.0-1.5% K2O and; (ii), slag: 17-20% SiO2; 15-20% Al2O3; 30-40% CaO; 1-6% Fe2O3; 4-11% MgO. Of all samples assessed, per 5 samples from various regions with various compositions (high, average and low content of metal oxides) were selected and tested as component of SC in vegetative pot and field experiments, i.e., to study the immobilization processes including microorganisms and inorganic ingredients. This study helped to elucidate the influence of ash and slag composition on microbial development.
The next stage was (i) to evaluate microbial activity of selected soils from Kyrgyzstan, (ii) to isolate microorganisms exhibiting antagonistic activity against pathogenic microorganisms present in the soil and, (iii) to utilize microbes as nutrient sources. Candidate microbial cultures were isolated from soils/crops and assessed as plant growth promoting microorganisms. The characteristics of the physiological groups of microorganisms were also investigated. Of different physiological groups of microorganisms selected, ca, 3 consortia of agronomical–valued microbial groups from undisturbed soils was selected as component of soil conditioners. Microorganisms, namely oligonitrophils, ammonifiers, nitrifiers, were tested based on beneficial bioactivity including plant biomass and stem length on commercial onion and lettuce crops.
Our results demonstrate that all the combinations ash/slag, humic acids and consortium of beneficial agronomical–valued microbial groups into one environmentally friendly soil conditioner possessed equal or higher growth-promoting potential in relation to lettuce. However, our results demonstrated clearly that among studied scope of soil conditioners only one of them could be recommended for further study in terms of practical applications. Namely, it was mixture consisting of humic acids, ash and oligonitrophils as soil conditioning agent.
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