IMPROVEMENT OF PHYSICAL AND MICROBIOLOGICAL PROPERTIES OF SOIL THROUGH POLYMERS APPLICATION

By

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B.Sc. Agric. Sci. (Biotechnology), Ain Shams University, 2011

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ABSTRACT

Sodaf Ahmed Ahmed Ahmed Karmany: Improvement of physical and microbiological properties of soil through polymer application. Unpublished M. Sc. Thesis, Department of Agric. Microbiology, Faculty of Agriculture, Ain Shams University, 2017.

In this study, five diversified types of extracellular polysaccharides (EPs) naturally produced by soil microbial cultures were used: xanthan from *Xanthomonas* isolates; dextran from *Leuconostoc* isolates; alginate from *Azotobacter* isolates; pullulan from *Aureobasidium pullulans* strains and curdlan from *Rhizobium* isolates. Isolation of different isolates of *Xanthomonas*, *Leuconostoc* and *Azotobacter* was performed on specific media from various samples while *Aureobasidium pullulan* and *Rhizobium* cultures were obtained from the unit of bio-fertilizers, Ain Shams Univ. The screening of potent cultures for each polymer was conducted based on their culture viscosities on specific productive media. Five isolates of *Xanthomonas*, four *Leuconostoc* isolates, four *Azotobacter* isolates, three strains of *Aureobasidium pullulans* and three *Rhizobium* isolates were cultured on different productive media to select the suitable medium for enhancing each polymer production. The biological activity of potent culture for each polymer was determined under optimal nutritional conditions which were found to be; modified med A5 with sucrose and, ammonium nitrate at 27C/N ratio for *Xanthomonas* Xc11. The highest production rate of dextran was obtained by *Leuconostoc* Lm24 on modified med B4 containing the original carbon and nitrogen sources but C/N ratio was modified to be 31.5. Modified med C2 was the best for *Azotobacter* Az 10 containing sodium citrate and original nitrogen source at modified C/N ratio of 9.68. Modified med D3 containing sucrose and original nitrogen source at C/N ratio of 63.69 was the optimal for *Aureobasidium pullulans* 2. *Rhizobium* R3 was grown in modified med E2 containing glucose and yeast extract at C/N ratio of 31.25 for the highest curdlan production. The produced polymers were

used as soil conditioners for two soil types using different concentrations to evaluate their effects on soil structure under un-leaching and leaching processes.

The parameters of soil properties indicated significant differences between all bio-treatments and control (without polymer). The dextran showed the highest positive effect whereas curdlan and pullulan behaved as the least potent among the amended soils.

The effect of environmental factors together with using industrial by-products as sole carbon source were examined on biopolymers production with *Xanthomonas* Xc11, *Leucnostoc* Lm24 and *Azotobacter* Az10 which produced the most effective biopolymers as soil conditioners. Glucose syrup as a carbon source exhibited the highest culture viscosities with all tested cultures compared to other byproducts.

The molecular analysis for the most efficient cultures revealed that they are *Xanothomonas campesteries*, *Leuconostoc mesenteroides* and *Azotobacter vinelandii*. The xanthan, dextran, and alginate were, produced under optimal nutritional and environmental conditions to characterize their chemical structure using ^{13}CNMR and FTIR analysis. These biopolymers and the synthetic polymers (polyacrylamide, diaper polymer) were cheeked for their efficiency in enhancing the microbiological and physical properties of the used soil as well as growth performance of *Lactica sativa* grown in sandy clay loam soil for 55 days under greenhouse conditions. The values of the measured parameters revealed positive effects on fresh and dry weights of plant and nutrient contents .

The microbiological activity in the plant rhizosphere, was increased significantly with all bio-treatments amendment especially with dextran.

The results of the measured properties of soil demonstrated that dextran treatment recorded the lowest values of cumulative added water and total drainable pores (TDP%) recording the highest values of porosity (%), available water and MWD_{wet} as well as increased the favorable

aggregates with diameters from 1 mm to 10 mm. The synthetic polymers amended soil attained negative effect with all measured parameters.

Key words: Extracellular polysaccharide, *Xanthonomas*, *Leuconostoc*, *Auerobasidium* , *Azotobacter*, *Rhizobium*, soil conditioners ,*Lactica sativa* , FTIR, ^{13} CNMR.

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