Development of Novel Super Absorbent Polymer Using Banana Pseudo Stem Waste to Increase Water Retention Capacity of Agricultural Soils

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Water scarcity of agricultural fields for irrigation is a huge problem in many parts of Sri Lanka especially in dry zone where it covers 70% of the agriculture production. The objective of this study is to prepare a novel environmentally friendly Super Absorbent Polymer (SAP) using cellulose that extracted from banana pseudostem fibers and study the water retention capacity of SAP amended agricultural soil (AS). Cellulose was extracted from banana pseudo stem fibers by alkaline pretreatment and cross-linked with 3.75% w/w citric acid in the presence of water. Cellulose and prepared SAP was confirmed using Fourier Transform Infrared spectroscopy (FTIR) and X-Ray Diffraction (XRD) measurements. The water retention capacity of SAP was investigated with distilled water (DW) and tap water (TW). The water retention ability was examined by soil without SAP and amending SAP concentrations of 0.25, 0.50, 0.75, and 1% w/w for depths of 0-10, 10-20, and 20-30 cm. Soils with dry bulk densities of 1.78, 1.69, and 1.76 g cm^{-3} in the dry zone and 1.12, 1.34, and 1.35 g cm^{-3} in the intermediate zone were used to the SAP amendment. The absorption peak at 1724 cm^{-1} was attributed to ester linkage due to anhydride formation and Full Width at Half Maximum values in XRD patterns for both cellulose and SAP were decreased from 3.020 to 2.950 with increased the crystallinity which confirm the cross-linking of SAP. FTIR and XRD results showed that the banana pseudo stem is a source for cellulose extraction. The maximum water retention capacity of SAP was 67.4 g/g for DW and 57.4 g/g for TW. SAP amended soils showed a significant increase in overall water retention than AS without SAP. The evaporation test showed that 0.75% is the best SAP concentration for water retention in all selected AS. It is needed to test water retention capacity for wet zone AS to get an overall idea about the effect of prepared SAP as the dry and intermediate zone AS showed the significant increase in water retention with the SAP amendment.

Keywords: Super Absorbent Polymer (SAP), Banana Pseudo Stem, Cross-linking, Evaporation Test, Agricultural Soils (AS)