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Eco-friendly cellulose-based hydrogels derived from wastepapers as a controlled-release fertilizer

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Abstract

In this study, an eco-friendly controlled release fertilizer cellulose-based hydrogel was prepared from cellulose fibers derived from wastepaper, epichlorohydrin (ECH) as a crosslinker and carboxy methyl cellulose (CMC) as a gelling agent. A maximum swelling capacity of 2000% was achieved for cellulose hydrogel with optimum composition. The soil moisture contents in the presence of optimized cellulose hydrogels were determined using the digital moisture meter. Maximum soil moisture of 36.5% was obtained in topsoil, followed by 30.1% in wet clayey soil and 23.4% in sandy soil after 7 days. Urea as a model fertilizer was loaded onto the cellulose hydrogels to control the release of fertilizer. The maximum loading capacity of urea in cellulose hydrogel is 0.51 g/g. The urea-controlled release profiles of the cellulose hydrogel in distilled water and various types of soils were investigated. The formulation of cellulose hydrogels was observed to facilitate the gradual release of urea, with about 74.71% release in topsoil, 73.37% release in wet clayey soil and 71.84% release in sandy soil within 42 days when compared to the free urea which was about 97.32%, 95.09% and 98.47% release in topsoil, wet clayey soils and sandy soils, respectively within 7 days. The result of this study shows that the urea-loaded cellulose hydrogel could be a promising controlled-release fertilizer.

Keywords Controlled-release fertilizers, Carboxymethyl cellulose, Swelling ratio, Water retention, Sustainable agriculture

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