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T504: Applications of Nanotechnology for the Environment and Circular Economy

Natural-based nanocomposite reinforced by Hydroxyapatite nanoparticles as a water reservoir for agriculture use

María Javiera Guarda-Reyes
Nano-Biotechnology Laboratory, Universidad de La Frontera, Temuco, Chile; Doctorado en Ciencias de Recursos Naturales, Universidad de La Frontera, Temuco, Chile

Marcela Calabi-Floody
Nano-Biotechnology Laboratory, Universidad de La Frontera, Temuco, Chile; Scientific and Biotechnological Bioresource Nucleus (BIOREN-UFRO), Universidad de La Frontera, Temuco, Chile

Maria de la Luz Mora Gil
Scientific and Biotechnological Bioresource Nucleus (BIOREN-UFRO), Universidad de La Frontera, Temuco, Chile

Humanity's growing population faces many challenges in a climate change scenario, such as drought. Water scarcity is a substantial impediment to the growth of crop species and represents a crisis for food security. Therefore, the development of agronomic strategies for the reduction of drought stress in crops is a crucial priority. Superabsorbent hydrogels (SAHs) have extensive applications in agriculture and have proven to be very beneficial for plant growth and soil health; however, most commercially available hydrogels are derived from petroleum and are difficult to degrade in soil, so migrating to strategies with eco-friendly, non-toxic materials is necessary. Carboxymethylcellulose (CMC) and hydroxyethylcellulose (HEC) are natural-based polymers that can be used to synthesize environmentally friendly superabsorbent hydrogels for numerous applications. However, these biopolymers result in hydrogels with poor mechanical properties. Different fillers can be used to improve this property, but occasionally they can decrease the swelling capacity. Hydroxyapatite nanoparticles (HAnps) are an excellent option to improve hydrogel characteristics since it can generate more stable structures. CMC/HEC/HAnps nanocomposites were synthesized, and Fourier Transformed Infrared Spectroscopy (FTIR) was used to confirm the crosslink reaction. The water swelling properties of the nanocomposite were optimized through design of experiments (DoE), with a 3 level factorial design of the nanoparticle loading and crosslinker. The water absorption analysis indicated that the SANs can be classified as superabsorbent since all of them show an absorption capacity above 100 g g^{-1}. Besides that, HAnps played an essential role in the water absorption capacity, and the incorporation of 5% of HAnps with 2 - 3% citric acid resulted in a material with a degree of swelling of approximately 800 g g^{-1}. The developed hydrogels showed unique characteristics, being adequate for agricultural systems aiming for water delivery to the soil. Further studies regarding the synthesis method and mechanical performance for the assessment of adequate application in soil.

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