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CARBOXYMETHYL CELLULOSE COATED UREA INTERCALATED MONTMORILLONITE NANOCOMPOSITES FOR CONTROLLED RELEASE OF UREA

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Nitrogen is one of the most important plant nutrients in fertilizers, and urea has been widely used to fulfil the global need. However, due to leaching and volatilization, 50 - 70% of urea is lost resulting in very low Nitrogen Utilization Efficiency (NUE) to plants. Slow and controlled release fertilizers are believed to have more potential in increasing NUE. Urea intercalated clay-polymer nanocomposites are one of the promising candidates as a controlled release nitrogen fertilizer. In this study, a nanocomposite was prepared by intercalating urea into montmorillonite (MMT) clay to control urea release rate. The nanocomposite was then coated with a polymer to further decrease the release rate of urea. Carboxymethylcellulose, a biodegradable and environmentally friendly polymer, was used as the coating. During this work, urea was intercalated into MMT matrix in 1:1 ratio in deionized water by stirring at 400 rpm for 1.0 h. Then, 5% polymer by mass, dissolved in hot (60 °C) deionized water, was added and stirring was continued at 400 rpm for further 30 min. Samples prepared were dried in oven at 60 °C for 48 h and characterized by powder X-ray diffraction. Expansion of the interlayer space of MMT indicated the successful intercalation of urea molecules into the interlayer space of nanoclay. A study was carried out to investigate the extent of release for soil collected from Kandy of Sri Lanka using 1:1 nanocomposite and commercial urea separately. The release study results showed that 60% commercial urea is released to the soil within 2 days whilst about 10% urea was released by nanocomposite for the same time interval. Furthermore, nanocomposite prepared took 26 days to release about 85% urea, and around 15% urea might have escaped as gasses or trapped inside the clay matrix. These findings reveal that the nanocomposite fertilizer prepared is a potential candidate to address the low NUE in agriculture.

Keywords: Biodegradable, Controlled release, Intercalation, Nanocomposite