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Encapsulation of nitrogen fertilizer urea in porous calcium carbonate nanocarriers derived from local mineral dolomite for effective and slow release

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Improvement of the utilization of fertilizer nutrients is important for the development and yield enhancement of agricultural production. Nitrogen is so far the most imperative nutrient for crops. Amongst the nitrogen fertilizers, urea is the most extensively used fertilizer owing to its high nitrogen content (46%) and comparatively low cost of production. However, because of surface runoff, leaching, and vaporization, the utilization efficiency or plant uptake process of urea is generally below 50%. About 45-75% of nitrogen of the applied fertilizers liberates to the environment and cannot be captivated by crops, which can be a large economic and natural resource losses and very serious environmental pollution like in algal blooming. Slow or controlled-release technology could successfully resolve these problems, and avoid or reduce the loss of fertilizers and environmental pollution. As such, this research was carried out to develop an economical, easily adaptable and scalable method to encapsulate urea in calcium carbonate nanoparticles (CCNP) synthesized using our own dolomitic recourses. Synthesized CCNP are in the nano-range between 20- 80 nm with average particle size of 38.9 nm in 90% confidence interval. The FT-IR spectrum urea encapsulated nanoparticles have all the bands corresponding to $CaCO_3$ and N-H at 3455 and 1625 cm^{-1}, C=O at 1677 cm^{-1} and C-N at 1453 cm^{-1} clearly indicating the presence of urea in CCNP. Titrimetry of urea before and after encapsulation show that 99.0% encapsulation of urea in CCNP. EDAX spectrum clearly shows the presence of the elements Ca, O and N which is derived from CCNP and Urea.

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