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SURFACTANT MODIFIED NANO-MONTMORILLONITE AS SLOW-RELEASE NITRATE FERTILISER

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The application of chemical fertiliser is the most straightforward way to increase crop yields. However, the overuse of fertilisers causes serious environmental hazards and human health problems. Most chemical fertilisers are inefficient because their nutrient release dynamics do not synchronise with plant nutrient uptake. As a result, most applied fertilisers tend to escape through leaching, adsorption, degradation, and surface runoff. We hypothesise that developing a biologically synchronised slow-release nano fertiliser (BSSRNF) will further improve nutrient use efficiency. Nitrogen (N) is the most important nutrient for all plant species, and it is primarily taken up in the forms of NH_4^+ and NO_3^-. Surfactant modified montmorillonite (SMM) was developed as a carrier molecule to slow down the release of NO_3^-. MMT's surface area was increased to retain NO_3^- by treating with a cationic surfactant hexadecyltrimethylammonium bromide (HDTMA). Scanning electron microscopy, Fourier transform infrared analysis, X-ray diffraction, and thermogravimetric analysis were used to characterise the material's surfactant modification. Further, MMT was modified by using different combinations of HDTMA and the maximum ratio of NO_3^- to HDTMA absorbed was determined. It demonstrated that the material modification increased the surface capacity by a factor of nine when compared to the unmodified MMT. Also, the sorption of nitrate can be well described by the Langmuir sorption isotherm. It further demonstrated that the supply of NO_3^- from fertiliser-loaded SMM was available after 60 days of continuous leaching. These findings indicate that SMM can be adopted to deliver NO_3^- in a synchronised, slow-release manner and thus has enormous potential to improve plant fertiliser N use efficiency in cropping systems.

Keywords: Fertilizer, Montmorillonite, Nitrate, Slow-release, Surfactant