

## **SURFACTANT MODIFIED NANO-MONTMORILLONITE AS SLOW-RELEASE NITRATE FERTILIZER**

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Application of chemical fertilizer is the most straightforward way to increase crop yields. However, the overuse of fertilizers causes serious environmental hazards and human health problems. Most chemical fertilizers are inefficient because their nutrient release dynamics do not synchronize with plant nutrient uptake. As a result, a majority of applied fertilizers tend to escape through leaching, adsorption, degradation, and surface runoff. We hypothesize that developing a biologically synchronized slow-release nano fertilizer (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  $\text{NH}_4^+$  and  $\text{NO}_3^-$ . Surfactant modified montmorillonite (SMM) was developed as a carrier molecule to slow down the release of  $\text{NO}_3^-$ . MMT's surface area was increased to retain  $\text{NO}_3^-$  by treating with a cationic surfactant hexadecyltrimethylammonium bromide (HDTMA). Scanning electron microscopy, Fourier transform infrared analysis, X-ray diffraction, and thermo gravimetric analysis were used to characterize the material's surfactant modification. Further, MMT was modified by using different combinations of HDTMA and the maximum ratio of  $\text{NO}_3^-$  to HDTMA absorbed was determined. It was clearly 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. Our further demonstrated that the supply of  $\text{NO}_3^-$  from fertilizer-loaded SMM was available after 60 days of continuous leaching. All of these findings clearly indicate that SMM can be adopted to deliver  $\text{NO}_3^-$  in a synchronized, slow release manner, and thus has enormous potential to be used to improve plant fertilizer N use efficiency in cropping systems.

**Keywords:** Fertililizer, Montmorillonite, Nitrate, Slow-release, Surfactant