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Hydroxyapatite – urea nano-hybrid as efficient plant nutrient systems

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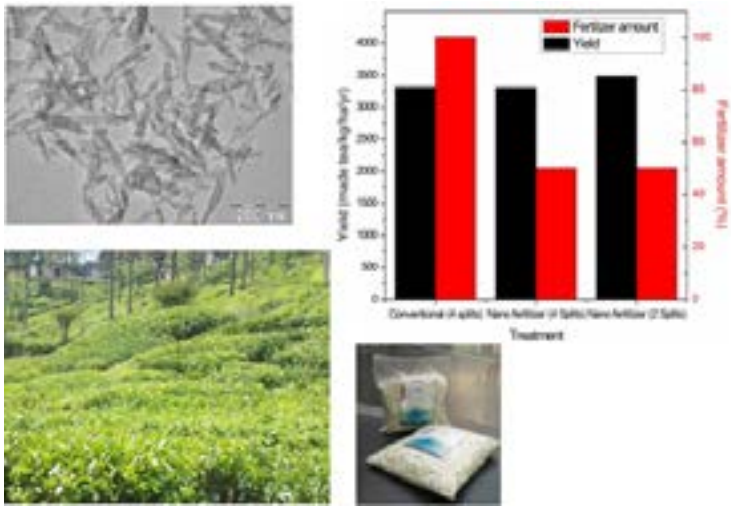
Urea remains the most widely used nitrogen fertilizer worldwide. However, its massive losses during fertilization remain an impediment for its bio-availability to crops. Therefore, slowing down the leaching and volatilization of urea during crop fertilization has emerged as a solution to not only in saving the cost of food production but also preventing environmental damage caused by excess urea accumulation. Although, it has been suggested that nanotechnology might provide solutions to this difficult problem, thus far, practical strategies to do so have remained elusive. In this regard, we have developed urea coated hydroxyapatite nano-hybrid as a platform for slow release of nitrogen. Further, we argued that if the percentage of nitrogen in the above nanocomposite can be made close to that of urea, it would make such a solution economically viable. Thus, sol gel mixing of phosphoric acid and calcium hydroxide in the presence of urea gave rise to urea coated hydroxyapatite rod shaped nanoparticles containing 40% N. This resulting suspension was successfully flash dried to provide a stable solid nanocomposite with an average particle diameter of approximately 60 nm. The laboratory process was successfully scaled up to pilot plant without sacrificing the properties observed at the bench scale. It served as an unprecedented nitrogen slow release composition in water column studies at laboratory level. These encouraging results were validated by applying this nano-hybrid as a slow release nitrogen fertilizer formulation in farmer's field trials for tea. The trials at farmer's field level conducted in gravel soil (pH 4.5–5.0), with 50% reduction of the recommended amount of N as urea (293.5 kg/ha per year) and with the reduction of number of splits (2 splits per year) yielded an increase of 5% of the yield compared to the treatments conducted using urea (587 kg/ha per year, 4 splits). This nanotechnology based slow release fertilizer approaches therefore, have the capacity to multiply into many futuristic sustainable global fertilizer solutions.



Biography

Nilwala Kottegoda is a Professor in Chemistry at University of Sri Jayewardenepura, and a Principal Research Scientist at Sri Lanka Institute of Nanotechnology. She obtained her BSc in Chemistry from University of Peradeniya and PhD in Material Chemistry from University of Cambridge, UK. She is the principal author of few US patents which were granted for the research wok in nano agriculture and they are the first few patents granted to Sri Lanka for nanotechnology based innovations. She also received the national award for the best innovation with commercial potential in 2011 and the Third World Academy of Science Young Scientist award to Sri Lanka in 2013.

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