

Nanotechnology for Sustainable Development in Sri Lanka

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Nanotechnology is an emerging and rapidly growing field. Its dynamics and prospects pose many great challenges to both scientists and society. In this context, nanotechnology could be both relevant and appropriate to sustainable development practices in Sri Lanka, opening up opportunities to address some of the countries' most critical development problems.

Nanotechnology has brought about a novel template for revolutionizing the agriculture sector by introducing new tools for the molecular treatment of diseases, rapid disease detection, and enhancing the ability of plants to absorb nutrients. Out of the many challenges, development of efficient plant nutrient systems have been at the highest priority in the global agenda. Of the several elements required by the plants through chemical fertilizers, the issues and challenges pertaining to N, P and K dominate the current commercial global agriculture. Considering the extensive use of fossil fuels and the production of greenhouse gases resulting from its use in agriculture, nitrogen fertilizers have the highest monetary value. Of the nitrogen fertilizer applied using conventional formulations such as urea, 50 – 70 % is lost to soil due to leaching into water streams and volatilization and emission as ammonia and nitrogen oxides and soil microorganism mediated incorporation into soil organic matter over time. This release of nitrogen to the environment gives rise to a number of environmental issues. In the quest for improving nutrient use efficiency, nanotechnology has brought about a novel template in introducing sustainable plant nutrient delivery systems.

In our approach, the platform based on urea coated hydroxyl apatite nanoparticles as slow release nitrogen formulations has opened up new opportunities for innovative and sustainable solutions to the problems pertaining to global fertilization challenges. Here, urea coated hydroxyl apatite nanocomposites are engineered to harmonize the nutrient release and the plant uptake thus minimizing the premature losses and environmental damage. More importantly, the synthesis of this nano-fertilizer system involves a one-step approach with a nitrogen loading percentage of 40% which is very close to the nitrogen percentage in urea (46%). This novel slow release nanocomposite system has demonstrated a promising outcome at field level for various crops, suggesting that the nano-plant nutrient formulation maintains a synchrony between nutrient supply and plant demand through slow release mechanisms as expected, thus leading to a saving of 25 – 40 % of nitrogen fertilizer with simultaneous improvement in the yield. In addition, the nano-fertilizer system has demonstrated minimum losses due to emissions. Such control in global N fertilizer consumption would immensely contribute towards the reduction of the carbon foot print by minimizing the burning of fossil fuel required for production of N based fertilizers. This nano-slow release fertilizer approach therefore, has the capacity to multiply into many futuristic sustainable global fertilizer solutions.