Synthesis of a micronutrient nanofertilizer by incorporating zinc oxide and copper oxide nanoparticles to alginic acid

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Technological advancements have paved way for mass production of nanoparticles of physiologically important metals which are used to promote plant growth by improving fertilizer formulations. Lack of micronutrients can cause adverse effects on plants. Hence, the need for micronutrient nanofertilizers arise. The objective of this study was to develop a complex capable of delivering micronutrients to plants while nourishing the soil. ZnO and CuO nanoparticles, which promote seed germination, were used as the test nano-nutrients and alginic acid was used as the soil conditioner. When these chemically synthesized nanoparticles were reacted with sodium alginate, a hydrogel was produced due to cross-linking of alginate chains by $Zn^{2+}_{(aq)}$ and $Cu^{2+}_{(aq)}$. This hydrogel was freeze-dried and characterized by FTIR and SEM techniques. SEM studies indicated that unreacted metal oxide nanoparticles were distributed and entrapped throughout the cross-linked alginate matrix. This confirmed that the synthesized nanofertilizer was capable of delivering Zn and Cu cations and metal oxide nanoparticles to plants. The release behaviour of the nanofertilizer was experimented in soil and water using the tea bag method. Results indicated that the release of metals was gradual and incremental over time. Plant uptake of Zn and Cu was determined by applying the nanofertilizer to tomato plants and conducting leaf analyses. To certain plants, the nanofertilizer was added with a compost capable of delivering NPK nutrients. Although Zn concentrations in all leaves were undetected by FAAS, Cu concentrations in compost added plants showed a much steadier increase with time.

Keywords: nanofertilizer, micronutrients, alginic acid, leaf analysis