

## Green Synthesized Iron Oxide Nanoparticles: A Nano-Nutrient for the Growth and Enhancement of Flax (*Linum usitatissimum* L.) Plant

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**Abstract :** Iron oxide nanoparticles ( $\text{Fe}_2\text{O}_3$  NPs) are widely used in different applications due to its ecofriendly nature and biocompatibility. Hence, in this investigation, biosynthesized  $\text{Fe}_2\text{O}_3$  NPs influence on flax (*Linum usitatissimum* L.) plant was examined. The biosynthesized nanoparticles were found to be cubic phase which is confirmed by XRD analysis. FTIR analysis confirmed the presence of functional groups corresponding to the iron oxide nanoparticle. The elemental analysis also confirmed that the obtained nanoparticle is iron oxide nanoparticle. The scanning electron microscopy and the transmission electron microscopy confirm that the average particle size was around 56 nm. The effect of  $\text{Fe}_2\text{O}_3$  NPs on seed germination followed by biochemical analysis was carried out using standard methods. The results obtained after four days and 11 days of seed vigor studies showed that the seedling length (cm), average number of seedling with leaves, increase in root length (cm) was found to be enhanced on treatment with iron oxide nanoparticles when compared to control. A positive correlation was noticed with the dose of the nanoparticle and plant growth, which may be due to changes in metabolic activity. Hence, to evaluate the change in metabolic activity, peroxidase and catalase activities were estimated. It was clear from the observation that higher concentration of iron oxide nanoparticles ( $\text{Fe}_2\text{O}_3$  NPs 1000 mg/L) has enhanced peroxidase and catalase activities and in turn plant growth. Thus, this study clearly showed that biosynthesized iron oxide nanoparticles will be an effective nano-nutrient for agriculture applications.

**Keywords :** catalase, fertilizer, iron oxide nanoparticles, *Linum usitatissimum* L., nano-nutrient, peroxidase

**Conference Title :** ICBN 2017 : International Conference on Biotechnology and Nanotechnology

**Conference Location :** Lisbon, Portugal

**Conference Dates :** April 16-17, 2017