

Title: Rice seeds biofortification using biogenic iron oxide nanoparticles synthesized by using *Glycyrrhiza glabra*: a study on growth and yield improvement

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Abstract: Iron, a crucial micronutrient, is an integral element of biotic vitality. The scarcity of iron in the soil creates agronomic challenges and has a detrimental impact on crop vigour and chlorophyll formation. Utilizing iron oxide nanoparticles (IONPs) via nanopriming emerges as an innovative method to enhance agricultural efficiency and crop health. The objective of this study was to synthesize biogenic IONPs from *Glycyrrhiza glabra* (*G. glabra*) plant extract using green chemistry and to evaluate their nanopriming effects on rice seed iron levels and growth. The synthesized IONPs were analyzed using UV–Vis spectroscopy, Fourier-transform infrared spectroscopy (FTIR), Scanning electron microscope (SEM), Transmission electron microscopy (TEM), and Energy-dispersive X-ray (EDX) techniques. The UV–Vis peak at 280 nm revealed the formation of IONPs. SEM and TEM showed that the nanoparticles were spherical and had an average diameter of 23.8 nm. Nanopriming resulted in a substantial enhancement in growth, as seen by a 9.25% and 22.8% increase in shoot lengths for the 50 ppm and 100 ppm treatments, respectively. The yield metrics showed a positive correlation with the concentrations of IONPs. The 1000-grain weight and spike length observed a maximum increase of 193.75% and 97.73%, respectively, at the highest concentration of IONPs. The study indicates that *G. glabra* synthesized IONPs as a nanopriming agent significantly increased rice seeds' growth and iron content. This suggests that there is a relationship between the dosage of IONPs and their potential for improving agricultural biofortification

Keywords: Iron Oxide Nanoparticles (IONPs); Nanopriming; *Glycyrrhiza glabra*; Rice Growth; Iron Biofortification

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