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Zinc and iron oxide nanoparticles improved the plant growth and reduced the oxidative stress and cadmium concentration in wheat

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1 **Zinc and iron oxide nanoparticles improved the plant growth and reduced the oxidative**
2 **stress and cadmium concentration in wheat**

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14 **Abstract**

15 The effects of seed priming with zinc oxide (ZnO) and iron (Fe) nanoparticles (NPs) on the
16 growth and cadmium (Cd) accumulation by wheat (*Triticum aestivum*) were investigated. Seeds
17 of wheat were primed with different concentrations of either ZnO NPs (0, 25, 50, 75, and 100 mg
18 L⁻¹) or Fe NPs (0, 5, 10, 15, and 20 mg L⁻¹) for 24 h by continuous aeration and then the seeds
19 were sown in a soil which was contaminated with Cd due to long-term application of sewage
20 water. Plants were grown till maturity under natural conditions with 60-70% moisture contents of
21 total soil water holding capacity throughout the experiment. Plant height, spike length, and dry
22 weights of shoots, roots, spikes, and grains were increased with NPs, in particular with the higher
23 rates of NPs. The results depicted that NPs positively affected the photosynthesis of wheat as

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