

Article title	Nanoparticle and Ionic Zn Promote Nutrient Loading of Sorghum Grain under Low NPK Fertilization
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Abstract	<p>This study evaluated the effects of ZnO nanoparticles (NP) or Zn salt amendment on sorghum yield, macronutrient use efficiency, and grain Zn-enrichment. Amendments were through soil and foliar pathways, under "low" and "high" levels of nitrogen, phosphorus, and potassium (NPK). In soil and foliar amendments, grain yield was significantly ($p \leq 0.05$) increased by both Zn types, albeit insignificantly with soil-applied Zn at low NPK. Across NPK levels and Zn exposure pathways, both Zn types increased N and K accumulation relative to control plants. Compared to N and K, both Zn types had a mixed effect on P accumulation, depending on NPK level and Zn exposure pathway, and permitted greater soil P retention. Both Zn types significantly ($p \leq 0.05$) increased grain Zn content, irrespective of exposure pathway. These findings suggest a nanoenabled strategy for enhancing crop productivity, grain nutritional quality, and N use efficiency based on Zn micronutrient amendments, with potential implications for improved human and environmental health.</p>
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