



THE UNIVERSITY OF TEXAS AT EL PASO

Comparison of the effects of ZnO nano/bulk materials on bean plants grown in different soil types



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Introduction

Nanomaterials ZnO NMs Environmental release Previous studies Beans



Nanomaterials (NMs)

 Thousands of commercially available products contain NMs Their volume of production and diversity of applications have grown over the past decade and continue to grow rapidly Although there are many benefits to using NMs in various applications, there is concern that their environmental implications are not fully understood

Keller et al. (2013) J. Nanopart. Res., Bandyopadhyay et al. (2012) Appl. Spectrosc.



ZnO applications







of ZnO NMs produced yearly



Piccinno et al. (2012) J.Nanopart. Res.







Oceans and soils are among the main sinks of NMs in the environment

Rizwan et al. (2016) J. Hazard. Mater.





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Introduction

Methods

Plant studies in ZnO NMs

Altered nutritional values [Peralta-Videa, et al. 2014] Reduced biomass production and root elongatic No s in N₂ fixation in nodules [Priester, et al. 2012]

> Decreased biomass Inhibit coil enzymes [Du, 2010]

> > Reduced production of developed Developed ret photosynthesis [Zhao Increased fruit yield Enlarged root and stems[Raliya, et al. 2015]

In-lab synthesized NMs







- Most consumed legume
- o 26 million tons/year produced
- Large variety of environments
- High nutritional quality @ low cost





Methods ZnO NMs

Experimental conditions

Plant exposure

Analysis





Experimental conditions

Plant: Red Hawk kidney bean

Treatments: Z-COTE, Z-COTE HP1

bulk ZnO, ZnCl₂

Concentrations: 0, 62.5, 125, 250, 500 mg/kg

Soils: Natural soil, enriched soil (50% potting mix)

Harvest: 45 and 90 days



Plant exposure



1

Z-COTE



2











ZnO NMs





Soil characteristics





Enriched soil (50% NS, 50% PM)



Organic Matter: pH: Total Diss. Solids: Phosphorus: Zinc:

6.8 1876 mg/L 985 ± 56 mg/100g 5.4 ± 0.2 mg/100g

18%





Mature plants







Soil I

Zn in root

Epstein (1994) Proc. Natl. Acad. Sci.



Enriched soil

 $\square 62.5 \square 125 \square 250 \square 500 \square 62.5 \square 125 \square 250 \square 500$



Biomass

		Fresh weight (g)		Dry weight (g)	
		Natural	Enriched	Natural	Enriched
	Control	8.97±0.41	17.16 ± 0.66	1.4 ± 0.08	2.72 ± 0.09
	Treatments	none	none	none	none
X	Control	10.71 ± 0.83	33.88 ± 1.36	1.35 ± 0.09	3.92 ± 0.12
	Treatments	none	 ★ ZnO Bulk ·250 42.85 ± 2.37 ↓ Z-COTE · 500 21.36 ± 1.56 	none	none









Hajrasuliha (1980) Plant Soil; Tavakkoli et al. (2010) J. Exp. Bot.





Mature pods



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The soil type highly affects the way the nanomaterials interact with the plant system



Summary

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Thank you for your attention

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