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Synthesis and characterization of nano zinc oxide for linseed

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Abstract
Zinc oxide (ZnO) nanoparticles were prepared via direct precipitation method in the laboratory and characterized with the help of Dynamic Light Scattering and Fourier Transform Infrared Spectroscopy (FTIR). A particle size of nano ZnO 45.18 - 48.50 nm, the Polydispersity Index in all the samples range from 0.224 to 0.250, indicating that these are mid-range values and the particles remain in disperse form in all the samples. The zeta potential values of synthesized nano ZnO particles are found to be -27.2 ± 7.6 mV revealing the better stability in aqueous suspension.

Keywords: Synthesis, characterization, nano ZnO, polydispersity index, dynamic light scattering and fourier transform infrared spectroscopy (FTIR)

Introduction
Micronutrient deficiencies in plants may lead to reduced yields and in severe cases, to plant death, also. Among the micronutrients, Zn deficiency is the most detrimental to crop growth and yield of all the cereal crops including wheat (Alloway, 2008, Marschner, 1995 [1, 7]). The deficiency of Zn in Indian as well as world soils is very well documented constraint in crop production and since last couple of decades, it is considered to be the 4thmost yield limiting nutrient after N, P, and K, respectively in India (Sillanpaa, 1990, Katyal and Sharma, 1991, Singh, 2009, Shukla *et al.*, 2014 [9, 5, 10, 8]).
Nanofertilizers are the important tools in agriculture to improve crop growth, yield and quality parameters with increase nutrient use efficiency, reduce wastage of fertilizers and cost of cultivation. The main reason for high interest in nanofertilizers is mainly their penetration capacity; size and very high surface area which is usually differ from the same material found in bulk form. Nanofertilizers are not only ecofriendly but also reduce environment pollution. Nanofertilizers are highly effective for precise nutrient management in precision agriculture with matching the crop growth stage for nutrient and may provide nutrient throughout the crop growth period. Nano-fertilizers increase crop growth up to optimum concentrations further increase in concentration may inhibit the crop growth due to the toxicity of nutrient. Nanofertilizers were very effective in nutrient uptake. Nanofertilizers have limitations like synthesis and characterization of nanofertilizer is a difficult job and it is less available in market. Nanofertilizers has some disadvantages like it is costlier in market and higher dose of any nanofertilizer led to decrease in yield.
Nanotechnology, which deals with the matter at nanoscale (1-100 nm) is commonly referred to as a generic technology that offers better-built, safer, longer-lasting, cost-effective and smart products that will find wide applications in household, communications, medicine, agriculture and food industry, amongst other.
Nano-fertilizer mainly delays the release of the nutrients and extends the fertilizers effect period. Nano-fertilizers have higher surface area and particle size less than the pore size of roots and leaves of the plant which can increase penetration into the plant from applied surface and improve uptake and nutrient use efficiency of the nano-fertilizer (Liscano *et al.*, 2000 [6]).

Material and method:
Zinc oxide (ZnO) nanoparticles were prepared via direct precipitation method in the laboratory. As demonstrated by Anonymous (2017-18). After the preparation of ZnO NPs, different characterization techniques were used to investigate their particle size (nm), polydispersive index (PDI) and count rate (Kcps), zeta potential and morphological characteristics. Dynamic light scattering (Malvern Zetasizer, Nano ZS 90) was used to check particle size (nm), polydispersive index (PDI) and count rate (Kcps) following the standard operating procedure at 25 °C. It is a laser diffraction method with a Multiple Scattering Technique which was used to determine the particle size distribution of the nanoparticles.

In order to find out the particle size and particle size distribution from the synthesized nanoparticles in aqueous media.

Fourier-transform infrared spectroscopy (FTIR) (Perkin Elmer, Spectrum II) was used to check functional group present on the surface of zinc oxide nanoparticles by applying infrared radiation (IR) to samples of materials.

Potassium bromide (KBr) pellet preparation was carried out using 1 mg of dried zinc oxide nanoparticles synthesized at pH 10.5 and 100 mg of KBr and pellet was prepared using KBr press. The pellet was later subjected to FTIR Perkin Elmer Spectrum II spectroscopy for analysis. Scans in the range of 400-4000 cm^{-1} were collected for each spectrum at a spectral resolution of 4 cm^{-1}.

Result and Discussion

Characterization of nano ZnO

Data presented in table 1 revealed that the prepared ZnO nanoparticles showed a particle size of 45.18-47.33 nm. The Poly-dispersity (PdI) Index scale in all the samples range from 0.224 to 0.250 indicates that it is the mid-range value and the particles remain in disperse form in all the samples. It can be considered as a good result because the particle size of synthesized ZnO nanoparticles is below than 100 nm (Hasnidawani *et al.*, 2016) [3].

Table 1: Characterization of ZnO NPs for particle size (nm), PdI and Kcps

Sr. No.	Sample details	Particle size (nm)	PdI	Kcps
1	ZnO NPs (ST)	45.18±1.60	0.224±0.022	225.2±0.2
2	ZnO NPs (1st spray)	46.8±1.50	0.249±0.024	225.2±0.8
3	ZnO NPs (2nd spray)	47.33±1.25	0.250±0.016	225.4±0.4

Surface charge of synthesized ZnO nanoparticles was measured following standard operating procedure using Zeta Sizer, ZS-90 instrument. Zeta potential measurement specifies the electro kinetic potential of a colloidal system (Garcia *et al.*, 1997) [2]. Magnitude of the zeta potential is an indicator of repulsive forces between particles and therefore it can provide a good estimation of the suspension stability (Hunter, 1981) [4].

The larger zeta potential values represent lower degree of aggregation that leads to higher degree of stability of nanoparticles and smaller z-averaged hydrodynamic diameter. At lower zeta values, the nanoparticles flocculate early and the stability in nano-suspension reduces.

The common dividing line between unstable and stable suspensions is taken as +30 or -30 mV; particles having zeta potentials beyond these limits are generally considered as stable (Zak *et al.*, 2011) [11].

The zeta potential value was found to be (-27.2 ± 7.6 mV), revealing the better stability of synthesized ZnO nanoparticles in aqueous suspension.

Size Distribution by intensity

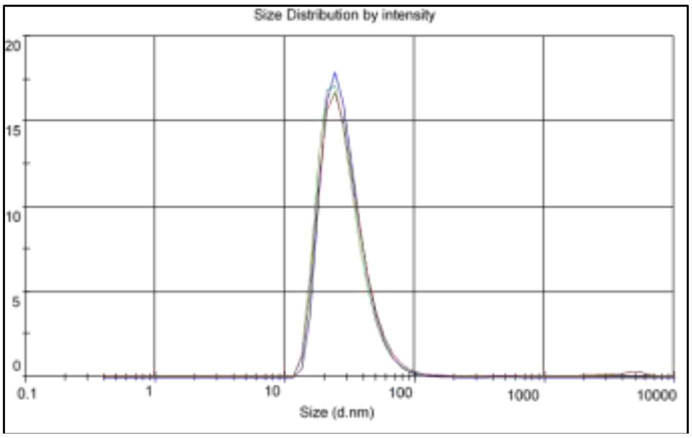

Fig 1: Particle size distribution of nano ZnO with seed treatment with 1000 ppm

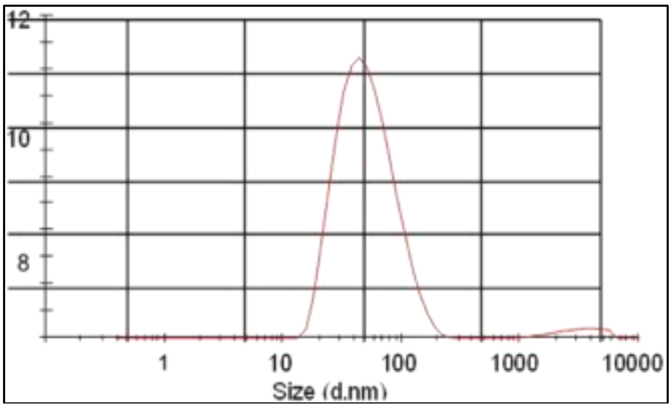

Fig 2: Particle size distribution of nano ZnO at foliar

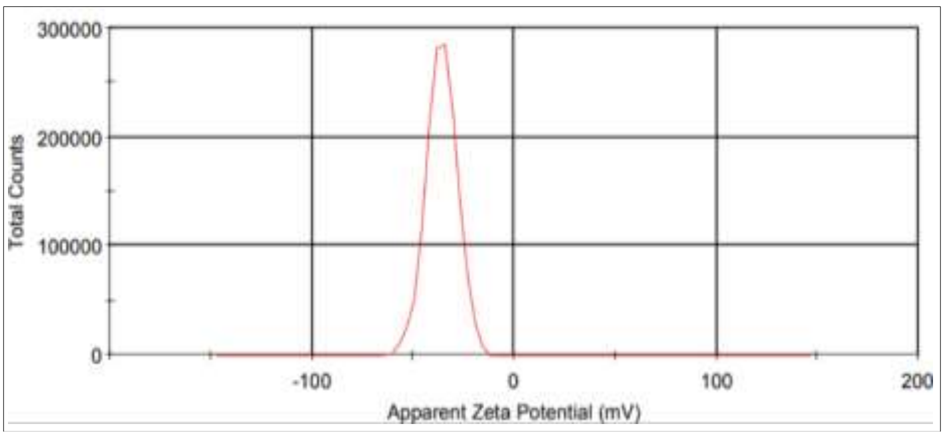

Fig 3: Zeta potential distribution

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References

1. Alloway BJ. Zinc in soils and crop nutrition (2nd edition). Brussels, Belgium: International Zinc Association; and Paris, France: International Fertilizer Industry Association. 2008, 135.
2. Garcia AB, Cuesta A, Montes-Moran, MA, Martinez-Alonso, A & Tascon, JMD. Zeta potential as a tool to characterize plasma oxidation of carbon fibres. Journal of colloid and interface science 1997;19:363-367.
3. Hasnidawani JN, Azlina HN, Norita H, Bonnia NN, Ratim S, Ali ES. Synthesis of ZnO nanostructures using sol-gel method. Procedia Chemistry 2016;19:211-216.
4. Hunter RJ. Zeta Potential in Colloid Science: Principles and Applications. Academic Press; London 1981.
5. Katyal JC, Sharma BD. DTPA-extractable and total Zn, Cu, Mn and Fein Indian soils and their association with some soil properties. Geoderma 1991;49:165-179.
6. Liscano JF, Wilson CE, Norman Jr. RJ, Slaton NA. Zinc availability to rice from seven granular fertilizers. AAES Research Bulletin 2000;963:1-31.
7. Marschner H. Mineral Nutrition of Higher Plants (2nd Ed.) Academic Press, London, 1995, 889.
8. Shukla AK, Tiwari PK, Prakash C. Micronutrients deficiencies visavis food and nutritional security of India. Indian Journal of Fertilisers 2014;10:94-112.
9. Sillanpaa M. Micronutrient assessment at the country level: an international study. FAO Soils Bulletin 63. FAO/Finnish International Development Agency, Rome, Italy 1990.
10. Singh MV. Micronutrient nutritional problems in soils of India and improvement for human and animal’s health. Indian Journal of Fertilizers 2009;5(4):11-26.
11. Zak AK, Razali R, Majid W, Darroundi M. Synthesis and characterization of a narrow size distribution of ZnO nanoparticles. International Journal of Nanomedicine 2011;6:1399-1403.