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Functional nanoscale materials in agriculture: The evergreen revolution?

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Nanotechnology includes design of nanomaterials with virtually infinite possibilities. The EU (European Commission, 2011) defines Nanomaterial as a natural, incidental or manufactured material containing particles, in an unbound state or as an agglomerate and where, for 50% or more of the particles in the number size distribution, one or more external dimensions is in the size range 1-100 nm. Nanoparticles (NPs) are the best known nanomaterials which have unprecedented surface effects due to the presence of high proportion of the atoms on their surface leads to relevant increase in the reactivity. Though, the properties of NPs are largely depends on size - the biological behavior of the NPs is determined by the chemical composition, coatings on the surface, increase in surface to volume ratio and shape. Nanotechnologies are already revolutionized the health care, textile industry, information and communication technology and energy sectors but the application of nanotechnologies in agriculture is still in it's infancy. The use of nanotechnology in agriculture shows promise. A number of reports are available in the literature on significant enhancement of plant growth and yield with the application of Nanoscale zinc oxide material in different crops like, peanut, maize, chickpea etc. Recently, researchers have reported on the potential role of nanomaterials in plant protection by the way of increasing dispersion and wettability of pesticides, better penetration of herbicides. Development of nanoparticulate delivery systems for slow - releasing of fertilizers, and the nanoscale materials for soil and water purification is been another interesting research area needs much attention. Nanosensors for soil quality and monitoring micro-environment of the plants, NPs for delivery of DNA into plants, Antimicrobial nanoemulsions for decontamination, detection of plant pathogens and contaminants in food products etc., are some of the interesting avenues for application of functional nanomaterials in agriculture. Thus, applications of nanotechnology in agriculture are promising - marching towards evergreen revolution - but it is the need of the hour to test the safety of these nanoscale materials once exposed to the environment and living organisms avoiding toxic elements and developing healthy alternatives. At this moment another important limiting factor for wide application of nanoscale materials in agriculture is the scale of production and prohibitive costs.

Biography

T N V K V Prasad is now Senior Scientist and in-charge of Nanotechnology laboratory at Institute of Frontier Technology Tirupati, and recognized as "National Resource Person in Nanotechnology", India. He received his MS and PhD in Physics with Electronics and Material Science specializations from Andhra University, India. He was awarded Endeavour Research Award from the Government of Australia in 2010 for his Post doctoral research. He introduced the concept "Agri-nanotechnology (Applications of nanotechnology in agriculture and allied science)" and filed two patents. So far, he published more than 70 research papers in peer-reviewed journals and authored two book chapters and coined the term "Phyconanotechnology". He has visited several universities as a high-level delegate and as visiting scientist including Johns Hopkins University, USA, University of Kentucky, USA, Kansas State University, USA, Tuskegee University, USA, and University of Florida, USA, University of South Australia, Australia. Currently, his research focus is on the development of agriculturally beneficial nanomaterials and their applications in agriculture and allied sciences.

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Visible light induced photocatalysis using zinc based spinel hetaerolite nanoparticles

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Spinel ZnMn2O4 nanoparticles were prepared by low temperature hydrothermal procedure and structurally characterized by X-ray powder diffraction (XRD), field emission scanning electron microscopy (FESEM), X-ray photoelectron spectroscopy (XPS), Fourier transform infrared (FTIR) and UV-visible spectroscopy which illustrate that the synthesized material is optical active and composed of well crystalline body-centered tetragonal nanoparticles with average size of ~38 ±10 nm. Hetaerolite nanoparticles were applied for the degradation of organic pollutant which executed high solar photo-catalytic degradation when applied to brilliant cresyl blue under visible light.

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