International Conference on Innovations and Research in Agriculture,
Food Science, Forestry, Horticulture, Aquaculture, Animal Sciences,
Biodiversity, Ecology and Climate Change
(AFHABEC-2018)

Phytotoxicity Assessment of ZnO Nanoparticles on Rice Plants

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Abstract—*Nanotechnology is an emerging technology, which can lead to new revolution in every field of science till 21st century throughout the world. The rapid development of nanotechnologies has encouraged the production of engineered nanoparticles (ENPs) worldwide. The use of engineered nanoparticles (NPs) in medicine, cosmetics, energy, agriculture and machinery are increasing rapidly and received much attention recently. Engineered nanoparticles (ENPs) have sizes smaller than 100 nm in at least one dimension e.g. titanium dioxide (TiO_2), zinc oxide (ZnO) etc. Different nanoparticles have been used by researchers for the growth and development of plants. The activity of nanoparticles is dependent on their structures. Effectiveness of NPs is dependent on its concentration which varies from plants to plant. Zinc oxide nanoparticle is a commonly used metal oxide engineered nanoparticles. Zinc oxide is used in a range of applications such as sunscreens and other personal care products, electrodes and biosensors photo catalysis, fertilizer and solar cells. Due to such wide range of applications it is expected that ZnO ENPs can be accidentally or incidentally released into the environment. Concern over the potentially hazardous effects of such nanoparticles has stimulated increased attention of research on toxicity. The investigation provided the information for the possible phytotoxic effects of ZnO NPs on rice plants. The effect of Zinc oxide nanoparticles (ZnO NP) on rice (Oryza sativa cv. PB1509) plant growth was assessed in hydroponics study. In hydroponic study Zn sources were applied at the rate of 0, 5, 25 and 50 mg Zn L^{-1} and one flask is used as only Hoagland's nutrient solution. Under hydroponic condition plant growth was retarded at 50 mg Zn L^{-1} concentration in ZnO NP treatments. ZnO NP significantly increased the super oxide dismutase, guaiacol peroxidase, ascorbate peroxidase activity and lipid peroxidation (measured as Malondialdehyde) activity in rice plants; however, catalase activity was significantly reduced as compared to control. Further this study revealed that inhibition of rice plant growth is source and concentration-dependent. On the basis this study it can also be concluded that, plant enzymes activities may can be sensitive tools for assessing the toxic effects of ZnO NP in plant system.*

Keywords*: Nanotechnology, Engineered nanoparticles (ENPs), Zinc oxide (ZnO), Titanium dioxide (TiO_2), Hydroponics.*