

Impacts of Nanoparticles on Soil Ecological Process and wheat Growth under Greenhouse Experiment

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Abstract—Manufactured or naturally occurring nanoparticles (NPs) have been mooted as having great potential for numerous applications in environmental applications. But there is an uprising concern about their undesirable effects on living systems in soil and plant growth. The effects of two types of metal oxide NPs (nano-ZnO and nano-Fe₂O₃), and a carbon based NPs (fullerene, C₆₀) on selected soil microbial community as well as their activity, and accumulation of nutrient in wheat straw were studied in a green house experiment. The NPs were incorporated in an Inceptisol to give a final concentration of 0.066% (w/w) for nano-ZnO and nano-Fe₂O₃ and 0.013% (w/w) for fullerene NPs. There were variable observations on population of microbial groups and enzyme activities in soils. The negative effect of NPs is evident in the case of bacteria, but this effect seems specific to type of NPs and type of microbial groups. Bacterial population was significantly lower in soils treated with nano-ZnO, nano-Fe₂O₃ and fullerene compared to control. The population of ammonia oxidizing bacteria found to be significantly lower in case of nano-ZnO and of nano-Fe₂O₃ treated Inceptisol. Urease activity and nitrification activity was decreased with application of nano-Fe₂O₃, whereas nano-ZnO showed higher values. Except urease activity, the effect of nano-ZnO found to be harmful on several other enzyme activities in the soil. The nitrogen content in wheat straw was not affected by NPs but phosphorus content in wheat straw was increased. Nano-ZnO significantly enhances zinc accumulation in wheat straw, whereas, nano-Fe₂O₃ enhances the accumulation of iron in wheat straw. The nanoparticles themselves or their dissolved ions were clearly toxic to the soil ecosystem but toxicity greatly varies with types of NPs.