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Nano-Pesticides: Recent Emerging Tool for Sustainable Agricultural Practices

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Abstract : Nanotechnology offers the potential of simultaneously increasing efficiency as compared to their bulk material as well as reducing harmful environmental impacts of pesticides in field of agriculture. The term nanopesticide covers different pesticides that are cumulative of several surfactants, polymers, metal ions, etc. of nanometer size ranges from 1-1000 nm and exhibit abnormal behavior (high efficacy and high specific surface area) of nanomaterials. Commercial formulations of pesticides used by farmers nowadays cannot be used effectively due to a number of problems associated with them. For example, more than 90% of applied formulations are either lost in the environment or unable to reach the target area required for effective pest control. Around 20−30% of pesticides are lost through emissions. A number of factors (application methods, physicochemical properties of the formulations, and environmental conditions) can influence the extent of loss during application. It is known that among various formulations, polymer-based formulations show the greatest potential due to their greater efficacy, slow release and protection against premature degradation of active ingredient as compared to other commercial formulations. However, the nanoformulations can have a significant effect on the fate of active ingredient as well as may release some new ingredients by reacting with existing soil contaminants. Environmental fate of these newly generated species is still not explored very well which is essential to field scale experiments and hence a lot to be explored in the field of environmental fate, nanotoxicology, transport properties and stability of such formulations. In our preliminary work, we have synthesized polymer based nanoformulation of commercially used weedicide atrazine. Atrazine belongs to triazine class of herbicide, which is used in the effective control of seed germinated dicot weeds and grasses. It functions by binding to the plastoquinone-binding protein in PS-II. Plant death results from starvation and oxidative damage caused by breakdown in electron transport system. The stability of the suspension of nanoformulation containing herbicide has been evaluated by considering different parameters like polydispersity index, particle diameter, zeta-potential under different environmental relevance condition such as pH range 4-10, temperature range from 25°C to 65°C and stability of encapsulation also have been studied for different amount of added polymer. Morphological characterization has been done by using SEM.

Keywords : atrazine, nanoformulation, nanopesticide, nanotoxicology
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