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NANO PESTICIDES AND ENVIRONMENT

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Abstract

The environmental effect of pesticides consists of the negative impact of pesticides on non-target species. Irrigation has increased the possibility of migration of pesticides through surface runoff into nearby water bodies and through percolation in groundwater. Fish and aquatic organisms may be harmed by pesticide contaminated water. This can thus be highly toxic to aquatic life and leads to the killing or inducing toxicity in particular stream. Conventional chemical pesticides are toxic and are threat to environmental health because of the water-insolubility of these formulations, nonbiodegradability and biomagnifications, etc. Nano-pesticides have the ability to overcome all these drawbacks and thus have become a safer and better alternative to the conventional formulations. The new dawn in agriculture with the potential of nanotechnology through nano-pesticides that approaches to inhibit plant pest definitely bears a tremendous potential to revolutionize the field of pesticide management in agriculture. Nano-pesticides (nano-sizing or the reduction of droplet size to a billionth) are used to increase the activity, surface area and water solubility of the pesticides active ingredients. Newer approaches are being implemented in the form of nano-pesticides to get maximum yield of the crop without affecting the environment. The US Environmental Protection Agency (EPA) considered being the first regulatory authority which has recognized the issues associated with nanopesticides and consulted to FIFRA Scientific Advisory Panel on the evaluation of nanometals present in pesticide products. Environmental groups and scientist working in the area of toxicology already warned that silver nanoparticles could be a problem for the environment and human health by assembling itself in water, soil and the aquatic environment. Nano-pesticides are having advanced properties that are expected to be new risks and benefits. In spite of growing uses of nanotechnology application in agriculture (synthesis of nano-pesticides) and many other sectors of the universal economy continue to raise questions and express concerns over unintentional exposure of nanoparticles on human and environmental health. Therefore it is necessary to check all the pros and cons related to nano-pesticides. The knowledge of the toxic effect of nano-pesticides on human health and the environment is scanty.

Keywords: *Nematicide, Molluscicide, Piscicide, Avicide, Rodenticide, Insecticides,*

Objectives: The main objectives of the present study are-

1. Characterization of CypNPs
2. Evaluate the 96 h LC50 value of CypNPs
3. Study and evaluate the nano-pesticides toxicity in order to preserve the quality of both the food chain and the environment.

4. Toxicity assessment of nano-pesticides

DISCUSSION AND RESULTS -

Pesticides

Pesticide includes all kind of herbicide, nematicide, molluscicide, piscicide, avicide, rodenticide, insecticides (insect growth regulators, termiticides etc.) bactericide, fungicide, animal repellent, antimicrobial, disinfectant (antimicrobial), and sanitizer, Which are used to control pests and weeds. The most common among these pesticides are herbicides which are used about 80% of all pesticides. In general pesticides are purposely serves as plant protection products, which in general, protect plants from fungi, insects or weeds and also use in household products.

Nano-Pesticides: Status of Knowledge

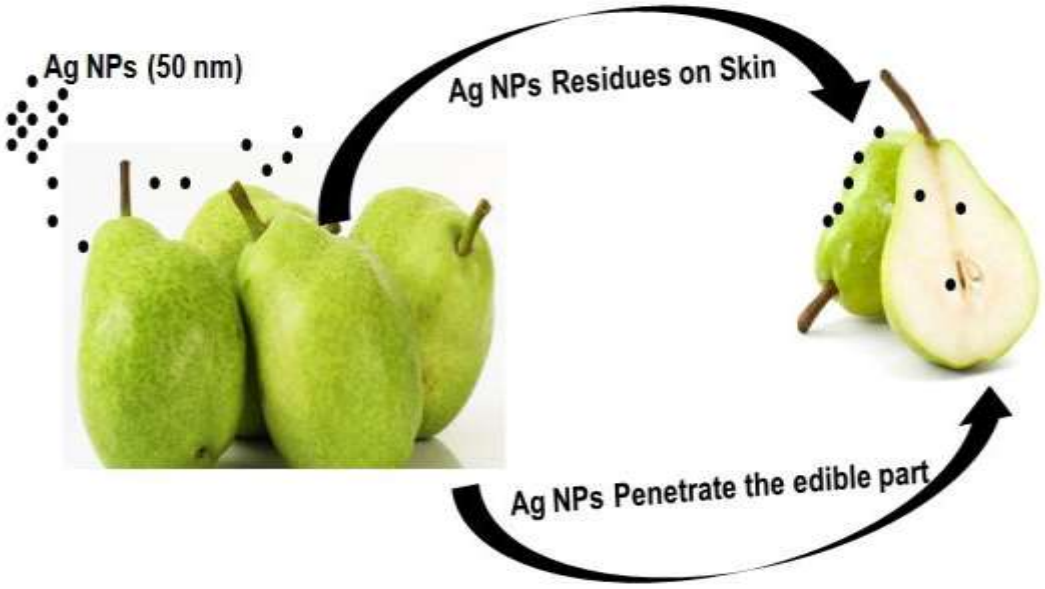
The world's limited cropland and growing population, motivated to take all the measures to increase crop production in order to ensure the food safety. Nanotechnology has the potential to revolutionize the different sectors of the agricultural and food industry with modern tools for the treatment of diseases, rapid disease detection, enhancing the ability of plants to absorb nutrients, etc. The examples of the applied nano-pesticides are nano-insecticides, nano-herbicides, nano-fungicides, and nano-nematicides, as well as encapsulation of active ingredients into biodegradable organic-based matrix systems and silica-based nanocarriers or silver and copper based nanoformulations. This new approach of nanotechnology is the formulation of nano-pesticides as an alternative of conventional pesticides.

Nanomaterials in Agriculture: Current Trends and Future Prospects

Natural nanomaterials already present in the environment in the form of volcanic dust in the atmosphere and colloids present in most soils, sediments and natural waters and have probably existed since from the earth's creation.The evolution of organisms occurs in a geochemical environment which is rich in natural nanoparticles. The nanoparticles include organic nanoparticles, iron oxides and other minerals present in environment play an important role in biogeochemical processes. However, the presence of natural nanoparticles does not mean that the entire organisms will be adapted to, or be tolerant of, manufactured nanoparticles.

Properties of Nanoparticles: Nanoparticles are considered to be the bridge between bulk materials and atomic or molecular structures. The structural arrangement of atoms and molecules are manipulated at the nanometer scale to produce the properties which are different from the bulk counterpart. Nanoparticles show unique properties of enhanced

surface to volume ratio, unexpected optical properties to produce quantum effects, surface plasmon resonance, quantum confinement in semiconductor particles, super paramagnetism in magnetic materials, and tremendous driving force for diffusion at higher temperature leading towards a wide range of applications. For example, gold and gold nanoparticles of 10 nm show different properties. Gold nanoparticles have decreased melting temperature, absorb green light and appear red, shows excellent catalytic properties, acts as a insulator and their equilibrium structure changes to icosahedral symmetry depending on size, while none of these properties are associated with the bulk gold.



Silver nanoparticles exposure and translocation inside the fruit

The synthesis of nanoform of pesticide molecules could lead to nano-pesticide emulsions that are more stable and toxic to pests and better absorbed into plants but may be these characteristics of nano-pesticides create new risks to human or the environment.The toxicological assessment of chlorfenapyr nanoparticles carried out on mice to know whether the nanoformulation of chlorfenapyr was less toxic for mice than the common formulation. The study may also indicate that the nanoformulation of pesticide may be safer to apply by reducing the environmental and human adverse effects (Wan-Jun *et al.,* 2010). But still there is a lack of knowledge on the fate, behavior and ecological risks of nano-pesticides which may differ from the conventionally formulated pesticide active ingredients. A group of researchers from University of Missouri College of Agriculture reported a study on silver nanoparticles that they have an ability to penetrate the plant surface and reached to the crop and translocate itself in the edible part of the fruit. The MU scientists began their experiment effectively mimicking pesticide application by dipping several pears in a solution containing

silver nanoparticle at 20 nanometers (nm) and 70 (nm) after that the team repeatedly washed and rinsed the pears and observed that both 20 and 70 nm nanosilver particles translocate itself on the pear's skin and pulp (Fig. 1). The penetration of nanoparticles inside the food is dangerous for consumers because after digestion it have an ability to relocate in the human body

The nano-pesticide is synthesized to reduce the doses and the contamination from the environment. But on the other side it also induces some negative impact in another way in the environment. Therefore it is not clearly known that how the fate, behavior and ecological risks of nano-pesticides differ from the conventional pesticide. Therefore, still there is a need of more researches in the field of nano-pesticides. Farm workers and rural residents are being exposed directly to these nano-pesticides, so the safety requirement is needed.

Effects of Pesticides on Environment

Pesticides use in agriculture and domestic purposes raises lots of issues associated with environmental and health and it is one of the major reasons of water pollution. Around more than 98% of sprayed insecticides and 95% of herbicides targeted non-targeted organism of air, water and soil (Miller, 2004). Moreover the application of pesticide also disturbs the biodiversity, decline pollinator (Wells, 2007), threatens endangered species (Miller, 2004) and destroys habitat especially for birds (Palmer *et al.,* 2007). The persistent Organic Pollutants such as organochlorine pesticides were categorized as 9 of the 12 most hazardous and persistent organic chemicals which are now mostly not in use (UNEP, 2005; Gilden *et al.,* 2010). Chlorinated hydrocarbon pesticides have quality to dissolve in fats and biological magnification occurs whereby these pesticides are more concentrated at higher level in food chain.

The activity and toxicity of pesticides is due to both innate chemical properties of compounds and environmental condition and processes (Sims and Cupples, 1999). For example the halogen group present in chemical structure slows down the degradation of pesticide in an aerobic environment (Sims and Sommers, 1986) and pesticides adsorption in soil may also slow down pesticide movement and decrease the bioavailability to microbial degraders (Wolt *et al.,* 1996). Pesticides exposure on people also cause acute and long term health effects, it causes irritation of the skin and eye to more severe effects such as affecting the nervous system, disrupting hormone and effecting reproductive problems and induces cancer (EPA, 2006; Bassil *et al.,* 2007). Previous studies reported that organophosphate insecticide induces significant alteration in neurobehavioral activities.

Conclusion

The increasing development of researches in nano-pesticide over the past couple of years has motivated a number of international organizations to consider the nano-pesticide as potential issues related to crop protection. Nanotechnology has revolutionized the delivery system of pesticides to its intended site of action which is considered to be in the process of initial exploration. However, the current level of knowledge is not considered to be enough for the understanding of the fate assessment of the use of nano-pesticide. Moreover, there lies the concern of environmental safety of the fate of the pesticide carriers. A great deal of research, therefore, is needed over the coming years with respect to: (i) the development of experimental protocols to generate the reliable fate properties, (ii) the investigations on the bioavailability and durability of nano-pesticides (e.g., release profiles, and aggregation behavior under realistic conditions), and (iii) evaluation of the current environmental risk.

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