



Nanoscience in Agriculture for Agrochemicals

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Due to development of modern systems for environmental condition monitoring, nanotechnology is able to improve human understanding for the biology of different crops and ultimately significantly enhance yields or nutritional values. In addition, it can offer routes to add value in crops or environmental remediation and also likely to revolutionize the next stage of development of genetically modified crops and plant breeding, molecular nanotechnology, plant disease diagnostics, efficient fertilizers and chemicals pesticides, post-harvest technology, soil management, water purification, animal production inputs, and precision farming techniques [1]. The environmental problems caused by overuse of the agrochemicals, particularly the pesticides, have attracted a lot of attention of scientists in recent years engaged in basic research. Nano scale techniques are also applying to enable the targeted delivery as well as increasing the toxicity of application of pesticide. This includes the inclusion of active ingredients having nano-scale into pesticides. The specific properties of these nano-scale materials are designed to maximize the effectiveness of these pesticides [2]. Recent research producing crystals in the nano-size range has provided evidence of improved efficiency. Some nano-agrochemicals are already in use; however other applications are still in their infancy stages. To increase the efficiency of pesticides and herbicides, nano-structured catalysts will help and thus allowing lower doses. Through the use of renewable energy supplies as well as catalysts nanoscience will also protect the environment indirectly to reduce existing pollution. Microbes through nanotechnology are being exploited as eco-friendly factories and viable alternatives to the physical and chemical methods of cleaning. Research has shown that alfalfa plants are grown in gold rich soil absorb gold nano-particles through their roots and accumulated nano-particles can be mechanically separated from the plant tissue following harvest. There are several nano plant protection chemicals available in the market such as nano-emulsions, nano-encapsulations, nano-suspensions. Nano-emulsions have many potential applications for the pests and diseases prevention measures [3]. It exhibit greater stability. It also increases coating of leaves and uptake through plant cell walls. Research is ongoing to make fertilizer and pesticide delivery systems which can respond to environmental changes. The vital aim is to make the plants use fertilizers, water, and pesticides more efficiently. This is for reducing pollution as well as to make agriculture more eco-friendly. Nano-suspensions is made up with poorly water-soluble pesticide having no matrix material suspended in dispersion [4]. The problems connected to poorly water-soluble and lipid-soluble pesticides delivery can be solved by formulating nano-suspensions. Compounds having insoluble in water and soluble in oil with greater log P value, nano-suspensions is preferred for them. Nanotechnology has extremely high potential tool in agriculture particularly used for rapid detection techniques, biosensor related control of pest and disease, soil management etc [5]. During nano formulations application as foliar spray and soil spray, both the pesticide

and carrier undergo reaction with the soil, insect, plant and atmosphere. But till date we are unable to identify that how these nano encapsulated pesticides degraded easily in the environment [6,7]. Leading agrochemical companies in India are Bayer Crop Science, Monsanto, BASF and Syngenta. They are actively engaged in nanotechnology research. Syngenta is the world's largest agrochemical company in terms of commercial applications of this technology. This company currently retail huge number of pesticides having nanoemulsion, e.g. 'Banner MAXX fungicide', 'Primo MAXX Plant Growth Regulator', 'Cruise MAXX Beans' and 'Apron MAXX RFC seed treatment'. Primo MAXX® is a plant growth regulator. If we apply this product prior to the onset of heat, drought, disease stress can strengthen the physical structure. This ultimately allow it to withstand ongoing stresses throughout its growing season. Another encapsulated product from Syngenta marketed under the name Karate® ZEON. This is a quick release micro-capsulated product. This contain active compound of lambda-cyhalothrin which can break open on contact with leaves.

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