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Nano Carrier Cargo Potential in Agriculture

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ARTICLE ID: 016

Introduction: Agriculture has always turn into a backbone of developing countries. With concern of providing food to ever increasing population. Nanotechnology can be broken in the value chain of entire agriculture product system. Nanotechnology is the make use of of matter on an atomic , molecular and super molecular level for industrial purpose. It is practically used in physics, medical science and now it is used in agriculture. Nanotechnology is first concepted in **1959** by DR. Richard P.Feynman . The term Nanotechnology was first coined by Norio Taniguchi in **1974.** The research of **Nanotechnology in agriculture** starts in about 1990"s , the momentum for use of nanotechnology in agriculture came only recently with the reports published by Roco the united states department of agriculture, the Nanoforum and Kuzma and Verhage along with like publications. **"Nano"** is derivative from Greek word meaning DWARF or small. Nanoparticle is any material having at least' one of its dimension in the range of 1- 100 nm (10 -9) m . A nanometer is one billionth of a meter. Due to its small size nanoparticles have some unique properties like higher charge density and reactivity , more strength , increased heat resistance , decreased melting point and different magnetic properties of nano clusters. The elements at nano scale changing their properties because there is large surface to volume ratio .and at the Nano scale, the motion of the electrons of elements is confined. Because this Movement is restricted, and particles or elements react differently with light compare to large scale particles. There is a greatest need of nanotechnology because Crop yield stagnation, Decline organic matter, Multinutrient deficiencies , Climate change, Shrinking arable land and water accessibility, Shortage of manual labor.

Nanoparticles: Nanoparticle is any material having at least' one of its dimension in the range of 1- 100 nm (10 -9) m . A nanometer is one billionth of a meter. A **nanocarrier** is

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nanomaterial being use as a transport element for another such as a drug or chemical or nutrient. Commonly used nanocarriers include polymers, carbon –base materials, liposomes and other substances. **Polymer nanocomposite** consists of a polymer or copolymer has nanoparticles or nanofillers dispersed in the polymer matrix. These may be in the range of 1-50nm. Combine nanoparticle with other nanoparticles. It is used to enhance mechanical, thermal, barrier properties.

Carbon nanotubes (1)Thermal conductor (2) Allotropes of carbon that have a cylindrical nanostructure with diameters ranging from 1- 50 nm.(3) CNT used as vehicle to delivery desired molecules into seeds so as to Protect them from diseases. (4) CNTs could Penetrate into hard card of germinating seed and exerted growth enchancing seed. **Magnetic mesoporous silica** NPs that comprises of a honeycomb-like porous structure with pore size and outer particle diameter in the nm range. This type of NP has hundreds of empty channels that are able of encapsulating or absorbing large amount of agrochemicals or bioactive molecules. **Solid lipid nanoparticles** (SLN) are globular nanoparticles, which makes these ideal candidates for the encapsulation of lipophilic bioactive compounds. The main advantage of SLN relies on their fairly low manufacture cost with the potential for scaling-up of production. However, potential disadvantages for its use in agriculture include poor cargo loading capacity and early cargo removal after polymorphic move during storage. **Nano-capsules** are nano-vesicular systems in which drugs are mutually with this in an inner void created by a unique polymeric membrane. Nano-encapsulation enhances drug delivery and efficacy, but the different method used for the preparation of nano-capsules often produces dispersions with low drug loading. This is a serious disadvantage when the seek is to obtain beneficial concentrations. In agriculture, nano-encapsulation technology has been used for the delivery of presently accessible pesticide molecules. However, the enhanced water solubility, which is advantageous for pesticide efficiency, brings environmental and in turn, rigid concern. By studying commercially available insecticide with an encapsulated active ingredient, Slattery et al. established that by encapsulating the in nano. **Metal based nanoparticles** include Quantum dots, nanogold, nanosilver and metal oxides such as titanium dioxide, zinc oxide, Magnesium oxide and iron oxide .

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Smart delivery of nanoparticles : The main challenge in drug delivery systems are to protect, transport and release biologically active compounds at the correct time in a safe and reproducible manner, usually at a specific target site. Drug delivery systems are engineered devices used to transport a pharmaceutical compound throughout the plant in order to release its therapeutic cargo in a controlled manner. By encapsulating the molecules within a protective shell –like structure, possible physical- chemical or enzymatic disruption of the active compound is increased but also undesirable side effects resulting from unspecific systemic distribution are reduced. Nano encapsulations of bioactive compounds helps to reduce the frequency of dosing desired during treatment and also may confer physical protection to the drug during storage prior to its use for controlled release of cargo. Charcteristics of smart delivery A vehicle that encapsulate functional ingredients, protect and delivery them to the needed site of action and on time. It's not only, that's important, but how you deliver it (1) High surface area (2) Sorption capacity (3)Controlled – release kinetics to targeted sites. Interaction of polymeric nanocomposite with plants (accumulation, uptake, and translocation), depends on different factors such as shape, size, surface charge, stability, chemical nature, functional group, and species of the plants.The cell-wall of the plants is one of the main sites of interaction with nonmaterial's/other micronutrients. The cell-wall does not allow any foreign particles including nonmaterials/other micronutrients because it acts as a physical barrier. The plant cell-wall contains phosphate, hydroxyl, carboxyl ate, sulfhydryl, and imidazole group that create complex bimolecular, thereby careful translocation and uptake.

Nano fertilizers : Nanofertilizer refers to a product that delivers nutrients to crops in one of the three conducts:

By encapsulation: The Nutrient can be encapsulated within Nano-materials such as Nanotubes or nonporous Material. Introduction nanomaterials are produced by using both physical (top-down) and chemical (bottom-up) approaches.

By Coating: Coated with a thin protective polymer film. Nanofertilizers can too be classifying based on their actions: control or slow-release fertilizers; control loss fertilizers; magnetic fertilizers or nanocomposite fertilizers (which use a nanodevice to provide a wide range of macronutrient and micronutrients in desirable concentration). Porous nanomaterials

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significantly decrease nitrogen loss by adaptable demand-based release, and by raising the plant uptake process. Example of porous nanomaterials comprise**:**

- **Ammonium charged zeolites,** which can enhance the solubility of phosphate minerals, showing an improvement in phosphorus availability and uptake by crops.
- **Graphene** oxide films, a carbon-based nanomaterial, can prolong potassium nitrate release, extending the time of function and minimizing losses by leaching.
- **Nanocalcite** (CaCO3-40%) with nano SiO2 (4%), MgO (1%), and Fe2O3 (1%) which not only get enhanced the uptake of calcium, magnesium and iron, but also mainly improve the intake of phosphorous by micronutrients zinc and manganese. which not only get enhanced the uptake of calcium, magnesium and iron, but also mainly improve the intake of phosphorous by micronutrients zinc and manganese.

Potential of nanofertilizers

Slow release: the nanocapsule slowly releases nutrients over a particular period of time. **Quick release**: the nanoparticle shell breaks ahead contact with a surface. **Specific release**: the shell breaks open when it encounters a specific chemical or enzyme. **Moisture release**: Nanoparticle degrades and releases nutrients in the occurrence of water. **Heat release**: the nanoparticle release nutrients as the temperature exceeds a set point. **pH release**: the nanoparticle only degrade in specified acid or alkaline conditions. **Ultrasound release**: the nanoparticle is ruptured by an outside ultrasound frequency. **Magnetic release**: a magnetic nanoparticle ruptures while showing to a magnetic field.

Nano gene therapy: Use of 3-100 nm mesoporous silica nanoparticle for smuggling foreign DNA into cells. Advantages of nano gene therapy is Highly proficient, Possible to incorporate different functions on single particle, Immunogenicity can be controlled. There is a great difference between Nanoparticle Mediated DNA technology and Recombinant DNA technology (1) Nanoparticle Mediated DNA technology is not species dependence. Nanoparticle collective with chemical compounds delivery genes into target cells. (Directly to nucleus, chloroplast and mitochondria, It is less time consuming and 85 % efficient to transfer DNA at target cell. It is highly stable and rarely show any disruption **where as** Recombinant DNA technology for transferring DNA, this technology is as species dependence (changing the species changed the transformation efficiency, It is very time

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consuming and less efficiency, it is might cause disturbance of genes/poor/unstable gene appearance due to the random DNA integration.

Nanopesticides : Nanopesticides are prepared either by very small particles of pesticidal active ingredients with pesticide properties.

Formulation of nanopesticides The research in nanotechnology has led to the development of diverse nanoformulation which can be applied in crop protection *viz.*, nano insecticides, nanoherbicides, nano-fungicides and nano-nematicide. Nano-pesticides are formulated According to their proposed formulations improving solubility, slow release Of active ingredients, prevent degradation *etc*. For achieving these purposes, modifications in the chemical nature carrier molecule contain be modified and classified as organic polymer-based formulations, lipid-based formulations, nanosized metals and metal oxides, clay based nonmaterial's *etc*. Some foremost nano-formulations are mentioned in this article. **Nano-emulsions,** generally an oil-in-water (O/W) emulsion is more ordinary as a nano-emulsion where, active ingredient of the chemical is dispersed as nanosized droplets in water, with surfactant molecules confined at the pesticide-water interface. Nano-emulsions get further classified based on the quantity and type of surfactants, as thermodynamically stable and kinetically stable. If the pesticide is partly soluble in the aqueous phase and impulsive formation of a stable emulsion happens when surfactant, pesticide, and water mechanism are brought together, that is a thermodynamically stable nano-emulsion. The insolubility of the active ingredient make the pesticide and surfactant to initially form a two-phase system and thus, a continuous shear make them to mix together and pesticides droplets in the nano-emulsion will remain dispersed for an extended period of time and so are considered to be kinetically stable. *Eg:* Oil in water nanoemulsion of neem oil has been developed for insect management using Tween 20 as the surfactant.

Nano-suspensions, also termed as nano-dispersions, are formulated by dispersing the pesticide as solid nanosized particles in aqueous media. In nanodispersions, the surfactant molecules get restricted at the particle surface where polar portions extend into the aqueous solution and the non-polar portions associating with the solid pesticide. *Eg:* Aqueous dispersions of nano-permethin and β- Cypermethrin be developed by researchers.

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Polymer-based pesticide nanocarriers are majorly deploy in the slow and controlled release of active component to the target site. Moreover, they can serve to improve dispersion in aqueous media and also as a protective reservoir.

Nano sensors: Nano sensors with immobilized bio receptor probes that are selective for target analyze molecules. Nano-sensors use the resolve the time of crop harvest, detect crop health and determine microbial or chemical contamination of the crop nano sensors used to diagnose disease caused by microorganisms, such as viruses, bacteria and fungi .

Conclusion : Nanotechnology requires a detailed understanding of science and material technology, in combination with information of the agricultural production system.We could say that the prospectus of nanotechnology is very bright.More studies are required to explore the mode of action of NP's, their interaction with biomolecules and their impact on the regulation of gene expression in plants. More research should be done on the effects of nanomaterials on human health, crop and the environmental safety.