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## Nanotechnology: A Promise for Modern Agriculture

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**ABSTRACT:** Nanotechnology is a cluster of chemistry, physics, engineering and biology. It has potential applications in research areas like medicine, aerospace, energy, textiles, information technology, mechanical engineering, biotechnology and agriculture. Agriculture forms the basement of a country's economy. Hence, it is necessary to develop new strategies and technologies to increase the production of cash crops. It is also important to educate the agriculturalists and make them familiar with modern trends and technologies in farming. Precision farming, nano fertilizers, biosensors etc. are widely explored all over the world. The use of nanoparticles is a recent trend in precision farming. Nano fertilizers as well as nano pesticides are now being used in our farmland. However, the mechanism of action is still not well known. This review is intended to explore the potential applications of nanotechnology in agriculture.

**KEYWORDS:** Biosensors, Nanoparticles, plant pathogens, organic farming.

### I. INTRODUCTION

Feynman was the primary one who gave an interview within the year of 1959 that a few years later impressed the abstract foundations of engineering science [19]. Development of nanotechnologies has taken a big extent since the Seventies [5]. Nanotechnology includes nanoparticles having one or additional dimensions within the order of a hundred nm or less [2]. Engineering science has the potential to revolutionize the various sectors of the agricultural and food trade with trendy tools for the treatment of diseases, fast sickness detection, enhancing the flexibility of plants to soak up nutrients, etc. [6]. In the scientific literature, there are several studies involving NPs and plants, providing a warning of the possible adverse effects once those materials act as transponders to specific targets inside of an organism, to specific organelles inside a cell, or as certain to a macromolecule or ribonucleic acid molecules within the cells [1]. Now a day, nanotechnology is extensively employed in contemporary agriculture to create true the conception of preciseness agriculture. Nanomaterials find applications in plant protection, nutrition and management of farm practices thanks to tiny size, high surface to volume magnitude relation and distinctive optical properties [2,12]. A wide vary of materials are accustomed create nano particles like metal oxides, ceramics, magnetic materials, semiconductor, quantum dots, lipids, polymers (synthetic or natural), dendrimers and emulsions [2]. Currently, positive and negative effects of NPs on plants are rumoured, and researchers have studied the results of NPs on plant germination and growth with the goal to market their use for agricultural applications [1]. In present day agriculture, sustainable production and efficiency are unimaginable without the use of agrochemicals such as pesticides, fertilizers, etc. [15].

Paper is organized as follows. Section II describes the route of nanoparticles into plants. After discussing the route of entry of nanoparticles, benefits of using biosensors is given in Section III. Section IV presents the miscellaneous applications of nanoparticles in agricultural sector. Finally, Section V presents conclusion.

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## II. ROUTE OF ENTRY OF NANOPARTICLES INTO PLANTS

Agriculture needs right smart quantity of water, and contributes considerably to its pollution through the utilization of pesticides, fertilizers and alternative agricultural chemicals [5]. So as to know the attainable advantages of applying engineering science to agriculture, the primary step ought to be to investigate penetration and transport of nanoparticles in plants [18]. It's better-known that built NPs move considerably with organic and inorganic constituents in soil [21]. Nano particles are absorbed into plant surfaces and brought up through many natural-nano or micro-meter plant openings[3]. NP uptake into the plant body will use completely different methods. The uptake rates depends on the dimensions and surface properties of the nano particles[3]. Larger nano particles will penetrate through cuticle free areas admire hydathodes, stigma of flowers and stomata [3]. The uptake of nanoparticles into plants is believed to be achieved from the injuries caused by herbivores in addition because the mechanical injuries. These wounds are the doors of entry for microorganism in addition as nano particle uptake [3]. Interaction of nano particles with the biological system Nano particles will move with biological systems in five ways: Chemical effects as metal ions within the resolution upon dissolution Mechanical effects as a result of exhausting spheres and outlined interfaces chemical change effects on surfaces Surface effects as a result of the binding of proteins into the surface by valency or non-covalent interactions Changes within the chemical surroundings several metals admire silver, Pt, Pd, Au, iron & Co catalyse chemical reactions admire chemical reaction reactions [3].

## III. BENEFITS OF USING BIOSENSORS

The union of biotechnology and engineering science in sensors can produce instrumentation of magnified sensitivity, permitting an earlier response to environmental changes and diseases [11]. A typical nano biosensor includes of three components; biologically hyper sensitized parts (probe), electrical device and detector [17]. The world's first biosensor to measure the activity of soil microorganisms was developed in 2004 by the Research Centre of Advanced Bionics (RCAB) of the National Institute of Advanced Industrial Science and Technology (AIST), Japan [7]. Biosensors, incorporated with new technologies in biology, microfluidics and nanomaterials, have various applications in agricultural production, food processing and environmental monitoring for in-field, on-line and period detection of pesticides, pathogens, cyanogenic materials, proteins, antibiotics, odour making microorganism, microbes, etc. in soil, air, water, food, plants and animals [4,7]. Nano sensors work by initiating accelerator reactions or byexploitation Nano-engineered branching molecules known as dendrimers as probes to bind to focus on chemicals and proteins [11]. The biosensor is capable of statement the attainable prevalence of soil diseases. The essential principle of soil diagnosing with the biosensor is to estimate the relative activity of favourable and unfavourable microbes within the soil determined on the idea of differential chemical element consumption in their respiration [7]. Advantages of exploitation nano sensors are tiny, portable, fast response and process (i.e., real-time), specific, quantitative, reliable, accurate, consistent, sturdy and stable which may overcome the deficits of gift sensors [11,20]. The opposite attention-grabbing application of bio- nano sensors is to cut back spore contamination in wind pollinated crops [20]. If an autonomous nano-sensors joined into a GPS system for period observation will be distributed throughout the sector to observe soil conditions and crop, it'd be of nice facilitate [11,20]. Organic farming makes use of computers, GPS systems, and remote sensing devices to live extremely localized environmental conditions, therefore decisive whether or not crops are growing at most potency or exactly characteristic the character and site of issues [13]. Nano sensors is also accustomed diagnose oil sickness (caused by infecting soil microorganisms, admire viruses, bacteria, and fungi) via the quantitative measure of differential chemical element consumption within the respiration (relative activity) of excellent microbes and unhealthy microbes within the soil [20].

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## iv. MISCELLANEOUS APPLICATIONS

Chitosan nanoparticles are being used in agriculture in seed treatment and as bio pesticide which helps the plants to fight off fungal infections[2].The nano structure plant food applications embrace magnified nutrient uptake potency in plants and developing polymer primarily based nano detector which might unharness solely the maximum amount plant food as demanded by plant roots[8]. Nano fertilizers might contain nano metallic element, silica, iron and titania, ZnCdSe/ZnS core shell QDs, InP/ZnS core shell QDs, Mn /ZnSe QDs, gold nano rods, core shell QDs, etc. [15].Development of combinatorial nano agro particles advanced that includes quite one active molecules will be one amongst the best-suited alternatives in combating the flora pathogens [4].Zinc nanoparticles are tested within the laboratory as bactericide and agent [2]. Al zeolites are used since they're extremely porous and permit the retention of the soil. These zeolites facilitate the dry soil additionally to retain all the wet content and facilitate to grab nutrients from the soil [9].Nano barcode system is multiplexed with varied infectious agent observers and has the potential to detect completely different pathogens at the same time [10]. Nanoencapsulation with nanoparticles within the style of pesticides permits for correct absorption of the chemicals into the plants [13].Nano-emulsions will encapsulate useful ingredients inside their droplets, which may facilitate a discount in chemical degradation [16].Recently, nano sized lignocellulosic materials are obtained from crops and trees that had opened a replacement marketplace for innovative and added nano-sized materials and merchandise.These will be applied in food and alternative packaging, construction, and transportation vehicle body structures [14].

## V. CONCLUSION

The emergence of nanotechnology happened just few decades ago, but its application is still expanding in sectors like medicine and agriculture. This versatile technology is a boon to mankind.Now a days, an agriculturalists makes use of biosensors, bio-nano pesticides, fertilizers. Nano particles can also be used as an excellent mechanism to fight against the bacterial and fungal pathogens. Much more of this technology is yet to be discovered. Therefore, we suggest that nanotechnology is a promise for modern agriculture.

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