



## Role of Nanotechnology in the Field of Agriculture: A Review

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### ABSTRACT

*The techniques of nanotechnology are largely utilized in plant protection, food production, processing, packing and carriage of agricultural products and quality enhancement and environmental quality controlling management. It has a lot of capability to create agriculture more and more effective by utilizing nanoagricultural chemicals and nanosensors. Nanoceramic instruments, nanopore filters, nanofeeds, nanofiltrations, nanolaminations, nanodelivery system can accurately transfer the drugs or micro nutrients at the suitable time and to the right part of the materials. Researches in the field of nanobiotechnology are becoming more and more advanced towards the capability of sequencing DNA in the nanofabrication gel freed systems which would be best suitable to allow for significant fast DNA mapping of different crop germplasms can highly give useful knowledge about different molecular markers in association with agronomically along with economically important characters. So, nanobiotechnology can boost up the worth of progress in molecular markers assisted breeding programs for the crop improvement. By the use of these engineered nanoscale materials in agriculture sector, foods and environment can have problems for the human consumptions and environment. The deficiency of enough scientific information about major risk-assessment features i.e. nanoparticles toxicity facts, bioaccumulations, ingestion risks or exposure knowledge leads towards the most concerned scenes. After the great advancements in nanobiotechnological techniques will lead to success in applications of this that agriculture will pick up.*

**Keywords:** Nanosensors, Researches, Nanoparticles, Risks, Nanobiotechnology, DNA sequencing.

### INTRODUCTION

Agriculture is considered the backbone of Pakistan. About more than 60% population directly or indirectly depend on agriculture for

their livelihood. Food security problems remain always the most relation of the humans. All nations are struggling too much with the issue since longer time.

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Mainly, it's principle plan for the progressing world including Pakistan (Vaghasia & Federman, 2011). Agriculture field in Pakistan contributes significantly to the national economies. Science and technology has performed a vital role in increasing agricultural production over the few years. A strong struggle towards agriculture has made possible to get a lot of food products and yields by utilizing widespread technology and extensive machinery (Wheeler, 2008). But during the recent years, the agricultural field has suffered many challenges such as lowering farm economy, lacking of natural assets, resurgence of the new diseases and pests and climate change like global warming. Growing population of humans puts pressure on this field to meet and to overcome the rising food demands. To overcome this problem, there is strong need to emphasize on researches, technology and distribution along with the human assets progression (Tohill, 2011).

Now, after the years of green revolutions and lacking in the agricultural yields in relation to the world populations growth, it is clear that the requirement of applying new techniques in the agriculture industries further than ever applied. New technologies likewise biotechnologies and nanotechnologies can perform a vital character in rising production and improving the qualities of the food produced by the farming communities. Many people believe that new technologies will overcome growing world food demands and will provide a massive series of health, environmental and economic benefits.

### **What is Nanotechnology Science?**

Nanotechnology is the science of technology and applied science that comprises in manipulation of the atoms and molecules for fabrication of the resources, instruments and different systems (Anonymous, 2009). This term nano is derived from the Greek word "dwarf (small)". The term nanotechnology was first of all announced in 1959 by a physicist who won noble prize for introducing this term, entitled "There's plenty of Room at the Bottom" Richard Feynman suggested by

utilizing a set of the conventional sized robotic arms to produce the replica by themselves but it was the one-tenth of the original size, after then utilizing this new set of arms to produce an even smaller set until the molecular scales are reached up to required level (Biswal et al., 2012). If, we have millions or billions of these molecular-scales armed robots, we can make programing of them to work in combined way to produce a macro scale products synthesized from individual molecules could be called as "a bottom up manufactured product" but opposed to the usual techniques of product "top down manufacturing" In 1986, K. Eric Drexler introduced this term of the nanotechnology (Eshita et al., 2011).

Nanotechnology is provisionally described as relating to the materials, structures and systems along with different processes that operate at the scale of 100 nanometers (nm) or less than it. A nanometer is equal to one billionth of a meter or thousandth of the thousandth of a thousandth of one meter. Nano is referred to a sized scale between one nanometer (nm) and 100 nm (Frazer, 2004). Nanotechnology is considered to cover the topics with viruses and other pathogens scales. Thus, it has high potential for the identification and elimination of the pathogens (Park, 2008).

Interdisciplinary and multidisciplinary researches at the unions of other disciplines likewise medicine, life sciences, chemistry, physics, engineering sciences and material sciences are basis of nanoscience and technology. Many areas such as water purifying technology, health care technology, nutrition, energy, electronics, advanced materials and advanced manufacturing would need cross and interdisciplinary researches in the fields of science and technologies (Frogget, 2009).

### **Big Challenges of the Field of Agriculture that are to be addressed under Nanotechnology Discussion forum**

1. Less production and yield of the cultivable areas
2. Food security problems for growing populations

3. Less agricultural input efficacy
4. Unsustainable farming managements
5. Vast uncultivated lands
6. Reduction of cultivable areas
7. Depletion of products
8. Low shelf life
9. Post-harvest losses
10. Global warming effects

### **Agricultural Productivity Enhancement**

#### **Exactness of agricultural farming**

Nanotechnology usage and its applications prepares agricultural farming much well targeted and best technical along with scientific implications. The exactness of farming prepares best usage of computers, globally involved satellite positioning systems and certain remote instruments to measure many parameters. There is possibility to get accurate information about environmental changes, soil texture conditions and plant diseases and health issues (Knight et al., 2010).

Precision agricultural farming means here that there are series of different systems which controls to each growth factor like light, temperature, nutrition and so on. Satellite systems are present that control the planting and harvest time by already present information (Nakamura *et al.*, 2011). This system permits the farmers when to plant and harvest the crops for avoidance of encountering the worst weather conditions. Suitable time period to get highest yield, best usage of fertilizers, irrigation managements lighting and temperatures are all controlled by these systems. A well nanotechnology tool is the usage of sensitive nuclear links in GPS systems controller (McClements et al., 2000). This is comprised of best tuning and most exact microsystems of soils; most best suited usage of inputs; new toxins production and formulation for pest control; new crops and animal characters manipulation; and more diverse and different farming practices of a very large scale for uniform yield and production (Pandey et al., 2010).

Now, nanotechnology has made miracle in the field of agriculture by vast

ramifications. We take cotton industry as an example where current techniques of spinning cotton are completely wasteful and from harvesting to fabric about 25% fiber is lost to either scrap or waste. However, a technique called electro spinning has made good usage of fiber like cotton balls, yarns and cotton batting (Park et al., 2006).

When a plant disease is detected at early stage, then we are able to overcome an outbreak of wastage of tons of foods like fruits, seeds and grains etc. But a solution is present in the field of nanotechnology to protect agriculture from bacteria, virus and fungal agents (Prasanna, 2007). There is a detection technique in nanotechnology that a farmer must adopt to overcome plant disease problems in less time and less expensive way that gives best results within short time and farmers do not need for big operations but just in few steps (Sellamuthu et al., 2011). GPS system for real time monitoring can be a best help for farmers to monitor soil texture and conditions, this would be a great help. The combinations of nanotechnology and biotechnology in sensors will make instruments of enhanced sensitivity permitting an early response to environmental variations and plant diseases (Shih et al., 2011).

The techniques of nanotechnology may be utilized in agriculture sector and yield production in the shape of nanosensors to control crop nourishment and pest control by identifying animal or plant diseases. These nanosensors may assist to enhance production and improved food security. These sensors perform the functions of external monitoring devices and do not finish in the foods by itself (Srilatha, 2011). The impacts of pesticides can be improved if a small amount of chemicals are enclosed in capsules in nanometer diameter when these are triggered by the pest presence that are to be controlled. Nanosensors have the functions to detect the pest, contaminants, nutrients and plant stress due to the temperature, drought, salinity or pressure. These sensors allow the farmers to help proper usage of inputs for efficient usage (Takefumi et al., 2002).

These progressed biosensors are considered ideal devices for the online monitoring of nerve agents and organophosphate pesticides. The bioanalytical nanosensors are used for the detection and quantification of very small sized contaminants like bacteria, viruses and toxins in agricultural field and food systems. There are special tools to detect these contaminants (St-Onge et al., 2010).

Certain nanoparticles that enters in to the pitch of controlling plant diseases are nanoforms of silver, carbon, silica and alumino silicates. The chemicals inside the nanoparticles are developed in such a way that on triggering the environmental situations, these chemicals are released. A pesticide applied to plants are ensured with nanochemicals, so that nano release of these chemicals will make best growth and will not harm the plants. Now leading pesticides companies are producing best nanopesticides and nanoherbicides at nano level (Takefumi et al., 2002).

Applications of agricultural pesticides, fertilizers, antibiotics and probiotics are normally applied by drench or spray systems to the soils or plants. Pesticides are applied as preventive to the plants. Nanosilver is most utilized and studied nano particle for the bio systems. It has strong power to combat diseases at nano levels. Nano silver solution which has an average diameter of 1.5 nm have ability to combat fungal contaminants. Nano silica-silver composite is known to be well absorbed in plants to increase disease resistance and stress tolerance (Tomlinson & Rolland, 1996).

Nano emulsions are the mixtures of two or more liquids that do not combine with each other but these are at nano levels. In these nano emulsions the diameters of the droplets are 500 nm or less than it. These nano emulsions are applied that saves the wastage of chemicals very easily (Douroumis, 2010).

Nano fertilizers are used to lessen nitrogen losses due to leaching and emissions by soil inhabitant microorganism. There is a linkage between nano fertilizers and soils that produce nano particles to overcome the problems of leaching (Elgindy et al., 2011).

## Veterinary Sciences

The chicken feed that contains nanoparticles binds to the harmful bacteria that lessens the chances of food borne contaminants. Nano clays may upgrade aflatoxins bad effects on the poultry. In the presence of light and humidity, these bacteria could be destroyed by coating with nano-titanium dioxide oxidation. So, the favorable delivery systems could overcome the problems by combating different animal disease (Forggett, 2009).

## CONCLUSION

Nanotechnology has great contribution towards enhancing agricultural production in a very sustainable way by utilizing agricultural inputs very accurately and by harming minimum to the environment. We should keep in our mind that human health should not be affected. The applications of nanotechnology in initial agriculture, product value addition, preservation of fruits etc. bring a big change in this sector. In agriculture, there is still need for more and more research to explore different problems. It is urgent need that there should be public debates on this topic of nanotechnology to make best awareness to people. There are much more products including beverages and food that are on the basis of nanotechnology farming. So, nanotechnology can be applied to the all aspects of food chains for quality and quantity enhancement that will lead to no health issues to the humans. And environment will be secured.

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