



## NANO TECHNOLOGY IN AGRICULTURE: FUTURE ASPECTS IN BANGLADESH

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### Abstract

Nanotechnology is a branch of science and promising field for future agriculture. Nanotechnology broadly used to refer both the science and technology of this emerging field. This has significant effect in agriculture and the potentiality for improvement safe environment. Nanotechnology deals with the smallest possible particle which raises hope for developing agricultural industry increases productivity with low input and this is the smart agricultural technology for future. In addition, as the most important source of increasing income, agricultural industry increases the use of this nanotech. At the same time significant challenges must be overcome for the benefits of nanotechnology to be realized. Scientists must learn how to manipulate and characterize. Government has to take responsibility for this concern. Nanotechnology have much more future prospects to enhance agricultural production by making much more advance use of nanopores, zeolotes, nanocapsules, nanosensors, etc. So, the review presents information on the use of application of nanotechnology and the challenges for adopting this new technology with the future aspects in agricultural industry.

**Key words:** Advancement in agriculture, challenges, molecular biology and nano technology.

### Introduction

Nano is a prefix which was derived from Greek word “nannos”, meaning “dwarf” means extremely small and denotes one billionth part of a specified unit indicating the factor  $10^{-9}$ . Nanotechnology is a term, was initially given by Norio Taniguchi in 1974. It can also be called as “Nanotech”, which is the study of manipulating matter up to atomic and molecular scale (Agrawal and Rathore 2014). The term nanotechnology is a branch of science that deals with the manipulation and engineering of nano-scale materials up to 1-100 nm to be precise in size (Dudo *et al.* 2011, Ehsani *et al.* 2012). Nanotechnology is the science of small things but not involved with small things. Basically, nanotechnology is a multi-disciplinary science. Nano technology is the manipulation of individual atoms, molecules or molecular clusters into structures to create materials devices with new or vastly different properties (Joseph and Morrison, 2006). According to Royal society, “Nanotechnologies are the designs, characterization, production and application of structure, device and system by unrolling the shape and size of at nanometre scale. Nanotechnology has a wide range of applications towards in agriculture, medicine, chemistry, physics, food industry, energy, telecommunications, textiles, electronics, sporting goods, construction industry, energy and automotive industry and so on (Qureshi *et al.* 2009, Bradley *et al.* 2011, Zambrano-Zaragoza *et al.* 2011, Rai and Ingle 2012, Fakruddin *et al.* 2012, Ditta *et al.* 2015).

Agriculture plays major role for the developing countries and it fills people abdomen as well as fuel the economy. The agriculture industry is the backbone of many countries economy, where more than 60% people of the world depends on directly or indirectly for their livelihood (Brock *et al.* 2011, Qamar *et al.* 2014). However, population are increasing day by day at an alarming rate. With this in view, there has to be new technology for providing more food with a shorter period of time. Basically, farmers use high doses of fertilizers and chemicals to increase the yield which affect the environment. Sustainable agriculture decreases due to use of excessive fertilizer, pesticide, herbicide, improper irrigation techniques, environmental factors such as climatic changes, etc. Nanotechnology have many potentiality to agriculture and the ambition of the nanotech in agriculture is to diminish the amount of hazard chemicals, minimize nutrient losses in fertilization and increased yield through pest and nutrient management (Prasad *et al.* 2017).

Day by day, the application and the importance of nanotechnology in the agricultural sectors is increasing all over the world. China, India, Japan and many other countries already have taken necessary steps to develop agricultural industry through nanotechnology. Researcher told that nanotechnology won't require huge investment like the traditional way. So, it is time to allocate resources and cope with the modern trend of technology in agriculture to enhance and sustain the growth of our economy. This review paper aims to discuss the prospect and scope of nanotechnology application agriculture in

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### **Methodology**

The present study is originally a review paper. All the data that are used in this paper are secondary data collected from various articles, journals and internet related to nanotechnology to share the knowledge about the application of nanotechnology, scope and prospects of the agricultural sector in Bangladesh. Various articles were collected for the review and to share the various expectancies of nanotech applications for future smart agriculture fundamental discussion were made on the basis of the results.

### **Discussion**

Nanotechnology is a promising field of interdisciplinary research and a novel scientific approach in agriculture. Nanotechnology has the potential to revolutionize the agricultural sector. Changes in agricultural technology have been a major factor shaping modern agriculture. Among the latest line of technological innovations, nanotechnology occupies a prominent position in transforming agriculture and food production. There are wide ranges of application of nanotechnology in agriculture.

Application of nanotech in seed technology is a fundamental part of increasing yield in agriculture. The agriculture industry cannot achieve the desired yield due to lack of quality seed. Seed is nature's nano-gift to man. Nanotechnology can be used to harness the full potential of seed. Without improving the seed science through the nanotech it will be difficult to reach the desire yield. Technology such as nanoprimer, nanobiosensors, coating seed are used in seed science. Nanoprimer accelerates seed germination, seedling growth, enhances starch metabolism, hydrogenase activity (Mahakham *et al.* 2017). Seed production is a tedious process especially in wind pollinated crops. Detecting pollen load that will cause contamination is a sure method to ensure genetic purity. Use of bionanosensors specific to contaminating pollen can help alert the possible contamination and thus reduces contamination. Nano-coating of seeds using elemental forms of Zn, Mn, Pa, Pt, Au, Ag etc. will not only protect seeds but used in far less quantities than done today. Quantum dots (QDs) is another nanotech which will be useful to separate unviable and infected seeds (Su and Li 2004). Coating seeds with nano membrane, which senses the availability of water and allow seeds to imbibe only when time is right for germination and even, reduce the herbicides and pesticides. The use of carbon nanotube improves the seed germination percentage through better permeation of moisture (Khodakovskaya *et al.* 2009).

Application of large amount of fertilizer is harmful for environment. Besides much of the fertilizers are unavailable to plants as they are lost as run-off leaching causing pollution. The mode of pesticide and fertilizer application enhances their efficiency and environmental impact. Proper application method of optimum quantities of fertilizer maximized nutrient uptake and reduced pollution. Nanomaterials have potential contributions in slow release of fertilizer. Nanocoatings or surface coatings of nanomaterials, on fertilizer provide surface protection for larger particles (Brady and Weil 1999; Santoso *et al.* 1995). Nanomaterials application includes with kaolin, polymeric chitosan control the release of NPK fertilizers sources (Wilson *et al.* 2008 and Corradini *et al.* 2010). Pesticides are substances or mixtures of substances broadly used to eliminate and control the harmful organisms, causing dramatic economic affect in agricultural production. Producers traditionally used excessive pesticides to combat and to control the harmful organism, leading significant economic losses in agricultural production. Nanotechnology in new formulations to enhance the effectiveness of these metabolites is made a significant contribution. (Gogos *et al.* 2012, Scott and Chen 2012, Fraceto *et al.* 2014). Nano technological formulation assist to combat the toxic effect from non target organism and boost up physicochemical stability and prohibit degradation of the active agent by microorganism (Durán and Marcato 2013). Nanotech help to detect the target species and to kill the species with the nanoparticles encapsulated herbicides.

Moreover, organic farming always a desire goal to increase productivity with less input like fertilizers, pesticides, herbicides among others through monitoring environmental variables. Organic farming makes use of computers, GPS systems, and remote sensing devices to measure highly localized environmental conditions, thus determining whether crops are growing at maximum efficiency or precisely identifying the nature and location of problems. Precision farming can also help to reduce agricultural waste and thus keep environmental pollution to a minimum. Although not fully implemented yet, tiny sensors and monitoring systems enabled by nanotechnology will have a large impact on future precision farming methodologies. With the help of smart sensors, precision farming will allow enhanced productivity in agriculture by providing accurate information, thus helping farmers to make better decisions.

Furthermore, nanotech improve the soil conditions to produce better yield, it helps to enhances the water holding capacity through the Hydrogels, nanoclays, and nanozeolites acting as a slow release source of water, reducing the hydric shortage periods during crop season. Applications of such systems are favourable for both agricultural purposes and reforestation of degraded areas. Organic e.g., such as polymer and carbon nanotubes and inorganic e.g., such as nano metals and metal oxides nanomaterials have also been used to absorb environmental contaminants (Khin *et al.*, 2012), increasing soil remediation capacity and reducing times and costs of the treatments.

In addition to packaging, nanotechnologies have an impact on the development of functional or

interactive foods, which respond to the body's requirements and can deliver nutrients more efficiently. Various research groups are also working to promote a new "on demand" foods, which will remain dormant in the body and deliver nutrients to cells when needed. Nanocapsules are the fundamental element in this sector that can be incorporated into food to deliver nutrients and the addition of nanoparticles to existing foods to enable increased absorption of nutrients.

Nanotechnology applications have the huge potential to change agricultural production by allowing better scientific management and conservation efforts to plant production. Scientists in nanotechnology can do countless contributions for the betterment of society by applying this technology in agriculture and food production systems. It provides a much better effective way of environment detection, sensing and bioremediation and can also enhance agricultural productivity by using- (i) Nanoporous zeolotes for controlled release and efficient amount of water, fertilizer etc. (ii) Nanocapsules for delivering of herbicide, vector and managing of pests. (iii) Nanosensors for detecting aquatic toxins and pests. (iv) Smart particles can be useful in effective environmental monitoring and purification processes. (v) Nanoparticle as a novel photo catalyst.

Coming nanotechnologies in the agricultural field seem quiet promising. Nanotechnology is a new and evolving area of study that could cause a great deal of harm due to its still ambiguous chemical properties. With the current application and advancements soon to come, nanotechnology will have a great impact on the direction that agriculture will take.

Nanotechnology, have the potentiality to the developing countries which are basically dependent to agriculture. Bangladesh, being still a developing country and economy depend on agriculture, can benefit immensely if Nanotech can be used properly. Nanotech can be used to rapidly increase production with low input as well as friendly environment.

However, Nanotechnology is a new technology and important to assess the risks. In order for the nanotechnology to be globally accepted, researchers need to find a way to ensure safer use of Nanotech without any possibility of harmful side effects. Government have to take necessary steps to adopt the technology, in this regard should look for researcher and technologist who are already applied to the different sectors in agriculture and for government have to handsome pay to them because countries like Bangladesh have more opportunities to apply this coming technology for future smart agriculture.

On the other, creating a bio economy is a challenging and complex process involving the convergence of different branches of science. Nanotechnology has the potential to revolutionize the agricultural and food industry with new tools for the molecular treatment of diseases, rapid disease detection, enhancing the ability of plants to absorb nutrients etc.

### Conclusion

Nanotechnology is an emergent field having enormous prospective to certainly impact on the agriculture. Thus, it is indispensable to take smart nanotechnology awareness in agriculture. Nanotechnology is a brand new technology and it is a revolutionary science that will change the agriculture and even, it offers a plethora of uses friendly options in the agricultural world. Nanotechnology is coming up as good means of cost effective and resource saving technique in the field of agriculture.

The role of nanotechnology in agriculture and food industry is proved to be useful for pest and disease detection, smart systems of chemicals and gene delivery in the crops. It will revolutionize agriculture system by increasing the productivity rate and reducing toxic substances. This is the time to incorporate nanotechnology in the agriculture system with further research studies and practical application in the field. In conclusion, considering the great challenges we will be facing, in particular due to a growing global population and climate change, the application of nanotechnologies as well as the introduction of nanomaterials in agriculture, potentially can greatly contribute to address the issue of sustainability.

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