Nano Technology for Increasing Productivity in Agriculture

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ABSTRACT

Nanotechnology is a rapidly evolving field with the potential to take forward the agriculture and food industry. It utilizes new tools which promise to increase food production in a sustainable manner and to protects crops from pest, nanotechnology derived devices are also explored in two field of plant breeding and genetic transformation. Nanotechnology can boost agriculture production, at the present time Nano-fertilizer are increasingly been used at alternates to bulk fertilizers and reduces pollution of soil and water by different agrochemical. Nanotechnology provide an excellent scope of novel application within the plant nutrition field to realize the longer-term request of the rising population because nano-particles have a exclusive physico-chemical characters i.e., high reactivity, high surface area, surface energy surface roughness, crystal structure and tunable pore size. The paper provides a critical analysis of the potential of nano technology as an important tool for enhancement of agricultural productivity.

Keywords - Nano-fertilizer, agrochemicals, Nano-sensor, Agriculture residues, Nanoparticles, physio-chemicals, potential, sustainable.

1. INTRODUCTION

Importance of agriculture to any or all human societies is characterized with increasing world population. The primary and most vital necessity of each human is to have food, and that is why every human is humans related to agriculture directly or indirectly. Growth of the agricultural sector as a context for development objectives is seen as essential in developing countries.

Upcoming technologies like bio- and nano-technologies will play a vital role in increasing production and raising the standard of food made by farmers. Several believe that these new technologies can secure growing world food needs and thereby deliver a large variety of environmental, health and economic blessings (Wheeler, 2005). Nanotechnology has evidenced its place in agricultural sciences and connected industries, as a knowledge base technology and a pioneer in solving issues related to agriculture.

Engineering science has several applications including the stages of production, processing, storing, packaging and transport of agricultural product. The utilization of engineering science in agriculture and

biology can seemingly have environmental advantages (Froggett, 2009). Engineering science as a replacement powerful technology has the flexibility to make huge changes in food and agricultural systems. Engineering science is in a position to introduce new tools to be used in biology and new materials to spot plant pathogens.

So far varied applications of engineering science in agriculture, food and animal sciences, has been proposed. Nanotechnology also will defend the setting indirectly through the utilization of other (renewable) energy provides, and filters or catalysts to scale back pollution and clean-up existing pollutants (Joseph and Morrison, 2006). Within the agricultural sector, engineering science analysis and development is probably going to facilitate and frame consecutive stage of development of genetically changed crops, animal production inputs, chemical pesticides and exactness farming techniques.

2. ENGINEERING SCIENCE AND AGRICULTURAL SECTOR

Despite many potential blessings of engineering science and thereby growing trends in publications and patents, agricultural applications haven't been able to create it to the market to a significant extent. Nanotechnology is outlined as the creation, utilization, and manipulation of materials, devices, or systems at the nanometre scale (Fathi *et al.*, 2012).

Nano materials are typically outlined as materials smaller than 100 nm and have distinctive properties when put next with their macro scale counterparts, thanks to the high surface to volume magnitude relation and novel chemical science properties like color, solubility, and natural philosophy (Zhu *et al.*, 2012; Singh *et al.*, 2017). Chemical being the foremost determinant of yield has gained a lot of attention in analysis since a long time. Although the analysis has achieved high productivity, still the nutrient use potency is astonishingly low (Subhramanian *et al.*, 2015).

Chinnamuthu and Boopathi (2009) stated that engineering science may be a powerful technology having the flexibility of making huge changes in food and agriculture. Basic conception of engineering science is that a substance will be manipulated at atomic level. Other properties and potentialities of engineering science, that have nice interest in agricultural revolution, are high reactivity, increased bioavailability and bioactivity, adherence effects and surface effects of nanoparticles (Gutierrez *et al.*, 2011). World agricultural cropping systems intensively use great amount of fertilizers, pesticides, herbicides to realize additional production per unit space however doses in addition to the optimum of those chemicals and fertilizers ends up in many issues like enhanced pollution (soil, water and air), low input use potency, decreased quality of food material, development of resistance in numerous weeds, diseases, insects, less financial gain from the assembly, soil degradation, deficiency of small nutrient in soil, toxicity to completely different useful living organism on top of and below the soil surface etc. Despite these issues there is an additional challenge to feed the growing population of the globe because of which these chemicals are continually being used despite of many severities they impose (Ghaly, 2009; Quasem *et al.*, 2009). Therefore, intelligent systems are required to monitor and minimize pesticide and antibiotic use (Sharon *et al.*, 2010). Carbon nano-fibres are used to strengthen natural fibres like those from coconut (*Cocus nucifera*) and sisal (*Agave sisalana*) and also for making nanoparticles that contain pesticides and control their release (Misra *et al.*, 2013)

3. NANO-BIOSENSORS AND AGRICULTURE

Nano sensors with immobilized bio-receptor probes that are selective for target analyte molecules are called nano biosensors. Their applications include detection of analyses like urea, glucose, pesticides etc., monitoring of metabolites and detection of various microorganisms /pathogens (Rai *et al.*, 2012). Controlled Environmental Agriculture (CEA) can be improved by the utilization of nano-sensors enhancing the aptitude to work out the time of crop harvest, detect crop health and determine microbial or chemical contamination of the crop. Smart nano sensors are being developed which may be linked to GPS system. Planting such autonomous biosensors has made real-time monitoring of crop husbandry promising by planting. Table 1 is adapted from Prasad et al. (2017) and highlights the commercially generated nano-biosensors and the companies involved in their manufacture.

Table 1: Commercially generated nano-biosensors and the companies involved in their manufacture.

Commercial Product	**Content**	**Company**
Nano-Gro	Plant growth regulator and immunity enhancer	Agro Nanotechnology Corp., FL., United States
Nano Green	Extracts of corn, grain, soybeans, potatoes, coconut and palm	Nano Green Sciences, Inc., India
Nano-Ag Answer	Microorganisms, sea kelp and mineral electrolyte	Urth Agriculture, CA, United States
Biozar Nano-Fertilizer	Combination of organic materials, micronutrients and macromolecules	Fanavar Nano-Pazhoohesh Markazi Company, Iran
Nano Max NPK Fertilizer	Multiple organic acids chelated with major nutrients, amino acids, organic carbon, organic micro-nutrients/trace elements, vitamins and probiotic	JU Agri Sciences Pvt. Ltd. Janakpuri, New Delhi, India
Master Nano Chitosan Organic Fertiliser	Water soluble liquid chitosan, organic acid and salicylic acids, phenolic compounds	Pannaraj Intertrade, Thailand

4. NANO-BIOFARMING

Nanotechnology can enhance crop's yield and nutritional values and may add value to crops or environmental remediation. The most up-to-date research in this field is cantered on the production of gold and silver nanoparticles with diverse plants including *Medicago sativa, Vigna radiata, Arachis hypogea, Cyamopsis tetragonolobus, Zea mays, Pennisetum glaucum, Sorghum vulgare, Brassica juncea, Allium sativum* L. etc. Depending on the nature of the nanoparticle, species of plant or tissue in which they are stored, metal nanoparticles of diverse shapes and sizes can be obtained. Preparation of metal nanoparticles has the advantage of being simple, cost-effective and environmental-friendly (Gutierrez *et al.*, 2011).

5. NANOTECHNOLOGY AGAINST AGRICULTURE

With the rapid expansion of nanotechnology, there is concern about the build-up of manufactured nanomaterial and their possible entry into the organic phenomenon (Priester *et al.*, 2012). Though the use of conventional nanoscale particles like protein and fats is not dangerous, the use of certain engineered nano-scale materials in agriculture, water, and food may have risks for human use and consumption, for the environment, or for both (Gruere *et al.*, 2011). Nano-materials can be easily absorbed from soil thereby exposing plants (Priester *et al.*, 2012).

6. NEED OF FUTURE RESEARCH

If agriculture is to continue to feed the world, it needs to become more like manufacturing technology. Understanding the crop DNA sequence is essential as it means that breeding itself can be made more precise. Nanomaterials have been known to enhance germination, growth, photosynthetic activity, nitrogen metabolism and other substantially significant aspects of plants. Therefore, the use of nanotechnology holds potential promises in providing improved yield, enhanced nutrition and better resistance towards diseases, stress conditions etc. So in future, nanotechnology should be used in production area for crop.

7. CONCLUSION

New tools are underway which will be equipped with nano devices capable of replacing many cellular types of machinery with great efficiency. Use of nanotechnology could permit rapid advances in agricultural research, like reproductive science and technology which can produce great deal of seeds and fruits unaffected by season and period, early detection of stresses and alleviating stress effects, and disease prevention and treatment of plants. In the future, nano scale devices could be used to make agricultural systems smart.

Apart from the potential benefits of nanotechnology in agricultural sector it also involves some risks. It cannot be claimed with certainty that nanotechnology is fully safe for human health, though its potential hazards are also not widely studied. Application of various nano-fertilizers have been shown to have a great potential in enhancing crop production and this may reduce the application of harmful chemical fertilizer for crop production thereby minimizing the pollution hazards.

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