"The contributed chapters in the book written by the faculties of science stream in the light of the recent thinking and developments in the field of science and education.- Science& Technology is now dominates almost every field of our activities.In summary, The faculties (Science stream) of GEMS Arts & Science college have made an excellent attempt to bring about this book Homo Scientia", covering almost all the important areas from biological sciences to artificial intelligence. Every article has its own merits in both academic and research fronts..I record my grateful appreciation and thanks to the contributors of this book for their untiring efforts."

Dr. Balagopalan Unni

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HOMO SCIENTIA

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HOMO SCIENTIA

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Brief Biography

Dr. B.G.Unni, (Balagopalan Unni) Ph.D
(Allahabad central University)
FRES (London), FIANSc , FISAgBc, FICCE

Former Chief Scientist and Area Coordinator (Biotechnology & Biological Sciences) DADD and Fulbright Fellow retired from CSIR service in 2015 after 38 years of research career at CSIR North East Institute of Science & Technology Jorhat Assam. Appointed at Assam down town University as Director-Research in March 2015 and continued up to June 2019 and then re-designated as Adviser Research in August 2019). Back in Kerala, Dr.Unni is appointed as Director Academic & Research at GEMS College of Arts & Science affiliated to University of Calicut from August 2019. Both the positions are on honorary basis to strengthen the institutions in research areas. He did his BSc Biology (1972-74, Ewing Christian College, Alld University), MSc in Biochemistry(1974-76)(Second Rank) and Ph.D in Biochemistry from Allahabad University(1976-80) and PDF in Molecular Biology from Texas A&M University, USA(1988-91). Dr. Unni is specialized in Biochemistry, Molecular Biology, and Biotechnology and well established in his area of research and completed more than 40 years of research in both basic and applied fields of research. Dr.Unni got more than 130 research papers, 190 abstracts, 35 papers in proceedings, 7 patents,1 technology.18 chapters in books, edited 3 books and 29 students

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received PhD degrees under his guidance and supervision. Dr. Unni had completed more than 20 projects sponsored by Commonwealth Science Council, London, Ministry of Non conventional Energy Sources, Department of Non conventional Energy Sources Govt of India, North Eastern Council Govt of India, Department of Science &Technology, Department of Biotechnology, Central Silk Board,GB Pant Institute of Himalayan Environment and Development, CSIR and DRDO, Ministry of Defense, Govt of India during his scientific tenure at CSIR NEIST. Dr Unni received- Fulbright Travel Award/ Fellowship (USA) Dr. B.M. Das Memorial Science award, Hebrew University Award , H.R. Cama Memorial Travel Award,COSTED Travel Award,. DAAD- fellowship-Germany, Well Mark International Scholarship (USA) & Technology award in life sciences by CSIR,Govt of India . Best Fulbright Alumni Chapter Leader-South Asia Selected by the United States Education Foundation In India (USIEF), New Delhi .Nominated to represent India at the International Fulbright Scholars meet at Marrakech, Morocco- Nominated by United States Education Foundation In India, New Delhi . Dr. Unni is in the editorial board of more than eight indexed journal in the country .Dr.Unni was nominated to various state and central committees such as High power committee for development of sericulture activities Muga, Eri,Tassar and Mulberry in Assam nominated by Governor of Assam, .Expert in the area of non mulberry sericulture, Ministry of Textiles, Advisory Board, Post graduate Biotechnology programme, Academic Council, Assam Agricultural University, Research Council, Central Silk Board, Ministry of Textiles , DBT's Nominee for Biosafety Committee ,Vice President SBC (India) Indian Institute of Science Bangalore, Vice President Indian Academy of Neuro-sciences, Member Fulbright Academy of Science & Technology, USA, Board of studies- Botany Nagaland University and Biotechnology Saugar University Madhya Pradesh., Fellow, Indian Academy of Neurosciences & Indian Society of Agricultural Biochemists, Fellow Royal Entomological Society, London UK and Scientific

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Advisor International Foundation of Science, Sweden, Member, Board of Studies Raiganj University (2017----), Member Research Review committee Tea Board of India (2016-2019), Member Advisory Committee Cancer Research Advisory Board, North East Cancer Hospital & Research Institute (2017--) President, Tea Improvement Consortium, Ltd, Tocklai Assam (2018-2020) .

Dr.Unni visited USA, Germany, Israel, Jordan, France, Morocco ,UK, Thailand ,Jordan, Singapore , China and UAE under various exchange program.

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Preface

I am very happy to learn that, the GEMS Arts & Science College is bringing out a series of books written by the faculty in this academic year. The college is occupying a very important position among the colleges in Kerala, the same way the college is having unique standing in both academic and research fronts too. This is because of the excellent management, faculties and the best performances of the students.. I have full confident that in the course of time, and with the sincere commitment and dedication of the faculties , students and with management , the college will attain high level perfection and excellence and became a model college in the state of Kerala

This book entitled " Homo Scientia" had comprehensive research topics in various aspects in the topics of cyber security, biotechnology, microbiology and geology.A brief description about the cybersecurity, the protection of computer set up such as hardware, software data from several threats have been described in the chapter The best practices for deploying and managing IPS network security tools have been explored. The integration of intrusion prevention system (IPS) solutions, adherence to security policies, regular updates, monitoring and the implementation of incident response procedures are considered to be the essential components of a comprehensive network security framework. The risk management in cyber security, various cyber-attack kinds, malware, and some strategies to tackle these attacks are also explained by the authors. A comprehensive overview of the evolution of computer graphics, exploring the advancements in hardware, software, algorithms, and techniques that have propelled the field from its early pixel-based beginnings to the current state of realism etc also described. Optical character recognition has been extensively investigated in the past few years, and has been proven that high recognition rates can be achieved in specific

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application scenarios using some standard and well-studied methods such as neural network, support vector machine (SVM), etc. The possibility of learning an appropriate set of features for designing optical character recognition (OCR) has been investigated

Biotechnology is an interdisciplinary science using modern technologies to construct biological processes in research, agriculture, formulation of pharmaceutical products and other related fields. The better understanding of advances in plant genetic resources, genome modifications, omics technologies to generate new solutions for food security under changing environmental scenarios etc have been discussed in this chapter. The increasing demand for food had a great impact on the agriculture sector to address the various challenges associated with crop productivity. The tremendous advancement in plant research helps in understanding plant biology for sustainable food security, functional ecosystems, crop improvement and human health. One of the sustainable farming techniques is the use of fertilizer at nano level. Nanomaterials that enhance plant nutrition could be considered as an alternative to the conventional chemical fertilizers. one chapter covered the importance of nano fertilizer to enhance metabolic processes in plants and reviewed the concerns in developing nanotechnological methods in the future. Metabolomics has now emerged as a powerful tool for the comprehensive analysis of metabolites within biological systems. One of the chapters provides a review on metabolomics, encompassing its methodologies, applications, potential impact on personalized medicine ,and discusses further the need for advancements in analytical technologies. The antifungal activity of mangroves, particularly Rhizophora species are one of the main sources for fungicidal compounds due to the presence of high concentration of phenols. The antifungal activity of Rhizophora species has been elucidated, and could be further utilized as biocontrol agents for fungal disease in agricultural crops. One of the chapters discussed the species identification and its impact on economical and ecological level in the species like Nutmeg, one of the important medicinal plants that had a greater attention ,however, it was very difficult to differentiate the sexual identity

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in the seedling stages. But the protein content screening among the studied plantlets had differentiated the sexes in the species as explained by the author.

AI (Artificial Intelligence) or machine intelligence enables farmers to enhance the quality and ensure a quick go-to market strategy for crops, and adoption of these algorithms to improve food industries. Artificial intelligence (AI) has also the potential to revolutionize education, from personalized learning to assessment and grading. Additionally, AI-powered tools can provide greater accessibility to students with disabilities, while also enabling more engaging and interactive content. AI continues to develop and become more prevalent in education, towards responsible and equitable implementation. However the negative and positive part of the AI may also be looked into.

The chapters related to microbiological aspects have also been incorporated in this book . Carbapenem-resistant A. baumannii (CRAb), bacteria that cause multi-infections in humans and resistant to multiple drugs too. The study attempted to isolate and characterize the bacterial species from the clinical specimens using biochemical techniques. The enzyme, carbapenemase produced by the bacteria was isolated and determined by different assays. Another study identified the antibacterial, antioxidant and anticancer activities of Ganoderma lucidum by various chromatographic techniques. Anticancer activity was also assessed on HeLa cell lines using MTT assay and DPPH assay. In one of the chapters,the author discussed L-asparaginase, one of the widely exploited enzymes for the treatment of acute lymphoblastic leukemia (ALL). Also attempted to isolate and characterize the enzyme from soil samples collected from different locations at Kerala. The study indicated that soils can provide a rich source for L-asparaginase which has got ample application in pharmaceutical industries.

The studies on various geological aspects with respect to different geographical areas in Kerala soil has been included in the book. The vertical geochemical variation and elemental mobility of the lateritic terrain in the Makkaraparamba of Malappuram District, Kerala has been very well investigated. Under extremely oxidizing and leaching conditions, laterite

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soil transformed into a variety of rocks and further developed into stable secondary product in the existing humid tropical and subtropical environments. The hydrogeological conditions in Kumbala- Kaliyar river basin, Kasaragod district, Kerala was assessed by means of Vertical Electrical Sounding (VES). The digital spatial data output of the present study would be much helpful for planning and management of surface and sub-surface water resources of Kasaragod River basin in which the Kasaragod township is centrally located

The contributed chapters in the book written by the faculties of science stream in the light of the recent thinking and developments in the field of science and education.Science& Technology is now dominates almost every field of our activities. In summary , The faculties (Science stream) of GEMS Arts & Science college have made a n excellent attempt to bring about this book Homo Scientia".covering almost all the important areas from biological sciences to artificial intelligence. Every article has its own merits in both academic and research fronts..I record my grateful appreciation and thanks to the contributors of this book for their untiring efforts.

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NANOFERTILIZERS: BENEFITS, PRODUCTION FROM ALLIUM CEPA AND ITS FUTURE OUTLOOK

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ABSTRACT

The tremendous population growth over the past century has been in a constant rise, hence the demand for food resources increases substantially. The use of sustainable farming techniques that can increase crop yield without utilizing large amounts of fertilizer is crucial. In this regard, nanomaterials that enhance plant nutrition can be considered as an alternative to the conventional chemical fertilizers. Nano fertilizers are crucial materials which is gaining popularity in agriculture to boost nutrient usage efficiency, lower fertilizer waste, and reduce cultivation costs thereby enhancing crop growth, yield, and quality metrics. Nano fertilizers also boost crop growth to the optimal point, a further increase in concentration could stunt crop growth due to nutrient toxicity. They also enhance the surface area available to the plant's various metabolic processes, thus speeding up photosynthesis and increase the amount of dry matter and crop output. In addition, this paper also reviews the basic concerns that must be resolved for the development and safe application of nanotechnology in future too.

INTRODUCTION

The world's population is growing quickly. By the end of 2050, there should be nearly six billion people on the planet. But

because of unique biotic and abiotic pressures, climatic changes, and water scarcity, crop productivity is declining. These prevent the agriculture sector from further development. This paves a way to an innovative technology called nanotechnology to overcome all of these obstacles.

Nanotechnology is a branch of science and engineering used for the design and production of structure, devices and systems by manipulating atoms and molecules at Nano scale. Using the same technology, the physical and chemical properties of substances at molecular level can be manipulated. However, biotechnology primarily focuses on harnessing biological technologies to control genetic, molecular, and cellular processes to produce goods and services with a wide range of applications. By comparing these two branches namely nanotechnology and biotechnology, a new field of science emerged known as 'Nano-biotechnology' which can be used to alter the properties of nanostructures and thus opening a way to apply these structures in the field of medicine, agriculture, and other fields.

According to Mitchell, the key components of agriculture include the production of crops and livestock, fisheries or aquaculture, and forestry for both food and non-food goods. The primary agricultural products can be divided into food, fibre, fuel, and raw materials (like rubber). The major food categories are cereals (grains), fruits, vegetables, cooking oils, meat, milk, eggs, and fungi. Modern agronomy, plant breeding, agrochemicals like pesticides and fertilizers, and technological improvements have all significantly increased food yields while simultaneously causing ecological and environmental harm.

Anything used to add nutrients to soil or plant tissues is a fertilizer. They promote faster plant growth. There are two ways to do this. The first is via using vitamin supplements. The second mechanism alters water retention and aeration to increase the efficacy of the soil. There are two types of fertilizers: natural and manufactured. The three main macronutrients that are contained in fertilizers are phosphorus, potassium, and nitrogen. Farmers employ a variety of ranges and forms of fertilizers, including dry form and pelletized form.

The use of artificial fertilizers is currently one of the most

popular methods for the growth of intensive agriculture. But utilizing chemical fertilizer constantly for a long time caused a variety of unexpected consequences. For instance, the connection between productivity and cost does not scale linearly, which results in a significant waste of mineral resources. Additionally, the millions of tons of artificial fertilizers that are yearly given to soil are not absorbed by plants. According to reports, crop fields can leak up to 50% of N and 90% of P, which can then enter the air or water and cause eutrophication in aquatic systems, the generation of greenhouse gases, and salinization of the soil . A buildup of nitrate in vegetable products is one concern brought on by the overuse of chemical fertilizers, which also affects the quality and safety of food. Many studies have demonstrated that organic farming, which rigorously prohibits the use of synthetic fertilizers, provides an alternative that might be able to mitigate the negative consequences of using chemical fertilization.

We are aware that the amount of agricultural land available today is shrinking daily as a result of environmental contamination, fertilization, and unintentional irrigation. To meet the nutritional demands of the expanding population as well as those of the emerging industry, agricultural production must also be increased. In recent years, nanofertilizers have been developed on a bigger scale to achieve the greatest quantity and best quality of goods from a given unit area. In addition to reduce the overuse of chemical fertilizers, nanofertilizers have the advantages of enhancing crop output and nutrient usage efficiency. They are environmentally safe and include micro and macro nutrients that may be used sparingly.

By altering conventional fertilizers or extracting distinct vegetative or reproductive plant parts using a variety of chemical, physical, or biological techniques, Nano-biotechnology is used to create fertilizers. These nanofertilizers can be used to increase soil fertility, agricultural production, and crop quality. High surface area nanofertilizers are available. Due to the substantially smaller particle sizes and greater specific surface areas of the nanofertilizer, the dissolving rate and extent of nanofertilizers in water/soil solution should be higher than those of the comparable bulk conventional fertilizers. Nanofertilizers have high reactivity with other compounds because of their less

size (that is less than 100nm). They have a high penetration rate into plant cells and faster movement through plasmodesmata to other cells. If the particle sizes of the nanofertilizers are smaller than the sizes of cell wall pores (5–20 nm), they may be able to penetrate the plant cells straight through the sieve-like cell wall structures. The ability for enhanced absorption and high reactivity of Nano fertilizers can contribute to the increase in the growth and development of crops.

Role of Nanofertilizers

By the age of conventional fertilizers, the nutrient use efficiencies barely exceed 30 - 35 % for nitrogen, 18- 20% for phosphorus and 35 -40% for potassium respectively, which persisted invariably for the past numerous periods. Nanofertilizers are well known to discharge nutrients gradually and consistently for more than a month which will help to improve the nutrient use efficiency without any linked detrimental effects. Nanofertilizers are a modernistic generation of synthetic fertilizers which contain all the nutrients in Nano scale range. Nanofertilizers are prioritized mostly because of their efficiency and environmental friendly nature in contrast to the traditional chemical fertilizers.

Nanofertilizers differ from all other types of fertilizers due to their high productivity, functionalities, advantages, and its simplicity in application. They improve growth parameters of plants such as height of plant leaf area, number of leaves per plant, increase in dry matter and chlorophyll, photosynthesis rate which outcome more translocation of photosynthates and production of various parts of the plant in contrast to chemical fertilizers. Nanofertilizers have an incredible capability to improve food quality, worldwide crop productivity, plant assurance, identification of crops, and monitoring of plant growth .

Recently a handful of experts made an effort to check the ability of nanotechnology to modify nutrient use efficiency. Nanofertilizers have many advantages in terms of practical application such as delayed discharge mechanism, deduction in the transportation and application cost, and generate moderately low salt build up in the soil as against conventional fertilizers

Nanoparticles have high potency in agricultural system like spotting of pollutants, plant diseases, pests and pathogens, restrained serving of pesticides, fertilizers, nutrients and genetic materials. And also they act as Nano-architects in the establishment and cementing of soil structure. Additionally, they can aid in the modification of biological pathways connected to altered plant gene expression, which in turn affects the development and growth of the plant .

Nanoparticles have diverse constitution from being composed of metal oxide, ceramics, silicates, magnetic materials, quantum dots, lipid polymers and dentrimers to emulsions. Arrangement of nanoparticles plays an important role in their application. For example, polymer coated nanoparticles are used as agrochemical carriers because of its controlled discharge ability. Metal nanoparticles show size dependent properties such as magnetism, fluorescence, and photo catalytic degradation which have application in sensor development, agrochemical degradation, and soil remediation

Nanofertilizer releases the nutrients in a governed mode in retaliation to the reactions to different signals such as heat, moisture and abiotic stress. It may also manage the release of nutrients, deliver appropriate amount of nutrients needed by the crops in adequate proportion and encourage productivity along with securing environment protection. Because of the low uptake efficiency of traditional fertilizers, they must be applied in large amounts. Examples of such nutrients are phosphorus and nitrogen-based fertilizers. Another negative impact of such fertilizer is that they quickly transform to some chemical forms which cannot be utilized by plants. This has an adverse consequence on the soil and environment as it results in the increase in emission of greenhouse gases and eutrophication. In contrast to the traditional fertilizers which are not only costly but also harmful to the humans and the environment, Nanofertilizers play a crucial role in holding soil fertility and enhancing crop return They are the ideal choice for agriculture since they increase plant growth directly or in combination with foliar application methods while preventing eutrophication and improving nutrient usage efficiency. Properties of Nanofertilizer is given in fig 1.

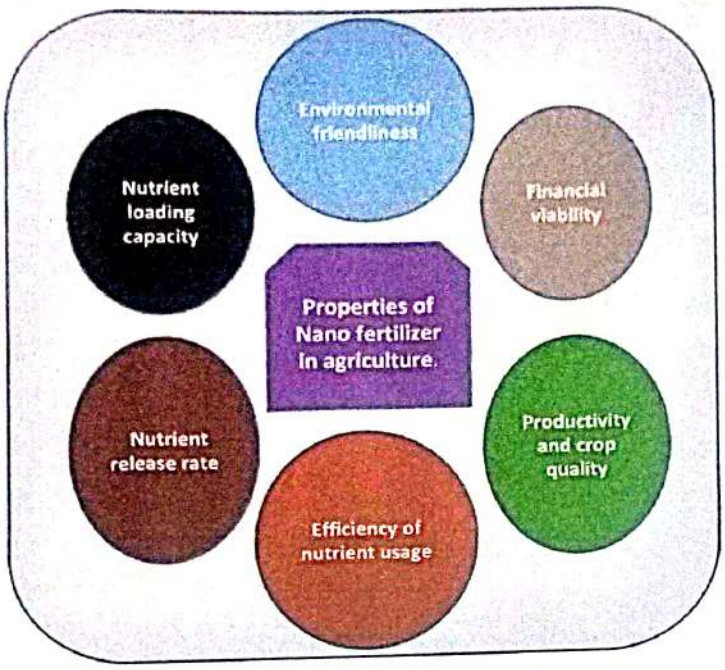

Fig. 1: Properties of Nano fertilizers in agriculture.

The diverse nanomaterials include silver (Ag), gold (Au), Aluminium (Al), single or multi walled nanotubes, magnetized iron nanoparticles, zinc (Zn), zinc oxide (Zno), copper (Cu), silica (Si), titanium dioxide (TiO2), and cerium oxide (Ce2O3) (Raliya et al., 2015), (Raliya & Tarafdar, 2013). Plants are highly skilled to occupy the nutrients and fundamental chemicals efficiently because of its high responsiveness. Hence these smart fertilizers are superior than traditional fertilizer. Effect of nanofertilizer in agriculture is summarized in fig 2.

Generation of Nanofertilizers

Nanotechnology is the management and control of shape and size at the nanometer scale used in the synthesis and application of devices. It has made possible for the use of fertilizers made of nanostructured materials, or "smart

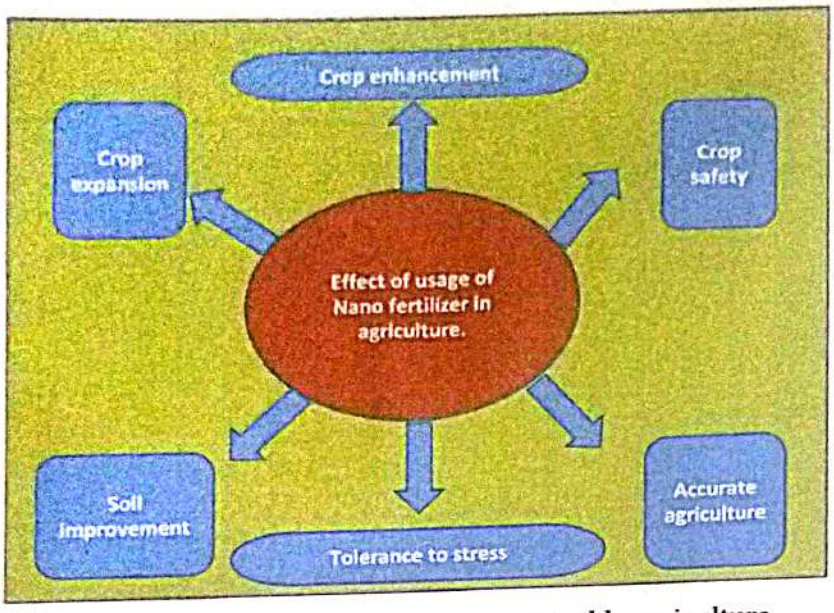

Fig. 2: Roles of Nano fertilizer in sustainable agriculture.

fertilizer". As the Nano particles have small size and varied physiochemical characteristics such as shape, surface chemistry, electrical charge and agglomeration, Nanofertilizers can be produced according to the demand and necessity of each crop using variety of materials such as silver, titanium, zeolite, copper, silica, aluminium, carbon, zinc and nitrogen and these have different application in the field of agriculture like desalination and removal of heavy metals from waste water, reduction of soil erosion, tracking devices, targeted delivery of nutrients, and food safety.

In addition, Nanofertilizers' composition can promote effective nutrient uptake, soil fertility restoration, ultra-high absorption, increased photosynthesis, increased production, decreased soil toxicity, decreased frequency of application, improved plant health, and decreased environmental pollution . Silica, iron, zinc oxide, titanium dioxide, cerium oxide, aluminium oxide, gold Nano rods, ZnCdSe/ZnS core-shell,

InP/ZnS core-shell, and Mn/ZnSe quantum dots are examples of nanomaterial constituents.

Table 1: Comparison of traditional fertilizers versus nanofertilizers.

Property	Nanofertilizer	Conventional fertilizers
Restricted release	Nutrient solution release rates and doses can be managed by nanofertilizers	Variations in reactivity and composition brought on by environmental factors
Nutrient loss	It is possible to reduce waste and leakage brought on by fertilizer application.	Consequences on the environment following the end of the nanofertilizer life cycle
Length of release	Comparing nanofertilizers to conventional fertilizers, they can prolong the time that nutrients are released	Effects of exposure according to dose and time on phytotoxicity
Efficiency	The uptake ratio is increased, and the release time of nanostructures is reduced	Chronic effects on consumers as well as long-term environmental implications
Solubility and dispersion	The soil is better at absorbing and fixing nutrients, which raises their bioavailability	Comprehensive eco-toxicological profiles that consider the effects on human health and the environment

The usefulness of nanomaterials as nanofertilizers for plant growth depends significantly on their size, composition, concentration, and chemical properties, as well as the type of crop. When water and nanoparticle suspensions containing the nanofertilizers react, nutrients are released into the soil

Different types of nanofertilizers can be synthesized by either bottom up or top-down approach. Multifunctional field studies are needed to make sure the fertilizing effects of nanofertilizers and different plants and pest pathogen interactions under varied environment.

Use of nanofertilizers that make use of the special qualities of NPs can increase the effectiveness of nutrient usage. By adding nutrients singly or in combination to the adsorbents with nano-dimensions, nanofertilizers can be created. Anionic nutrients are loaded after surface modification to produce nanomaterials via physical and chemical means, whereas cationic nutrients are loaded with the target nutrients just as they are.

Nanofertilizers are modified fertilizers created by chemical, physical, or biological means to enhance their characteristics and composition, which can increase crop production. The nutrition can be delivered as nanoscale particles or emulsions, it can be coated with a thin polymer coating, or it can be contained within nanoporous materials. This novel approach involves the encapsulation of fertilizers within nanoparticles.

Compared to conventional fertilizers, they have a number of benefits that improve the farming's quality standards. Solid NPs also have an impact on farmlands. Due to the rising demand for ecologically safe, effective, and non-toxic nanofertilizer synthesis technologies, the bio-fabrication of NPs using biological processes has attracted a lot of attention. Nanoporous materials, nanoscale additive fertilizers, and nanoscale coating fertilizers can all be used to make nanofertilizers in accordance with the nutritional requirements for plant growth and development.

Carbon-based Nano materials, such as carbon nanoparticles carbon nanotubes fullerenes, and fullerols, have emerged as crucial plant growth regulators because they speed up germination and boost the amount of protein, chlorophyll, and NPs in plants. Depending on the physical or chemical process used, different types of organic and inorganic nanomaterials can be used to make different kinds of nanofertilizers. Lipids, polymers, and CNTs are examples of organic nanomaterials, whereas metal oxides including AgO, MgO, ZnO, and TiO2 are inorganic nanomaterials. Alternative fertilizer chemicals known

as polymeric NPs use biodegradable, natural, and agriculturally secure carriers, such chitosan.

Synthesis of different types of nanofertilizer from onion peel:

One of the most frequently grown crop plants in the world, the onion, which is used for both food and medicinal purpose. Onions are a key component of many cuisine products because of their distinctive, potent smells and scents. Calcium, iron, manganese, magnesium, phosphorus, potassium, zinc, selenium, flouride, and iron are among the different minerals. Moreover, it is abundant in proteins, salt, potassium, phosphorus, and carbohydrates. The mineral nutrients play a very important role in plant growth and development. Generally, the application of mineral nutrients increases growth, yield and quality of crops. Potassium content in onion peels is about 234 mg of the fruits and it is the most important element that is used as fertilizer. It is essential for promoting the plant vigor, resistance to pests and disease, help in fruit growth, involved in regulating several enzymes in plant. Each macronutrient has a unique character and takes part in a range of plant metabolic activities. Also, certain flavonoids were discovered in onions, which includes Quercetin and anthocyanins. Among the phenolic compounds with physiological and biochemical functions in plants, Quercetin is a powerful antioxidant; It provides salinity protection to tomato plants.

Silver nanoparticles from *Allium cepa*

Among the many metallic nanoparticles used in medicinal and agricultural applications, silver nanoparticles are one of the most important and fascinating nanomaterials. In both nanoscience and nanotechnology, are crucial Due to their distinctive physical and chemical characteristics, silver nanoparticles are being employed more and more in a variety of industries, including medicine, food, health care, agriculture, consumer goods, and industrial applications. They include high electrical conductivity, optical, electrical, thermal, and biological characteristics

The onion peel was first taken off and rinsed twice with

distilled water before being sliced into little pieces. Using a high-speed mechanical blender, mix 10 g of weighted onion with 100 ml of purified water to make a homogeneous slurry. The resultant slurry was combined with the 70% alcohol and agitated for 1 minute. The mixture of alcohol and water was heated while being stirred for four minutes. The mixture was filtered using Whatman Paper 1 after cooling and incubate at 400°C for 24 hours. In order to conserve it for later use, dissolve the precipitate in distilled water. With steady stirring at 60°C-65°C for 5 minutes, 5 ml of onion extract and 5, 10, and 20 ml of 1.0 mM AgNO3 were combined, and the mixture was then incubated for 5 days at room temperature. AgNPs were obtained by centrifuging for 20 minutes at 15,000 g. Disperse AgNPs in deionized water three times before being centrifuged to verify purity. AgNPs and onion extract were kept as lyophilized powders.

Zinc oxide nanoparticles from *Allium cepa*

Zinc oxide nanoparticle is the second most prevalent metal oxide after iron and it is inexpensive, safe, and it can be prepared easily. Zinc oxide nanoparticle is among one of the most researched studies conducted due to its ability to apply in various downstream applications.

Divalent cations, the form in which zinc is absorbed, are an important micronutrient. It is necessary for the production of energy, protein synthesis, membrane integrity, and plant growth. Moreover, zinc is necessary for the activation of several enzymes that are involved in the production of auxin and chlorophyll. It participates in the activation of proteases, phosphoryl hydrolase, peptide, and enzyme-like dehydrogenases. Due to their small size, zinc nanoparticles alone or in the form of oxides are rapidly absorbed by plant roots and made readily available to all parts of the plant. Other metallic nanoparticles, such as magnesium, have been utilized for similar functions.

To get rid of the dust particles attached to it, wash the onion peel waste many times with double-distilled water. Dry it for 7 days at 40°C in the oven. Grind it into powder using a home grinder. Sieve it to get rid of any larger particles that

didn't entirely grind during the earlier process. Weigh 10g dried onion peel powder and mix it with distilled water in a 250 ml Erlenmeyer flask. To this add 100 mL of 80% ethanol. Heat the aforementioned combination at 60 °C for 20 minutes with continuous stirring for 24 hours. Cool the mixture to room temperature and pass it through Whatman filter paper No. 1. The remaining filtrate was evaporated in a rotary evaporator, leaving around 50 mL for the synthesis of NPs, while the remaining filtrate can be heated to 45 °C and evaporated in a rotary evaporator to completely dry extracts. The extract was dried and kept for use later in a freezer at 4 °C .

Stir continuously a 200 mL solution of 2 mM ZnCl2 for 20 hours. Maintain the pH at 8 throughout the experiment by applying 1M NaOH solution. Add 30 mL of onion peel extract solution to the aforementioned solution with continuous stirring. Note the colour change after 30 minutes. Keep the solution under stirring conditions for 4 hours, after the incubation period ZnONPs will be synthesized. Centrifuge the mixture at 7000 rpm for five minutes, separate the solution and residue from the rest of the mixture. Decant the solution retaining the precipitate in place. Clean the surface of the precipitate repeatedly distilled water and ethanol to remove any impurities. Dry the precipitate at 80 °C. The final powder can be then calcined in a muffle furnace at 400 °C at a slow pace of 5 °C per minute.

Drawbacks associated with nanofertilizers

There are certain toxicity-related hazards associated with using NPs as fertilizers to boost agricultural production and increase the availability of plant nutrients. Although these tiny particles can more easily enter biological systems and provide serious risks, it is still unclear how poisonous, safe, or how NPs will affect the environment.

NPs produced by physical and chemical processes are more hazardous than those created by biological methods. Additionally, compared to metal and metal oxide NPs, organic NPs are less harmful to soil microbes. NPs are used to provide nutrients to plants, but their nano-toxicity is still a worry for

both people and the environment.

When it comes to their widespread application under various pseudo climatic conditions around the world, nanofertilizers are more expensive than conventional fertilizers, which is a major obstacle. This is also true in the case of lack of standardization and recognized formulation, which causes differing effects on the same plants in different areas The fact that many products on the market today are "micron"-sized rather than "Nano"-sized fertilizers, which further shows a lack of monitoring of nanofertilizers, is a sad truth that must be faced. The long-term survival of these particles in plant systems is severely harmful The lack of a risk management framework for nanofertilizers, the expensive price of nanofertilizers, the unstandardized formulation process (due to the diverse psuedo climatic conditions, the same nanomaterial produces variable results), and the lack of sufficient production or availability of nano fertilizers are additional drawbacks

Future outlook of nanofertilizers

The development of a nano-composite to deliver all the critical nutrients needed by a crop in an appropriate ratio through an intelligent delivery system is currently being researched. To boost crop productivity and lessen the negative environmental effects that go along with it, new fertilizers must be developed that are more efficient to use and capable of avoiding nitrogen losses by precisely matching nutrient supply to crop need. Future agriculture and related fields could undergo drastic changes as a result of nanotechnology. Especially, it has been demonstrated that fertilizers based on nanotechnology enhance plant nutrition and growth through the site-specific delivery of fertilizers and vital nutrients by NPs with controlled release formulations. Yet very little has been done to implement nanotechnology in the agriculture industry.

Before being applied to farmlands, NFs must be introduced in the nursery stage of crop production and closely monitored. Considering the potential problems and difficulties involved with nanomaterials, developing regulatory frameworks to assure the secure use of such NFs would probably encourage

their deployment and make sure these NFs are used safely.

Furthermore, as majority of nanomaterials are metallic and may result in soil metal contamination, choosing the right nanomaterial, kinds, doses, and application techniques is essential for achieving beneficial effects. Nanomaterials' biocompatibility and toxicity must be determined in order to determine their exposure to the environment and safety. Because designed NPs are smaller than bulk particles, some of them may end up ingested by plants through dietary or food chain contamination, which could have an adverse effect on the ecosystem. Further research and laboratory testing are needed before agricultural nanomaterials are extensively employed; as a result, educational programs and research activities should ultimately lead to economic viability. To achieve the goal of NF commercialization for large-scale agricultural applications, public acceptance and regulatory compliance must both be considered.

CONCLUSION

The use of various nano-fertilizers has a stronger impact on improving agricultural output since it lowers the cost of fertilizer for crop production and reduces pollution risk. The use of nanofertilizers in agriculture needs to be of higher social concern. By using Nano-fertilizers effectively, fertilizer nutrient utilization efficiency in crop production can be increased. Considering the optimum applied doses and concentration, nanofertilizers increase crop growth and yield, but if the concentration is higher than the optimum, they also have an inhibitory impact on the crop plant, which inhibits crop growth and yield. The application of nanotechnology in contemporary agriculture contributes to the improvement of the world economy by offering assistance and advancements in various ways. Regarding the numerous issues brought on by the growing population, animal and plant diseases, and climate change, the introduction of NPs makes a significant contribution to resolving these urgent problems while increasing the use of conventional fertilizers to boost crop production, ultimately harming the environment. As comparison to conventional resources, the

effectiveness and agronomic efficiency have greatly increased with the introduction of NPs and the environment is protected through controlled release. Many nanofertilizers are being developed, and some of them have even been put on the market. Understanding the physiological and biochemical responses imposed by plants requires taking into account on the research of NP-plant interaction. In order to find and quantify NPs through the plant system and understand their transformation and safety implications in a complex system, emerging approaches are being developed.

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