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POTENTIAL OF NANOPARTICLES IN AGRICULTURAL CROPS : AN OVERVIEW

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ABSTRACT

Millet plants were subjected to the challenge posed by Pyricularia grisea, the progression of blast disease was prevented in the treated plants. This was in contrast to the group that served as the control. The application of a combination treatment consisting of CuChNp to finger millet plants resulted in a degree of protection that was approximately 75% effective. Plants of finger millet that were treated with CuChNp exhibited a significant uptick in the number of defensive enzymes that they produced. This was the true with regard to both the quality and number of enzymes that were generated. There is a significant relationship between the decreased incidence of blast disease and the increased production of protective enzymes in CuChNp-treated finger millet plants. This is supported by the existence of a strong connection.

Keywords: including medical, engineering, agriculture, environmental

INTRODUCTION

Synthesizing nanoparticles is an artificial process that may be accomplished by a variety of methods, including thermal decomposition, electrochemistry, a micro-oven aided procedure, and green chemistry. Several of these processes, unfortunately, involve the use of potentially harmful chemicals, significant levels of energy consumption, and, as a result, poor levels of material conversion. As a result, developing a procedure for the synthesis of nanoparticles that is less harmful to the environment is a pressing requirement in today's world, and the significance of this endeavor is growing with each passing day. The exploitation of microorganisms and plant extracts in such an ecologically friendly technique is a simple, practical, and sustainable alternative to the use of chemical methods for the production of nanoparticles.

It has been known for a long time, and the evidence to support it, that plants have the ability to decrease metal ions not only on their surface but also in their organs and tissues, even those that are located a great distance from the spot where the ions are being absorbed. This capability of plants is put to good use in the field of phytomining, which is the process of using plants or plant parts to extract valuable metals from the ground that would not be practical to mine for economic reasons otherwise. Phytomining is also known as phytoextraction. After the plant has been harvested, such metals that have collected in the plant might be repeated. The practice of phytomining has uncovered the fact that plants store metals in the form of nanoparticles. Several plant metabolites, such as terpenoids, polyphenols, sugars, phenolic acids and alkaloids, proteins, and others, also enable the bio reduction of such metal ions in plants into nanoparticles. This process is called "bio reduction."

A nanoparticle is defined by the size at which its key features begin to diverge from those of a comparable bulk substance. This size is the distinguishing element for what is recognized as a nanoparticle. Nanoparticles and colloids are almost the same size, with a diameter that can range anywhere from 1 nanometer to 1 millimeter. In addition to this, the physical properties of nanoparticles are significantly distinct from those of the bulk material in a number of crucial aspects.

NANOTECHNOLOGY'S ROLE IN THE FUTURE OF SUSTAINABLE FARMING

Agriculture is the fundamental practice of raising plants and livestock, both of which are essential to the continued existence of human beings. Our natural resources and the ecosystem are both greatly impacted as a result of this. A long-term food supply for a future population that is expected to develop may be provided by agricultural production using sustainable methods, which would not cause damage to our natural environment or result in the depletion of natural resources. Agricultural sustainability accomplishes this goal by delivering an adequate food supply alongside a pristine and verdant setting.

Increasing agricultural productivity through balanced nutrient uptake, supplying better quality water, and timely bounded targeted application of crop-specific pesticides for improvement of soil quality and health could be beneficial for agricultural sustainability through the implementation of nanotechnology. This could be accomplished through the use of nanotechnology in agriculture. Nanotechnology offers a wide range of applications in sustainable agriculture, including the management and monitoring of plant development; the protection of plants from a variety of diseases; the delivery of chemicals to specific locations; and the improvement of the quality of food products.

New Frontier in The Development Of Agriculture

In spite of the fact that the word "nanotechnology" has been in use in a broad variety of sectors for quite some time, the production of nano particles may also be used to the field of agriculture. Considering that this is a relatively new breakthrough, it warrants more research. As a result of recent developments and the ability to control the size and structure of the particles and, as a consequence, govern the properties of the material, prospective industries have opened up, including the fields of agriculture, medical, and environmental sciences. These new fields have the potential to make significant contributions to society. These technologies undoubtedly have the potential to be advantageous to the agricultural sector and have the ability to aid in the resolution of complex problems such as lower quality yields as a result of the repercussions of biotic and abiotic stress. Other considerations, such as inadequacies in nutrition, environmental circumstances, and air pollution, might also be taken into account. In addition to making it possible for agricultural methods to be more precise, the further development of nanotechnology can be of assistance in reducing the severity of these repercussions or perhaps removing them entirely. In recent years, there has been an increase in the popularity of precision agriculture and farming, as well as the fabrication of wireless networking and the shrinking of sensors. All of these developments are meant to monitor, analyze, and regulate agricultural operations. In instance, special criteria for site management may be applied to both the pre and post agricultural production aspects of a given circumstance. This is possible since agricultural production is a continuous process. Recent developments in tissue engineering, such CRISPR/CAS mRNA and sgRNA, have the potential to have enormous implications, which may be proved through scientific study. These implications have the potential to have major effects

OBJECTIVES

1. Examine the nutritional enhancement of millets through nanobiotechnology interventions.
2. Investigate the use of nanomaterials for post-harvest preservation and quality improvement of millets.

REVIEW OF LITERATURE

According to Silve et al.'s research from 2020, TiO2-nanoparticles (TiO2-NP) have the potential to hinder the development of plants. Plants of Triticum aestivum L. were subjected to varied concentrations of TiO2-NP (P25) for a period of 21 days. The concentrations tested were 0 mg L-1, 5 mg L-1, 50 mg L-1, and 150 mg L-1. The levels of more than 70% of the identified metabolites were found to be altered in response to P25, and the influence on metabolic pathways increased in proportion to the dose of TiO2-NP. The changes were most pronounced in the leaf tissue. The metabolism of tyrosine was activated by the roots, which also upregulated monosaccharides, azelaic acid, and -amino butanoic acid. On the other hand, the metabolisms of reserve sugars and tocopherol, as well as the pathways leading to phenylalanine and tryptophan, were upregulated in the leaves. In conclusion, these NP-pollutants have a significant impact on a number of crop metabolic pathways, which may eventually lead to a reduction in plant performance.

Soliman et al. (2020) investigated the impact that biosynthesized AgNPs had on the development of seedlings of three different species: Zea mays L., Trigonella foenum-graecum L., and Allium cepa L. The leaves of blue gum (Eucalyptus globules L.) were used to perform the biosynthesis of silver nanoparticles, which were then described. Studies were conducted to investigate the effects of applying biogenic AgNPs at various concentrations (25, 50, 75, and 100 mg L1) on the germination of seeds, the growth of seedlings, the level of oxidative stress, and the antioxidant enzyme activities. There was a statistically significant improvement in the seed germination and growth of A. cepa L., Z. mays L., and T. foenum-graecum L. after the application of AgNPs (p 0.05). The applications of AgNPs boosted the activity of antioxidant enzymes such as catalase, peroxidase, and ascorbate peroxidase as well as the contents of glutathione and ascorbate, while increasing the concentration of AgNPs reduced the amount of malondialdehyde in the sample. In conclusion, the addition of silver nanoparticles to either monocot or dicot plant seeds greatly improved seed germination, as well as the antioxidant machinery and early growth features of the plants.

Broad bean (Vicia faba L.) plants were cultivated in soil amended with 0, 10, and 100mg cadmium sulphide (CdS) NPs per kg soil for 4 weeks, and then the phenotypic, biochemical, and metabolic responses of the plants to CdS-NP stress were investigated. Tian et al. (2020) reported these findings. Upon exposure to CdS-NP, metabolomics analysis showed a significant up-regulation (1.2 to 39.2-fold) of several antioxidative metabolites. These metabolites included N-acetyl-5-hydroxytryptamine, 2-hydroxybutanoic acid, putrescine, and flavone. However, there were no obvious negative phenotypic effects, including plant biomass, photosynthetic pigment contents, or lipid peroxidation.

Zhang and Xu (2020) conducted research on the underlying physiological and molecular mechanisms of ZnONP-mediated plant growth in tomato plants. Tomato growth was increased by foliar spraying with ZnONPs at concentrations of 20 and 100 mg/L. This led to an increase in chlorophyll content as well as photosystem II activity. Comparative transcriptome research demonstrated that ZnONPs elevated the expression of a set of genes involved in nutrient element transport, carbon/nitrogen metabolism, and secondary metabolism in tomato, and the metabolome analysis provides more support for the conclusion. Additional analyses showed that foliar spraying with ZnONPs increased the expression of genes encoding antioxidative enzymes, transporters, and the enzymes or regulators involved in carbon/nitrogen metabolism and secondary metabolism. This resulted in an improvement in the levels of antioxidation, sugars, and amino acids in tomato plants that were deficient in iron.

Nanotechnology in crop production

Nanotechnology is a potential control that can coordinate information on a variety of vital scientific discoveries and evidences at the nanoscale level. Nanotechnology has emerged as an innovative and intelligent sector that is ushering in a new era of nano-horticulture. This new era aims to reform the harvest enhancement and sustenance application ways via the utilization of a variety of unique gadgets and things for the purpose of increasing yield profitability. Table 10.1 outlines how nanoparticles may be utilized in the agriculture industry to provide plants with additional micronutrients. Nanoparticles, due to their extremely small size and the proximity of a large number of surface molecules, have an increased reactivity for a variety of distinct chemical processes. Nanoparticles have significant promise in the agricultural sector as a result of their improved bioactivity and bioavailability

APPLICATION OF NANOTECHNOLOGY IN SEED SCIENCE

A seed is a biological unit that is capable of duplicating itself and is able to exist on its own even in challenging situations. Seeds may grow into new plants even if they are exposed to harsh conditions. The application of nanotechnology enables one to realize the potential of a seed that has not yet been exploited. The production of seeds is a time-consuming process, and this is especially true for plants that are pollinated by the wind. Monitoring the pollen load and looking for symptoms of contamination is a certain method that may be used to safeguard the unaltered genetic content of an organism. Pollen flight may be affected by a number of elements, including temperature, humidity, the speed of the wind, and the amount of pollen that is generated by the crop. The utilization of bionanosensors that are specific to contaminating pollen can aid in alerting persons to the risk of contamination, which in turn lessens the quantity of contamination that has occurred. It is also feasible to utilize this method to prevent pollen from genetically modified crops from infecting field crops. This may be accomplished by removing genetically modified crops from the field. The same strategy may be utilized to attain this goal. Before being sold, seeds are being genetically altered to incorporate new gene combinations. This practice is becoming increasingly common. It's possible that the usage of nanobarcodes, which can be encoded, are readable by machines, last for a long time, and are smaller than a micron, might make it easier to keep track of seeds that have been bought and sold. regrettably, seeds are the vector for the spread of illness, and viruses regrettably kill seeds that have been maintained a high percentage of the time. Not only will preserving seeds by the process of nanocoating them with elemental forms of zinc, manganese, platinum, gold, and silver keep the seeds intact, but it will also require far lower amounts of application.

It was decided to employ a technique known as quantum dots (QDs) as a fluorescent marker paired with immuno-magnetic separation in order to study E. coli 0157:H7. This technique will be helpful in distinguishing healthy seeds from those that have been tainted by contamination. According to the findings of the research that was conducted by Natarajan and Sivasubramanian (2007), the application of pesticides and herbicides has undergone a sea change as a direct result of the development of technologies such as encapsulation and controlled release methods. In addition, it is possible to instill seeds with nano-encapsulations that contain a specific strain of bacteria. This process results in the creation of what are known as smart seeds. As a direct consequence of this, the seed rate will be reduced, while concurrently guaranteeing that the field stand is right and that crop performance is improved. An intelligent seed that has been pre-programmed to only germinate when there is adequate moisture present may be utilized for the aim of reforesting a whole mountain range. This would ensure that the seedlings only sprout in conditions that are optimal for their growth

CONCLUSION

The findings led the researchers to the conclusion that the various ratios of MMT-based POPD nanocomposites may be effectively manufactured by employing the sonochemical intercalation process. Using a variety of spectroscopic and microscopic approaches, the nanocomposites were satisfactorily characterized in terms of their surface charges, the process of intercalation, the d-spacing values, the size, and the morphology of the nanocomposites. The aggregation-inhibiting properties of the nanoclay and nanocomposites were tested, and the results of these tests suggest that the nanoclays and nanoclay-based polymer nanocomposites have acted as a potential therapeutic molecule, inhibiting the process of protein aggregation from the very beginning of the process.

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