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Review Article

Nanotechnology and biological advances, novel tools for plant genetics and physiological role of newly crops and limited factors affecting growth

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Abstract

Nano-pesticides are essential for the successful and sustainable management of different pests, and they can decrease the use of agrochemicals, thereby mitigating current environmental dangers. Nevertheless, advancements in nano-particles or micro-particles, as well as distribution models for biolistic gene delivery in various plants, are still needed to enhance grain growth and crop and plant protection. , seed priming is being used effectively to expedite and synchronize germination, increase seedling vigor, and make plants extra resilient to various biotic and abiotic stresses, resulting in increased efficiency and quality of food. Nano fertilizers have distinct properties like mega absorption, increase in production, enhanced activity of photosynthesis, and a substantial improvement in leaf surface area. Growth of plants is changed to a particular environment conditions at different phases of development; and hence, a proper choice of planting date increases photosynthesis efficacy. In this perspective, providing carbon nano-tubes in to the chloroplasts has resulted in a progress for plants' enhanced capacity to collect more energy from the sun. Lower rates of photosynthetic activity in the crop plants under the cold stress limited metabolic pathways for Carbon assimilation.

Keywords: Photosynthetic activity, stomata conductance, Carbon assimilation, nanotechnology.

INTRODUCTION

Bio- fortification is the deliberate enhancement of a food's nutritional value through breeding, biotechnology and agronomic methodologies. It varies from traditional fortification because it helped to improve a plant's nutrient value during the growth instead of manual process of adding minerals, vitamins and the trace elements during the processing. Bio-fortification has profound consequences for reaching communities that have no or confined access to conventional supplements and the methods of fortification. It gives benefits for society while posing the least amount of risks to health of individuals and populations [1-3].

Nano-pesticides with the high potential capabilities can remove synthetic pesticides. The decline in the level and accurate and consistent release of bioactive constituents with suitable Nano - materials can improve pest - control efficiency over time. As a result, Nano-pesticides are essential for the successful and sustainable management of different pests, and they can decrease the use of agro - chemicals, thereby mitigating current environmental dangers. These pesticides have a different response than the synthetic pesticides that increases their effectiveness. Furthermore, concentrating on the important aspects of plant physiology could be augmented to include various relevant applications. Plant nanotech progression could be sped up by boosting multiple approaches to the smart methods for the synthesis of Nanomaterials. Nevertheless, advancements in nano-particles or micro-particles, as well as distribution models for biolistic gene delivery in various plants, are still needed to enhance grain growth and crop and plant protection [4-6].

The use of Nano fertilizers allows for the controlled release of nutrients in to soil, consequently preventing water contamination. The effect of TiO2 nano-particles on growth of maize was found to be significant, whereas the impact of TiO2 bulk intervention was found to be insignificant. TiO2 nano-particles improve retention of light and diffusion in plants. Researchers discovered that titanium and silicon nano-particle compounds improve nitrate reductase activity and uptake capacity in the soybean plants, raising their fertilizer and water use effectiveness. Nano fertilizers have distinct properties like mega absorption, increase in production, enhanced activity of photosynthesis, and a substantial improvement in leaf surface area [7-8].

Bio-fabrication of nano-materials that use the reduction abilities of secondary plant metabolites has the capability to boost functional nano-particles for the treatment of microbial resistance [17, 22]. It has the benefit of enabling an environmentally friendly synthesized technique, low-cost reactants, and the contrivance of bio-compatible nano-materials [8, 9, 23]. Plant based TiO2 nano-partcles have the potential to significantly absorb on surface of pathogens and plant-materials, at which they act to kill pathogens while also promoting and growth of plant and organogenesis [8-10].

Nanotechnology for plant genetics and physiological role of newly crops

Carbon based nano-materials, in addition to the previously mentioned Mn3O4 and CeO2 nano-particles are a great example of a correlation among conventional products and nano-products. Carbon-quantum-dots (QD) have potential applications in the agriculture sector due to their ease of synthesis, good stability, sturdy photoluminescence, higher solubility of water, excellent bio-compatibility, tunability capabilities, and lower toxicity. Whereas the mechanism was unknown, carbon nano-dots [50 mg L1, size 3.9 nm by transmission electron microscopy (TEM), –16.9 mV, leaf infiltration] enhanced the water deficit resistance of groundnut plants. Multiwall carbon nano-tubes improved salt content stress tolerance in the Brassica napus and broccoli Multiwalled carbon nano-tubes improved salt content stress tolerance in the Brassica napus and broccoli [11-13].

The influence of grain treatment with the bare Zinc Oxide nano-particles, dextran (DEX) and dextran sulphate (DEX (SO4)) coated Zinc Oxide nano-particles, and regular zinc sulphate (ZnSO4) food. Bio-genic nano-particles made from natural extracts of fungi, bacteria and plants can contain a higher concentration of phytochemicals, like phenolics, terpenoids, proteins, sugars, and flavonoids with carbonyl and hydroxyl functional groups. zinc distribution inside the plant as well as tissue and biomass growth. The kind of charge on coated materials influences the uptake of zinc, translocation, and deposition in various tissues of wheat [14, 15].

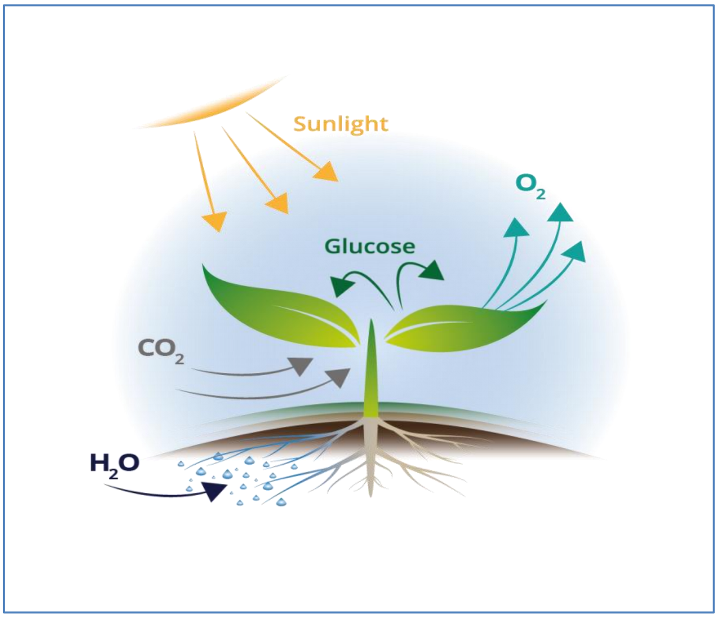

Fig-1: Shows the principles for the plant cellular and physiological processes for foods

Nano-particles are used as coating on the surface of finished products. There are various coating methods used for the application of nano-particles on to the textile fibres, like sol gel, layer by layer and plasma polymerization. These methods can increase the durability of fabrics and make it resilient to the adverse weather conditions. The structure of nano-coating components, like surfactants as well as carrier medium, has the potential to change the surface texture of the fabrics. Nanotech has significant market viability in textile sector. This is primarily because of the fact that traditional methods for imparting various properties to fabrics frequently do not result in long-term effects and will lose their capabilities after washing or wearing. Nanotech could provide excellent strength for fabrics because nano-particles have such a large surface area to volume ratio and higher surface energy, displaying better affinity for the fabrics and increasing component durability. Furthermore, a nano-particle protective layer on fabrics has no effect on their comfortable wear or hand feel [16-20].

Various environmental conditions encompass various phases of growing plants. "Appropriate sowing date" is among the most important factors in achieving maximum yield. Growth of plants is changed to a particular environment conditions at different phases of development; and hence, a proper choice of planting date increases photosynthesis efficacy. During in the early growth stages in rainy season crops, temperatures can exceed 40°C. It led to a significant reduction in the grain yield due to repeated flower falls, complete absence of fertilization, catalyzed disablement of *rubisco activase* and pollen viability, result in the complete enzyme failings [21-24].

Both the soaking and the subsequent drying could stimulate stress related feedback (e.g., heat shock proteins, anti-oxidant processes), likely to result in cross resistance to certain other stressors. Furthermore, speedier germination reduces the time germinating grains are exposed to harmful ground conditions. And hence, seed priming is being used effectively to expedite and synchronize germination, increase seedling vigor, and make plants extra resilient to various biotic and abiotic stresses, resulting in increased efficiency and quality of food. Bio-genic nano-particles made from natural extracts of fungi, bacteria and plants can contain a higher concentration of phytochemicals, like phenolics, terpenoids, proteins, sugars, and flavonoids with carbonyl and hydroxyl functional groups. These complexes are organic metal reducing agents which can perform as a capping to stabilise nano-particles in the colloidal solutions [25, 26].

The use of nano-technology in the agriculture has just been deemed as an important and exciting technology for feeding the nation's ever increasing number of individuals. It has not only revolutionized agricultural production by implementing unique nutrients of nano-fertilizers (NFs), but has also aided in crop protection by developing nano-pesticides, efficient irrigation systems, and greater plant efficiency in utilizing the energy of the sun [7]. In the case of traditional fertilizers, low utilization performance (20 to 50%) and cost intensive increases in use rates have prompted researchers worldwide to promote and develop the use of nano-fertilizers. In this perspective, providing carbon nano-tubes in to the chloroplasts has resulted in a progress for plants' enhanced capacity to collect more energy from the sun. Furthermore, these tubes could be used as a synthetic antenna for catching different wavelengths of light that are outside of their normal limits, like uv light, green, and infrared rays [28-29].

Every year, a lot of food is ruined due to a lack of suitable packing methodologies and skills. Nano based techniques already have proven to be most efficient among cutting-edge food packaging and processing technologies. Nano-materials used in nano-processing and wrapping methods could indeed enhance and safeguard the higher quality and life expectancy of the food. Metallic nano-particles like Ag, TiO_2, MgO, and Cu, edible anti-microbial nano-composite films, and gas scavengers are examples of active food nano-packaging materials. It has been well founded that various sorts of Ag nano-particles have different impacts on the fruit shelf life. Many agriculturally rich countries have widely used Ag Nanoparticles to extend shelf life of fresh fruit and vegetables. India, the world's 2nd largest supplier of fresh fruit and vegetables, employs numerous nano-particles based on Ag nano-structures to improve the long term storage capacity and freshness of the vegetables and fruits. Ag nano-particles extend the shelf-life of lime and apple [30-32].

Nano-sensors are utilized to identify residue of pesticides, determine the requirements of nutrients, and diagnose the crop pests. However, inappropriate use of nano-particles will be hazardous to crops and the atmosphere. As a result, study based appropriate use of nano-materials is required for reducing post-harvest wastage of farming crops and improving quality food production [33-34].

Nowadays, sustainability in the agriculture is required. It may be acknowledged to offer a strong ecological model in the long run. Too much ploughing of soil, which causes erosion, and watering without adequate drainage are two practices that can cause lengthy soil destruction. This will result in soil salinity. This is to meet the needs of humans for food, livestock feed, and fibre. Lengthy experiments are designed to prove the effect of various practices on soil characteristics that are critical to sustainable development and to provide valuable data on this goal. Nano-chemicals have emerged as promising agents for the pest management and growth of plants. Fertilizers are necessary for plant growth. Nano-materials used as fertilizers may have characteristics such as yield improvement and lower environmental toxicity. Plants can provide a regarded as a key for bio-accumulation in to the food supply chain. Recent agricultural advancements include the use of nano-particles to improve the efficacy and safety of plant-based chemicals. Numerous researchers have indicated the impacts of multiple nano-particles on plant phytotoxicity and growth, which include magnetite (Fe3O4) nano-particles and plants [1, 4, 9, 11].

Nanotechnology has the capacity to enhance a wide range of industries, including medical services, textiles, information and communications technologies (ITC), materials, and energy. Nanotech is extremely significant in agricultural production, packaging and processing of food, water purification and food security, environmental cleanup, improvement of crops, and crop protection. Agricultural production can be increased by using nano-materials to elicit genetically modified plants and animals, site specific drugs and gene distribution of molecules at the molecular level in plants and animals, and nano-array based genetically modified plants and animals under stress conditions. Low levels of reactive oxygen species are usually generated during the physiological metabolic reactions such as photosynthetic or respiration mechanisms and they play a significant signaling role in the plant development and also in growth. Their concentration increases rapidly under the abiotic stress conditions, and if not monitored, can cause cellular injury and destruction. Aside from their toxic effects to proteins, nucleic acids and lipids enhanced the production of ROS under the harsh circumstances plays an important role in complex signaling network of plant response to stress. The anti - oxidant system keeps their concentrations at non-toxic levels by accumulating a broad range of enzymatic or non-enzymatic anti-oxidant molecules in the tissues of plant to satiate ROS caused by stress [11, 27, 31].

CONCLUSION

Drought stress, alone or in the combination with the cold stress, seriously impacted leaf respiration, photo-chemical activities, assimilation of CO2, and generation of energizing pressure at photosystem-II level, ETC rate, and transpiration while functioning on sugarcane. Lower rates of photosynthetic activity in the crop plants under the cold stress have been attributed to very less CO2 mesophyll and stomata conductance, impaired chloro-plastic growth, limited metabolic pathways, reduced quantum-efficiency, and the quantum-yield for Carbon assimilation.

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