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Review Article

Increase Potential of Environmental Stresses and Climatic Risk of Heavy Metals in Plants and Control through Nanotechnology Advances

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Abstract

Different heavy salts accumulated in the soil causing the soil salinity and damage the biological processing occurring in plants such as photosynthesis and light reactions. Climate changes also promote the accumulation of heavy metals by promoting the chemicals substances in the leaves and roots cells that causing the chlorosis. Coal combustion release the large amount of mercury metals that acting as toxic for the plants. There is need to design the biological and mechanical processing the removal of salts and toxic wastes from surfaces in such a way that no eruptions of plant materials occur at the surfaces. Nanotechnology employed the nanoparticles to capture the toxic metals through biological and chemical process that is more reliable and less expensive. A large variety of nanoparticles in the form of nanobased graphene oxides, graphite oxides and CNT, mesoporous silica materials have been used for controlling the pollution caused by heavy metals. These nanoparticles are compatible for the plant growth by suppressing the crop diseases by acting directly on phytopathogens. Therefore, it is reliable for controlling the risk of environmental pollution caused by heavy metals.

Keywords: Biological methods, heavy metals, graphite oxides, pollution, photosynthesis.

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INTRODUCTION

Different crops affected due to accumulation of toxic metals and damage the roots and other necessary parts of the plants. Different heavy salts accumulated in the soils causing the soil salinity and damage the biological processing occurring in plants such as photosynthesis. Heavy metals appear to be more toxic when their concentrations increased at extreme level. Due to which, water of drinking becomes polluted and unfit for health consumption [1, 2]. Different methods have been used in order to control the accumulated heavy metals on the soil surface by mechanical means that helpful for clearing the soil salinity and improve the crop growth. The other method included the desalinize soils of accumulated heavy metals on the soil surface. This method allows the removal of salts and toxic metals not have much practical significance due to eruption of plant cells. Sometimes, bioleaching can be used for removal of heavy and toxic metals that could be effective procedure salty drainage water is discharged through subsurface drains [3-5].

Bioleaching also effectively used in the areas of agricultural kind type that depends upon soil fertility. It is effective in the winter season as plants can conserve the water and other chemical compounds effectively for their growth and development and seed germination. These methods not much reliable in summer seasons as plants unable to conserve much of the water and other supplementary ferreters effectively

for their proliferation of normal cells. The bioavailability of water and other considerations. It also causes the poisonous sulfur dioxide emissions harm the environment and can cause health problems for miners, and bioleaching avoid. There is need to design the biological and mechanical processing the removal of salts and toxic wastes from surfaces in such a way that no eruptions of plant materials occur at the surfaces [6-9].

Table-1: Shows the biological effects of heavy metals and toxicities concerns

Causing agents/approaches	Uses	Biological Role	Agricultural/meta Concerns
Heavy salts	Accumulated in the soils causing the soil salinity	Damage the biological processing occurring in plants such as photosynthesis.	Metal toxicity concerns
Climate changes, Coal combustion	Also promote the accumulation of heavy metals by	Promoting the chemicals substances in the leaves and roots cells that causing the chlorosis.	Heavy metals accumulation
Electric conductivity, Bulk density	Used for removal of toxic metals and more reliable methods to measure soil	This can be measure by measuring the electric conductivity through nanotechnology devices depending on specific concentrations of salts.	Through agricultural approaches
Nanotechnology Approaches	Use of variety of nanobased graphene oxides, graphite oxides and CNT, mesoporous silica materials	Used for controlling the pollution caused by heavy metals.	It is reliable and low cost due to efficient industrial processing

Environmental stresses and control through nanotechnology

Heavy salts that causes the contamination of soils by disrupting the layers of earth crusts that ultimately leads to the weathering in which rocks dissolved with the passage of time.

Through the process of slow weathering, many salts can cause to accumulate in the underneath's ground water. These salts also cause the water pollution by mixing with drinking water. When, usage of this water can be carried out, it causes the crops deformation and abnormal development throughout the plant cycles [10, 11]. Running water is the leading cause of soil erosion, because water is abundant and has a lot of power. Applications of fertilizers and organic amendments also add salts to the soil that causes the soil salinity in the presence of untreated water. While on the other hand, process of high frequency of weathering, toxic metals can cause to accumulate in the earth crust layers by damaging them[1, 8, 10].

Throughout the course of plant development, water saturation in plants depending upon many factors such as salts in groundwater a plants ability to remove the toxic metals from surfaces. Due to presence of toxic metals, process of osmosis and flows from more salt-concentrated causes the imbalances of nutrients flow that causing the osmolysis. When the salt concentration is too high, it means that the soil's osmotic potential is essentially negative. The high salt concentrations in the plants cells unable to uptake the appropriate nitrogen that causes abnormal plant growth [13-15]. Therefore, salting in process slow down the plant development processes and causes a yield loss than acquired optimum level. Climate changes also promote the accumulation of heavy metals by promoting the chemicals substances in the leaves and roots cells that causing the chlorosis. There is need to design the biomechanical process that can remove the toxic metals in order to achieve the desired yields.

Different methods are used for removal of toxic metals and more reliable methods to measure soil salinity. This can be measure by measuring the electric conductivity through nanotechnology devices depending on specific concentrations of salts. With a rise of salt concentration in the solution, its conductivity rises, too. While on the other hand, low detection of salt concentration in the solution causes the conductivity rises to drop. Through this measurement, different concentrations of the sodium percentage can be accurately measured in appropriate manner. Bulk density also used for removal of toxic metals and more reliable how well plant seedlings can emerge and how well air can circulate through the soil [16-18].

Coal combustion release the large amount of mercury metals that acting as toxic for the plants. This metal can mix with nearby by areas and form stable chemical compounds that cause the redox reactions. In order to control the mercury through combustion process, pH of the system determines the stable forms of Hg under the oxidizing conditions. Mercury is most

toxic in its alkylated forms which are soluble in water and volatile in air [19-20]. Through alkylation reaction, large variety of chemical compounds with stable state form that can be acting as inhibitory for the plant growth root developments and seedling. Therefore, nanotechnology devices have been used in order to access the tight binding compounds with mercury. By accessing their concentrations, it is easy to control the pollution caused by heavy metals. It mainly varies the concentrations of typical heavy metal. More concentrations of the chemicals with high oxidizing ability and form complexes with mercury, more pollution can be created. Therefore, biological control based methods in which fungi or other species used in order to capture the chemical compounds. This can be accessed by heavy metals removal for the utilization of filamentous fungi biomass. Bacterial mercury resistance can be seen in Proteobacteria. These organisms can converted the toxic form of mercury into the less toxic form through the methylation [11, 21, 22].

Although, biological pollution can be controlled through chemical and physiological methods but nanotechnology approach is more reliable than traditional methods. Nanotechnology employed the nanoparticles to capture the toxic metals through biological and chemical process that is more reliable and less expensive. While on the other hand traditional methods are not reliable due to high cost and large volume precautions during oxidation and reductions. Sometime, a variety of microorganisms can be sued such as fungi, or bacteria under aerobic or anaerobic conditions during which organic matter in wastewater for removal of heavy salts is oxidized or incorporated into cells that can be eliminated by removal process or sedimentation is termed. But, the appreciable reactions can be carried out that capturing the lead and mercury and suitable for crops and sustainable agricultural developments [23-25].

Toxic metals can interfere with normal growth of plant development and accumulation can leads to soil salinity. These conditions increased the risk of drought under the normal osmotic potential. Due to availability of excess nutrients in case of excessive use of fertilizers, layers of earth crust starts causing the eruption that ultimately leads to soil erosion. These conditions can be treated through the appropriate analysis of soil samples with advanced agricultural machinery that can increase the yield of available soils. Salt export sometimes greatly exceed salt import that's causes the drainage fraction a rapid desalinization dramatically at the extreme level. Nanotechnology employed the nanomaterials for removal of salts and can increase crop yield by increasing fertilizer nutrient availability in soil and nutrient uptake by plants. These nanoparticles are compatible for the plant growth by suppressing the crop diseases by acting directly on phytopathogens[21,23,25]. Through nanotechnology, oxidative reactive species can be revealed through nanoparticles reactions as it can convert or re-use pesticides. Although, nanoparticles are used for the seedling and plant growth in bidirectional mode but the flow of nutrients among different plants groups can be manipulated the discovery of novel nanoparticles that targeted the insects and increase the plant resistance against a variety of diseases [26-28].

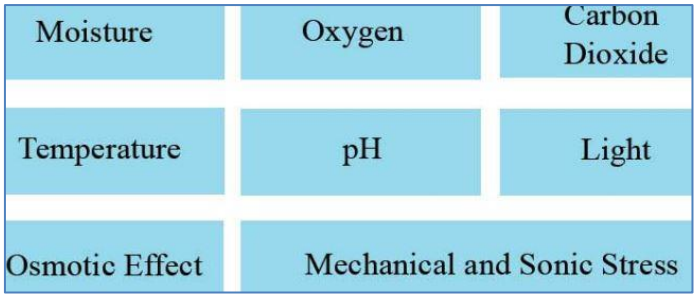

Fig-1: Shows the different environmental stresses/factors affecting plant growth

Different metals affecting the plants in different ways such as copper accumulation in the roots cells is relatively weaker then other metals. It also playing important role in inclusion in the active centers of redox enzymes. It has vital roles in the plant growth and biological processing of biomass but it depends upon its concentrations. Low consumption of copper cannot accelerate the physiological process as high concentrations increase the variety of reactive oxygen species that disruption of the physiological process [29, 30]. Cu-based NPs induce toxicity to soil micro-organisms due to their antimicrobial properties. Exposure to copper nanoparticles had significant toxic effect with all the sizes tested when compared to unexposed control cultures. Copper based nanoparticles of smaller size and higher concentration exerted the maximum toxic effects. They are also applied to the different parts of plants in order to enhance the agricultural processing for promoting the seed varieties. Sometimes, excess applications of nanoparticles can cause serious hazardous issues both for plants as well as human as it can leach out the cultivated soil and move to the foods of human consumption can cause lungs and other respiratory problems. Therefore, there is need to design the safe nanoparticles beneficial for plants and human [12, 29, 30].

Flotation separation nanotechnology method is used for removal of toxic metals or oils form soils in which solid nanoparticles binds tightly to the toxic metals or chemicals in order to reduce their toxicities. This is commonly used for soil testing for separate mixed plastic is too difficult using gravity separation. Biological conducting of ions through gradient for removal of salts leads the oxidation at the anode with generation of hydrogen ions allowing the selected toxic metal from the solution [31, 32].

A large variety of nanoparticles in the form of nanobased graphene oxides, graphite oxides and CNT, mesoporous silica materials have been used for controlling the pollution caused by heavy metals. These nanoparticles possess a lot of promise for additional applications for efficient and precise sensors for soil applications. Biomass for bioenergy as new developments for capturing of metal pollutants in the soils. It is reliable and low cost due to efficient industrial processing [33, 34]. Soil remediation can be accessed through the high biological activities for capturing and removal of heavy metals. In this way, they can be converted to less toxic substances that can be easily degraded by the plant body. One of the best examples is the use of nano-based sensors for detecting harmful pesticide residue in the soil, like detecting Mn impurities. These nanosenors are more reliably used due to degrading capacity [35-36].

Nanoparticles are most active for converting the more toxic into less toxic substances because of their interest for heavy metal absorption capability in soil and groundwater aggregate into micro- to millimeter scale aggregates. This can be achieved through the appropriate amount of the adsorbates on the adsorbents under the normal conditions of temperature and pH[37-38]. One of the most commonly used nanoparticles for removal of heavy salts is Fe3O4 nanoadsorbents spirally for the removal of lead ions from aqueous solution. Phytoextraction is commonly used for soil remediation that can readily absorb heavy metals and purify the soil of its contaminants. Different Biological and chemical nanoparticles treatment have been adversely employed for contaminated soil, leachate, wastewater and ground water [39-42].

CONCLUSION

Soil pollution, salinity, climate change, environmental stresses affected the growth, developmental processes of plants. While on the other hand, increased risk of toxic metals causes serious toxicities among the different phyla of plants by reducing the overall yields. Therefore, nanotechnology that multidisciplinary branch of science in which specific nanoparticles employed for controlling the risk of environmental pollution caused by heavy metals. Nanoparticles are much safer than the other traditionally used chemicals for treatments of heavy metals.

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