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Role of Nerium in heavy metal removal

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Introduction

The issue of heavy metal poisoning has become increasingly problematic due to factors such as uncontrolled industrialization, increased transportation, agricultural practices, fast urbanization, and metal plating. Using several forms of transportation, the amount of heavy metal toxicity is rising over the safe limit due to unburned fuel and smoke from malfunctioning cars. These metals are harmful to human health as well as the plants they fall on. Thus, eliminating heavy metals from the environment is now of utmost importance. A significant part of cleaning the air, water, and land is done by plants. In addition to macronutrients (nitrogen, phosphorus, potassium, sulphur, and manganese) that are vital for growth and life, plants also require necessary nutrients for heavy metals. Thus, plants could be a major way to remove heavy metals from the atmosphere. Plants can absorb heavy metals through a variety of channels, including the soil, water, environment, and other sources. Biochemical membranes are also permeable to heavy metals.

The major environmental factors that effects metal uptake

Soil acidity, the ability of heavy metals to exchange cations with other minerals, and the concentration of macro- and micronutrients are the main environmental factors that affect plants' ability to absorb metals. This leads to accumulation in plant tissue and alters the composition of the plant community. Various species of trees and plants have various heavy metal limitations. Hyperaccumulators are plants that accumulate heavy metals hundreds or thousands of times more than typical plants.

Hyper accumulator

Accumulator plants require more heavy metals in their numerous organ systems. The presence of heavy metals and the proportion of metals in different plant species' organs are mostly determined by the morphophysiological traits of the plants. The present classification splits all plant species into three groups based on the previously mentioned classification.

1. The accumulator, which mostly stores metals in soils with high and low metal concentrations.
2. The indicators, which show how much metal is present in the environment based on the concentration of metals in plants.
3. The excluder, which limits the amount of heavy metals that can

enter the shoots regardless of how high the concentration of metals is in the surroundings and in the roots.

So, by using these accumulators and indicators we can remove the heavy metals from environment.

Phytoremediation by plants

Compared to traditional cleanup techniques like excavation and reburial, phytoremediation can be up to 1000 times less expensive. Furthermore, it provides long-term on-site treatment as opposed to merely relocating the contamination. A great deal of study has been done to improve accumulating properties thanks to plant engineering. Several methods for enhancement include the following:

1. Somatic and sexual hybridization can be used to achieve this in the absence of known "phytoremediation" genes.
2. Mutagenesis of specific high biomass plant species may also result in improved Phyto remediating cultivars.
3. By introducing genes responsible for accumulation and resistance from wild slow growing plants to fast growing high biomass plant species.

Mechanism of phytoremediation

Plants have multiple ways of cleaning polluted areas. The main methods for preventing toxicity are found in the root and leaf systems, which are where most contaminants are absorbed by plants. The vast surface area of the root system allows it to collect and retain non-essential pollutants as well as the water and nutrients needed for growth. As plant roots emit organic and inorganic exudates into the rhizosphere, they alter the soil-root interface and have an impact on the stability and aggregation of pollutants. Exudates from roots fluctuate and are dependent on the properties of the soil. The second system is the leaf system, which has many pores. When particles of heavy metals settle on the leaves, these pores partially remove the heavy metals and purify the surrounding air.

Phytoremediation processes

- Phytodegradation or phyto-transformation
- Phytostimulation or rhizodegradation
- Phytovolatilisation
- phytoextraction or phytoaccumulation
- Rhizofiltration
- Phytostabilisation

Limitation and selection of plant for phytoremediation

A crucial and challenging step in the phytoremediation process is choosing the plant. Seasonal cycles and climatic conditions are also taken into consideration while choosing a plant. The following are some crucial variables to consider while choosing a plant species for Phyto remedy:

- High growth rate and biomass yield.
- Adequate metal accumulation, translocation, absorption, and potential
- Tolerance level with regard to known metals present at the site.
- The ability to withstand severe drought and water logging.

Phytoremediation in Nerium

The plants having more accumulation properties can be used for removal of heavy metal (Verma et al., 2013) in the roadside environment in an affecting and natural way. A lot of work has been done on bioindicators especially for road side plants. Nerium oleander is a shrub belongs to family Apocynaceae. A

common fast growing evergreen shrub, widely cultivated in the Mediterranean area for ornamental purposes. The plant is expected to gather elements mostly from airborne sources and substrate on the leaf surface. Additionally, it was discovered that this shrub is a widely used, somewhat hardy, and drought-tolerant landscaping plant. It is utilized for outdoor planter boxes, living privacy screens, and hedges (Harrison et al., 2012). It has already proven profitable to employ this species to study the bio-accumulation of trace elements.

Using plants to remove pollutants from soil, sediment, and water within the plant root system is a special and selective absorption ability known as phytoremediation (Tangahu et al. 2011). Although many plant species have been found to be capable of accumulating heavy metals, N. oleander is regarded as one of those plants that plays a crucial role in lowering heavy metals in the natural world. N. oleander because of its oblong leaves, which have thick cuticles covering their skin.

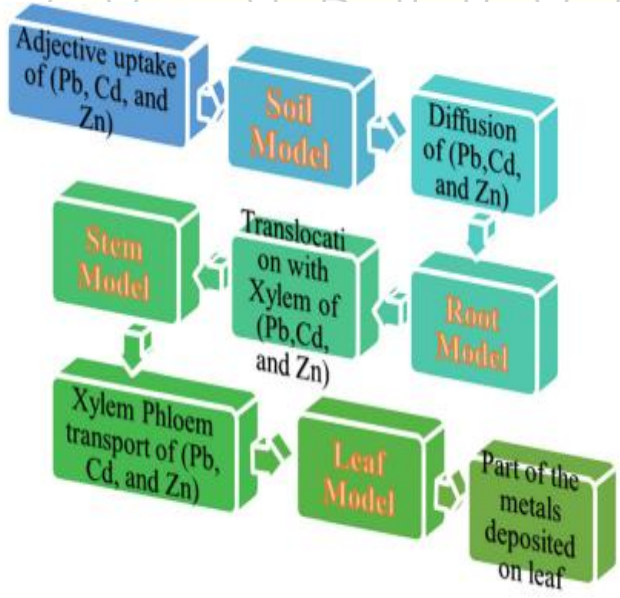

Fig. Phytoremediation Uptake Model (UPM)

According to Doganlar *et al.* (2012), N. oleander was found to be an effective biomonitor of heavy metals, particularly Pb and Zn in leaf tissue. In order to quantify the absorption of heavy metals from contaminated soils and anticipate the movement of pollutants from soil to plants information that is crucial for heavy metal remediation, simple absorption Plant Model (Phytoremediation Uptake Model -UPM) systems were employed.

Utilizing the Phytoremediation Uptake Model (UPM) to forecast the soil's absorption of heavy metals such as zinc (Zn), cadmium (Cd), and lead (Pb). The contribution of diverse paths to the remediation of these heavy metals through different components, leaves, stems, and roots was estimated using UPM. Additionally, it covers the deposition of soil as well as soil-root-leaf and soil-leaf pathways.

Conclusion:

Nerium oleander has demonstrated significant potential in the phytoremediation of heavy metals from contaminated soils and water. Studies have shown that this plant can effectively absorb and accumulate various heavy metals, making it a valuable, low-cost, and eco-friendly solution for environmental cleanup. Its robust growth and adaptability to different conditions further enhance its suitability for widespread use in mitigating heavy metal pollution. Therefore, Nerium oleander represents a promising candidate for sustainable and natural remediation strategies to address environmental contamination issues.

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