Genetic Evolution in Phytoremediation Plants Preserving Environment

[1]Hemant Rajveer Singh, [2]Parvinder Kaur, [3]Tanwarjeet Singh
[1]Patent Analyst, Scintillation Research and Analytics Services Pvt. Ltd., Mohali, Punjab
[2]Associate Engineer at IDEA Cellular Private Limited
[3]Student, Cornel Institute, Auckland, New Zealand

Abstract - In this hectic world most of the companies and environmental industries has bed contributing most of their research in preserving environment from major exotic pollutants of soil, water and air. It has been experimentally examined that most for the pollutants are completely exhausting pedosphere, hydrosphere, atmosphere, lithosphere and biosphere of the environment. It has been seen that Countless efforts has been experimented from the last three decades to diminish pollution causing sources and remedying the polluted air, soil and water resources. However the genetic evolution of Phytoremediation process and plants made using this procedure are becoming most appropriate sacking sources of these pollutants. Phytoremediation plants evolve degradation and detoxification of harmful plants by absorbing pollutants from the air, water and soil. These plants are amazing metabolic and absorption abilities, even transport structures that can utilize nutrients or impurities selectively from the growth matrix, soil or water. This paper gave an explanation of how Phytoremediation plants come in existence and how it can rumble the environment for future.

Keywords- *Phytoremediation, Green Revolution, Pollutants Contaminants and Toxic Metals, Types of Phytoremediation plants.*

I. INTRODUCTION

Phytoextraction is a substitute procedure of phytoremediation in which plants eradicate hazardous elements or compounds from soil, air or water more likely heavy metals. Metals which have a high density and might be poisonous to organisms even at relatively low concentrations. Phytoextraction is a process of absorbing these pollutants from the soil, air, water and even absorb toxic elements automatically. These plants are genetically made having magnificent capacity for absorbing, utilizing and extraction.

In order to keep quality of soil and water and preserve them free from impurity, constant efforts have been made to development in technologies that are easy to held, maintainable and economically possible. Physicochemical methods have been broadly used for alleviating polluted soil and water, specifically from the hubs and at a narrow scale. Nevertheless, they experience more problems at a huge scale of remediation because it costs a lot. The use of plant species for cleaning polluted soils and waters named as phytoremediation has gained increasing attention since last decade, as an emerging cheaper technology. Many studies have been conducted in this field in the last three decades. Numerous plant species have been identified and tested for their traits in the uptake and accumulation of different heavy metals. Mechanisms of metal uptake at whole plant and cellular levels have been investigated. Progresses have been made in the mechanistic and practical application aspects of phytoremediation. They were reviewed and reported in this paper [1].

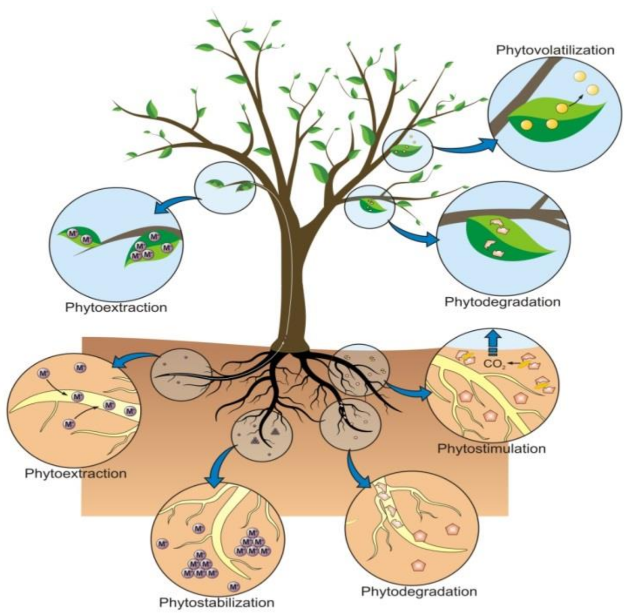

Fig.1: Phytoremediation process

Scientific research conducted that At the end of the 19th century, **Thlaspi caerulescens** and **Viola calaminaria** were the first plant species documented to accumulate high levels of metals in leaves. In 1935, Byers reported that plants of the genus Astragalus were capable of accumulating up to 0.6 % selenium in dry shoot biomass. One decade later, scientist identified plants able to accumulate up to 1% Ni in shoots. More recently, researcher reported tolerance and high Zn accumulation in shoots of Thlaspi caerulescens. Despite subsequent reports claiming identification of Co, Cu, and Mn hyperaccumulators, the existence of plants hyperaccumulating metals other than Cd, Ni, Se, and Zn has been questioned and requires additional confirmation [2].

II. PHYTOREMEDIATION: FUNDAMENTAL PROCESSES INVOLVED AND CHARACTESTICS

Phytoremediation of contaminated soils is generally believed to occur through one or more of the following mechanisms or processes:

- phytoextraction,
- phytostabilization,
- phytodegradation,
- phytovolatilization,
- rhizofiltration and
- rhizodegradation[4] [5],

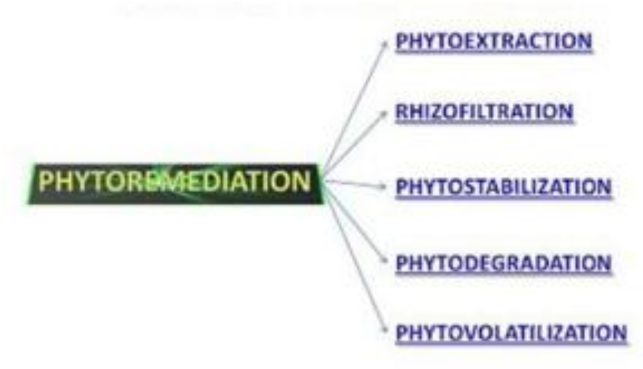

Fig.2: Phytoremediation Types

Phytoremediation is applicable to a broad range of contaminants, including heavy metals and radionuclides, as well as organic compounds like chlorinated solvents, polycyclic aromatic hydrocarbons, pesticides/insecticides, explosives, and surfactants [3].

However, as a plant-based remediation, phytoremediation has low remediation rate, and generally need a longer period in comparing with other physicochemical methods. This short coming limits its application particularly in the developed urban areas, where land is extremely expensive. The remediation rate of phytoremediation is different with case by case, as the plant growth was influenced easily by the climate, soil conditions and management practices. Phytoremediation has limited depth. The use of phytoremediation is limited by the climate, soil type, geological conditions of site to be cleaned, and the accessibility for agricultural equipment [3]. The process involving Phytoremediation is shown in this below Table 1.

Table I: Phytoremediation Processes For Remediation of Contaminated Soils

Phytoremediation processes	Explanation
Phytoextraction	Plants absorb contaminants and store in above-ground shoots and the harvestable parts of roots.
Phytostabilization	Roots and their exudates immobilize contaminants through adsorption, accumulation, precipitation within the root zone, and thus prevent the spreading of contaminants.
Phytodegradation	Plant enzymatic breakdown of organic contaminants, both internally and through secreted enzymes.
Rhizodegradation (phytostimulation)	Plant roots stimulate soil microbial communities in plant root zones to break down contaminants.
Phytovolatilization	Contaminants taken up by the roots through the plants to the leaves and are volatized through stomata where gas exchange occurs.

III. TYPES OF PHYTOREMEDIATION

Scientist's research has amended new techniques and make's phytoremediation plants genetically.

a) **Rubber plant:** Rubber plant also named as Ficus Elastica need less space to grow and it can purify larger amount of oxygen in less time [6].

Figure.3. Rubber Plant

- Toxins that can be taken up: Formaldehyde
- Accumulation Quantity: Hyperaccumulator
- Accumulation Type: N/A

b) **Ryegrass-** Also named as Lolium Multifloroum

- Toxins that can be taken up: Arsenic, Barium, Cadmium, Chromium, Copper, Diesel Fuel, Lead, Manganese, Nickel, Polycyclic Aromatic Hydrocarbon (PAH), Zinc Accumulation.
- Quantity: N/A
  Accumulation
- Type: Rhizodegradation, Phytovolitization

- Notes: Rygrass is one of nature's greatest phytovolatilazation device. It takes up toxins well and molecularly changes them to become safe particles in the air. Perennial grass shown to uptake nutrients and to significantly enhance degradation of TPH and PAH's in soils. Hardiness zone: 3-9.

Fig.4: RyeGrasss

c) **Reed Canary Grass-** Also named as Phalaris arundinacea.

Fig.5: Reed Canary Grass

- Toxins that can be taken up: Cadmium, Cesium, Nickel, Polychlorinated Biphenyl (PCB), Polycyclic Aromatic Hydrocarbon (PAH)
  Accumulation Quantity: N/A
- Accumulation Type: N/A
- Notes: Glomus mosseae as chelating agent (amendment). It increases the surface area of the plan roots, allowing roots to acquire more nutrients, water and therefore more available radionuclides in soil solution [7].

IV. REFERENCES

[1]. I. Mohammad, Lone, H. Zhen-li, J. Peter Stoffella and Y. Xiao-e, "Phytoremediation of heavy metal polluted soils and water: Progresses and perspectives" Journal of Zhejiang Univ Sci B, (2008) Mar, pp. 210–220.

[2]. M. M. Lasat, " Phytoextraction of Metals from Contaminated Soil: A Review of Plant/Soil/Metal Interaction and Assessment of Pertinent Agronomic Issues," Journal of Hazardous Substance Research, Vol. 2, No. 5, 2000, pp. 1-25.

[3]. K. Oh, T. Cao, T. Li, and H. Cheng, "Study on Application of Phytoremediation Technology in Management and Remediation of Contaminated Soils" Journal of Clean Energy Technologies, Vol. 2, No. 3, July 2014

[4]. K. Oh, T. Li, H. Y. Cheng, Y. Xie, and S. Yonemochi., "Development of Profitable Phytoremediation of Contaminated Soils with Biofuel Crops," Journal of Environmental Protection, vol. 4, pp. 58-64, 2013

[5]. X. J. Wang, F. Y. Li, M. Okazaki, and M. Sugisaki, "Phytoremediation of contaminated soil", Annual Report CESS, vol. 3, pp. 114-123, 2003.

[6]. P. Kaur and H. R. Singh, "A Review Paper on Plants that helps to reduce pollution"

[7]. Source link: http://www.steviefamulari.net/phytoremediation/commonSearch.php?plant_letter=R