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Checklist Of Flowering Plants Used In Phytoremediation Found In Sindh, Pakistan

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Abstract: Sixteen species are reported from Sindh province which can be useable for the purpose of Phytoremediation or environmental cleanup. These species can be helpful for the removal of heavy metals which includes Aluminium, Chromium, Copper, Nickel, Lead, Mercury, Selenium, Hydrocarbons, Caesium, Silver, Uranium and Zinc from the soil.

Keywords: Phytoremediation, Pollution, Heavy metals, Environmental cleanup, Sindh, Pakistan.

1. INTRODUCTION

Chemicals mostly produced and used in efforts to improve human health, living standard, agriculture, medicine and national defence activities. Production, distribution, use, misuse and disposal of chemicals cause environmental pollution, which threaten human health and whole ecosystem. Manufacturing of paints, batteries, pesticides, industrial wastes, mining and land application of industrial and domestic sludge cause heavy metal contamination of Urban and agricultural soils. Naturally heavy metals also occur but rarely they reach toxic levels. The most common heavy metals which affect the human health and whole ecosystem are Lead, Cadmium, Arsenic, Mercury, Nickel, Copper, Chromium, Manganese and Zinc. Excess accumulation of heavy metals in soil is toxic to human beings and other organisms. Long-term heavy metal exposure causes chronic problems.

Arsenic: Affects kidneys, Central Nervous System and skin poisoning.

Cadmium: Affects kidneys, liver and GI tract.

Lead: Mental lapse.

Research also proved that technologies or practices that take advantage of natural systems are the best for removal of pollutants from environment. Various type of research has demonstrated that plants play an effective role in cleaning up contaminated soil (Wenzel *et al.*,1999). This cleanup process is known as Phytoremediation. Phytoremediation word is derived from the Greek word Phyto means Plant and Remediation or remedium means to restore or to clean (Cunningham *et al.*, 1996). with usage of plants to degrade Phytoremediation is a general term which is concerned or remove soil pollutants such as pesticides, crude oil, solvents, poly aromatic hydrocarbons, landfill leacheats and specially heavy metals, wild flowers were used to degrade hydrocarbons from oil spill in Kuwait (Brady and Weil,1999). Phytoremediation is known as environment friendly, aesthetically pleasing, cost effective and most suitable environmental pollutant removal approach for developing countries (Ghosh and Singh 2005).

Various types of Phytoremediation according to Schwitzguebel (2000). Phytoextraction: It is also known as phytoaccumulation or phytoabsorption. It is specific process for remediation of metals. In this process plant roots absorb pollutants and uptake it to stem and leaves.

Phytotransformation: It is contaminant destruction process. It is metabolizing or degradation of contaminants within plant or degradation of contaminants in sediments, sludges, soil, ground water or surface water by producing enzymes.

Phytostimulation: This process is followed by the stimulation of fungal and microbial degradation by releasing exudates into the root zone.

Phytovolatilization: It is contaminant transfer or removal process. It is helpful in contaminant transfering from ground water or soil water to the atmosphere through plants.

Phytostablization: It is also termed as phytoimmobilization. Phytostabilization is helpful in reduction of pollutant mobility in atmosphere or preventing their migration to ground water or in ecosystem.

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Rhizofiltration: It is also known as phytofiltration.This process is mainly concerned with absorption of pollutants from water.

Hydraulic control: Its indirect remediation process through trees by controlling ground water movement. Trees establish dense root mass that takes up large amount of water.

Cunningham *et al.,* (1997) and Brooks *et al.,* (1998) worked on different hyperaccumulator plant species and reported that phytoremediation may be asked latest technique but concept is very old.

Chaney *et al.,* (1983) were the researchers who first time suggested the role of hyperaccumulator species for phytoremediation of metal-polluted areas. Before this due to slow growth and small size, hyperaccumulator species were believed to have limited potential in this field (Cunningham *et al.,* Comis,1996, Ebs *et al.,* 1997). Semi-aquatic plants were used by researchers for treatment of radionuclide waters in starting of the nuclear period (Salt *et al.,* 1995 and Timo feev-Resovsky *et al.,* 1962).

Cunningham, and Ow (1996) suggested that conventional technologies for the removal of metal-polluted sites have been used mostly due to quick results but it is not cost effective and environment friendly. Reeves and Brooks (1983), Baker and Brooks (1989 and Baker *et al.,* 1991) reported that some plants have accumulation ability of heavy metals in their tissues without exhibiting toxic symptoms.

Ensley *et al.,* (2000) research described increasing potential of Phytoremediation due to its low cost and environment friendly. Dushenkov *et al.,* (1995) worked on terrestrial plants and reported these plants are most suitable for metal accumulation specially *Brassica juncea* Czern. and *Helianthus annus* L. are effective in removal of Cadmium (Cd), Chromium (Cr) ,Copper (Cu), Nickle (Ni), Lead (Pb) and Zinc (Zn).

Dushenkov and Kapulink (2000) worked on plant selection for rhizofiltration and suggested that plants must have the ability of accumulation and tolerance against metals.

Major environmental issues of Sindh are identified as degradation of fresh water bodies, marine pollution, urban and indoor air pollution, industrial and municipal solid waste, industrial toxic waste, deforestation, excessive use of pesticides and improper disposal of infectious hospital waste. Sindh province is the industrial hub of country, including Karachi, Nooriabad, Hyderabad, Kotri and Sukkur industrial zones having textile, cement, leather, tobacco, steel, varnish, paint, glass and sugar industries. KITE and SITE Karachi are two larges zones of Pakistan. There is no effluent treatment plant and waste containing hazardous materials, oils and heavy metals is ultimately discharged into coastal waters through Lyari and Malir canals. In Hyderabad and Sukkur regions sugarcane based industry is a major cause of industrial water pollution due to discharge of wastewater containing high pollutant.

2. MATERIAL AND METHOD

For plant collection purpose, random selection has been carried out from some districts of Sindh. Collected material was preserved as herbarium material. Herbarium specimens were properly identified and labelled. Areas of the collection and ecological notes were mentioned on the labels. Literature survey also has been done for the identification of plants which is based on different floras and published literature. Collected material was described with complete morphological description.

3. RESULT AND DISCUSSION

After thorough review of literature and field study we have recorded the following plant species found in Sindh province, which are important for Phytoremediation

Brassica juncea Linn.
Family: Brassicaceae
Type of Plant: herb, cultivated.
Vern. name: Mustard /Sarhein.
Accumulate: Chromium (Accumulator) Copper (Hyper accumulator), Nickel, Lead, Uranium) and Zinc.

***Brassica oleracea* Linn.**
Family: Brassicaceae.
Type of Plant: herb, cultivated.
Vern. name: cabbage/ Band Gobi.
Accumulate: Lead.

***Brassica napus* Linn.**
Family: Brassicaceae.
Type of Plant: Herb, cultivated.
Vern. name: Rape seed plant.
Hyperaccumulator: Chromium, Mercury, Lead, Selenium and Zinc.

***Cynodon dactylon* (**Linn**.) Pers.**
Family: Poaceae.
Type of Plant: herb, wild.
Vern. name: Barmuda grass/ Lawn grass.
Accumulate : Hydrocarbons.

***Cocos nucifera* L.**
Family:Palmae
Type of Plant: tree, cultivated.
Vern. name: Coconut palm/Naryal.

Accumulates: Caesium.
***Eucalyptus tereticornis* Smith.**
Family: Myrtaceae.
Type of plant: tree, cultivated.
Vern. name: Forest redgum.
Hyperaccumulator : Caesium.

***Eichhornia crassipes* (Mart.) Solma.**
Family: Pontederiaceae.
Type of plant: herb, wild.
Vern. name: Water Hyacinth.
Accumulates : Chromium(A), Copper(A), Mercury(H), Lead(H) and Zinc (A).

***Helianthus annus* L.**
Family: Asteraceae.
Type of Plants: herb, mostly cultivated rarely wild.
Vern. name: sun flower.
Accumulates :Uranium(H) and Lead(A).

***Hydrilla verticillata* (L.f.) Royle**
Family: Hydrocharitaceae.
Type of plant: herb, wild.
Vern. name: Hydrilla.
Accumulates: Chromium(A), Mercury(H) and Lead(H).

***Hordeum vulgare* Linn.**
Family: Poaceae.
Type of plant: herb, cultivated.
Vern. name: Barley/Jao.
:Accumulates:Aluminium.

***Salix viminalis* Linn.**
Family: Salicaceae.
Type of plant shrub, wild.
Vern. name: Common Osier.
Hyperaccumulator: , Silver, Mercury and Petrolium hydrocarbons.

***Sorghum halepense*(Linn.)Pers.**
Family: Poaceae.
Type of plant: herb, wild.
Vern. name: Johnson grass.
Accumulates :Caesium.

***Typha latifolia* L.**
Family: Typhaceae.
Type of plant: herb wild.
Vern. name: Broadleaf Cattail
Accumulates: Lead.

***Triticum aestivum* Linn.**
Family: Poaceae.
Type of plant: herb, cultivated.
Vern. name: Wheat.
Accumulates: Lead.

***Vicia faba* Linn.**
Family: Fabaceae.
Type of plant: herb, cultivated.
Vern. name: Horse Bean.
Accumulates: Aluminum.

***Zea mays* Linn.**
Family: Poaceae.
Type of plant: herb cultivated.
Vern. name: Corn/Makai.
Accumulates: Uranium
Table: Showing details of species with accumulators.

S.No.	Name of Elements	No. of Species accumulates
1.	Lead	08
2.	Chromium	04
3.	Mercury	04
4.	Caesium	03
5.	Uranium	03
6.	Zinc	03
7.	Aluminum	02
8.	Copper	02
9.	Hydrocarbons	02
10.	Nickel	01
11.	Selenium	01
12.	Silver	01

Maximum number (08) of species reported in Sindh province accumulates leads where as selenium, silver and nickel accumulated by one species respectively and it is observed that Lead is frequently present in automobiles and affects on the land present on roadside. It is suggested that the cultivation of wheat, mustard and cabbage near road side land is helpful in elimination of lead contaminated sites. These reported species can be used for the environmental cleanup of different areas which are polluted due to different sources of effluents of site areas of Karachi, Kotri, Hyderabad and Sukkur, beside this it also helps contaminated sites of sugar industries spread all over the Sindh Province.

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