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Plant: A Natural Purifier of Environment

Abstract: *Plants and plant communities are very important to humans and their environment. Plants provide to our environment many important things. The oxygen in the air we breathe comes from the photosynthesis of plants. The quality of the air can be greatly influenced by plants. Plants can stop the movement of dust and pollutants. Through the intake of carbon dioxide, plants can also lessen the greenhouse effect caused from the burning of fossil fuels like coal. Plants are extremely important to the quality of the water we use. A diverse cover of plants aids in maintaining healthy watersheds, streams, and lakes by holding soil in place, controlling stream flows, and filtering sediments from water.*

Keywords: *Environment, Hazards, Phyto-remediation, Plants, Pollution, Remedy*

I. INTRODUCTION

Lucky for us, nature has a way of keeping itself clean. There are many powerful air-cleaning plants that naturally remove pollutants from the air. Our nation needs to provide better protection for people who are affected by these environmental factors and we need to require the implementation of new technologies that will prevent much of the pollution our communities experience today**.** One of the ways to reduce the effects of pollution is to increase flora. Trees, shrubs, herbs, house plants, vegetable crops and decorative flowers can reduce the amount of CO_2 in the environment and increase oxygen content. They provide nourishment for the entire food chain as well as the earth itself. They are also a safe and effective solution to some of our biggest environmental pollution. The study called NASA Clean Air has been led by the National Aeronautics and Space Administration (NASA) in association with the Associated Landscape Contractors of America (ALCA). Its results suggest that certain common indoor plants may provide a natural way of removing toxic agents such as benzene, formaldehyde and trichloroethylene from the air, helping neutralize the effects of sick building syndrome. During this research some air-filtering plants were discovered which eliminate significant amounts of benzene, formaldehyde and trichloroethylene [1]. In this article, we are focusing on use of plants as a natural purifier to reduce pollution from our habitat so that to make environment clean and green. Plantation can be effective remedy against pollution whether it is air, water, soil or noise pollution. It comprises several causes of pollution and their treatment by simply growing plants around our ambience.

II. AIR POLLUTION

Trees and vegetation in parks can help reduce air pollution both by directly removing pollutants and by reducing air temperatures and building energy use in and near parks. These tree effects can reduce pollutant emissions and formation. However, park vegetation can increase some pollutants by either directly emitting volatile organic compounds that can contribute to ozone and carbon monoxide formation or indirectly by the emission of air pollutants through vegetation maintenance practices such as operation of chain saws and use of transportation fuels. Park trees can shield people from ultraviolet (UV) radiation, as tree leaves absorb about 95% of UV radiation [2].

III. EFFECT OF TREES ON AIR POLLUTION

There are many factors that determine the ultimate effect of trees and parks on pollution. Many plant and park effects are positive in terms of reducing pollution concentrations. For example, trees can reduce temperatures and thereby reduce emissions from various sources, and they can directly remove pollution from the air. Pollution removal by trees in cities can range up to 11,100 tons per year[3]. The values of pollution removal are based on economists estimates of "externality values," which are used to place an

economic value to the negative side effects of air pollution on society. Parks, being smaller in extent than entire cities, would have lower total removal rates and values, but could have greater removal effects per acre than the city average due to their relatively high tree cover. One acre of tree cover in a park will likely have pollution removal totals around 80 pounds per year, but the total could exceed 200 pounds per year in more polluted areas with long growing seasons (e.g., Los Angeles)[4]. The average value of pollution removal per acre of tree cover is about $300 per year [3].(fig:1)The National Space Technology Laboratories have recently published a series of papers on the usefulness of water hyacinth *(Eichhornia crassipes)* and also alligator weed *(Alternanthera philoxeroides)* in removing pollutants from sewage and industrial waste.

IV. PLANT SPECIES FOR POLLUTION CONTROL

While selecting the species for pollution control the following are the important characteristics could be considered. Plants should be evergreen, large leaved, rough bark, indigenous, ecologically compatible, low water requirement, minimum care, high absorption of pollutants, resistant pollutants, agro-climatic suitability, height and spread, canopy architecture, growth rate and habit, aesthetic effect (foliage, conspicuous and attractive flower color), pollution tolerance and dust scavenging capacity. Different types of leaves tend to have differences in several aspects of their surfaces. Some types of leaves have greater surface rigidity or roughness than other leaves, which may affect their stickiness solubility. Stickier leaves are better for collecting particles because more particles would stick to their surface. Therefore, certain plant leaves may be more useful for efficient dust capturing than other plants. The various morphological features are also major factors for dust capturing by leaves (CPCB. 2006. Annual report, 4:80-99). Choice of eco-friendly plant species in urban environment to mitigate airborne particulate pollution During tree plantation in an urban environment little or no attention has been paid to evaluate the effect of trees on filtering the particulate matter. New housing developments offer an opportunity to control atmospheric particulate pollution through tree plantations. Trees such as Tamarind (*Tamarindus indicus*) having smaller compound leaves are generally more efficient particle collectors than larger leaves. Particle deposition is heaviest at the leaf tip and along leaf margin. In the preliminary survey of dust fall on common roadside trees in Mumbai, carried out by Shetye and Chaphekar [5] reported that the shape of leaves of Mango (*Mangifera indica)*, Ashoka (*Polyalthea longifolia*), Pongamia (*Derris indica*) and Umbrella (*Thespepsia populnea*) trees captured higher amounts of dust as compared to other neighboring plants. Dochinger (1973) a plant pathologist of USDA forest service ohio, reported that the filtering effect of evergreen trees are better than the deciduos trees [5]. In Singapore; it has been noted that a single row of trees planted with or without shrubs can reduce particulate matter by 25% and each hectare (2.471 acres) of plantation can produce enough oxygen to keep about 45 persons [6]. The value of trees in urban environment is now generally recognized not only aesthetically but also functionally in helping to make cities and towns agreeable places to live and work in. The first choice should be, therefore, to select easily propagated and readily available, medium growing, ecologically much suitable, pest and disease resistant tree species and also require less maintenance should be given top priority. Columnar and medium-sized trees are preferred [5]. Ingold reported that the leaves with complex shapes and large circumference area reported to be collected particles more efficiently [7]. Many trees like Neem (*Azadirchta indica*), Silk cotton (*Bombax ceiba*), Indian laburnum (*Cassia fistula* and *C. siamea*), Gulmohar (*Delonix regia*), Pipal (*Ficus religiosa*), Jacaranda (*Jacaranda mimosifolia*), Indian lilac (*Lagerstroemia indica*), Temple or Pagoda tree (*Plumeria rubra* and *P. alba*), Java plum (*Syzygium cumini*) and several other roadside and street trees have found more suitable in urban environment[8].

V. WATER POLLUTION

Water pollution is a serious problem for the entire world. It threatens the health and well being of humans, plants, and animals. Over two thirds of Earth's surface is covered by water; less than a third is taken up by land. As Earth's population continues to grow, people are putting ever-increasing pressure on the planet's water resources. In a sense, our oceans, rivers, and other inland waters are being "squeezed" by human activities—not so they take up less room, but so their quality is reduced. Poorer water quality means water pollution**.** According, to the environmental campaign organization WWF "*Pollution from toxic chemicals threatens life on this planet. Every ocean and every continent, from the tropics to the once-pristine Polar Regions, is*

contaminated."[9]. Fortunately, Earth is forgiving and damage from water pollution is often reversible.

Vegetative filter strips for water pollution control in agriculture

Orchards, vineyards and row crops have the greatest erosion rates in irrigated agriculture, especially those that are managed with bare soil between tree or vine rows. The vegetative filter strip (VFS) offers one way to control erosion rates and keep soil in the field rather than letting it be carried off site in drainage water. A VFS is an area of vegetation that is planted intentionally to help remove sediment and other pollutants from runoff water [10].

Aquatic plants for removal of pollutants (Pb, Cu, Cd, Fe, Hg and chromium) from leather Industries:

Hydrilla verticillata; Spirodela polyrrhiza; Bacopa monnierii; Phragmites karka; Scirpus lacustris; Water hyacinth (*Eichhornia crassipes*); Pennywarth (*Hydrocotyle umbellate;* Duck weed (Lemna minor; Water velvet (*Azolla pinnata*) [11].

VI. SOIL POLLUTION

It is difficult to define soil pollution exactly because different opinions exist on how to characterize a pollutant; while some consider the use of pesticides acceptable if their effect does not exceed the intended result, others do not consider any use of pesticides or even chemical fertilizers acceptable. However, soil pollution is also caused by means other than the direct addition of xenobiotic (man-made) chemicals such as agricultural runoff waters, industrial waste materials, acidic precipitates, and radioactive fallout.

Soil pollution can lead to water pollution if toxic chemicals leach into groundwater, or if contaminated runoff reaches streams, lakes, or oceans. Soil also naturally contributes to air pollution by releasing volatile compounds into the atmosphere. Nitrogen escapes through ammonia volatilization and de-nitrification. The decomposition of organic materials in soil can release sulfur dioxide and other sulfur compounds, causing acid rain. Heavy metals and other potentially toxic elements are the most serious soil pollutants in sewage. Sewage sludge contains heavy metals and, if applied repeatedly or in large amounts, the treated soil may accumulate heavy metals and consequently become unable to even support plant life.

VII. PLANTS AS A REMEDY TO TREAT SOIL POLLUTION

Phytoremediation

Phytoremediation is the use of living green plants for *in situ* risk reduction and/or removal of contaminants from contaminated soil, water, sediments, and air. Specially selected or engineered plants are used in the process. Risk reduction can be through a process of removal, degradation of, or containment of a contaminant or a combination of any of these factors. Phytoremediation is an energy efficient, aesthatically pleasing method of remediating sites with low to moderate levels of contamination and it can be used in conjunction with other more traditional remedial methods as a finishing step to the remedial process.

One of the main advantages of phytoremediation is that of its relatively low cost compared to other remedial methods such as excavation. The cost of phytoremediation has been estimated as $25 - $100 per ton of soil, and $0.60 - $6.00 per 1000 gallons of polluted water with remediation of organics being cheaper than remediation of metals. In many cases phytoremediation has been found to be less than half the price of alternative methods. Phytoremediation also offers a permanent in situ remediation rather than simply translocating the problem. However phytoremediation is not without its faults, it is a process which is dependent on the depth of the roots and the tolerance of the plant to the contaminant. Exposure of animals to plants which act as hyper-accumulators can also be a concern to environmentalists as herbivorous animals may accumulate contaminates particles in their tissues which could in turn affect a whole food web [11].

VIII. NOISE POLLUTION

According to the World Health Organization, noise pollution is the third most hazardous environmental type of pollution which proceeded by only air (gas emission) and water pollution. The research carried out in two phases, the first stage of the research noise and plant types providing the suction of noise were evaluated through literature study and at the second stage, definite types [11]. Plantation design approaches and suggestions concerning to the diversity to be used, which are peculiar to roadside, were developed to discuss the role and the

function of plant material to reduce the noise of the traffic.

It is known that 70% of the world's urban population lives in developing countries [12]. The increasing population and improving technology have brought about changes in the economic and social structure of societies. Much of these urban populations are vulnerable to the ill health effects of noise. Despite being a less frequently considered type of environmental pollution; noise has a major negative impact on the quality of life in cities. Especially dense transportation systems, including roads, railways, and air traffic, characterize the modern urban environment. These systems have caused environmental noise (also known as community noise) pollution [13,14]. Many studies have been conducted to reduce the noise levels and its negative effects in various countries all over the world. The acoustical effect of a belt of trees/vegetation near roads has been a popular research topic over the past 40 years [15,16]. Besides the fact that plant material practices aiming at preventing traffic noise are economically more suitable when compared to nonliving materials such as concrete wall, plastic plate, they should also be preferred due to the fact that they will contribute to the environment aesthetically with the properties of colour and shape changing depending on the season [17]. The list of benefits provided by road trees is long and diverse [18].

Street trees protect pedestrians from the sun and the rain, and provide critical spaces and shelter for street vendors. While street trees may constitute only a small fraction of green cover in most cities, wooded streets constitute the most accessible green spaces for the vast majority of low to medium income city dwellers who lack access to other green spaces in residential and commercial areas [19]. These trees help in reducing storm water runoff, thus reducing the likelihood of flooding and damage to urban properties. They act as noise filters, purify air and sequester carbon [20,21]. Urban reduction of noise with plants when sufficient area is provided in the urban ecosystems is of great importance. It is going to be more efficient that putting the plant belts together with noise barrier wall and soil wall to blocking the noise.

Table 1: Use of Some Common Households Plants to Clean Air [22]

Plant name	Description	Chemical vapor removal[1]	Light requirement	Remarks
Areca palm (butterfly palm), *Dypsis lutescens*	Clusters of erect, slender, cane-like stalks with feathery yellow-green fronds.	8	Sun to semi-sun	Releases an abundant amount of moisture into the air. Fast growing.
Bamboo palm, *Chamadorea elegans* or *C. erumpens*	Clusters of small slender canes. Graceful fans with rich green color.	9	Semi-sun	Releases an abundant amount of moisture into the air. Easy to care for.
Boston fern, *Nephrolepis exaltata*	Stiff fronds arch outwards, drooping downward as they age.	9	Semi-sun	Releases an abundant amount of moisture into the air. Ideal for hanging baskets. Mist and water frequently to reduce leaf drop.
Corn plant, *Dracaena fragrans* 'Massangeana'	Shiny medium green leaves with a bold yellow-white stripe down the center. Develops a solid woody stem. Leaves concentrate at the top of each stem.	8	Semi-shade	Survives in dimly lit areas. Occasionally will send up a small spray of fragrant white flowers.
Dendrobium orchid	Has beautiful exotic blooms, usually in clusters or in a row along canes.	7	Semi-sun	Flowers are long lasting.
Dracaena deremensis 'Janet Craig'	Erect stems with a rosette of broad, smooth, glossy, darkgreen leaves 12 inches long and 2 inches wide.	8	Semi-shade	Grows quickly. Tolerates dimly lit areas, but growth will be slow.

Dracaena deremensis 'Warneckei'	Leaves, 2 feet long and 2 inches wide, are green with white and gray-green stripes.	6	Semi-shade	Grows slowly. Tolerates low light and dry air. Retains its variegation in low light.
Dragon tree, *Dracaena marginata*	Smooth, gray, erect canes. Leaves, 2 feet long and 1/2 inch wide, are deep, glossy green with red edges along the margins. Leaves cluster at the end of each cane.	6	Semi-sun to semi-shade	Tolerates relatively low light and dry air.
Dumbcane, *Dieffenbachia* varieties*	Wide, blotched green and white (cream) leaves. Unbranched stems arch downward.	7	Semi-sun to semi-shade	Fast growth.
Dwarf date palm, *Phoenix roebelini*	Stately main trunk with graceful, green fans that droop elegantly. Fronds reach 3 feet and grow horizontally.	9	Semi-sun	Very slow grower. Adapts well to low light levels.
English ivy, *Hedera helix**	Vigorous climber which sends out aerial roots that attach to any surface. Dark green leaves have 3 to 5 lobes.	9	Semi-sun to semi-shade	Easy to grow. Ideal for hanging baskets. Generally does not do well in high temperatures.
Ficus bennendijkii 'Alii'	Slender dark green leaves.	7	Full sun and semi-sun	Easy to grow. May have some leaf drop until it adjusts to its new location.
Florist's mum, *Chrysanthemum morifolium*	Produces a brilliant display of colorful flowers.	9	Full sun and semi-sun.	Avoid midday sun as the heat may age the blossoms prematurely.
Gerbera daisy, *Gerbera jamesonii*	Sturdy stems that have colorful flowers. Leathery leaves.	9	Full sun and semi-sun	Releases abundant moisture into the air. Avoid midday sun as the heat may age the blossoms prematurely.
Golden pothos, *Epipremnum aureum*	Vine with green heart-shaped leaves with gold or cream colors.	5	Semi-shade to shade	One of the easiest houseplants to grow. Fast growth. Can be grown as a hanging basket or trained to climb.
Kimberley queen fern, *Nephrolepis obliterrata*	Fern with graceful, drooping fronds and lush green foliage.	9	Semi-sun to semi-shade	Releases an abundant amount of moisture into the air. Mist and water regularly to reduce leaf drop.
King of hearts, *Homalomena wallisii*	Dark, olive-green, oval-shaped leaves with areas of silver or cream. Leaves 8 inches long.	7	Semi-shade to shade	Slow growing. Can be difficult to maintain.
Lady palm, *Rhapis excelsa* or *R. humilis*	Large palm with fans 6 to 12 inches wide with 4 to 10 thick shiny leaves. Brown hairy main trunk with thin arching stems.	7	Semi-sun	Grows slowly. One of the easiest houseplants to care for.
Lily turf, *Liriope muscari*	Grassy arching evergreen leaves reaching 6 to 18 inches long. May be dark green or variegated.	7	Semi-sun to semi-shade	Produces small spikes of white or lavender flowers.
Peace lily (White flag), *Spathiphyllum* varieties	Sends up stiff erect stalks that produce beautiful white spathes. Dark green leaves stand erect in the juvenile stage, but start to bend as they mature.	8	Semi-shade to shade	Releases an abundant amount of moisture into the air. Tolerant of low light. Will bloom indoors.
*Philodendron erubescens** 'Red Emerald'	Vining habit. Burgundy-red leaves are long and narrow with yellow veins.	6	Semi-shade to shade.	Easy to grow. Needs to be staked or given support for climbing.

Rubber plant, *Ficus elastica**	Thick, leather-like, glossy, dark-green leaves that contain a rubber-like latex.	9	Semi-sun to semi-shade.	Easy to grow. Tolerates low light.
Schefflera (umbrella tree), *Brassaia actinophylla**	Has long stems with 7 to 16 deep green leaves, each up to 12 inches long.	8	Semi-shade.	Easy to grow.
Spider plant (airplane plant), *Chlorophytum comosum*	Sends up slender, arching shoots with leaves that may be green or green with a broad center stripe of yellow or cream. Leaves 6–12 inches long.	6	Semi-sun to shade.	Ideal for hanging baskets. Has small white flowers at the end of aerial runners, which are followed by airborne plantlets.
Weeping fig, *Ficus benjamina**	Treelike growth habit. Graceful drooping branches. dark green, pointed, glossy leaves.	8	Full sun to semi-sun.	Leaf drop is common until it adjusts to its new environment.

*****1: Rating 1 to 10, with 10 being excellent and * may be hazadens or toxic if eaten or comes in contect with eyes or skin.**

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