

ROLE OF MEDICINAL PLANT IN CONTROLLING ENVIRONMENTAL (AIR) POLLUTION

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ABSTRACT

The role of plants in developing a healthy atmosphere is very desirable in the context of deteriorating environment resulting from increased urbanization, industrialization and improper environmental management. This investigation has attempted to screen plants for their ability to improve the design and development of healthy environment. It is necessary that plants used must be tolerant to air pollution. In this study, dust removal capacities and Air Pollution Tolerance Index (APTI) of plants commonly used for green belt establishment. On the basis of APTI and some biological parameters of plants study of different medicinal plant will be discussed at this paper.

Keywords: Medicinal plants, APTI

INTRODUCTION

Air pollution is the introduction of chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms, or cause damage to the natural environment or built environment, into the atmosphere. The main air pollutants are represented by gases forms, particles in suspension, different ionizing radiation and noise. The gases forms are: oxidized and reduced forms of carbon (CO_2 , CO , CH_4), of nitrogen (NO_2 , NO , N_2O_4 , NH_3 , NH_4^+), SO_2 , O_3 , C_6H_6 vapors', Hg, volatile phenols, Cl_2 , etc. The particulate forms are: PM10 and PM2.5 particulate matter, heavy metals with toxic effect (Pb, Ni, Cd, As), polycyclic aromatic hydrocarbons PAHs, etc. The air pollutants factors can be chemical (chemicals), mechanics (particles in suspension) physical (ionizing radiation) and acoustic (noise).

Most of the sources of air pollution are related to man's activities as a result of

the modern lifestyle. Principal pollution sources include chemical plants, industry automobiles, coal-fired power plants, oil refineries, petrochemical plants, nuclear waste disposal activity, incinerators, plastics factories, and other heavy industry. Agricultural air pollution comes from spraying of pesticides and herbicides. common soil contaminants are chlorinated hydrocarbons (CFH), heavy metals, zinc, arsenic and benzene.

Harmful effects of pollution have both acute and chronic effects on human health. Health effects range anywhere from minor irritation of eyes and the upper respiratory system to chronic respiratory disease, heart disease, lung cancer, and death. Air pollution can affect the quality of the air we breathe, the water and even the rain that we are experiencing. In the womb it may cause neurological problems including slower reflexes, learning deficits, delayed or incomplete mental development, autism and

brain damage and in adults it causes Parkinson's disease, multiple sclerosis, Alzheimer's disease, heart disease, and even death. The Greenhouse Effect also referred to as global warming. Ozone depletion is another result of pollution.

Pollution control is the process of reducing or eliminating the release of pollutants (contaminants, usually human-made) into the environment. It is regulated by various environmental agencies that establish limits for the discharge of pollutants into the air, water, and land. A wide variety of devices and systems have been developed to control air and water pollution and solid wastes. In order to mitigate environmental pollutant and to protect the biosphere from the adverse effects of pollution four important issues should be highlighted explicitly these issues include changing life style to control or decrease the emission of pollutant developing technologies to avoid or mitigate emission making rule and regulate to reduce emission decontamination of existing pollutant in the environment. gaseous pollutant and particulate once released in the atmosphere dispersed rapidly mechanical treatment processes in such situation are very energy intensive and costly while plant are driven by solar energy self reproducing and concentrate , detoxify pollutant the ability of plant to clean up dispersed ambient pollutant has been confirmed in a number of studies (Hill 1971, Okona etal 1988, Simonich and Hites 1994, 1995, Pacala et al 2001) thus plant is a natural monitor and detoxifier device of toxic pollutant in our ambient environment while adding value to our building, landscapes and

communities. In fact there is no device available either mechanical or chemical which can completely check the emission of pollutant at the source. Pollution is released to the atmosphere only the plant are the hope which can move up the pollutant by adsorbing, absorbing and metabolizing them from the atmosphere. Therefore the plants role in pollution abatement has been increasingly recognized in recent years.

There are various ways and means to mitigate the urban environmental pollution. Plan-ting of trees and shrubs for abatement of pollution and improvement of environment is an effective way and well recognized throughout the world. Proper planning and planting scheme depending upon the magnitude and type of pollution, selection of pollution- tolerant and dust scavenging trees and shrubs should be done for bioremediation of urban environment.

AIMS & OBJECTIVES

- To know the role of medicinal plant in controlling the pollution.

MATERIAL & METHODS

- The whole study is based on the literary material collected from classical books, modern books and magazine and internet sources.

Selection of 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 (straight undivided trunk), 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. Different types of leaves tend to have differences in several aspects of their surfaces. Following are the mechanisms of some medicinal plant are given how they can help to diminish the pollution.

➤ ***Azadirachta indica A.Juss***

Neem has been referred as an “air purifier”. It absorbs some of the environmental pollutants (SO₂), and act as an “air freshener” by releasing oxygen and odorous principles. Neem tree growing in a highly polluted area is not affected by various gases. It has a greater ability to adapt to stress from exposure to air pollution. Neem is tolerant to most soil types including dry, stony, shallow soils, lateritic crusts, highly leached sands and clays. With an extensive and deep root system, the hardy Neem can grow and flourish even in marginal and leached soils. It is one of the very few shade-giving trees that thrive in the drought prone area. The trees are not at all delicate about the water quality and thrive on the merest trickle of water.

➤ ***Holoptelea integrifolia planch***

It is a fast growing tree with a good canopy. It is resistant to gaseous pollutants. Due to the rough leaf surface it traps dust and particulate pollutants. It is good for plantation on Roadside as well as in the Greenbelt around Thermal power plants.

➤ ***Ficus religiosa Linn***

It is a common tree of roadside with a good canopy. It is resistant to gaseous

pollutants. The leaves of this tree are known to emit a lot of oxygen into the environment. It can be used as biomarkers and mitigators of pollutant coming out of automobile exhaust. It is good for plantation on Roadside especially highways.

➤ ***Dalbergia sissoo Roxb***

Higher chlorophyll content in plants favors tolerance to pollutants. Ascorbic acid is an antioxidant that is found in growing parts of the plant and influences resistance to adverse environmental conditions, including air pollution. The sawdust works in the absorption of nickel ions and has the potential of removing these heavy metals from industrial and commercial waste water sources. *Dalbergia sissoo* is an ideal tree species to monitor and indicate the Pb concentration in air.

D. sissoo Roxb is said to be good performer with a high APTI (Air pollution tolerance index). It has been successfully grown in area where air pollution, poor drainage, compacted soil, and or drought are common. The tree can thrive on a variety of soil types, from dry to wet but is not particularly salt tolerant. Ecologically Indian rosewood provides numerous services to the landscape and environment. It is used as a windbreak and shelter belt and as a shade tree in intercropping of orchards, mango, tea, and coffee plantations. Since it has an aggressive root system and is prone to suckering it is commonly used for erosion control and soil stabilization along stream and river banks. It is widely planted in its native countries for reforestation programs. It is also valued for its ability to increase soil fertility through nitrogen fixation and is intercropped for these reasons as well .it is

planted in urban areas along roadsides and in gardens as an ornamental.

➤ ***Tamarindus indica* Linn**

Avenue tree with an intermediate air pollution tolerance index (APTI). Hence can be used for plantation on roadside. It has been found that tamarind fruit shells both in its natural and acid treated forms are excellent biosorbents for the removal of chromium ions. The twigs and branches of Tamarind are very resistant to wind, making it especially useful as a shade or street tree for breezy locations.

➤ ***Anthocephalus cadamba* Miq**

It is resistant to gaseous pollutants. It sheds large amounts of leaf and non-leaf litter which on decomposition improves some physical and chemical properties of soil under its canopy. This reflects in increases in the level of soil organic carbon, cation exchange capacity, available plant nutrients and exchangeable bases. It is quick growing, large; has large spreading and grows rapidly in first 6-8 year. The tree is grown along avenues, roadsides and villages for shade. These are suitable for reforestation programmes.

➤ ***Nyctanthes arbortristis* Linn**

Nyctanthes has a good canopy. Its leaves are rough and hairy which help in retaining the dust and particulate pollution.

➤ ***Caesalpinia pulcherrima* Linn**

It is an ornamental large shrub with beautiful flowers shows high tolerance to chromium. Salt tolerant and can grow in full sun or part shade.

➤ ***Thevetia neriifolia* Juss**

It has been recommended for growing along roadsides in areas polluted by automobile emissions. The tree is very popular and can be found in every

homestead. It is a tough, drought and termite resistant species with a high rate of survival.

According to Vastushastra advantage of plantation of plants in different direction:

East: like *Mimusopos elengi*, *Artocarpus integrifolia*, *Ficus bengalensis* should be planted in East direction, these will protect from early sun rays having harmful cosmic radiation because these plants having big & crowded leaves. *Elengi* provide fragrant fresh air.

South: *Ficus racemosa* Linn, *Tamarindus indica*, *Areca catechu* plants are having small or fid leaves they allow the wind to pass through the leaves and avoid heavy sunrays. It will reduce the heat of (*Utraynayana kala*) and severity of southern wind.

West: *Ficus religiosa*, *Alstonia scholaris*, *Cocos nucifera* etc due to leaves structure and arrangement these plants will not obstruct sun rays and these will purify air.

North: *Ficus lacor*, *Calophyllum inophyllum*, *Butea monosperma*, *Mangifera indica*. These plants will absorb humidity of the soil and purifies the atmosphere by absorbing humidity from soil these plant will reduce the coolness of the atmosphere. These will give the necessary oxygen for life.

Plant which should be planted in all direction: *Aegel marmelos*, *Terminalia chebula*, *Cedrus deodara*, *Saraca asoca*, *Acacia catechu*, *Santalum album*.

DISCUSSION

Vegetation naturally cleanses the atmosphere by absorbing gases and some particulate matter through leaves. Plants have a very large surface area and their leaves function as an efficient pollutant-trapping device. Some plants have been

classified according to their degree of sensitivity and tolerance towards various air pollutants. Sensitive plant species are suggested to act as bio-indicators. Levels of air pollution tolerance vary from species to species, depending on the capacity of plants to withstand the effect of pollutants without showing any external damage. This study is useful for the better understanding and management of air quality as well as in selection of suitable plant species (with high APTI) for plantation in industrial area as well as roadside. Singh and Rao (1983) have suggested a method of determining Air Pollution Tolerance Index (APTI) by synthesizing the values of four different biochemical parameters i.e. leaf extract, pH, ascorbic acid, total chlorophyll and relative water contents.

The APTI was calculated by using the following formula (Singh and Rao, 1983).

$$\text{APTI} = \frac{[A(T+P) + R]}{10}$$

Where, **A**= Ascorbic acid (mg/g dry wt.)

T= Total Chlorophyll (mg/g dry wt.)

P= pH of leaf extract.

R= Relative water content of leaf tissue (%).

Based on the APTI value the plants were conveniently grouped as follows (Kalyani and Singaracharya, 1995):

APTI value Response

30 to 100 Tolerant

29 to 17 Intermediate

16 to 1 Sensitive

<1 Very sensitive

Holoptelea integrifolia planch – 55.8 very high, *Azadirachta indica A juss* -30.5 high tolerance, *Ficus religiosa Linn* – 25.77 moderate Tolerant (in descending order). Therefore highly tolerant, moderately tolerant and intermediately tolerant species will be suitable for the establishment of an

effective “green belt” around the polluted area.

Different types of leaves tend to have differences in several aspects of their surface some types of leaves have greater surface rigidity or roughness than other leaves, which may affect their stickiness or particle 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 plant. The various morphological features are also major factors for dust capturing by leaves. The crown area of plant is depending upon the morphological features of the leaf.

Studies shows dust removal capacities of various plants - (calculated by gm/m²)

Nyctanthus arbortristis linn 2.58%, *Ficus religiosa Linn* -7.72% *Thevetia peruriana Juss*- 12.56% *Anthocephalus cadamba Miq*- 16.71% *Dalbergia sissoo roxb*-17.02% , *Azadirachta indica A.juss*-25.54% , *Holoptelea integrifolia Planch*-35.01% (in ascending order)

The results form a basis for the selection of tolerant species fit for sites continuously exposed to elevated levels of particulate pollutants.

CONCLUSION

The importance of trees in urban environment is now widely recognized that they too cleanse the particular air pollution and help to make cities and town more agreeable places to dwell upon. The study concluded that judicious placement of plants in urban canyons can reduce the pollution The present paper recommends various tree species for urban planting so that a wider usage of local as well as exotic

tree species can be explored for controlling air born pollution in urban climate.

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