Dust Capturing Efficiency of Road-Side Plants Growing at Ahmedabad Cross-Roads

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ABSTRACT

The air pollutants which cause plant injury are primarily gases, but some particulate matter or dusts do affect vegetation. Ambient Air constitutes various size ranges of solid particles commonly recognized as Particulates or Dust, which are continuously agglomerated and deposited, on various surfaces. Foliar surface of plants is continuously exposed to the surrounding atmosphere and is, therefore, the main receptor of dust. This physical trait can be used to determine the level of dust in the surroundings, as well as the ability of individual plant species to intercept and mitigate particulate pollutants.

In the present study, five common roadside plant species growing at the cross-roads of Ahmedabad city namely *Ficus benghalensis*, *F. religiosa*, *F. glomerata*, *Azadirachta. indica* and *Polyalthia longifolia* were studied to find dust trapping efficiency and morphological characters responsible for their dust trapping efficiency.

Keyword: Ahmedabad, Dust, Plants, Morphology,Trapping efficiency

INTRODUCTION

Ahmedabad city is highly polluted due to rapid growth of industries and heavy vehicular traffic. Particles of all types cause dust pollution in the environment. Industrial and combustion processes, cement dust, dust from grinding and crushing factories, fly ash from power plants, agricultural waste burning as well as automobile exhaust, rise of chemical dust from the surface of industrial solid waste in dry windy weather also increases the particulate pollution problems.

Human health is very closely linked to environmental quality, as the Etiology of most of the human diseases being related to the status of the living environment of man. According to statistics, 25% of all preventable illnesses are caused by detrimental environmental factors [UNEP, United Nations Children's Fund, WHO 2002].

Our respiratory system has a number of mechanisms that help in protecting us from air pollution. The hair in our nose filters out large particles. The sticky mucus in the lining of the upper respiratory tract captures smaller particles and dissolves some gaseous pollutants. When the upper respiratory system is irritated by pollutants sneezing and coughing expel contaminated air and mucus. Prolonged smoking or exposure to air pollutants can overload or breakdown these natural defences causing

or contributing to diseases such as lung cancer, asthma, chronic bronchitis and emphysema.

Researchers have shown that Plants (including trees) can act as biological filters, removing large quantities of particles from the urban atmosphere. This is predominately due to their large leaf areas relative to the ground on which they stand, and the physiological properties of their surfaces i.e. the presence of trichomes or waxy cuticles on the leaves of some species. Interception of particles by vegetation has been shown to be much greater for street trees due to their proximity to high intensities of road traffic.

MATERIALS AND METHODS

Dry technique (Das & Pattanayak, 1977)

From each plant, ten matured leaves were collected in the separate polythene bags during winter, summer and rainy season. Leaves were collected at the height of three to four meters from eight different polluted cross-roads of Ahmedabad city. In this technique first the intact leaf was weighted (in mg) then dust particulates from leaf surfaces were gently collected with the help of camel hair brushes and the weight of leaf was measured again. The amount of dust deposition in mg/cm^2 was calculated as:-

$$\text{Dust content (mg/cm}^2\text{)} = \frac{\text{Wt of intact leaf- initial wt of leaf}}{\text{Total surface area of leaf (cm}^2\text{)}}$$

Finally average was taken and graph was plotted to find the amount of dust deposition on various plant species.

RESULT AND DISCUSSION

According to Bernatzky (1974) urban air usually contains significant amounts of dust. Different reasons were given by different researchers for the dust holding capacity of plants. Dust interception and retention depends upon leaf orientation, age, roughness and wettebility of the surface Beckett *et al*., (2000) and Neinhuis and Barthlott (1998).It also depends on the strength and constancy of wind, the porosity of the vegetation with respect to air movement and the amount and intensity of rain according to Raupach *et al* (2001). It has been established that leaves and exposed parts of a plant generally act as persistent absorbers in a polluted environment Samal and Santra (2002).

In the present study we observed that *F. benghalensis* showed maximum dust trapping efficiency among all the plants which may be due to its habitat and morphological characters. It is an evergreen plant with big and horizontally arranged leaves. It has rough leaf surface due to the presence of hairs, vein is thick, large and many on the lower surface all these characters help dust to adhere more on leaves. Ahmed and Yunus (1981) reported that larger and more vein lets are the main characters of a leaf which help for dust collection. Once the dust particles settled down there are less chance to rid of as it has small petiole, which reduces the movement of leaf. Anatomical features of leaves also play an important role of high dust capturing capacity. *F. benghalensis* have sunken stomata and is having hairy presence which helps in condensation of water vapors taking

place during transpiration process. This helps in maintaining moisture condition on leaf surface and increases the capturing of dust by these plants.While in the case of *F. religiosa* less dust is observed compared to *F. benghalensis* may be due to long petioles that help the leaves to flutter during wind, and the vertical position of the leaves which prevents dust retention. Leaf petioles are more efficient particulate impactors than either twigs (stems) or leaf lamina Garg *et al* (2000). Also the leaves of *F. religiosa* are smooth and partially pendulous; therefore, the dust settled on the leaf surface due to gravitational force or even by wind may slip down. Dust found on the leaf surface is mainly due to many and thick veins. *F. glomerata* has glossy and glabrous surface, petiole is small, and leaves are not horizontally arranged which prevent dust to settle down but vein lets are large, very sparsely pubescent and surface is sticky that holds dusts. *A. indica* is an evergreen tree. Leaves are horizontally oriented with small petiole having thin veins which help in dust accumulation. But surface of leaf is smooth and glossy so dust particles slip down. Lower dust accumulation for *P. longifolia* may be due to the thin lamina of their leaves and vertical position of the leaf. Also though leaf is large the surface is glossy and leaves are vertically suspended due to which dust slip down. Dust accumulation occurs mainly at the margins that are wavy.

The influence of leaf characteristics on dust accumulation has also been studied Garg *et al* (2000), Somashekar *et al* (1999) and Vora *et al* (1986). Leaf morphology plays an important role in trapping the dust from the environment. Ahmad *et al* (1981) reported that the dust trapping efficiency of plants depends on the morphological traits of leaves such as epidermal and cuticular features, surface geometry, phyllotaxy, orientation, size and area of a leaf etc. Shetye and Chaphekar (1980) observed that evergreen plants with horizontally oriented leaves are good dust trappers than deciduous or evergreen plants with vertically suspended glabrous leaves. Das *et al* (1981) also concluded that evergreen trees with simple and rough surfaced leaves are better dust collectors than those of deciduous trees with compound and smooth surfaced leaves. Similar finding were obtained in the present investigation. With all these morphological characters position/location of tree also plays an important role. If the tree is nearer to the road chance of getting more dust increases. Therefore, on the basis of their dust trapping efficiencies selected plants can be categorized as high (*Ficus benghalensis*), medium (*Ficus religiosa* and *Ficus glomerata*), and low (*Azadirachta indica* and *Polyalthia longifolia*) dust trappers respectively. Crust formation on the leaf surfaces of *F. benghalensis* and *F. religiosa*, was observed at site- 2, 4, & 5(Paldi, ST and Naroda) due to continuous spraying of unbrunt residues of diesel and petrol by the vehicles on the leaves. Similar result of crust formation on leaves was obtained by Bhatnagar (1986). According to him the urban and industrial dust gets stick on unburnt oil residues already present on leaves in polluted area and combindly they turn into a crust layer on the leaves of such plants.

CONCLUSION

On the basis of their dust trapping efficiencies selected plants can be categorized as high (*Ficus benghalensis*), medium (*Ficus religiosa* and *Ficus glomerata*), and low (*Azadirachta indica* and *Polyalthia longifolia*) dust trappers respectively.

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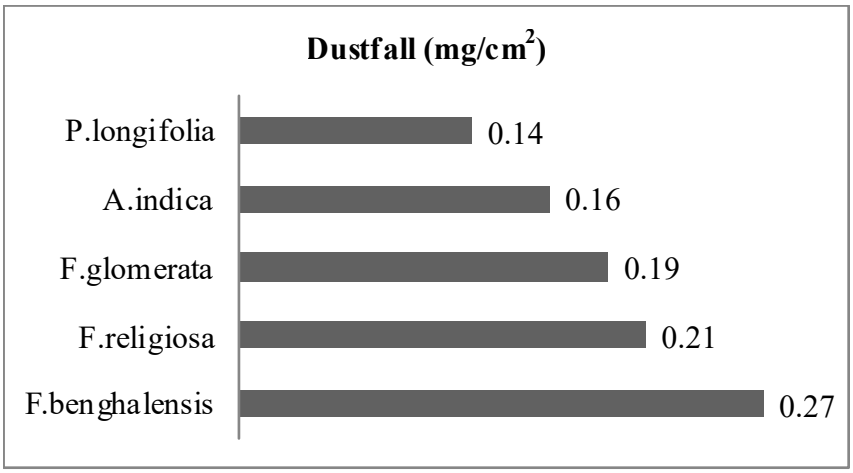
Graph-1 Average Dust capture of Leaf of Plant Species



Graph-1 shows significantly that Ficus benghalensis to have maximum dust accumulation while Polyalthia

longifolia to have minimum dust accumulation. The trend of dust deposition among all the species was as follow F. benghalensis > F. religiosa > F. glomerata > A. indica > P. longifolia.

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