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Assessment of the dust catching capacity of the leaves of some plant species growing along the road sides

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Abstract

The present study has been carried out to assess the dust catching capacity of the leaves of five different species viz. *Alstonia scholaris* Linn., *Cassia siamea* Lam., *Morus alba* L., *Nerium indicum* L. and *Thevitia peruviana* (Pers.) *K. Schum*, growing along the road side (taken as polluted site) and away from the road side (taken as reference site). The evaluation of the data revealed that the dust content on the surface of leaves of all selected species was more at polluted locations in comparison to those growing at reference location. Among the selected species *Cassia siamea* Lam. shows highest dust catching capacity while the minimum dust catching capacity has been recorded for *Nerium indicum* L. The highest dust catching capacity of *Cassia siamea* Lam. has been attributed to its horizontal position of leaves while the minimum dust catching capacity of *Nerium indicum* L. to its thick, leathery surface and the orientation of the leaves which are growing at an angle with the stem.

Keywords: air pollution, dust catching capacity, Jammu, plant leaves

Introduction

Plants are more susceptible to air pollution than others as these are stationary and continuously exposed to chemical pollutants from the surrounding atmosphere (Kumar *et al.*, 2005). The plants particularly growing along the road sides always remain exposed to the dust. The foliar surface of plants is an important receptor of atmospheric pollutants. The deposition of dust, soot etc. on the surface of leaves may lead to clogging of stomata and reduction of gaseous exchange and also inception of light by leaf which would lead to reduced photosynthetic rate and overall growth.

Polluted air has drastic effects on living organism. It is estimated that in all big cities in the country about a million tons of pollutants are being ejected into the atmosphere every day. On an average 75% of these pollutants are released by automobiles (Dubey and Pawar, 1985). Jammu, once regarded as the city of temples is now better recognized as city of traffic congestion and bad air. The city has dubious distinction of possessing maximum number of per capita vehicles just second to Tokyo (Anon, 1997). Vehicular emission, source of the major air pollution, is assuming alarming proportion in Jammu. There is a increasing trend in the concentrations of SO_2 and NO_2, while the concentrations of SPM is higher than the prescribed levels at majority of the road crossing along the national highway passing through the Jammu city as has been reported by Raina and Sharma (2006). In India, there is slow growth of road infrastructure and high growth of transport performance and number of vehicles which imply that Indian roads are reaching a saturation point in utilizing the existing capacities (CPCB, 2000). In Jammu city also, there is tremendous increase in the number of vehicles without the proper development of road infrastructure. It is worthwhile to mention that till 2006, 3,29,445 vehicles were registered with R.T.O. Jammu and till September 2013 there number increased to 6,01,388. The increase in the vehicular number on the existing roads leads to generation of more particulate matter, which is a matter of serious concern as it is affecting the health of people and also the other organisms.Trees can intercept atmospheric particles and absorb various gaseous pollutants. It is well documented that plants can effectively adsorb and reduce particulates in the air by capturing the airborne

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particulate matter such as foliar dust, hydrogen fluoride, SO_2, some compounds of photochemical reaction and heavy metals such as mercury (Hg) and lead (Pb) from the air on their leaves (Lin 1976; Freer-Smith *et al*., 1997; Brack, 2002; Liu *et al*., 2008). Plants remove air pollutants by three means - absorption by leaves, deposition of particulates and aerosols over leaf surfaces and fall out of particulates. Several studies have been carried out in India to highlight the problem of dust deposition on the surface of leaves, (Vora *et al*.,1986, Agarwal and Tiwari, 1997, Pandey *et al*., 2003, Barik *et al*., 2005, and Prajapati and Tripathi, 2008) but not much has been done in this regard in Jammu region.

Material and Methods

A thorough survey of Jammu city has been done to select the two locations having the selected plant species growing under approximately similar ecological and edaphic conditions. Based on the observed level of vehicular pollution one of the locations i.e. Campus of Govt. College for Women, Gandhi Nagar with very low traffic rate has been designated as reference site where selected plant species were growing at about 200 meters away from the main road. Different crossings, dividers present on portion of the National Highway from Vikram Chowk to Gandhi Nagar have been taken as polluted sites.The mature leaves/leaflets of approximately same size and age (leaves of the third node from up) from the plants growing at both the locations have been collected in morning hours (6 – 8 AM) in separate polythene bags and brought to laboratory for further analysis. The leaves in a group of 10 along with polythene bags were washed with distilled water in a beaker which was dried at 70^o C. From the initial and final weight of the beaker, amount of the dust was calculated (Vora *et al.*, 1986.). To find out the surface area of the leaf graph sheet method was used. The average of the result obtained from 10 leaves has been expressed in gm/cm^2.

Results and Discussion

Air quality status at Vikram chowk and surrounding areas (Raina and Sharma, 2006), which is a part of polluted site in the present study, has been depicted in Table 1 while the average dust deposition (gm/cm^2) on the leaves of different selected plant species growing at two different locations has been depicted in Table 2. Perusal of Table 1 revealed that ambient air quality class of Vikram chowk falls under 'Heavy air pollution' class as per the Air Quality Index (Dayal and Nandini, 2000). High traffic load, bad conditions of roads, old vehicles, adulteration in petrol and diesel generate more of dust and thereby increases dust fall on the plant leaves. The deposition of dust depends upon the conditions of the road The perusal of data of Table 2 revealed that the dust deposition on the leaves of the plant species growing along the road side is higher than the plants present at the reference site.

Table 1. Air quality status for SO_2, NO_2, SPM (ug/m^3) at different traffic crossings in Jammu city

Sites	SO_2 (µg/m^3)			NO_2 (µg/m^3)			SPM (µg/m^3)			Air quality Index(AQI)
	Permissible value	Observed value	Value of quality rating	Permissible value	Observed value	Value of quality rating	Permissible value	Observed value	Value of quality rating	
A – Traffic crossings										
I-Vikram chowk	80	82.43	103.03	90	23.06	25.62	300	1016.14	338.71	96.33 (Heavy air Pollution)
II-Satwari chowk	80	32.86	41.07	90	11.80	13.11	300	1165.71	388.57	59.36 (Moderate air pollution)
III- Rehari chowk	80	14.88	18.6	90	9.08	10.08	300	697.36	232.45	35.19 (Light air pollution)
B- New University Campus										
Near gate	20	41.91	209.55	20	14.65	73.25	70	304.48	434.97	188.30 (Severe air pollution)
Inside campus	20	7.26	36.3	20	2.11	10.55	70	101.16	144.51	38.10 (Light air pollution)

Table 2: Average dust catching capacity (g/cm^2) of the selected species of plants

S.No.	Species	Average value of Reference site	Average value of Polluted site	S.D Reference site(g/cm^2)	S.D Polluted site(g/cm^2)
1	*Alstonia scholaris*	0.0006	0.0044	0.00022	0.00169
2	*Cassia siamea*	0.0012	0.0067	0.001083	0.001658
3	*Morus alba*	0.0004	0.0024	0.000216	0.000816
4	*Nerium indicum*	0.0004	0.0017	0.000252	0.000216
5	*Thevitia peruviana*	0.0006	0.0044	0.000596	0.001767

(S.D. = Standard Deviation) **(Source - Raina and Sharma, 2006)**

Also the maximum dust deposition has been recorded on the leaves of *Cassia siamea* Lam. followed by the *Alstonia scholaris* Linn. and *Thevitia peruviana* (Pers.) K. Schum while the minimum dust deposition has been recorded for the leaves of *Morus alba* L. . On the basis of dust deposition, selected species of plantscan be arranged in the increasing order of dust catching capacity as *Nerium indicum<Morus alba<Alstonia scholaris and Thevitia peruviana< Cassia siamea.*

The higher dust catching capacity of the plant species can be attributed to the size, position and structure of leaves. The leaves of *Cassia siamea* Lam, *Alstonia scholaris* Linn. and *Thevitia peruviana* (Pers.) K. Schum, have more dust deposition than the leaves of *Morus alba* L. and *Nerium indicum* L. due to their waxy coating and horizontal position. Wagela *et al.* (2002) and Raina and Bala (2007) also reported maximum dust concentration on the plants having horizontal position of leaves. This suggests that the dust removal capacity varies between species. This variation between species may reflect the nature of the leaves including size, morphology, smooth or wrinkled surface, presence of wax or a sticky surface (Liu and Peart, 2012).The dust removal capacity of individual tree species should be taken into account in the management of greening plantation in and around urban areas. The study will help to understand the role of trees in decreasing atmospheric dust pollution in urban areas of Jammu.

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