ESTIMATION OF FOLIAR DUST CONTENT AND DUST HOLDING CAPACITY AMONG DIFFERENT ROADSIDE PLANTS

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Abstract

Vegetation captures gases, particulates and aerosols from the atmosphere more effectively than other land surfaces. In Kolkata the level of air pollution in the city is growing at an alarming rate over the past several years. One of the main factors for air pollution in Kolkata is transportation The objective of this study was to determine the foliar dust content and dust holding capacity of local roadside plants growing in selected localities of Kolkata. This investigation is a part of a student research project for undergraduate students of Botany of Gurudas College.

Key words: foliar dust content, dust holding capacity, air pollution, student research project

Introduction

The amount of dust particles presents in the atmosphere causes air pollution. The impact of atmospheric particles ranges from mild respiratory infections, through asthma, pneumonia and cardiovascular conditions to death [1, 2].The effects can be long-term or short-term. Vegetation captures gases, particulates and aerosols from the atmosphere more effectively than other land surfaces [3]. The dust present in the atmosphere is ultimately settle on ground and on vegetation. Dust deposits on leaf of urban trees may contain particulate matter (PM), non-gaseous components, carbon compounds, metals, pollen and soil particles. Rapid and unplanned urbanization making this problem more acute in many megacities in developing countries [4].In Kolkata the level of pollution in the city is growing at an alarming rate over the past several years. The influx of large population from the rural areas putting immense pressure in the city's infrastructure and it is getting difficult to manage it properly [5, 6].Several factors result the air pollution level in Kolkata. One of the main factors is transportation [7, 8].

Plants play an important role in combating air pollution [9].Plants can be used as biological indicators and/or offer a sink for particulate matter and its associated pollutants, including toxic metals in the environment, because their leaves capture dust [10]. The plant leaves act as a passive or active collector for air-borne pollutants like gases, aerosols and dusts. Plants filter out pollutants from the air in three ways, viz., absorption by the leaves, deposition of particulates and aerosols on leaf surface, and fallout of particulates on the leeward (downwind) side of the vegetation because of the slowing of the air movement. The capacity of leaves as dust receptors depends upon many morphological parameters viz. epidermal and cuticular features of leaves, surface geometry, phyllotaxy, type of canopy, leaf pubescence

etc. The dust deposition not only depend upon the size and area of leaf surfaces but also the nature of leaf surfaces, thickness of leaf, orientation etc. which play an important role in the concentration of dust deposition.

Objective

The objective of this study was to determine the foliar dust content and dust holding capacity of local roadside plants growing in selected localities of Kolkata.

Material and Methods

11 (Eleven) leaf samples belonging to 7 (seven) plant species and 6 (six) angiosperm families were used for this students' research project. The different roadside plants were collected, put separately in plastic bags and brought to the college laboratory. The leaves were washed with some distilled water. Suspensions of dust were collected in petri dish. The weight of the petri dish with the dust suspension was noted with the help of a digital balance. The petri dish with the dust suspension was placed in a pre-heated hot air oven for one hour and thirty minutes. When all the distilled water evaporated the weight of the petri dish with dust was taken. The outline of the different leaf samples was drawn on a graph paper and the area of the leaf of each sample calculated.

Estimation of foliar dust content per unit area (mg/cm^2)

Weight of the Petri dish with dust suspension (mg) was denoted W_1.

Weight of the Petri dish with only dust after all water evaporated (mg) was denoted as W_2.

Weight of foliar dust (mg) = $W_1 - W_2$

Estimation of foliar dust content per unit area (mg/cm^2) = $W_1 - W_2$ / Area of leaf sample

Estimation of dust holding capacity

As the leaf samples were collected from roadside plants for the estimation of dust holding capacity (mg/cm^2/month) the number of exposures was taken as 30 (average days in one month) and presumed that the areas had dust pollution on all days of the month.

Dust holding Capacity (mg/cm^2/month) = Total weight of dust/ Total leaf area X $\frac{30}{}$

Anatomical features

Transverse sections (TS) of the leaf along the mid-rib portion were made. The anatomical features were studied under a compound microscope.

Results:

Estimation of foliar dust content per unit area (mg/cm^2)

The foliar dust content per unit area of the 11 leaf samples were calculated as per the formula in Material and Methods. The result is shown in Table I.

Table I. Estimation of foliar dust content per unit area among different leaf samples collected from roadside plants from different localities of Kolkata

SL. NO.	SCIENTIFIC NAME	FAMILY	COLLECTION AREA	LEAF AREA (cm^2)	FOLIAR DUST (mg/cm^2)
1	*Artocarpus heterophyllus*	Moraceae	EM Bypass	72.12	*2.773*
2	*Artocarpus heterophyllus*	Moraceae	Phoolbagan	75.32	*1.327*
3	*Mangifera indica*	Anacardiaceae	Baguihati bus stop, VIP Road	62.06	*4.834*
4	*Mangifera indica*	Anacardiaceae	Field area, Gurudas College	47.88	*2.088*
5	*Ficus racemosa*	Moraceae	Apollo Gleneagles, EM bypass	180.92	*12.961*
6	*Ficus benghalensis*	Moraceae	4-point Crossing, Phoolbagan	91.91	*0.304*
7	*Ficus benghalensis*	Moraceae	Gurudas College campus	46.26	*0.065*
8	*Nerium oleander*	Apocynaceae	Jora-Mandir Crossing, VIP Road	16.58	*18.090*
9	*Nerium oleander*	Apocynaceae	Sector 1, Salt Lake	17.01	*11.750*
10	*Lantana camara*	Verbenaceae	Hyatt regency, EM bypass	24.29	*9.060*
11	*Trewianodiflora*	Euphorbiaceae	Field area, Gurudas College	17.53	*1.312*

Estimation of dust holding capacity (mg/cm^2/month)

The dust holding capacity among three leaf samples collected from different locations of Kolkata was calculated. The results are shown as Table II.

Table II. Estimation of foliar dust holding capacity among three roadside plant species collected from different localities of Kolkata

SL. NO.	SCIENTIFIC NAME	FAMILY	COLLECTION AREA	DUST HOLDING CAPACITY (mg/cm^2/month)
1	*Artocarpus heterophyllus*	Moraceae	EM Bypass	1.153
2	*Artocarpus heterophyllus*	Moraceae	Phoolbagan	0.529
3	*Ficus benghalensis*	Moraceae	EM Bypass	2.149
4	*Ficus benghalensis*	Moraceae	Gurudas College campus	0.042
5	*Nerium oleander*	Apocynaceae	Jora-Mandir Crossing, VIP Road	32.732
6	*Nerium oleander*	Apocynaceae	Sector 1, Salt Lake	20.723

Anatomical features

Transverse sections (TS) of the leaf along the mid-rib portion were made. Pictures of the leaf transverse sections of 4 (four) plant species are shown as Fig. 1, 2, 3 & 4. Black particulate depositions can be seen in the transverse sections of the leaves.

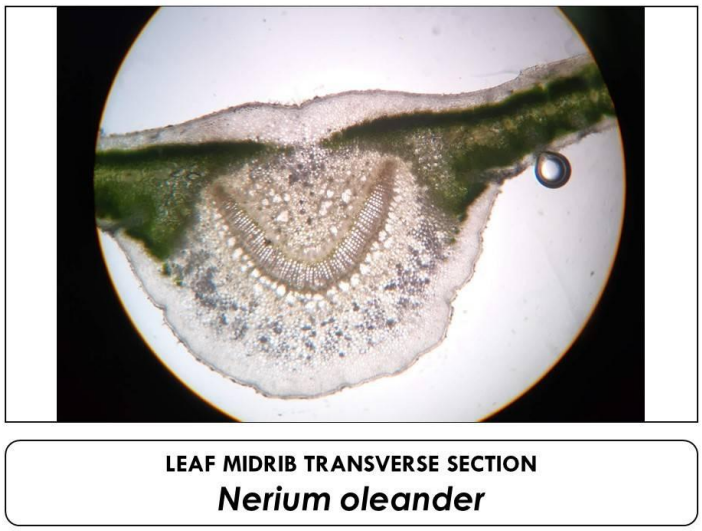

Fig. 1

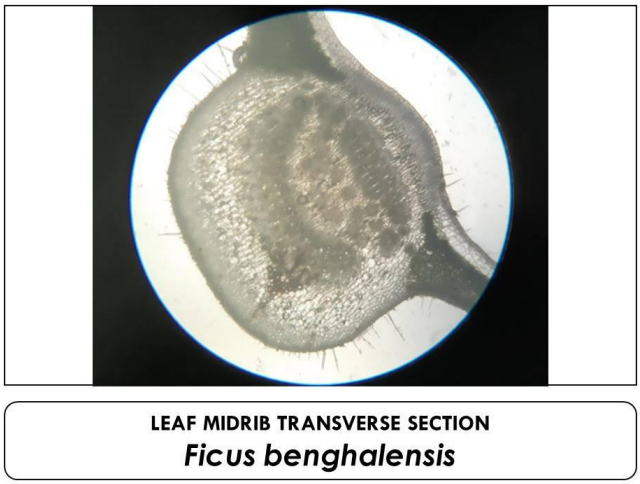

Fig. 2

Fig. 3

Fig. 4

Discussion

The dust deposition on leaves of urban trees reflected the dust pollution in the air; thus, foliar dust is a suitable indicator for monitoring dust pollution in the air. Urban trees differed in dust holding capacity among the sample used in this investigation. The highest performer in this regard was *Artocarpus heterophyllus*, collected from the E M Bypass which has very high vehicular traffic. Significantly lower were among the sample *Ficus benghalensis* collected from Gurudas Park which is way from the main road.

The results in Table II show a difference in the dust holding capacity per unit area for one month of 30 days among the different samples. The leaves taken for this study were of different shapes and size. It was thought that broad leaves would contain more foliar dust and have a higher dust holding capacity. But the results show that the dust holding capacity was highest in *Nerium oleander* in roads with high vehicular traffic as well as areas with low vehicular traffic.

Black particulate depositions can be seen in the transverse sections of the leaves as shown in Fig. 1-4.

Conclusion

Variation in foliar dust content as well as dust holding capacities have been observed. The dust holding capacity of individual tree species should be taken into account in the management of greening plantation in and around an urban area. It has been observed that *Nerium oleander* has been planted in long stretches beside the EM Bypass, especially near Science City. The results of this student research project are in agreement with the choice of roadside plants planted there.

Limitation of the study

During collection of the leaf sample and final laboratory work there is a possibility that some foliar dust may be lost. This foliar dust loss would affect the results. Precaution needs to be taken to ensure minimal (if any) loss of foliar dust.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this work.

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