



Bio monitoring of Suspended particulate matter and its effect on Relative Water Content and pH of selected Roadside plants in the urban areas of Mizoram, India

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Abstract

The signification increased in particulate pollution in the past few years cause serious deleterious effect on the living environment. The need of the hour is the abatement of this threading effect from the pollution. The present study on the biomonitoring of Suspended Particulates Matter (SPM) through selected roadside five plants species (*Artocarpusheterophylla*, *Bauhuniaverigata*, *Delonixregia*, *Ficusbenghalensis* and *Ficusreligiosa*) at different sites in urban area of Aizawl city determine tolerant species to air pollution in the prevailing atmospheric conditions. The physical parameters including Dust Deposition Capacity, pH and Relative Water Content of the plant were analyzed in order to check the effect of dust on the plants. *Ficusbenghalensis* (Banyan), *Artocarpusheterophylla* (Jack fruit) and *Ficusreligiosa*(Peepal) plants have more tolerance of dust attraction and its effect to Relative Water content and pH is minimal.

Keywords: Particulate pollution, aerodynamic, tolerance, eco-sustainable.

Introduction

Particulate pollution in our country has increased significantly during the past few years due to rapid increase in population and industrialization. The change in the quality and composition of air resulting from the human activities, it may be regarded as polluted¹. Particulate matter of the atmosphere is a diverse element mixture². Because of the adverse impact on health and vegetation, particulate matter is of great concern³. The health implication of aerodynamic fine particles diameter smaller than 10 mm was highlighted after numerous epidemiologic studies⁴⁻⁸. Vegetation injury and crop yield losses due to air pollutants are causing increased concern⁹. In view of the deleterious impacts of particulate matters, it is quite obvious to investigate the feasible and eco-sustainable control technologies¹⁰. One of the best methods for the assessment of air pollution of dust/particulate matter is by analysis of different trees, grasses, and vegetables that grow near roadsides of the urban areas.

The tolerance of plants to air pollution varies from plant to plant¹¹. The study of this topic deals with biomonitoring of Suspended Particulates Matter (SPM) through selected roadside five plants species (*Artocarpus heterophylla*, *Bauhinia verigata*, *Delonix regia*, *Ficus benghalensis* and *Ficus religiosa*) at different sites in urban area of Aizawl city, therefore, determination of the plant species among the five selected plants which are more tolerant to air pollution in the prevailing climatic conditions. These studies will provide valuable information for the people in the selection of sensitive and tolerant plants species for identification of the heavy pollution

of urban areas and also the use of tolerant plants species for management of air pollution.

Material and Methods

Description of the study area and study site: The site i.e. urban areas of Aizawl city, Mizoram, for study were from Temple to Bawngkawn (Durtlang road). The sites included all main traffic network (Bungkawn, Dawrpui, Chanmari, Bawngkawn) they are mainly disturbed by auto vehicular activities. All the sites are most polluted part of Aizawl city, there is always a heavy traffic flow as the sites are commercial places as well as residential and some are link to National Highway. Being commercial and residential area these sites are mostly dusty especially from anthropogenic activities like construction and demolition, vehicular exhaust, rock dust, waste, smoke etc. These dusts mostly pose a threat to human and environment, so it is taken for the study purpose.

The dust material are mostly deposited on the aerial part of the tree i.e. leaf. By collecting the dust along with the leaf carefully and examine in the laboratory the certain parameters, we can easily identified whether the plant is good for attracting dust or particulate matter which are floating in the air of that particular area. The physical parameters like Dust Deposition Capacity, pH and Relative Water Content for the selected plants were analyzed to check the effect of dust on the plants.

Sampling and analysis: The studies were conducted in three seasons, i.e. rainy of 2011, winter of 2011 and summer of 2012.

Leaf samples of roadside plants like *Artocarpus heterophylla*, *Bauhunia verigata*, *Delonix regia*, *Ficus benghalensis*, *Ficus religiosa* which were of different habits including large trees, small trees, and shrubs growing on roadsides were obtained from both side edges. Further, the efficiency on the collecting capacity of dust particles (particulate matter) out of the air by vegetation were also taken in account while sampling. From each plants at least 6-12 young leaves (in triplicate) was selected for the study.

The upper leaf surfaces of the selected plants were cleaned to remove the dust present on them with a fine brush (in- situ). Using transparent polythene bags, the leaves selected for control were covered facilitating evapo-transpiration. To accumulate dust on their upper surface for a specific time, the selected leaves were left as it is. After completion of the specific period allotted, the surface of those leaves were cleaned and the dust present were collected in a tracing paper (pre-weighed). The petioles were removed from the leaves for further analysis in the laboratory. The graph paper method was applied for each leaves area (in cm²).

For Dust deposition, the dust collected was weighed using an electrical balance and calculated using the formula.

$$W = (w_2 - w_1) / a$$

Where: W = dust deposited (mg/cm²), w₁ = weight of tracing paper without dust, w₂ = weight of tracing paper with dust, and a = leaf total area (cm²)¹².

Leaf relative water content was determined and calculated with the formula¹³,

$$RWC = \frac{FW - DW}{TW - DW} \times 100 (\%)$$

Where: FW = Fresh weight of the leaf, DW = Dry weight of the leaf, TW = Turgid weight of the leaf,

For pH, 5gm of the fresh leaves was homogenized in 10ml distilled water. The solution was then filtered with Wattman's filter paper and after calibration of the pH meter using buffer solution of pH 4 and 9, the pH of the leaf extract determined.

Results and Discussion

Dust Deposition Capacity of the leaves: From the findings the dust deposition capacity was recorded maximum during the winter season followed less in summer season and very least in rainy season as the season for the year was accompanied with heavy rain and windy condition as seen under the table-1. Among different plants it was investigated that *Ficus benghalensis* has the highest dust deposition capacity followed by *Artocarpus heterophylla*, *Ficus religiosa*, *Delonix regia* respectively and *Bauhunia verigata* has the lowest dust deposition capacity, which may be attributed to morphology, physiology and biochemistry of plants leaves tolerance to dust/particulates.

Relative Water Content: The second parameters Relative Water Content of the different plants were recorded maximum during the rainy season followed less in summer season and minimum in the winter season as seen under the table-2. Among different plants it was investigated that *Bauhunia verigata* has the highest relative water content followed by *Delonix regia*, *Ficus religiosa*, *Artocarpus heterophylla* respectively and *Ficus benghalensis* has the lowest relative water content.

Table-1
Dust Deposition of different plant species in different seasons

Species no.	Name of the Species	Dust deposition capacity (mg/cm ²)		
		Rainy Season 2011	Winter Season 2011	Summer Season 2012
1.	<i>Artocarpus heterophylla</i>	0.00032	0.0140	0.0052
2.	<i>Bauhunia verigata</i>	0.00022	0.0012	0.0025
3.	<i>Delonix regia</i>	0.00017	0.00116	0.0039
4.	<i>Ficus benghalensis</i>	0.00045	0.0311	0.0061
5.	<i>Ficus religiosa</i>	0.00019	0.0124	0.0041

Table-2
Relative Water Content of different plant species in different seasons

Species no.	Name of the Species	Relative Water Content (RWC in %)		
		Rainy Season 2011	Winter Season 2011	Summer Season 2012
1.	<i>Artocarpus heterophylla</i>	78.18	71.41	74.66
2.	<i>Bauhunia verigata</i>	96.57	79.03	84.23
3.	<i>Delonix regia</i>	85.03	88.09	73.27
4.	<i>Ficus benghalensis</i>	88.08	60.45	70.63
5.	<i>Ficus religiosa</i>	93.61	70.19	79.12

Leaf Extract pH: The third parameter pH was recorded maximum during the winter season followed less in summer season and least in rainy season as seen under the table 3. Among different plants it was investigated that leaf extract pH was highest in *Ficus reliogosa* followed by *Ficus benghalensis*, *Artocarpus heterophylla*, *Delonix regia* respectively and it was found to be least in *Bauhunia verigata* which may be affected by the composition of the dust.

Air pollution arises from the emissions of automobiles and their activity which is a threat to the health of living organism particularly human beings. Climate characteristics, nature of sources and the anthropogenic activities near the monitoring sites explained the seasonal variation¹⁴. Air pollution in the study site i.e. roadsides of Bungkawn to Bawngkawn (Durtlang road) is rapidly rising to an alarming condition due to automobiles activities and urbanization. Rapid increase in automobiles activities, traffics, increasing number of construction work sites along with the other developmental works contributes most of air pollution problems, which leads to the plant growth damaging factor.

Several biochemical's, physiological and morphological characteristics are the factors to absorb and adsorb pollutants by each plant species with their foliar surface¹⁵. By planting tolerant plant species, environmental benefits can be obtained as they act as a pollution sink and for this it is essential to evaluate the plants with respect to their tolerance level to air on polluted areas¹⁶.

The most important prerequisite for plants life is water and its shortage may cause severe stress to terrestrial plants¹⁵. Under air pollution stress condition, plants maintain balance physiologically with the high relative water content of their body. High relative water content favors drought resistance in plants¹⁷. Plants cannot survive well due to low water supply from the roots to supply photosynthesis if the leaf transpiration rate reduces due to the air pollution. pH determination can be useful for identification of tolerant species. Low pH content is more susceptible plant species and plants with pH around 7 are tolerant species¹⁵.

Conclusion

Ficus benghalensis (Banyan), *Artocarpus heterophylla* (Jack fruit) and *Ficus reliogosa* (Peepal) may be useful for

biomonitoring of particulate matter by analyzing three parameters i.e Dust deposition capacity, Relative Water content and pH. Our study proves that the above mentioned plants have more capability of dust attraction and reliable for the roadside plantation for green belt. Thus, we can conclude that studies in Biomonitoring of Suspended Particulate Matter are handy for future planning for better and cleaner environment which is the basic need for existence of life on the earth.

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Table-3
Leaf Extract pH of different plant species in different seasons

Species no.	Name of the Species	pH		
		Rainy Season 2011	Winter Season 2011	Summer Season 2012
1.	<i>Artocarpus heterophylla</i>	5.2	6.92	6.4
2.	<i>Bauhunia verigata</i>	6.6	5.5	6
3.	<i>Delonix regia</i>	5.9	6.5	6.1
4.	<i>Ficus benghalensis</i>	5.24	6.98	6.3
5.	<i>Ficus religiosa</i>	5.56	7.86	6.8

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