

## Air quality Impacts on Anatomical and Biochemical Parameters

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**Abstract:** Plant can act as an indicator of environmental pollution by changing its anatomical, biochemical and physiological features. This has been well recognized in the past. In our township, a case of study was undertaken to determine the extent of air pollution and its impact on some dominant local flora by studying their anatomical-biochemical features of leaves in a comparative manner. The total chlorophyll content, epidermal thickness, stomata length and breadth of the leaves were found to decrease while the leaf thickness, stomata frequency were found to increase in case of pollution stress plant with respect to control plant population of non polluted habitat. This indicates that the pollutants have imparted direct adverse effect on biochemical and anatomical make-up of the population stressed plant. In the present investigation a study was made to measure the level of primary air pollutants such as Suspended particulate matter (SPM), SO<sub>2</sub> and NO<sub>x</sub> in different blocks (A, B, C & D) of our township and to evaluate their impact on some vegetation of the area. Our township is a satellite urban cluster with industrial and residential mixed zone. The foliar anatomical and biochemical parameters were analyzed over a period of winter season.

**Key words:** Air pollution; Suspended particulate matter-Sulphur dioxide-Nitrogen oxides.

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### I. Introduction

Air pollution occurs when harmful or excessive quantities of substances are introduced into Earth's atmosphere. Sources of air pollution include gases (such as ammonia, carbon monoxide, sulfur dioxide, nitrous oxides, methane and chlorofluorocarbons), particulates (both organic and inorganic), and biological molecules. It may cause diseases, allergies and even death to humans; it may also cause harm to other living organisms such as animals and food crops, and may damage the natural or built environment.

Air pollution is a significant risk factor for a number of pollution-related diseases, including . The human health effects of poor air quality are far reaching, but principally affect the body's respiratory system and the cardiovascular system. Individual reactions to air pollutants depend on the type of pollutant a person is exposed to, the degree of exposure, and the individual's health status and genetics. Indoor air pollution and poor urban air quality are listed as two of the world's worst toxic pollution problems.

Several angiosperm plant could be used as biomonitor which can be detect the presence of gaseous pollutants. Environmental pollution and its impact on plants have well recognized during past few decades. The role of air pollutants causing injury to plant either by direct toxic effect or modifying the host physiology rendering it more susceptible to infection. In severe case of pollution the injury symptoms were expressed as foliar necrosis or completely disappearance of<sup>1-2</sup> the plant. . Several workers have also previously studied the impact of air pollution on plants with reference to foliar anatomical and biochemical changes by experimenting on various sensitive plant in vitro<sup>3-8</sup>. Leaf is the most sensitive and reliable part than any other parts of plant like stem, root, flower, fruit & seed; it may act as a persistent absorber and exploiter in polluted environment<sup>9</sup>.

In the present investigation a study was made to measure the level of primary air pollutants such as Suspended particulate matter (SPM), SO<sub>2</sub> and NO<sub>x</sub> in different blocks (A, B, C & D) of our township and to evaluate their impact on some vegetation of the area. our township is a satellite urban cluster with industrial and residential mixed zone. The foliar anatomical and biochemical parameters were analyzed over a period of winter season (Nov, 1997 to Feb, 1998).

### II. Materials and Methods

A total number of twenty air samples were studied in four sampling stations at five consecutive days. Twenty four hourly average data of ambient air quality of the sampling site shown in Table-1.

The air sampling was done in winter season in the different blocks of our township because the pollutant intensity is found higher in this season. The plant samples were also collected simultaneously from the sampling areas, A control experiment was made in non-polluted site (Haringhata farm area).

The air samples were collected by help of High volume sampler (HVS) for 24-hours. Subsequent measurement were made by conventional methods. For determination of SO<sub>2</sub>, NIN and SPM., methods as described in Indian standard, IS-5182, part-vi and part-iv were adopted.

The fresh fully expanded leaves (5<sup>th</sup> to 8<sup>th</sup> nodal leaves from the apex of the twigs) of five dominant plants of this area were collected for analysis. The plants were *Cocos nucifera* L., *Mangifera indica* L, *Musa sapientum* L, *Polyalthia longifolia* (Sonn) Thw. And *Swietenia mahagoni* Jacq. Five replica of each samples were prepared for foliar anatomical and biochemical analysis.

**Table 1 – Ambient Winter air quality of Township (Average mean of five data +/- 24-hours)**

S.No.	Parameters Ug/m <sup>3</sup>	Locations				National Standard for various sites		
		Site-1	Site-b	Site-c	Site-d	Residential	Industrial	Sensitive
1.	SO <sub>2</sub>	60.30	64.80	32.20	78.40	80	120	30
2.	NO <sub>x</sub>	93.50	52.20	42.90	84.50	80	120	30
3	SPM	220.80	226.10	155.60	202.90	80	120	30

Site-a : A – Block (Sensitive Residential area).                      Site-b:    B-        Block        (Residential        area)

Site-c : C- Block (Educational Institutions)                      Site-d :    D- Block or Silpanchal (Ind.area)

(a) Chlorophyll content was measured by sing spectrophotometer (Spectronic-20D) at 663 nm and 645 nm, after acetone (80%) extract<sup>10</sup>.

(b) Stomata study was done by taking epidermal imprints of leaf samples using adhesive Quick fix and prepared for microscopic study.

(c) Measurement of leaf thickness and epidermal layer thickness were made by hand sections of leaves were prepared and treated with a saturated alcoholic solution of Sudan-III for twenty minutes and ready for microscopic study<sup>12</sup>. Using stage and ocular micrometer in compound microscope done the microscopic measurements.

### III. Result and Discussion

The SPM concentration of A,B and D-block were exceeding the permissible Indian Standard level for residential area (i.e. 200 µg/m<sup>3</sup>). The present of No<sub>x</sub> at A and D-blocks is also higher than the permissible Indian Standard level for residential area (i.e. 80 µg/m<sup>3</sup>) and however the concentration of SO<sub>2</sub> in all the four blocks lower than the permissible Indian Standard level for residential area (i.e. 80 µg/m<sup>3</sup>). In town the emission sources re mainly from local nearby industries, Bandel thermal power plant, automobile exhaust and also domestic activities.

The pollution load depends upon its emission level from different sources, the location and height of emission sources and also micro-meteorological factors. The wind rose of the study region in the study period indicates that the predominant wind flow is in Noth-East direction. A spectrum of ambient air quality (i.e. concentration of SPM; SO<sub>2</sub> and NO<sub>x</sub>) of four different blocks i.e. A-block (Sensitive residential area), B-block (residential area), C-block (Educational institutions and residential area) and D-block or Silpanchal (industrial area) of township in winter season is shown in Table-1. The map of the study region indicating different blocks, source of fission and sampling stations are shown in Fig.1. The van rose of the study period is also shown in Fig.2. Thus it is observed from the present study that the ambient air quality of township is fairly polluted.

There are several reports of changes in morphological and physic-anatomical make up of the plant affected by air pollutants<sup>13-17</sup>. The foliar features of five dominant plant species studied from respective polluted areas.

**Table.2-** Some previous studies in India on foliar traits with reference to air pollution impact survey on plants.

S.No.	Plant Species	Refernces
1.	<i>Syzygium cumini</i>	Srivastava & Fafii (1978)
2.	<i>Psidium guajava</i>	Ghouse & Khan (1978)
3.	<i>Bauhinia purpurea</i>	Kasat & Agarwal (1981)
4.	<i>Pongamia Pinnata</i>	Kasat (1982)
5.	<i>Artocarpus integrifolia</i>	Debnath & Nayar (1983)
6.	<i>Ficus henghalensis</i>	Debnath & Nayar (1983)
7.	<i>Ficus religiosa</i>	Debnath & Nayar (1983)
8.	<i>A Istonia scholaris</i>	Debnath & Nayar (1983)
9.	<i>Polyalthia longifolia</i>	Debnath & Nayar (1983)
10.	<i>Boerhaavia diffuse</i>	Gupta(1987)

Township in comparison with the non-polluted area were given in Table-2. The total chlorophyll content of leaves in plants of polluted habitats is lower than the non-polluted habitat and the chlorophyll-a content found higher than the chlorophyll-b content in all plant except *Swietenia mahagoni*. In case of *Mangifera indica* there is minimum reduction of chlorophyll content, this indicates that the plant with is tolerant to pollution stress. Moreover there is variation of total chlorophyll, chlorophyll-a and chlorophyll-b content of different plant species in different study areas indicates the differential response of plant species to pollutants. In India many plant species were studied previously on the respect of air pollution, some of them are given in Table-2.

The stomata frequency, stomata length and breadth were studied and found that in all cases the stomata frequency of polluted habitats were higher than the non-polluted habitat and however stomata length and breadth of non-polluted habitat is higher than the polluted habitats. It also reported earlier that stomata plays a significant role in polluted habitats by changing or modifying themselves. The increase of stomata frequency and decrease of stomata size of leaves have the common phenomenon in polluted environments<sup>18-21</sup>. The leaf thickness of all the studied plant are higher in polluted areas than the non-polluted area. The epidermal features of leaves in polluted environment were studied previously by several workers<sup>22-24</sup>.

In the present investigation it was observed that the upper and lower epidermal thickness of leaves of the experimented plant species were found decrease in polluted habitats than the non-polluted habitat. The increase of leaf thickness and decrease of epidermal layer thickness indicates that the pollutants accelerate the expansion of spongy parenchyma cells in the leaves, that acts as storage tissue.

The above micro-morphological changes are mainly due to air pollution effect. The possible secondary additive factors could not affect the morphology. As the soil type and weather of the neighboring areas are very much same.

In township area there are many land area that are laying exposed i.e. devoid of plants. There is no plantation area around the industries. In an around every industry there is need of plantation, that some what help for air-pollution abatement in this township.

The open exposed areas with in the township or its surroundings should be utilized for thick plantation. Preferably some quick growing evergreen plants having thick canopy should be planted for prefer green belt development.

It may refer from literature review and present experiment that most suitable plant species for green belt development of the area are as follows, *Cassia siamiae*, *Syzgium cumini*, *Accacia auriculogorinis*, *Azadiracta indica*, *Mangifera indica*, *Swietenia mahagoni*, *Polyalthia longifolia* and *Samanea saman*.

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