Effect of Air Pollution on Leaf Properties of Selected Plants

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Abstract: **The present study is mainly focused on effect of environmental pollution on leaf properties of selected plants, *Azadiracta indica, Catharanthus roseus, Calotropis procera, Tabernaemontana divaricata* and *Nerium oleander* are collected from polluted and non-polluted areas. The plants have been selected randomly based on population in and around Coimbatore. The study revealed that there is decrease in stomatal size and increase in density of leaves from highly polluted sites. This is contributing adverse impact on leaf properties like chlorophyll content, stomatal density, stomatal index and growth in the selected plants.**

***Keywords*: Air pollution, leaf property, stomata, population, Industrial revolution**

INTRODUCTION

Air pollution has become one of the major problems in urban areas. Tree in city area are facing the adverse impacts of air pollution. The leaf is the most sensitive part exposed to air pollutants. Affected plants show some common effects such as decrease in chlorophyll content, inhabitation in photosynthesis and decreasing plant growth. Air pollutants cause both direct and indirect effects on the metabolism of roadside plants even before visible symptoms appear [12]. Urban forests and trees in the urban areas can improve air quality through filtering and uptake of gases and particles [1]. Plants are exposed to low light intensity and they make use of available light energy. Plants typically express phenotypic differences in response to environmental changes [10][13]and [8].
Under different environmental conditions, plants allocate biomass in several organs in order to capture optimum light, water, nutrient and carbon dioxide, for its maximum growth rate [2]. Several studies have been done in anatomy of vegetative organs under polluted condition. Turgor changes in the guard cells determine the area of stomatal pore through which gaseous diffusion can occur, thus maintaining a constant internal environment within the leaf [5]. In plants stomata play a major role in gaseous exchange and transpiration in which stomatal control is a critical process in plant adaptation in various environments. In this study the investigation was carried out to know the effect of environmental pollution on leaf properties of plants in urban area.

I. MATERIALS AND METHODS

Collection of Plant Material

The urban study site was in city of Coimbatore (11° 1′6N, 76° 58′ 21E) elevation 1,348 feet. Coimbatore is located in the river bank of Noyyal and surrounded by Western Ghats. Coimbatore is the second largest city in Tamil Nadu and it is recognized as 16th largest urban agglomeration in India.
The Coimbatore district have urban (71.37%) and rural (29.63%) population. Polluted plants were collected in Goundapalayam, non-polluted plants were collected in Keeranatham village. The collected plants were identified with local floras. *Flora of British India* [7]; *Flora of the presidency of Madras* [4]; *Flora of Tamil Nadu* [9].
The fresh leaves were used for macro-scopical and microscopical study. All the plants leaves were macroscopically studied for its length and width. The results were noted for all selected plant samples (Table 1).

Specimen Preparation

Clear the piece of the leaf (middle part) by boiling with chloral hydrate solution or alternatively with chlorinated soda. Peel out upper and lower epidermis separately by means of forceps. Keep it on slide and mount in glycerin water. Arrange a camera lucida and drawing board for making the drawings to scale. Draw a square of 1mm by means of stage micrometer.

Place the slide with cleared leaf (epidermis) on the stage. Trace the epidermis cell and stomata, identification of the stomata has been done on the basis of arrangement of guard and subsidiary cell of the stomata.

III. RESULTS

The present study was undertaken to assess the influence of environmental pollution on leaf properties of selected urban plants. A total of 5 plant species *Azadirachta indica, Calotropis procera, Catharanthus roseus, Nerium oleander* and *Tabernaemontana divaricata* were collected and identified during the investigation, A total of 5 plant species, 4 species belonging to the family Apocynaceae. 1 species belonging to the family Meliaceae. Apocynaceae was the dominant family because they are more adaptable to the urban area and are resistant plants towards pollution.

Types of Stomata

The stomatal type was studied in the selected plant species in *A. indica*, *C. roseus*, *T. divaricata* were noted to have Anomocytic type of stomata *C. procera* seem to have presence of Paracytic type of stomata and *N. oleander* had presence of sunken stomata. (Table 1). The leaf area is an important leaf function trait which is very much related to leaf length and leaf width.

Table -1. Stomatal type, leaf length, leaf width of selected polluted and non-polluted plants.

S. No.	Plant Name	Type of Stomata	Non -Polluted		Polluted	
			Leaf Length (cm)	Leaf Width (cm)	Leaf Length (cm)	Leaf Width (cm)
1	*Azadirachta indica*	Anomocytic	7.3 ± 0.2^{d}	3.0 ± 0.2^{c}	6.2 ± 0.7^{d}	2.7 ± 0.3^{c}
2	*Calotropis procera*	Paracytic	9.4 ± 0.7^{c}	4.9 ± 0.7^{a}	7.2 ± 0.9^{c}	3.9 ± 0.4^{a}
3	*Catharanthus roseus*	Anomocytic	3.9 ± 0.5^{e}	1.9 ± 0.2^{e}	3.5 ± 0.4^{e}	1.4 ± 0.6^{de}
4	*Tabernaemontana divaricata*	Anomocytic	12.5 ± 0.3^{b}	4.2 ± 0.4^{b}	9.5 ± 0.6^{b}	3.3 ± 0.8^{b}
5	*Nerium oleander*	Sunken	18.2 ± 0.5^{a}	2.2 ± 0.3^{d}	14.3 ± 1.2^{a}	1.8 ± 0.3^{d}

Results are average ± SE (n=3). Different letters denote significant differences at $p < 0.05$ - Tukey's test.

Leaf Length

The leaf length was measured and the results revealed that there was reduction in leaf length in polluted plants when compared to non-polluted plants. In the selected plants, *Nerium oleander* (Polluted) showed the highest reduction in leaf length (3.9cm) in comparison of Non- polluted plants, followed by *Tabernaemontana divaricata* (3.0cm), *Calotropis procera* (2.2cm), *Azadirachta indica* (1.1cm) and *Catharanthus* (0.4mm) (Table 1).

Leaf Width

Among the selected polluted and non-polluted plants there were reduction in the width of leaf in the polluted plants. In polluted plants *Tabernaemontana divricata* (0.9mm) showed the highest reduction in leaf width followed by *Nerium olender* (0.4mm), *Azadirachata indica* (0.3mm) and *Catharanthus roseus* (0.5mm) (Table 1).

IV. DISCUSSION

Pollution occur due to the traffic emissions and human population. Soil qualities from urban site have higher concentration of metals like lead which is a heavy metal with low plant mobility [6] and other metals including zinc, chromium and copper than that of rural site. The present investigation reported that the leaf properties of the plants, which are in the polluted urban area is highly affected than the plants which are in the non-polluted rural area.

Air pollution may severely affect the plant metabolisms and the pollutants may cause leaf injuries, stomatal damage, premature senescence, decrease photosynthetic activity, disturb membrane permeability and reduce growth and yield in sensitive plants species. Five different plants species were selected belonging to the family Apocynaceae and Meliaceae. Collection of leaves were done in both polluted and non-polluted area. This exhibits great difference in anomocytic, paracytic, and sunken stomatal type of the leaf. A reduction of stomata is also found in response to elevated CO_2 concentrations, frequently present in city centers [14]. The difference between the length and width of the leaves were more affected in urban areas. The loss of stomatal density causes less photosynthetic activities in the plants [11].

Dust particles were present on the leaf surface. In urban site, the particles were abundant and clumped together; whereas they were less on leaves from rural site. Plant anatomical functions were also affected. These results support that plane leaves can cope with pollution [3].

V. CONCLUSION

In this study, the plants in urban site reveals that Apocynaceae was the dominant family, because they were more adaptable and resistant towards pollution. Also, structural leaf properties like reduction of leaf area, stomatal density and probably thin cuticle have been affected the leaf characteristics. Plants in polluted area act as an air filter and these are only source of traffic exhaust in urban areas which could conserve our environment for the future.

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