MORPHOLOGICAL AND ANATOMICAL STUDIES OF LEAVES OF DIFFERENT PLANTS AFFECTED BY MOTOR VEHICLES EXHAUST

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SUMMARY: Morphological and anatomical studies of leaves of roadside trees (Ficus bengalensis L., Guaiacum officinale L. and Eucalyptus sp.) of polluted and unpolluted areas were carried out. All the plants showed no visible morphological and anatomical changes. However, some reduction in these characters were observed in leaves which were collected from the city center. Significant reduction in length and area of leaflets and length of petiole of G. officinale of polluted plants was recorded. Similarly, reduction in the anatomical characteristics of polluted leaves of the above mentioned species was also observed. Significant reduction was particularly recorded in spongy parenchyma and lower epidermis in F. bengalensis and Eucalyptus sp., respectively.

Key Words: Morphology, anatomy, air pollution.

INTRODUCTION

The increasing number of industries and automobile vehicles are continuously adding toxic gases and other substances to the environment. Karachi being an industrialized and trade center suffer both from industrial and automobile exhausts. It has been observed that plants particularly growing in the urban areas affected greatly due to varieties of pollutants [oxides of nitrogen and sulphur, hydrocarbon, ozone, particulate matters, Hydrogen fluoride, peroxyacyl nitrates (PAN) etc.]. The automobile pollutants have long term effects on plants by influencing CO_2 contents, light intensity, temperature, and precipitation. Plants need special protection because they are not only a source of food but are also helpful in cleaning the environment.

Some of the workers (2-10) have reported the effects of air pollution on the morphology and anatomy of different plants species. This work was designed to investigate the effects of automobile pollution on the morphology and anatomy of some common trees growing along the busy roads of Karachi.

MATERIALS AND METHODS

Fresh leaves of *Ficus bengalensis L., Guaiacum officinale L.* and *Eucalyptus sp.* were collected near the roads of Guru Mindir in city area. Guru Mindir was chosen only because at this point the density of vehicles was greater as compared to other areas in the city. (KDA Traffic Engineering Bureau report, unpublished). Moreover, most of the roadside trees also showed highest growth reduction at this point (2). Beg *et al.* (1) have determined high level of smoke and contents of tarry deposit and lead on leaves of trees at Guru Mindir. Similarly, leaves of the above species were also collected from a clean area in the University campus. Leaves were collected in replicates from trees which were having similar DBH and uniform height and growth form.

Length, breadth and area of the leaves were determined, petiole length was also recorded. Fine sections of leaves were taken transversely through the midrib, stained with safranin and mounted in glycerin. These sections were examined under the microscope for quantitative measurements of cuticle, epidermal layer, hypodermis and mesophyll cells with ocular scale.

RESULTS AND DISCUSSION

The roadside plants in Karachi city are continuously exposed to different pollutants (carbon monoxide, oxides of nitrogen and sulphur, particulate matter, lead etc.) which are released into the environment as a conse-quence of incomplete combustion in the automobile engines. This study reveals that all the plants investigated showed no visible morphological injuries or anatomical changes. However, some hidden injury or physiological disturbance might have occurred which caused reduction in Morphological and anatomical characters of all the plants (Table 1).

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Table 1: Effect of motor vehicles exhaust on the leaf characteristics of different species.

	Ficus bengalenis		Guaiacum officinale		Eucalyptus sp.	
	Non-polluted	Polluted	Non-polluted	Polluted	Non-polluted	Polluted
Length of leaf (cm)	13.3 (0.7)	12.3 (0.8)	2.9 (0.4)	1.2 (0.1) *	18.3 (0.7)	17.2 (0.7)
Breadth of leaf (cm)	11.6 (0.2)	10.4 (0.4)	1.6 (0.2)	1.0 (0.2)	1.4 (0.0)	1.4 (0.1)
Area of leaf (sq.cm)	103.8 (7.6)	86.2 (7.5)	3.4 (0.9)	0.8 (0.2) *	17.7 (1.0)	16.3 (1.5)
Length of petiole (cm)	2.8 (0.1)	2.6 (0.1)	0.8 (0.1)	0.3 (0.1) *	2.0 (0.0)	1.9 (0.1)

Leaflet in cases of *G. officiale*
( ) Stardard error
* Significant at p = < 0.05

Length, breadth and area of leaves and length of petiole showed that in all the species *(F. bengalensis, G. officinale* and *Eucalyptus sp.)*, the leaves which were collected from a polluted area from the city center showed reduction in all the parameters investigated. *G. officinale* leaves showed significant reduction in length and area of leaflet and length of petiole as compared to other tree species. Other workers in the previous years also showed significant reduction in different leaf variables in the polluted environment in comparison with clean atmosphere. Ninova *et al.* (10) in their study on *Platanus acerifolia* showed changes in leaf blade and petiole size in the polluted air. Reduction in dimension of leaf blade of five tree species in the vicinity of heavy dust and SO_2 pollution

Table 2: Effect of motor vehicles exhaust on the leaf anatomy of different species.

	Ficus bengalenis		Guaiacum officinale		Eucalyptus sp.	
	Non-polluted	Polluted	Non-polluted	Polluted	Non-polluted	Polluted
Upper cuticle	26.6 (2.0)	25.7 (1.6)	-	-	17.6 (1.8)	16.2 (2.0)
Upper epidermis	52.0 (1.1)	54.6 (2.7)	12.8 (0.9)	12.8 (0.4)	28.1 (0.6)	27.5 (1.5)
Upper hypodermis	-	-	35.0 (1.1)	31.5 (1.1)	87.0 (1.1)	87.3 (3.1)
Upper palisade	85.3 (2.0)	83.5 (1.7) *	52.9 (1.6)	51.0 (2.2)	106.5 (1.3)	104.8 (1.7)
Spongy parenchyma	74.6 (2.7)	42.2 (1.1)	62.6 (2.6)	55.9 (2.3)	164.3 (2.1)	155.4 (5.5)
Lower palisade	35.5 (1.6)	36.8 (0.4)	59.5 (2.6)	51.0 (1.6)	95.5 (2.5)	96.1 (0.8)
Lower hypodermis	-	-	30.7 (0.8)	28.8 (1.6)	80.5 (2.4)	88.8 (5.5) *
Lower epidermis	47.5 (1.1)	48.8 (1.6)	13.7 (0.4)	12.4 (0.9)	22.3 (1.5)	17.9 (1.1)
Lower cuticle	11.5 (1.6)	11.5 (1.1)	-	-	15.9 (2.3)	16.8 (1.9)

All measurements were made in micron (μ),
Leaflet in cases of *G. officinale*
( ) Stardard error
* Significant at p = < 0.05

was also observed (11). *Euphorbia hirta* growing in coal smoked environment showed reduction in leaf area (5). Significant effects of automobile exhaust on the phenology, periodicity and productivity of roadside tree species was also reported (2).

Similarly, leaf anatomy of the above mentioned species also showed reduction in cuticle, epidermis, hypodermis, palisade, parenchyma cells in polluted leaves as compared to leaves collected from non polluted area of the University. Significant results were particularly observed in spongy parenchyma and lower epidermis in *F. bengalensis* and *Eucalyptus sp.*, respectively. Changes in shape and structure of thin walled mesophyll cells have been widely reported. Mesophyll cells are thin walled and are in direct contact with the environment through stomates. The parenchytamous cells of spongy parenchyma becomes flattened due to continuous exposure to pollutants. This has been indicated in Table 2, the significant reduction in spongy parenchyma in leaves of *F. bengalensis* of a polluted area. Similarly, Iqbal (7) has shown significant reduction in palisade and spongy parenchyma in leaves of white clover of a polluted population. On the other hand Godzik and Halbwacks (4) have shown fine and irregular cuticular folding on each epidermal cell of both adaxial and abaxial sides of *Aesculus hippacastanum* in the vicinity of air pollution sources. Chloroplast performation of mesophyll cells was seen in red maple trees after exposing to only 0.15 ppm SO_2 for 42 days (8). Karenlami (9) has suggested that different structural changes in mesophyll cells were due to lack of starch grains, occurrence of large droplets of lipid like material and the swelling of thylakoides as was observed in *Pinus ponderosa.*

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