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THE EFFECTS OF AIR POLLUTION ON STOMATAL CLOGGING, CARBOHYDRATE AND CHLOROPHYLL CONTENTS IN CERTAIN ROADSIDE PLANTS

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Karachi is the most industrialized and largest city in Pakistan where increased economic activity is continuously spoiling the environment. The city centre is particularly suffering from air pollution due to heavy traffic, large number of vehicles pollute the air by adding exhaust gases. Carbon, rubber, smog reactants, hydrocarbons and oxides of nitrogen are released into the environment as a consequence of incomplete combustion in the automobile engines.

Prindle & Charles (1962) studied the effects of motor vehicles upon animals and plants. They described that automotive emissions consisting principally of carbon monoxide, carbon dioxide, the oxides of nitrogen, and a variety of unburned or partially oxidized hydrocarbons, participate in the formation of photochemical smog. These smog substances appeared to be more dangerous than the original emission. They found that automotive emission damaged the agricultural crops. Darley *et al* (1963) studied the effects of pollution derived from automobiles on plant damage. Different gases and compounds found in the exhaust were damaging to the leaves of a variety of crop plants, and the physical and chemical systems within the plants were disrupted by the photoxicants. Sitnikova (1963) made a physiological study of photosynthesis and the dynamics of corbohydrate and chlorophyll accumulation in trees and shrubs under different growth conditions (an ore concentration plant, a botanical garden and a metallurgical plant). He found that considerable amount of gas and dust in the vicinity of industrial plants caused an increase in photosynthetic rate in trees most resistant to smoke and gas like Russian olive, elm, ash, maple balsam and poplar. In view of these considerations, the effect of air pollution on stomatal clogging, carbohydrate and chlorophyll content of certain road-side plants was studied.

Materials and Methods

The samples of leaves of some plants were collected from M.A. Jinnah Road, Karachi, to examine the effect of air pollution on stomatal clogging, chlorophyll and carbohydrate contents. The leaves of the same species were also collected from the Karachi University Campus, where the atmosphere is relatively unpolluted, for a comparative study. To ascertain the effect of air pollution on the clogging of stomata, impression of lower epidermis of leaves were obtained using transparent nail polish. The strips were studied under microscope and the percentage of stomata completely clogged, partially clogged and open were calculated.

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Carbohydrates were estimated by Jensen (1955) method. Chlorophyll contents were determined by Kouchkovsky method as described by Shaukat (1973).

Conclusion

Differences in the carbohydrate contents in the leaves of plants growing in polluted and unpolluted conditions was found. In *Ficus bengalensis*, *F. infectoria*, *F. religiosa*, *Gauicum officinale* and *Polyalthea longifolia*, there were small differences in the carbohydrate content in polluted and unpolluted conditions. The least difference was found in *F. bengalensis* where 0.60% carbohydrate was found in polluted conditions while 0.64% was found in unpolluted conditions. In *G. officinale*, 0.64% carbohydrate was found in polluted conditions while 0.70% in unpolluted conditions. In some other plants that are not very common like *Carissa carrandus*, *Cordia myxa*, the difference in the carbohydrate was greater in both the conditions. Since the climatic conditions except pollution were similar in both the localities, the difference in carbohydrate may be due to air pollution presumably derived from automobiles.

TABLE 1. Effect of air pollution on carbohydrate content of different plants.

Name of the species	Carbohydrate content %	
	Polluted conditions	Unpolluted conditions
Carissa carandus Linn	0.01	0.70
Cordia myxa Linn.	0.70	1.60
Ficus bengalensis Linn.	0.60	0.64
Ficus infectoria Roxb.	1.10	1.40
Ficus religiosa Linn.	0.25	0.40
Gauicum officinale Linn.	0.64	0.70
Mangifera indica Linn.	0.50	1.80
Polyaltha longifolia Benth. and Hk. f.	0.50	0.80

The chlorophyll content was also found to be reduced in polluted conditions than unpolluted conditions in all the plants except *C. myxa* It may be due to the fact that *C. myxa* was growing at some distance away from the road in the house, where better growth conditions with abundant supply of water may be available. The least difference in chlorophyll content in both the conditions was found in *F. bengalensis* in which 0.337 mg/g chlorophyll content was found in polluted conditions while 0.400 mg/g in unpolluted conditions. The least difference in chlorophyll

TABLE 2. Effect of air pollution on chlorophyll content in different plants.

Name of species	Chlorophyll contents mg/g					
	Polluted conditions			Unpolluted conditions		
	a	b	a & b	a	b	a & b
Bogainvillea spectabilis Willd.	0.210	0.296	0.506	0.270	0.380	0.650
Cordia myxa Linn.	0.183	0.151	0.334	0.151	0.130	0.281
Ficus bengalensis Linn.	0.175	0.202	0.377	0.170	0.230	0.400
Ficus infectoria Roxb.	0.187	0.279	0.466	0.270	0.360	0.630
Gauicum officinale Linn.	0.182	0.160	0.430	0.270	0.350	0.620

and carbohydrate content in *F. bengalensis* is in conformity that this plant is showing near about as good growth in polluted conditions as in unpolluted conditions. In *G. officinale* the difference in chlorophyll content in both the conditions was the greatest, in which 0.430 mg/g chlorophyll content was found in polluted conditions while 0.620 mg/g in unpolluted conditions.

A large number of stomata were found to be clogged in the leaves of plants growing in polluted conditions. This clogging of stomata seems to be due to the deposition of soot particles derived from automobiles. The clogging of stomata

TABLE 3. Effect of air pollution on stomata in different plants.

Name of species	Stomata completely clogged %	Stomata partially clogged %	Stomata Open %
Azadirachta indica Juss.	40.00	45.00	15.00
Carissa carrandus Linn.	45.00	50.00	5.00
Cordia myxa Linn.	30.00	70.00	negligible.
Ficus bengalensis Linn.	35.70	60.80	3.50
Ficus infectoria Roxb.	42.85	53.57	3.58
Gauicum officinale Linn.	28.12	65.93	5.95

was greater in those leaves which have their lower epidermis hairy or rough, as in the case of *F. bengalensis* and *C. myxa*. The clogging of stomta was slightly lesser in those plants which have smooth lower epidermis. As the new leaves are formed, soot and dust particles begin to deposit on the leaves, and with the passage of time, the amount of these particles on the leaves increase, consequently a large number of stomata get clogged.

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