DUST ARRESTING CAPACITY OF SOME PLANTS

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Abstract - Air borne dust particles represent a complex mixture of organic and inorganic substances of varying shape and size causing serious environmental hazards. Dust kicked up by heavy vehicles on highway cause air pollution and also affects human health causing allergic and respiratory diseases. Phenomenon of imprisonment of such dust pollutants by some plants atroad side on National Highway at Maharashtra was studied using leaves as experimentalmaterial. Plant species like Pongamia pinnata L. of family Fabaceae, Mangifera indica L. offamily Anacardiaceae, Annona squamosa L. of family Annonaceae, Alstonia scholaris L. offamily Apocynaceae and Calotropis procera of family Asclepiadaceae were selected for dustpollution studies. Dust holding capacity of leaves of above plants was analysed and its effecton chlorophyll content was further studied. Maximum deposition of dust was found to be inCalotropis procera and chlorophyll content was found to be minimum in the same plant.Hence this study pays attention on the role of plants as bio accumulator of dust on road side.

Key wards - Dust Arresting Capacity, Chlorophyll Content, Leaves, Highway

I. INTRODUCTION

Air pollution has adverse effect on plants (Talukdar et. al., 2018). Particulate air pollution is mainly due to emissions by vehicles through traffic on roads. Roads include all national/state highways, interconnecting various area in the cities and villages. The pollution from vehicles is due to discharge like CO, unburnt HC, Pb, NO2 and SO2 and SPM mainly from tailpipes (Dayal, 2011). Long term exposure to suspended particulate matter canbe hazardous to human health (Fennelley, 1975). National highways with heavy traffic are responsible for pollution in cities and villages on its route.National Highwaysare occupied by many herbs, shrubs and trees. Air consists of dust along with other microbiota which in turn is hazardous to plant growth and human health. Dust particles are carried out by wind and ultimately settle down on the ground as well as plant organs particularly leaves.Recently, public awareness has been raised to CO_2 problems and fine particle matter (PM, fine dust), especially because of increasing traffic and anthropogenic activity in urban areas (Cwiklak et al. 2007).In India 30-35% of air pollutants comprises of dustparticles (Sett, 2017).

Plants have been reported as good dust collectors and useful in quick reclamation of mined out areas (Maiti, 1993).

Pollution damage ranges from simple reduction of the photosynthetic efficiency of the target plant to stomatal closure leading to cell/tissue changes, leaves' necrosis, chlorosis, etc(Ulrichs et al., 2008). Manyplantsare commonly planted along roadsides where ambient dust level is greatest. Plants intercept tons of dust, absorb noise and serve as acoustic screens on busy highways. Vegetation contributes in reducing dust concentration in environment by acting as anaccumulating device for air pollutants. Taking this into account, the present study was conducted on some plants on National highway- 6, Nagpur, Maharashtra, India.

II. MATERIALS AND METHODS

Study area

Nagpur is practically at geographical center of India, in fact the zero milestone of India is in this city. All major highways NH-7 (Varanasi - Kanyakumari)& NH-6 (Mumbai - Sambalpur - Kolkata) and major railways trunk route (Mumbai, Chennai, Howrah and Delhi) pass through the city. Nagpur district lies between 21^0 09' North Latitude and 79^0 40' East Longitude. For the present work NH-6 passing through Nagpur was selected as study area.

Collection of samples:

Dust deposited fresh leaves of five plant species like Pongamia pinnata L., Mangifera indica L., Annona squamosa L.,Alstonia scholaris L. and Calotropis procera were collected in the months of October - 2018 to January 2019 from NH-6, Nagpur (M.S.), India from polluted and control area. The leaves from top, middle and basal region of each plant was considered, collected and used for experimental analysis.

Measurement of dust fall on the leaves

Five mature leaves of each sampled plants were collected in a separate polythene bag. The process was repeated for three readings. Average reading was considered for further calculations. The measurement of dust fall was carried out by the method of dry technique (Das and Pattanayak,1977). Zip lock polythene empty bagswere weighed and then dust particulates from leaf surfaces were gently collected with the help of camel hair brush in the bags.The amount of dust deposition in $mg/cm^2$was calculated as per the following formula-

Dust content (mg/cm^2) = (Weight of dust content polythene bag – Weight of empty polythene bag)/Total surface area of leaf (cm^2)

Estimation of chlorophyll

About 1 g of leaf sample was cut in to small pieces and homogenized in a pre-cooled mortar and pestle using 80% (V/V) acetone. A pinch of calcium carbonate was added while grinding. The extract was centrifuged at 3000 rpm for 15 min and made up to 25 ml with 80% (V/V) acetone. The clear solution was transferred to a colorimeter tube and the optical density was measured at 645 nm and 663 nm, against an 80% acetone blank in Spectrophotometer.The chlorophyll content was calculated according to the method of Arnon (1949).

III. RESULTS AND DISCUSSION

The use of plants as monitors of air pollution has long been accepted since plants often are the initial indicators of air pollution. The present studies on the plants growing in roadside area of National Highway 6 at Nagpur, India indicatedthe dust holding capacity and Chrolorophyll spectrum of experimental plants viz. Pongamia pinnata L. (Fabaceae), Mangifera indica L. (Anacardiaceae), Annona squamosa L. (Annonaceae), Alstonia scholaris L. (Apocynaceae) and Calotropis procera (Asclepiadaceae) in control and polluted area. Dust was collected from leaves of experimental plants and dust holding capacity was calculated (Table 1). Chlorophyll a , chlorophyll b and total chlorophyll was recorded for the these plants (Table 2).Calotropis procera have shown maximum dust accumulation and minimum chlorophyll content as compared to other taxa studied. Chlorophyll content was found to be reduced in polluted area. Work on impact of dust pollution on plants is reported by Shukla et al.(2008) in industrial area at Rewa (M.P.), India. A reduction in the photosynthetic pigments of plant leaves growing in higher polluted site as compared to non or less pollutedones (Giri et al.,2013). Rai and Panda studied the dust deposition efficiency of selected road side plant species of Aizawl, Mizoram and the response of dust deposition on the biochemical aspect of leaves such as pH, relative water content and total chlorophyll content.

Dust generated from the different industries cause damages to mango plant (Sandeep et al, 2019). Alstonia, Mangifera indica were found as good dust catchers (Maiti, 1993).Ficus benghalensis, Ficus relisiosa and Azadiracta indica were found very effective and natural means of air pollution (Rahul & Jain, 2016).

Dust arresting capacity of leaves was found to be inthe following order-

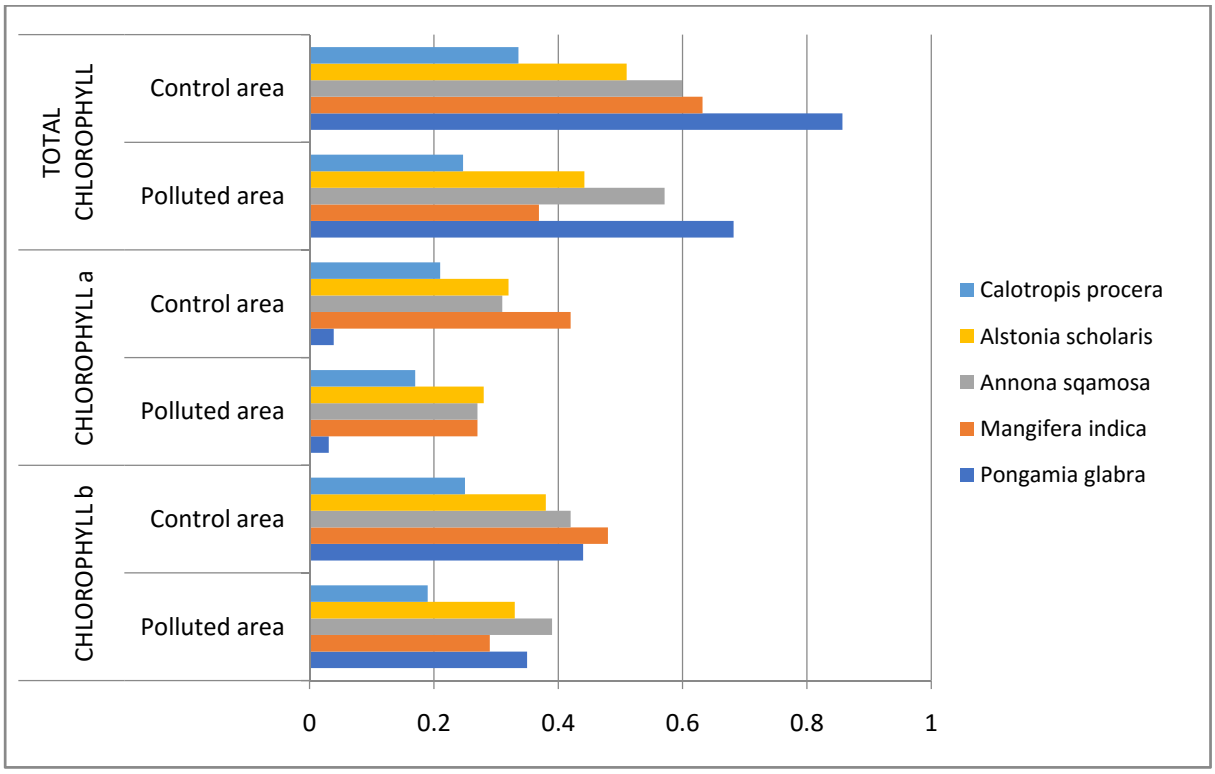
Calotropis procera (0.08& 0.016 mg/cm^2) >Pongamia pinnata L. (0.0090& 0.0076 mg/cm^2) >Alstonia scholaris L. (0.0040 & 0.0031 mg/cm^2) >Mangifera indica L. (0.0038& 0.0030 mg/cm^2), Annona squamosa L. (0.0036 & 0.0029 mg/cm^2). Total chlorophyll content was found to be less affected as compared to its control reading in Annona squamosa followed by Alstonia scholaris ,Calotropis procera , Pongamia glabra and Mangifera indica. Such plants can be recommended for greening alongside roads. The foliage of plants filters several numerous solid particles due to roughness and large contact area. Thus can reduce the damaging effect of particulate pollution (Meusel et al., 1999). Air pollution originating from rapid industrialization, urbanization, Metrolisation, population growth has perturbed the pristine environment of roadside ecosystems. Planting of trees and shrubs for abatement of pollution and improvement of environment is an effective way. In this context role of plants in developing a healthy atmosphere is very crucial. Impact on the plant community has been studied worldwide in terms of plant interactions with the environment, since they are much more sensitive in comparison to other organisms (Abbasi et al. 2004). Plant benefits are well known for various purposes. Apart from routine applications, plants role in combating pollution indirectly as bioindicators and bio accumulators of pollutants like dust is promising. Different plants have different dust arresting capacities hence studies on this aspect should be carried out in various plants growing in polluted areas like industries, urban environment and alongside roads like National highways.

Table 1 :Average Dust captured by leaves (mg/cm ^{2}) in Control and experimental area

Sr. No.	Family of the Plant	Name of the Plant	Control Area	Experimental area
1	Fabaceae	Pongamia pinnata	0.0076	0.0090
2	Anacardiaceae	Mangifera indica	0.0030	0.0038
3	Annonaceae	Annona squamosa	0.0029	0.0036
4	Apocynaceae	Alstonia scholaris	0.0031	0.0040
5	Asclepiadaceae	Calotropis procera	0.08	0.016

Table 2 : Chlorophyll Spectrumat control and polluted sites

	CHLOROPHYLL b		CHLOROPHYLL a		TOTAL CHLOROPHYLL	
	Polluted area	Control area	Polluted area	Control area	Polluted area	Control area
Pongamia glabra	0.35	0.44	0.031	0.039	0.682	0.857
Mangifera indica	0.29	0.48	0.27	0.42	0.369	0.632
Annona sqamosa	0.39	0.42	0.27	0.31	0.571	0.599
Alstonia scholaris	0.33	0.38	0.28	0.32	0.442	0.51
Calotropis procera	0.19	0.25	0.17	0.21	0.247	0.336



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