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Original Research Paper

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ASSESSMENT OF AIR QUALITY INDEX OF ALIRAJPUR DISTRICT ALONG MINING SITE

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ABSTRACT Alirajpur district is situated in western part of Madhya Pradesh. Narmada Rivers make its Eastern and Southern border. Plants show specific response to air pollution and continuous exposed into air and accumulate pollutants and it is confine on their surface. In the present study species were exposed to different air pollution load for short duration. Plants are the sources to monitor air pollution and it is initial receptors of air pollution. In the present study we have select three species namely *Diospyros melanoxyion, Madhuca indica,* and *Eucalyptus Citriodora var. Maculata* Hook. to find out the effect of air pollutants on it which are growing in two different site namely Panwani village (site-1) considered as Low polluted area and khakhari (site-2) considered as high polluted area . In the present study AQI was analyzed 24 hour average conc. of conventional pollutants at two site at noted on year 2017-2018.Three species growing at polluted site showed reduction in size of leaf,no.of stomata and leaf biomass.

KEYWORDS : Air pollution, Alirajpur, Narmada Rivers

INTRODUCTION

Pollution is serious problem today because of rapid growth of industrialization, urbanization and uncontrolled exploitation of natural resources. It has brought many environmental crises by polluting air. Plants show specific response to air pollution. Air pollution affected plant physiological process as well as morphology and anatomy changes in their life cycle are noted. Leaf is directly exposed into sunlight and it is very sensitive part of the plant (Rani *et al.*2016).Air pollution is affected plant growth and productivity and resulting in loss of economy of the world as well as formers and adversely affected it. Plants leaves absorb and accumulated air pollution. Plants leaves are bio-indicator of pollution load of the area and it is convenient sources of environmental monitoring sources. Air pollution blocks stomata; reduce photosynthesis, increase leaf temperature, formation of fruit, leaf growth, chlorosis etc. in this studies we have known impact of air pollution on these trees with various parameters e.g. Fresh weight, Dry weight, L/B ratio, Specific Leaf Area, Dust deposition, Stomatal Size & index, pH, conductivity, Protein content, Enzyme activity, Photosynthetic pigment analysis, Ascorbic acid content are studied.

Study Area:

Alirajpur District was carved out of Jhabua District on 17th May 2008. The distance of Alirajpur from Indore is 220 km. whereas Vadodara is only 150 km. away. Dahod is the nearest railway station, which is connected by road by 70km. A village called Amkhut is considered as Switzerland of M.P. and another village named "Kathiwada" is called 'Cherapunji' of M.P. Alirajpur district lying between 22°18'N latitude and 74°20'E longitude, covers an area of 3182 square kilometers. Mahee and Narmada rivers make its Eastern and Southern border. According to census 2011, Alirajpur population is 728,999. Alirajpur District average Rainfall is 850 mm. Alirajpur District temperatures ranges between 23°- 30°C. Bhagoriya is a special cultural public festival of Alirajpur district.

METHODOLOGY

Alirajpur is tribal District of Madhya Pradesh with having very dense population along with many dolomite industries, thus having large amount of pollution which denotes the ambient air quality. Forest is maintaining the ecological balance and purifies the air. Due to dolomite industries in the area large scale damage and caused air pollution. Large amount of pollutant deteriorate the quality of ambient air/damaging effects of air pollutants on plants have long been recognized. In order to assess air quality of mining site of Alirajpur district, 1st step in this direction to the evolution of ambient air quality which indicate air quality. For this work is undertaken in order to evaluate existing conc. of pollutants in an area and impact of air pollutants on air quality. Two monitoring site were selected for it. At this site sampling is done in 8 hourly average samples were collected for 24 hours in twice a week. SPM (suspended particulate matter), Sulphur dioxide, oxides of nitrogen were monitored during study period. Sampling and analytical procedure followed during this ambient air quality monitoring is based on the procedure laid down in standard method.

Sampling Stations

To study ate air pollution on plants of Alirajpur district was carried out and site was selected on the pollution based availability and trees growing within the quarry site were taken.In the present study we have select three species namely *Diospyros melanoxyion, Madhuca indica,* and *Eucalyptus Citriodora var. Maculata* Hook. to find out the effect of air pollutants on it which are growing in two different site namely Panwani village (site-1) considered as Low polluted area and khakhari (site-2) considered as high polluted area . In the present study AQI was analyzed 24 hour average conc. of conventional pollutants at two sites at noted on year 2017-2018.Control samples were collected 6 kilometers from the study from trees of equal girth with those of the study area. Leaf samples were taken from the lowest branch of each selected tree facing the pollution source. Freshly collected samples were labeled, and placed in sealed poly packs and immediately sent to the laboratory for analysis.

Leaf Area

Mature leaves of selected plant species were sampled in leaf area measurements. Leaves were collected from polluted and low polluted areas. Leaves were kept in polythene bags and brought to laboratory for measurements.

Length/ Breadth Ratio Of Leaf

Length and breadth of leaf parts were measured with the help of thread and measuring scale. Leaf breadth was measured in upper, middle and lower part and average of three was taken as final breadth.

Fresh And Dry Weight Of Leaf

To find out fresh and dry weight of leaves sampling was done in control and both the polluted areas. Leaf samples were collected from the sampling station between 9-10am in Fresh weight and dry weight of the leaves were taken with the help of Digital Pan Balance and leaves were placed in oven at 80°C for 24 hrs.

Structure And Size Of Stomata
Mature leaves of selected plant species were sampled. Number and size of stomata were measured with the help of ocular and stage micrometer. Mature leaves of the plants from polluted as well as low polluted area were plucked and brought to laboratory in polythene bags kept in ice box Leaves were washed for stometal studies.

Stometal Index
Leaves of each species were washed carefully with water and boiled in conc. nitric acid for 2- 3min. Boiled leaves were washed thoroughly with water in watch glass and lower and upper epidermis were peeled. Each epidermal surface was then stained with saffranin, mounted in glycerin on a slide and observed under (10×40) × in a microscope. Observations were taken in upper, middle and lower region of leaf lamina. Three observations were made in each region for upper and lower epidermis. Stometal index was measured after calculating field area using stage and ocular scale. The formula used to calculate stometal index is as follows:
Stometal index = [S/(S+E)] X 100
Where, S = number of stomatal cells per unit area, E = number of epidermal cells per unit area

Dust Deposition
The dust deposited on each leaf was carefully brushed off on a butter paper and weight of leaf dust was measured using electronic balance. Average dust deposition of 10 leaves was then calculated. The obtained amount was divided by the area of leaf and finally deposition was expressed as gcm^{-2}. The average leaf area was determined using manual planimeter.

Leaf wash pH and conductivity
Ten fully mature leaves of each selected plant were plucked carefully from a height of 1 to 2 meters and placed in polythene bags. Samples were brought to laboratory and leaves were washed in separate beakers with 50ml of distilled water and each polythene bag was also washed with distilled water to remove dust remaining inside polythene bags. The pH and conductivity of leaf wash was measured by digital pH meter and conductivity meter.

Stomata Type:
the stometal complex types were observed and recorded following the terminologies of Evert. (Evert,2006)

Stomata size (length and width):
the stomata length and width were measured using Motic microscope software in four replicates for each sample.

Stometal Density:
the stometal density was determined as the number of stomata per square millimeter.

Determination of Biochemical Parameters of Leaf Extracts
Determination of Ascorbic Acid Content (AA)
This was determined according to Bajaj and Kaur (1981) method, using spectrophotometer. One gram of the leaf sample was treated with 4ml of oxalic acid – EDTA extracting solution in a test tube. Then 1 ml of orthophosphoric acid was added followed by 1 ml of 5% H2SO4 and 2 ml of ammonium molybdate, and then 3 ml of water. The solution was allowed to stand for 15 minutes after which the absorbance at 760 nm was measured. The concentration of ascorbic acid was extrapolated from a standard ascorbic acid curve.

Determination of Chlorophyll Content (TCH)
This was determined using the method of Arnon (1949). Exactly 3g of the leaf sample was blended and then extracted with 10 ml of 80% acetone, left for 15 minutes and the liquid portion decanted and centrifuged at 2,500 rpm for 3 minutes. The supernatant was collected and its absorbance measured at 663 nm using spectrophotometer.

Determination of Leaf pH Leaf pH was determined by "direct reading engineering method" (DREM) using a digital pH meter. The leaf extract was made by cold maceration of the leaf with de-ionised water, filtered through an ashless filter and the filtrate used for pH determination. The pH meter was precalibrated before it was used with buffer solution of pH 4 and 9. The pH electrode was carefully dipped into the filtrate in a 10ml beaker. The value displayed on theCrystal Liquid Panel (CLD) was taken as the true pH value. The exercise was done in triplicate and the average of the three readings was used.

Determination of Percentage Relative Water Content (RWC)
This was determined using the method described by Singh (1977) Fresh leaf sample was weighed and recorded as Fresh Mass (FM). It was floated in distilled water inside a closed petri dish at room temperature for 24 hours. At the end of the incubation period, the leaf sample was wiped dry gently with blotted paper and re weighed to obtain the Turgid Mass (TM). It was then placed in a pre- heated oven at 80°C for 48 hours. Thereafter the leaf was weighed to obtain the Dry Mass (DM). The relative water content was calculated using the formula:

$$Rwc = \frac{FM - DM}{TM - DM} \cdot 100$$

Where;
FM = Fresh mass
DM = Dry mass
TM = Turgid mass.

Statistical Analysis :
Analysis of variance (ANOVA) was done using statistical package for social sciences (SPSS) version 20 to check for significance (at $p \leq 0.05$) among the three samples and Duncan multiple test range was used for mean separation. Students' Independent t-test was used to check for significance (at $p \leq 0.05$) between the samples obtained from the control and study area.

RESULT AND DISCUSSION
The present study on three species of growing at the two sites that air pollution causes significant changes in foliar morphology. Considerable reduction in fresh and dry weight of leaves was observed in both the species. More reduction in dry weight of leaf was recording *Eucalyptus* species the other species a pollution site. Marked reduction in leaf area L/B ratio and L/D ratio was recorded in Eucalyptus sps. Due to SPM has reported by Jain & Sreelatha 2006. Size of stomata and stometal index was found to be reduced in both the species growing at polluted site. More reduction is stometal size and index was observed in *Eucalyptus* sps. Reduction in stometal size due to air pollution (Gupta & Ghouse 1986, Salgare & Throat1990, Tiwari 2005) Low stometal frequency has been observed (Datta & Sinharoy 1987, Rani 2006) in response to polluted air. Heavy dust deposition was observed in both the plant species at polluted site. Maximum dust deposition was found in *Madhuca indica,* Deleterious effect of dust on the morphology of leaves as expressed by the reduction is size, necrosis, damaged leaf margin and change of colour (Gunamani 1991) pH of leaf wash and leaf extract was found to be acidic in both the species at polluted site. Conductivity of Leaf wash and extract was more at polluted site. The result clearly indicated entry of noxious gases like Sox and NOx through cuticle and stomata. Thus altering the pH of leaf surface and that of extract, which is highly damaging and is

primary cause of reduction in chlorophyll contents. Total chlorophyll, carotenoid content of both the species were reduced at polluted site, maximum reduction was found in *Madhuca indica*. Reduction in chlorophyll contents due to air pollutants such as SOx, NOx, and CO has been reported by many earlier workers (Tripathi &, Gautam 2007, Joshi & Swami 2009, Pawar et al. 2002). Ambient air quality and air pollution index for different bio-indicator stations studied. Ambient air quality standard taken for calculation of air pollution index 140 $\mu g/m^3$ for SPM, 60 $\mu g/m^3$ for SO_2 and 60 $\mu g/m^3$ for NOx (**Table -1**). Rating scale for indices are given in **Table-2.** Biochemical indicators of different species of different stations are given in **Table-3.** Study of sampling site bio- Parameter is given in **Table-4.**

Table -1: AQI of different stations.

SN	Bio-indicator station	Pollution ($\mu g/m^3$)			API	Load
		SPM	SO_2	NO_x		
1)	S-1	395	19.2	23.9	117.6	Severe
2)	S-2	275	13.7	17.4	82.33	Heavy
3)	S-3	215	15.6	19.1	70.0	Moderate

Table-2: Rating Scale For Indices

SN	Index value	Air pollution
1.	0-25	Clean
2.	26-50	Light
3.	51-75	Moderate
4.	76-100	Heavy
5.	>100	Severe

Table-3: Biochemical Indicators Of Three Species At Different Bio-indicator Stations

Species	Site	Chl.	Protein	Sugar	Amino acid	Ascorbic acid	NR (μ mole NO_2 formed g^{-1} FW hr^{-1})	SOD	Px (change in OD/30 sec./g
	(mg/g)	(mg/g)	(mg/g)	(mg/g)	(mg/g)	(mg/g)			
Diospyros melanoxyion,	Control	8.1	18.1	16.0	6.1	3.7	3.0	82.0	1.0
	S-1	7.8	17.7	13.2	8.1	6.2	3.9	99.1	1.2
	S-2	9.2	18.0	14.9	5.8	5.2	3.1	85.2	1.4
	S-3	8.8	18.8	14.9	5.9	5.1	4.0	59.1	1.5
Madhuca indica,	Control	9.8	13.8	10.8	3.1	2.3	2.0	57.9	0.2
	S-1	3.2	9.0	6.0	4.7	3.9	3.1	62.1	0.4
	S-2	6.3	9.9	8.0	4.5	2.4	2.1	59.9	0.3
	S-3	8.0	10.2	9.0	3.5	2.9	3.0	61.9	0.2
Eucalyptus Citriodora var. Maculata Hook.	Control	8.5	27.5	14.0	8.5	4.8	4.0	79.1	0.6
	S-1	6.6	29.1	12.0	9.7	6.2	6.1	88.1	0.7
	S-2	7.3	27.9	13.1	9.2	5.9	5.1	86.1	0.8
	S-3	8.2	31.1	11.9	8.9	6.1	4.9	83.1	0.7

Data represent mean of four replicates. Results are significant at 0.1 % ($p<0.001$)

Table-4: Parameter Study Of Sampling Site

Sn	Parameters	Diospyros melanoxyion,		Madhuca indica,		Eucalyptus Citriodora var. Maculata Hook.	
		Site-1	Site-2	Site-1	Site-2	Site-1	Site-2
1.	Fresh leaves weight	71.1±0.4	64.2±0.4	51.2±0.6	42.8±0.3	49.7±0.1	0.2
2.	Dry weight of leaves	31.0±0.2	29.6±0.2	18.2±0.3	16.2±0.6	16.2±0.1	14.1±0.04
3.	Leaf area	1640±5.1	1090±0.6	1211±9.2	690±4.2	1080±7.8	687±3.5
4.	L/B Ratio	110±0.8	88±0.4	102±0.5	66±0.2	100±0.2	64±0.1
5.	L/D Ratio	6312±24.1	5080±22.6	4816±21.1	3102±24.1	4614±19.5	3094±22.4
6.	Stomata size	100.2	73.0	99.1	69.5	97.927.8	67.9
7.	Stometal index upper surface	33.6	21.0	29.2	20.1	27.5	18.5
8.	Stometal index lower surface	35.2	23.1	31.2	19.2	29.2	17.4

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