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Effect of dolomite mining on physiology of selected trees at Alirajpur (M.P.), India

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Abstract

An extensive study assessed to find out Air pollution tolerance index standards of ten plant species growing around Alirajpur block of Madhya Pradesh, India by assessing some physiological and biochemical properties of plants. It is recognize the plant species that are forbearing to grown up in dolomite mining areas of Alirajpur district. Three plant species air pollution tolerance index (APTI) is high in unpolluted area and it is decreased in polluted area **I.** *Annona squamosa* L. 16.9 and 12.945; **II.** *Syzygium cumini* (L.) Skeels 14.30 and 12.33 **III.** *Holoptelea integrifolia* Roxb. 14.0 and 10.2. six plants APTI is less in unpolluted area and it is increased in polluted area **I.** *Albizia lebbeck* (L.) Benth. 11.62 and 11.88; **II.** *Azadirachta indica* Juss. 10.28 and 12.234; **III.** *Ficus benghalensis* L. 13.54 and 41.094; **IV.** *Mangifera indica* L. 9.77 and 12.934; **V.** *Tamarindus indica* L. 31.50 and 13.688; **VI.** *Ziziphus jujube* Mill. 5.119 and 39.25**.** *Albizia odoratissimma* (L.) Benth plant APTI is almost equal in unpolluted and polluted areas.with.12.0 and 11.9. The evaluated APTI for the studied plants at control site the range of 5.119 -31.506 and polluted site are in 10.2-41.0984 respectively.

Key words: Air pollution tolerance index, Alirajpur, Dolomite, Ascorbic acid, Relative Water Content, Leaf extract pH, Total Chlorophyll Content.

Introduction

Mining is an economic activity that withdraws resources from nature. The natural resource capital is nothing but the various ecological services that we derive from nature and our surroundings. In the process of mineral extraction, mining causes massive damage to the landscape and biological communities. The Alirajpur district of Madhya Pradesh India is bestowed with rich natural vegetation as well as large reserve of mineral resources.

Air pollution is a global phenomenon arising out of the unsustainable unplanned and rapid development. Air quality is deteriorating today due to various gas concentration is rising I the atmosphere. Now a day there is no system developed to completely eliminated air pollutants but nature have many system to deal with harmful results of different anthropogenic activity up t certain limit. Plant that is survives well act as pollution scavenger and act as sink and filter to minimize pollution by their physiological processes and improving air quality. The plants which can withstand higher pollutant concentration can serve as tolerant species and may be suggested to act as pollution scavengers (Sharma et.al. 2017).about 80% of cities violate the air pollution regulation standards in India (CPCB 2014).In 2009 CPCB found that 43 out of 88 industrial areas were critically polluted in India. The aim of this study was to assess the Effect of dolomite mining on physiology of selected trees at Alirajpur (M. P.), India by examining the biochemical and physiological parameters viz. chlorophyll, ascorbic acid, pH, relative water content of selected trees. The impacts of air pollution on ascorbic acid content (Hoque et. al. 2007), chlorophyll content (Flowers et. al. 2007), and leaf extract pH (Klump et. al. 2000) and RWC (Rao, 1979) has extensively studied.

Study area

In the state Madhya Pradesh, district Alirajpur is one of the most important agricultural district having 3 tehsils, 6 blocks and 551 villages. Alirajpur district lays on the geographical coordinates of $22^0$18' N and 74^0 21' E. covers an area of 3182 square kilometers. Topography of area included extremely hilly area comprising number of parallel ranges rising abruptly from the level ground. The area is undulating with a number of small hillocks rising 10 to 30 m. above the surrounding place. The highest point here is 1430 ft. above Seed level. The soil is sandy in nature, yellow brown in colour, acidic in reaction, low water holding capacity and has low organic matter and nutrients. Mahee and Narmada rivers make its Eastern and Southern border. According to census 2011, Alirajpur population is 728,999. Alirajpur District average Rainfall is 912.8 mm. Alirajpur District temperatures ranges between 23^0- 30^0C.the average annual temperature is 26.4^0c.may is the warmest month of the year and January is the coldest month of year.

Methodology

a. **Sampling and its analysis:** ten plants are selected and collected from mining and unmining site. Five relpicants of plants are collected and brought to laboratory for analysis. Then immediately fresh weight is taken and for other studies it is stored in refrigerator.

b. **Determination of Air pollution tolerance index (APTI):** It determine by using method and formula describe by Singh and Rao (19683).APTI=A(T+P)+R/10
A=ascorbic acid content (mg/g),T=total chlorophyll (mg/g),P=Leaf extract pH,R=Relative water content %.

c. **Ascorbic acid:** It determine by using method describe by Anne Marie Helmenstine (2018).
20 ml sample solution pippetted into 250 ml of conical flask and then150ml of distilled water and 1ml of starch indicator is added then titrated with 0.005 Mol/L iodine solutions. In the end point dark blue colour is occurred due to starch-iodine complex. Repeated it until concordant result is obtained. Ascorbic acid is calculated in the sample of leaf in mg/100ml.

d. **Total chlorophyll content:** It determine by using method describe by Arnon(1949). Fresh leaves of 3g blended and extracted with 10ml of 80% acetone and leaf it for 15 minutes for thorough extraction and centrifuge for 3 minute on 25000rpm and suspended collected and absorbance taken at 645nm and 663nm.for concentration of chlorophyll 'a' and chlorophyll 'b'(mg/g-fresh leaf) estimate is done by Maclachlan and Yentsch (2013) formula.
chlorophyll 'a' =12.7 X O.D.663-2.69 X O.D.645
chlorophyll 'b'=22.9 X O.D.645-4.68 X O.D.663
Total chlorophyll content a+b=8.02 XO.D.663+20.2X O.D.645

e. **Leaf extract pH:** It determine by using method describe by Agbaire and Esief (2009) .5gms fresh leaves homogenized with 10 ml deionized water then filtered and pH is determine with buffer solution of pH 4.

f. **Relative water content (RWC):** It determine by using method describe by Singh1997.It is determine by fallowing formula
RWC=FW-DW/TW-DW X100.
Where FW=Fresh weight; DW= Dry weight; TW=turgid weight.
Fresh weight of leaves is noted by weighing of them then dried in 70^0C for overnight then taken dry weight. Leaves are immersed in water overnight, blotted dry and then weighed to obtain the turgid weight.

Results and discussion

The analysis value of all parameters carried out on ten plant species collected from two selected sites namely Aambhua and Kund villages of Alirajpur district of Madhya Pradesh. Aambhua is non mining site which is called control and Kund is mining site. The data are presented in table-2 and figure-2 showing the graphical representation of air pollution tolerance index (APTI) of samples collected from site I namely Aambhua and site-II namely Kund village of Alirajpur district. Chlorophyll pigments (CP) exist in highly organized state and may undergo several photochemical reactions under any stress induced such as oxidation, reduction, pheophytinisation and reversible bleaching. Hence any alteration in chlorophyll concentration may change the morphological, physiological and biochemical behavior of the plant.

In the following three plant species air pollution tolerance index (APTI) is high in unpolluted area and it is decreased in polluted area **I.** *Annona squamosa* L. 16.9 and 12.945; **II.** *Syzygium cumini* (L.) Skeels 14.30 and 12.33 **III.** *Holoptelea integrifolia* Roxb. 14.0 and 10.2.

In the following six plants APTI is less in unpolluted area and it is increased in polluted area **I.** *Albizia lebbeck* (L.) Benth. 11.62 and 11.88; **II.** *Azadirachta indica* Juss. 10.28 and 12.234; **III.** *Ficus benghalensis* L. 13.54 and 41.094; **IV.** *Mangifera indica* L. 9.77 and 12.934; **V.** *Tamarindus indica* L. 31.50 and 13.688; **VI.** *Ziziphus jujube* Mill. 5.119 and 39.25.

In the following plant APTI is almost equal in unpolluted and polluted areas. **I.** *Albizia odoratissimma* (L.) Benth.12.0 and 11.9. The evaluated APTI for the studied plants at control site the range of 5.119 -31.506 and polluted site are in 10.2-41.0984 respectively.

In three plant species studied APTI are decreases at polluted site indicating that they are under going to the pollution stress. Six species has shown an increase in their APTI, where as in one plant there is not much change as stated in the results. Therefore, the result indicates that these seven species may be more tolerable to the stress caused by mining dust pollution.

Conclusion

APTI is increased and percentage of APTI is also high, these are highly suggestible to develop the green belts. Mining area generally records significant dust fall effecting plant health..The indiscriminate and unscientific mining, absence of post-mining treatment and management of mined areas are making the fragile ecosystems more vulnerable to environmental degradation hence leading to large scale land cover/ land use changes.

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Table-1: APTI parameters studies in mining and non mining areas

S.N.	Species	Family	CONTROL					POLLUTED				
			AA	TCH	pH	RWC	APTI	AA	TCH	pH	RWC	APTI
1.	*Albizia lebbeck (L.) Benth.*	Leguminosae	7.25	0.31	6.8	64.71	11.62	5.6	0.76	6.9	75.4	11.884
2.	*Annona squamosa L.*	Annonaceae	10.2	0.49	6.4	90.63	16.09	6.8	0.38	6.1	85.3	12.945
3.	*Azadirachta indica A.Juss.*	Meliaceae	3.44	0.73	6.3	78.85	10.28	5.6	0.92	7.5	74.6	12.234
4.	*Ficus benghalensis L.*	Moraceae	5.2	0.86	7.5	91.93	13.54	38.9	0.62	7.6	91.1	41.094
5.	*Mangifera indica* L.	Anacardiaceae	5.42	0.46	6.1	62.2	9.77	4.8	0.46	6.3	96.9	12.934
6.	*Syzygium cumini (L.) Skeels*	Myrtaceae	6.36	1.87	6.3	91.04	14.30	4.2	1.44	6.4	90.4	12.332
7.	*Tamarindus indica L.*	Leguminosae	62.7	0.3	3.5	76.8	31.50	9.2	0.37	5.9	79.2	13.688
8.	*Holoptelea integrifolia Roxb.*	Ulmaceae	5.1	0.79	7.1	98.02	14	3.44	0.74	7	75.7	10.2
9.	*Albizia odoratissimma (L.) Ben.*	Leguminosae	7.24	0.29	6.7	65.72	12	5.65	0.74	6.8	76.5	11.9
10.	*Ziziphus jujube Mill.*	Rhamnaceae	5.4	0.45	5.9	16.9	5.119	37.8	0.6	7.4	90.1	39.25

Abbreviation: AA=Ascorbic acid content; TCH= Total Chlorophyll Content RWC= Relative Water Content; APTI= Air pollution tolerance index

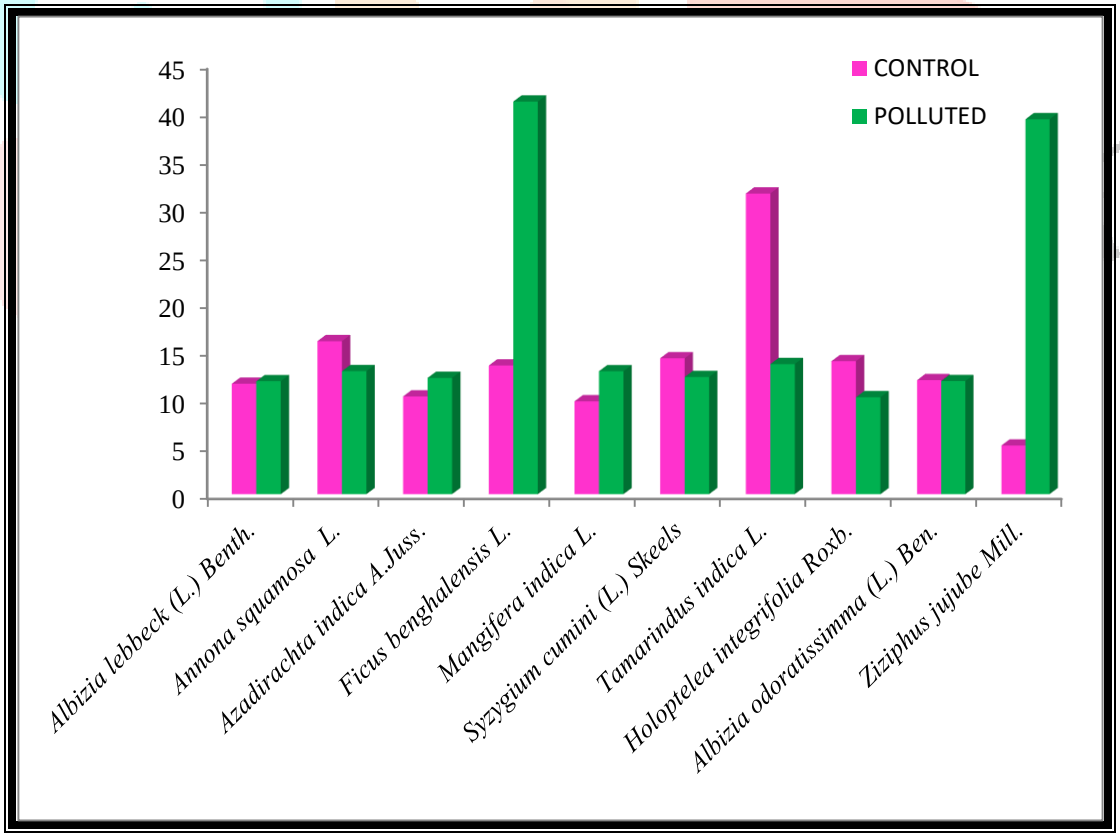

Figure-1: Graphical representation of APTI of sample collected from site-I and site- II