

## Effect of air pollution on leaf venation pattern of some tree species at Satna, Madhya Pradesh, India

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### Abstract

The automobile emissions constitute a major source of environmental pollution in Indian cities. Effect of urban air pollution on road side tree species *Mangifera indica* Linn., *Azadirachta indica* A. juss., *Polyalthia longifolia* Benth. et Hook. F. and *Cassia siamea* Linn. has been studied with special reference to venation pattern of leaves. Effect of air pollution on leaf venation pattern observed at two sampling sites (reference and polluted). The qualitative parameters like primary vein type, course of primary vein, course of secondary veins, inter-secondary vein, marginal ultimate venation, areoles shape, pattern of tertiary veins and type of venation pattern and the quantitative parameters such as length of primary vein in mm, no. of secondary veins along one side of primary, highest degree of vein order, no. of areoles /mm<sup>2</sup>, average size of areoles and absolute veinlets no. in 1000 were examined. The study shows that leaf venation pattern of tree species growing in polluted area were not much affected by air pollution.

**Keywords:** air pollution, venation pattern, environmental pollution, quantitative parameters, tree species

### 1. Introduction

Industrialization and the automobiles are responsible for maximum amount of air pollutants. Plants being constantly exposed to polluted environment absorb and accumulate pollutants, impinging on their leaf surface. Damaging effects of air pollutants on plants have long been recognized.

In urban environments, trees play an important role in improving air quality by taking up gases and particles (Woo and Je, 2006) <sup>[1]</sup>. Plants when exposed to air borne pollutants, most plants experienced physiological changes before exhibiting visible damage to leaves (Liu and Ding, 2008) <sup>[2]</sup>. Each plant leaves show a specific venation pattern. The remarkable diversity in the leaf venation pattern of plants has attracted the attention of researchers. We studied the effect of air pollution from vehicle exhaust combined with the pollution generated by the human activities, on leaf morphology and venation pattern both qualitatively and quantitatively. Plants *Mangifera indica* Linn., *Azadirachta indica* A. juss., *Polyalthia longifolia* Benth et Hook F. and *Cassia siamea* Linn. were observed. These plants were chosen because they are common and can be found in different polluted sites.

### 2. Material and Methods

Satna is located at 24.34°N 80.55°E with an average elevation of 317 meters (1033 feet). The location is renowned for dolomite mines and limestone. Satna, is smallest commercial city of Madhya Pradesh is credited to have very dense population and heavy vehicular density. Thus having large amount of pollutants which detenate the quality of ambient air.

The study was conducted at two sampling sites. Site-1 includes Civil Line and Peptech colony. It has been considered as reference area/non polluted area (NPA) as in this area there is very low traffic. Site-2 Govt. Girls College road and Semaria Chowk, which is a major polluted area of

Satna city, so the Site -2 has been considered as polluted area (PA).

### Collection of leaf sample

During study period (January 2016 - May 2016) leaf samples of selected plants were collected randomly from both the sampling sites. We collected 5 leaves from the central part of each plant. Only fresh leaves were used in this study.

The leaves were cleared by the procedure (Rao, *et al.* 1980) <sup>[3]</sup>. Following qualitative and quantitative parameters related to leaf venation pattern were worked out. The qualitative parameters such as, primary vein type, course of primary vein, course of secondary veins, inter secondary vein, marginal ultimate venation, areoles shape, pattern of tertiary veins and type of venation pattern were observed. Quantitative parameters such as no. of secondary veins along one side of primary vein, highest degree of vein order, no. of areoles /mm<sup>2</sup>, length of primary vein in mm., average size of areoles and absolute vein lets no. in 1000 were examined in cleared and stained sample leaves.

### 3. Results and Discussion

The present study shows that the course of primary vein is straight unbranched, inter secondary vein is present simple and pattern of tertiary vein is orthogonal reticulate in all investigated plants leaves.

Course of secondary veins is straight looped, marginal ultimate venation is looped and venation pattern is Brochidocampitromous in leaves of *Mangifera indica* (Linn.), *Polyalthia longifolia* (Benth.et Hook F.) and *Cassia siamea* (Linn.). In *Azadirachta indica* course of secondary veins is straight, marginal ultimate venation is incomplete and venation pattern is craspendrodromous. Primary vein type is moderate in *Polyalthia longifolia* and *Cassia siamea* but it is stout in *Mangifera indica* (Linn.) and massive in *Azadirachta indica*. Qualitative parameters were found similar both in

polluted and reference area (Table 1). Thus the qualitative parameters of leaf venation do not affected by air pollutant. Table 2 represents the quantitative parameters of leaf venation pattern of investigated plants growing at polluted site and reference site. In observation table the length of primary vein in mm, no. of secondary veins along one side of primary and absolute vein lets no. in 1000 were reduced in all observed plant species at polluted site. Significant reduction in length and area of leaflets in *Cassia* polluted plants has also been reported by Tiwari *et al.* (2008) [4]. Reduction in leaf area of *Cassia siamea*, *Azadirachta indica* and *Dalbergia sissoo* due to air pollutant has been reported by Jain and Sreelatha (2006) [5]. Similar observations also have been reported by Shweta Tiwari (2012) [6]. Reduction in leaf area due to air pollution was reported in *Mangifera indica*, *Azadirachta indica* and *Cassia siamea* by Pathak and Pancholi (2014) [7]. The qualitative parameters and some quantitative parameters

such as, number. and size of areoles and highest degree of vein order were found similar in both polluted and non-polluted leaves of all observed plants species (Fig. 1(a) to Fig. 3(b)). Thus in general significant difference in venation pattern is not observed in selected leaves from NPA and PA. It might be due to high tolerance power against air pollution in plants (Jyothi and Jaya, 2010) [8]. It also reported by Das and Prasad (2010) [9] that *Mangifera indica* and *Azadirachta indica* are the air pollution tolerant species. In present study, effect of air pollution not observed on leaf venation pattern of selected plant species, which also supported by Sachs (2008) [10]. He reported that the growth hormone auxin has an enormous effect on the venation pattern. Furthermore, it has been also found about mutations that affect the auxin transport lead to strongly modified venation patterns (Laguna, *et al.* 2008; Mahankale and Arorei, 2012; Khamparia and Chatterjee, 2014; Narwaria and Kushwaha, 2012 and Shrivastava, *et al.* 2013) [11-15].

**Table 1:** Effect of air pollution on qualitative parameters of leaf

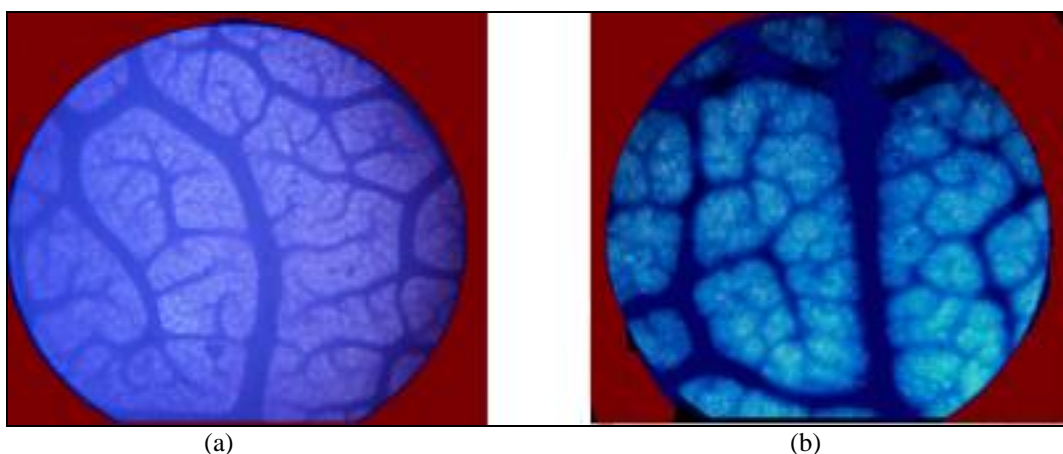
S. No.	Name of plant	Course of primary vein	Primary vein type	Course of secondary vein	Inter secondary vein	Marginal ultimate venation	Areoles shape	Pattern of tertiary vein	Venation pattern
		R & P*	R & P*	R & P*	R & P*	R & P*	R & P*	R & P*	R & P*
1.	<i>Mangifera indica</i>	Straight unbranched	Stout	Straight looped	Present simple	Looped	Irregular	Orthogonal reticulate	Brochido-camptodromous
2.	<i>Azadirachta indica</i>	Straight unbranched	Massive	Straight	Present simple	Incomplete	Irregular	Orthogonal reticulate	Craspen-drodromous
3.	<i>Polyalthia longifolia</i>	Straight unbranched	Moderate	Straight looped	Present simple	Looped	Quadr-angular	Orthogonal reticulate	Brochido-camptodromous
4.	<i>Cassia siamea</i>	Straight unbranched	Moderate	straight looped	Present simple	Looped	Penta-polygonal	Orthogonal reticulate	Brochido-camptodromous

R=Reference area, P\*=Polluted area, same as in R

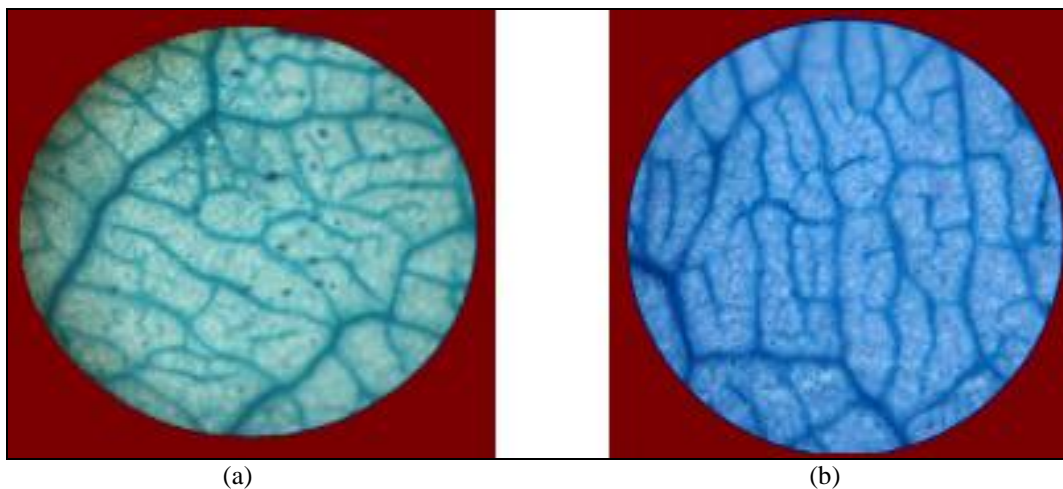
**Table 2:** Effect of air pollution on quantitative parameters of leaf (Average reading of leaves in both areas)

S. No.	Name of plant	Length of primary		No. of secondary vein along one side of primary		Highest degree of vein order		No. of areoles / mm <sup>2</sup>		Average size of areoles		Absolute vein lets no. in 10000	
		R	P	R	P	R	P	R	P	R	P	R	P
		1.	<i>Mangifera indica</i>	148.2 ±3.5	142.8 ±2.2	20 ±1.5	18.8 ±1.3	6 ±0	6±0	2±0	2±0	0.5±0	0.5±0
2.	<i>Azadirachta indica</i>	59.02 ±2.55	52.82 ±2.6	14.6 ±1.14	13.8 ±1.09	7±0	7±0	2±0	2±0	0.5±0	0.5±0	2.06 ±1.06	1.16 ±0.096
3.	<i>Polyalthia longifolia</i>	187.7 ±4.32	184.7 ±5.4	20.6 ±0.89	20.2 ±0.83	5±0	5±0	2±0	2±0	0.5±0	0.5±0	9.63 ±0.098	9.61 ±0.19
4.	<i>Cassia siamea</i>	59.82 ±1.70	59.32 ±1.70	13.8 ±1.64	12 ±1.87	5±0	5±0	2±0	2±0	0.5±0	0.5±0	5.43 ±0.23	4.95 ±0.21

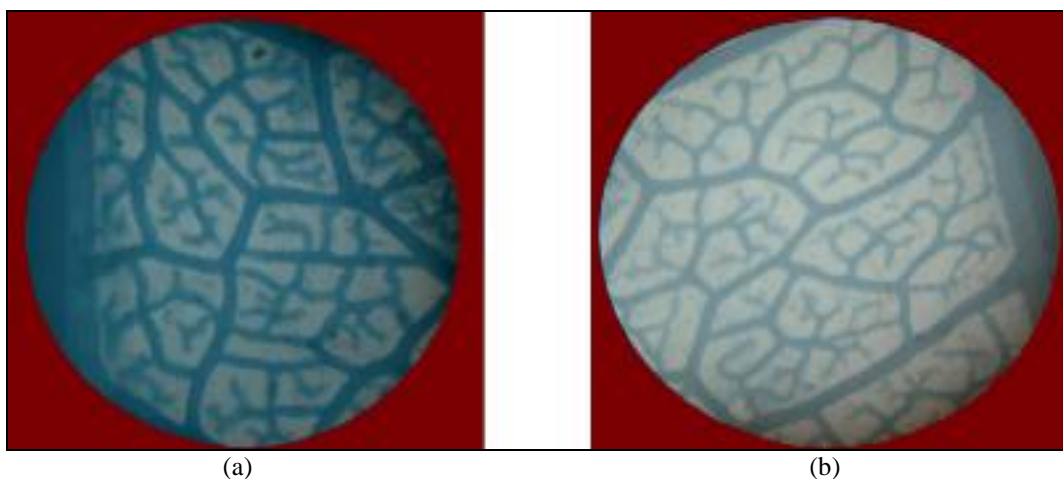
R=Reference area, P=Polluted area



**Fig 1:** Areoles of *Mangifera indica* in (a) non-polluted and (b) polluted leaf (10 X 10)



**Fig 2:** Areoles of *Azadirachta indica* in (a) non-polluted and (b) polluted leaf (10 X 10)



**Fig 3:** Areoles of *Cassia indica* in (a) non-polluted and (b) polluted leaf (10 X 10)

#### 4. Conclusion

In this work, we focused on effect of air pollution on leaf venation pattern of *Mangifera indica*, *Azadirachta indica*, *Polyalthia longifolia* and *Cassia siamea* and concluded that the leaf venation pattern of these plants species is not affected by air pollution, so far as qualitative and some quantitative parameters are concerned. Probably this is due to the fact is that the leaf venation pattern genetically controlled.

However some quantitative parameters such as; length of primary vein in mm., no. of secondary veins along one side of primary and absolute veinelt no. in 1000 were found to be reduced in polluted site samples. Thus the air pollution affects leaf architecture upon some extent quantitatively.

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