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Research Article
Dust Pollution Affect Morphophysiological traits of Plant *Mangifera indica* Linn.

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Abstract

Background and Objective: Many air pollutants seriously affect morphological traits of the plant. Dust is the major and important part of air pollutants, generated by coal mines, thermal power plants, cement industries, cursor industries, road transport etc. When this dust comes with contact with the plants it cause many negative effects on morphology and physiology of the plant. **Materials and Methods:** In this study, dust deposition on the leaves decrease the productivity e.g., chloroplast content, stomatal blockage etc. Korba is the industrial city of the Chhattisgarh state. Many coal based power plant and coal mines are situated here which produced plenty of dust. In this study three parameter have been taken e.g., dust load, leaf area and pH of leaf wash and tried to understand effect of dust on *Mangifera indica*, the Mango plant. **Results:** In this study four different sites have been selected where thermal power plants and coal mining produce plenty of dust and ash particles. Leaves collected from the Korba, which is mining area are suffering badly from dust stress. **Conclusion:** During the study we observed that leaves of the *Mangifera indica* have been damaged morphologically and physiologically due to the dust. Dust load and high pH cause physical injury, necrosis, stomata blockage, reduce photosynthesis etc. Dust pollution decreases the economical and nutritional value of the Mango.

Key words: *Mangifera indica*, pollutants, dust load, stomatal blockage, morphological traits

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Along with development industrialization brings many environmental problems and pollution. Air pollution produced by industries contains dust as major part and this dust particles pose serious threat to the living being. In India there are up to 35% of dust present in air pollutants . Coal mines, coal based power plants, road transport, cement industries and stone crushers release huge quantity of dust particles in to the atmosphere. In current scenario of large scale deforestation, destruction of biota and other ecosystem components are being attributed to be the effect of dust pollution[1]. When the air current passes through a tree, some portion of the dust particle adhere to the upper and lower portion of the leaves, some of these are bounced back or deposited elsewhere depending upon the size and character of the particle, wind velocity and the surface area of deposition[2]. After deposition dust particles stick to the leaf surfaces till they get washed off. Very fine dust particle enters through stomatal pores and deposit in to sub-stomatal cavity. Dust on leaves blocks stomata and lowers their conductance to CO_2, simultaneously interfering with photo[3] system II. Dust particles pose physical and chemical effects on the plants. Dust pollution also causes leaf chlorosis due to its effect on chlorophyll biosynthesis[4]. Chukwu[5] studied the impact of cement dust on *Chromolaena odorata* and *Manihot esculenta* around a cement factory in Nigeria and reported that the weather conditions and location of plants from the source of dust emission influenced the distribution of the dust. Rai and Panda[6] studied the dust deposition efficiency of selected common roadside 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. The smaller size of dust particles cause more damage. Effect of air pollutants especially industrial gases have been studied widely by many workers but effect of dust particles on plants have not gained proper attention. Therefore, it tried to understand the effect of dust particles on Mango plant.

Mango, (*Mangifera indica* Linn.) is member of family Anacardiaceae and one of the most important and widely cultivated tree in the India. Mangoes are rich source of vitamins A, C and D. This evergreen tree is planted on road side for shade and fruits. The plants reach height of 15-18 m and survive for several years. The plant is important part of the religious ceremonies and customs in India.

MATERIALS AND METHODS

Study area: Korba is the industrial hub and power capital of Chhattisgarh state was accorded the status of a full-fledged revenue district on 25th May, 1998 covering an area of 7,14,544 ha and located an altitude of 304.8 m above the sea level. Korba experiences a hot, arid temperate climate and receives an average 1506.7 mm rainfall annually. Korba is situated in the north of Chhattisgarh and lies 22°01-23°01 latitude and 82°09-83° longitude. Korba is one of the most polluted city in the country and ranked 5th in the "critically polluted area" (Report of CPCB 2017).

Major dust producing industries in the Korba district:

- **Thermal power plant:** The CSEB west, CSEB east, DSPM, NTPC, Lanco-Amarkantak, Balco
- **Coal mines:** The SECL (Korba, Kusmunda, Gevra, Dipka open cast coal mines)

Sample site: For the study four site have been selected:

- **Korba:** Korba is the headquarter of the district. Sample were collected from SECL Korba residential colony
- **Kusmunda:** Kusmunda is an other coal mine area situated 10 km far from Korba. Sample were collected from SECL Kusmunda residential colony
- **NTPC:** National Thermal Power Plant is one of the biggest thermal plant of the district generating about 2100 MW electricity
- **Satrenga:** Satrenga is situated about 36 km far from the Korba and one of the most popular picnic spot of the district. Satrenga is considered as non polluted area therefore, it selected this site to compare with above three site

In month of April, 25-25 leaves from road side Mango tree of each site were collected from the height of 3 m. After the collection of leaves weight of the leaves was taken then leaves were washed with distilled water and wiped with dry and clean cotton cloth, after drying 30 min in the shade under the fan they were weighed again, dust weight was determined by decreasing weight of leaves. The pH of the solution obtained from washing of the leaves were determined by the ELICO table top pH meter. Leaf area of leaves determined by graph plot method[7].

RESULTS AND DISCUSSION

The Table 1 showed that leaves collected from Korba have maximum weight loss after washing due to deposition of

Table 1: Dust load on the leaves (total weight of 25 leaves)

Sample sites	Weight of leaves (g)	Weight of leaves after wash (g)	Difference in weight/dust load (g)
Korba	98	73	25
Kusmunda	94	74	20
NTPC	88	76	12
Satrenga	84	81	03

Table 2: Average leaf area of the collected leaves

Sample sites	Leaf area (cm^2)	Percentage reduction from non-polluted site e.g., Satrenga
Korba	37.94	33.11
Kusmunda	41.41	26.99
NTPC	46.33	18.31
Satrenga	56.72	00.00

Table 3: pH of dust water obtained from washing of leaves

Samples	pH
Korba	8.1
Kusmunda	8.0
NTPC	7.9
Satrenga	7.5

plenty of dust particle. Dust particles weight on leaves collected from Korba is 25 g which is due to coal dust comes from near by coal mines. Almost similar result were reported from Kusmunda. In NTPC thermal power plant fly ash and other particle released at height through Chimneys, hence its effect on leaves is less compare to Korba and Kusmunda. Satrenga which is almost non polluted area have very less amount of dust particles in air therefore weight of dust on leaves collected from Satrenga is only 03 g. On other hand after washing leaves of Satrenga have maximum weight e.g., 81 g it means biomass and productivity of the leaves are much more than other three sites. Dust load on leaves cause mechanical injuries and increase susceptibility for pathogens, necrosis, blockage of stomata, increase leaf surface temperature, reduced fruit setting[8], suppression of fruit production[9], inhibit pollen germination[10], slow down the gaseous exchange[11], interrupt light absorption and slow down photosynthesis[8].

When we determine the leaf area of leaves collected from different sites, average leaf area of Satrenga is maximum (56.75 cm^2). Satrenga is non polluted area so, leaf shows maximum growth and expansion. Minimum leaf area reported in leaves of Korba (37.94 cm^2) which is 33.11% less than Satrenga leaves (Table 2). Polluted area's leaves showed curling, folding, necrosis etc., due to dust so, leaf area becomes less, similar result was observed by Singh and Kant[12], Kamalakar[13]. Srivastava and Kumar[14] and Krishnamurthy *et al.*[15] revealed retarded growth and reduced leaf due to emission of pollutants.

Leaves collected from the sites were washed with distilled water and pH test was done for the solution obtained after washing. Leaf wash solution obtained from Korba's leaves is weak base (8.1) whereas solution obtained from Satrenga's leaves is very slightly base or near to neutral (7.5) (Table 3). Leaf dust reacts with moisture and releases Ca(OH)2 (highly alkaline). This enters through stomata and injures the cell and causes partial denaturation of chloroplast and subsequent decrease in pigments in the cells of damaged leaves[16]. Mango plant showed optimum growth in range of 4.5-7.0 pH. Many study showed that as the pH of water goes up, the rate of growth for the plant goes down.

CONCLUSION

The study shows that dust generated from the different industries cause damages on Mango plant. Leaves are most suitable organ of the plant to hold the dust on its upper and lower surface. Dust holding capacity of any leaf determined by its size, orientation and arrangement. Simple leaf holds more dust than compound leaf. Dust has physical and chemical properties, it may produce necrotic spotting. In presence of moisture, it solidifies into hard adherent crust, which can damage plant tissue and restrict growth . Mango is sensitive to dust pollution thus, dust pollution decreases the economic and nutritional value of the crop.

SIGNIFICANCE STATEMENT

This study discover the effect and stress of coal mines dust on the leaves of road side plants and represent the common morphological deformities, that can be beneficial for the horticultural and agricultural research . This study will help the researcher to uncover the critical areas of plant morphology and plant physiology and how the coal dust effects the productivity of the plants, that many researchers were not able to explore. Thus a new theory on plant health, its productivity may be arrived at.

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