International Journal of Research in Medical and Basic Sciences
Volume 5 Issue 3, March 2019 ISSN: 2455-2569 Impact Factor: 4.457
Journal Homepage: http://mbsresearch.com, Email: mbsresearchp@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal

EVALUATION OF LEAF DUST ACCUMULATION ON SELECTED PLANTS GROWING IN POLLUTED AND NON-POLLUTED AREAS OF KURUKSHETRA DISTRICT, HARYANA, INDIA

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Abstract

Air pollution, caused by vehicular emissions, industrialization, and population growth, increases harmful gases like Sulphur dioxide, carbon dioxide, and carbon monoxide, harming vegetation, animals, and humans. Plants can effectively monitor air pollution as their leaves act as absorbent and provide large surface area for the absorption of particulate matter. A study in Kurukshetra, Haryana, analysed leaf dust accumulation in various plant species to map particulate matter pollution. Results showed that *Dalbergia sisso*, *Ficus benghalensis*, *Ficus religiosa*, and *Azadirachta indica* leaves had higher dust accumulation in polluted sites compared to control sites.

INTRODUCTION

Rapid deterioration of ambient air quality has been witnessed over the years due to economic growth, higher industrialization and consistent population rise. Automobile emissions contribute about 57-75% of total emissions in urban areas (WHO, 2006). It has been reported that rural areas have low pollutants level than the metros (Lagerwerff and Specht, 1970; Sawidis et al., 1995, 2001). Metro cities in India exhibit quite similar scenario, where emissions from vehicles account for 30-40% of NOx, 10% of SO_2, 70% of CO, 50% of HC's and 30% of SPM of total air pollutant emissions, a massive 2/3rd proportion of which is contributed by two-wheelers (Longhurst and Brebbia, 2012).

Pollutants commonly found in dust on the roads can be potentially harmful to roadside vegetation, wildlife and the neighbouring human settlements. Plants can be effectively used for monitoring air pollutants as different plant species respond to different types of air pollutants and provide enormous leaf area for the absorption and accumulation of air pollutants to reduce the pollution level in the air environment. Generally exposed areas of a plant especially leaves act as

constant absorbers for particulate matters. Plant leaves have been regarded as bio-filters as they absorb large quantities of particles from the environment. Thus, air quality in urban/ arid areas can be improved by planting trees along road sides and agricultural lands. The plant species which are more sensitive act as biological indicator of air pollution. The seasons of the years by impacting atmospheric deposition, interception of dust by leaves and the variation in weather parameters influence dust accumulation and biochemical concentrations in plant leaves. Plants have the potential to serve as an excellent quantitative and qualitative tool to evaluate the impact of air pollution.

The present study aims to investigate the leaf dust accumulation on certain plant species grown alongside road in order to compare their capability to accumulate particulates and trying to map the Particulate Matter pollution, to provide essential data for the recognition and control of air quality as well as for further environmental study.

MATERIALS AND METHODS

STUDY AREA

The plant material will be collected from the four sites of Kurukshetra district Haryana (road side, an industrial area, Sector area & rural area).The Kurukshetradistrict of Haryana has a variety of plant species in its plantation. In this work, we selected eight plant species that were observed to be common to all four sites for the research of response to ambient air pollution. The following plant species were picked for the current study.

1. *Morus alba*
2. *Eucalyptus tereticornis*
3. *Dalbergiasissoo*
4. *Ficus benghalensis*
5. *Ficusreligiosa*
6. *Azadirachtaindica*
7. *Polyalthialongifolia*
8. *Albizialebeck*

Measurement of dust falls on the leaves

From each plant, ten matured leaves were collected in the separate polythene bags during winter, summer from November 2018 to October 2019. Leaves were collected at the height of three to

four meters from all the sites. For dust fall measurement, the method of Dry technique described by Das and Patanayak (1997) was followed. In this technique first the intact leaf was weighted (in mg) then dust particulates from leaf surfaces were gently collected with the help of camel hair brushes and the weight of leaf was measured again.

$$\text{The amount of dustdeposition in mg/cm}^2\text{was calculated as: } = \frac{\text{Weight of intact leaf – initial weight of leaf}}{\text{Total surface area of leaf (cm}^2\text{)}}$$

RESULTS AND DISCUSSION

Dust accumulation: The observations for dust accumulation of all the selected plant species for reference and polluted sites have been presented in **table-1**.

Morus alba: The measurements for Dust accumulation in *Morus alba* at control site have been observed to be 0.25mg/cm^2 while at polluted site, its value has been observed to be 0.32mg/cm^2(P1), 0.31 mg/cm^2 (P2),0.27 mg/cm^2 (P3). The dust fall increase at polluted site in comparison to control site. The dust fall was drastically changed during the monsoon change. Itshows that season influenced the dust accumulation.

Eucalyptus tereticornis

The measurements for Dust accumulation in *Eucalyptus tereticornis*at control site have been observed to be 0.15mg/cm^2 while at polluted site, its value has been observed to be 0.19mg/cm^2(P1), 0.17 mg/cm^2 (P2),0.15 mg/cm^2 (P3). the dust fall increase at polluted site in comparison to control site.

Dalbergiasissoo

The measurements for Dust accumulation in *Dalbergiasissoo* at control site have been observed to be 0.47mg/cm^2 while at polluted site, its value has been observed to be 0.58mg/cm^2(P1), 0.55 mg/cm^2 (P2),0.49 mg/cm^2 (P3). The dust fall increase at polluted site in comparison to control site.

Ficus benghalensis

The measurements for Dust accumulation in *Ficus benghalensis*at control site have been observed to be 0.29mg/cm^2 while at polluted site, its value has been observed to be 0.34mg/cm^2(P1), 0.32 mg/cm^2 (P2),0.30 mg/cm^2 (P3). the dust fall increase at polluted site in comparison to control site.

Ficusreligiosa

The measurements for Dust accumulation in *Ficusreligiosa* at control site have been observed to be 0.23mg/cm^2 while at polluted site, its value has been observed to be 0.27mg/cm^2(P1), 0.25 mg/cm^2 (P2),0.23 mg/cm^2 (P3). the dust fall increase at polluted site in comparison to control site.

Azadirachtaindica

The measurements for Dust accumulation in *Azadirachtaindica* at control site have been observed to be 0.35mg/cm^2 while at polluted site, its value has been observed to be 0.42mg/cm^2(P1), 0.40 mg/cm^2 (P2),0.38mg/cm^2 (P3). the dust fall increase at polluted site in comparison to control site.

Polyalthialongifolia

The measurements for Dust accumulation in *Polyalthialongifolia* at control site have been observed to be 0.12mg/cm^2 while at polluted site, its value has been observed to be 0.15mg/cm^2(P1), 0.15 mg/cm^2 (P2),0.13mg/cm^2 (P3). the dust fall increase at polluted site in comparison to control site.

Albizialebeck

The measurements for Dust accumulation in *Albizia lebeck*at control site have been observed to be 0.02mg/cm^2 while at polluted site, its value has been observed to be 0.09mg/cm^2(P1), 0.06 mg/cm^2 (P2),0.03mg/cm^2 (P3). The dust fall increase at polluted site in comparison to control site.

The ability of plants to intercept dust depends on their surface geometry, phyllotaxy, and leaf external characteristics such as hairs, cuticle etc., height, and canopy (Nowak, 1994; Neinhuis and Barthlott, 1998, Pal et al., 2002). Workers like Prusty et al. (2005) Prajapati and Tripathi (2008) and Rai (2016) also reported massive increase in the accumulation of dust recorded in all

the plants growing at polluted location in comparison to reference location. An increase in the values for dust accumulation has also been observed in the present study during study period.

CONCLUSION

There was significant increase in the values of dust accumulation in the period of present study for *Dalbergiasissoo, Ficusreligios, Ficus benghatlensis,* and *Azadirachtaindica*. The average values computed during study period for dust accumulation depicted increase in all the plants from polluted site in comparison to plants growing at control site.

Table-1: Measurement of dust falls on the leaves (mg/cm^2) of the Selected plant species growing four different sites (polluted and unpolluted)

Selected Plant Species	**Sampling Sites**			
	Site-P1 (Roadside area)	**Site-P2 (Industrial Area)**	**Site-P3 (Urban Residential Area)**	**Site -C (Rural area with negligible pollution)**
Morus alba	0.32	0.31	0.27	0.25
Eucalyptus tereticornis	0.19	0.17	0.15	0.15
Dalbergiasissoo	0.58	0.55	0.49	0.47
Ficus benghalensis	0.34	0.32	0.30	0.29
Ficusreligiosa	0.27	0.25	0.23	0.23
Azadirachtaindica	0.42	0.40	0.38	0.35
Polyalthialongifolia	0.15	0.15	0.13	0.12
Albizialebeck	0.09	0.06	0.03	0.01

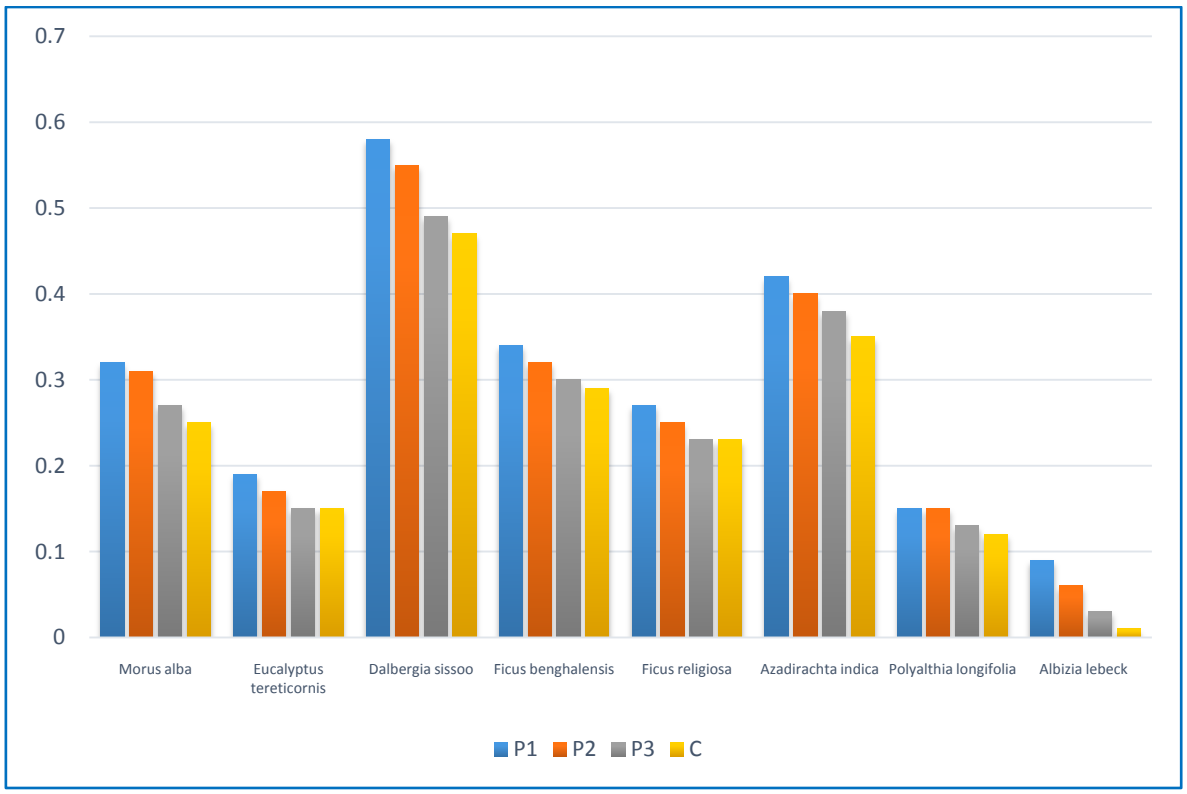

Figure -1: Measurement of dust falls on the leaves (mg/cm^2) of the Selected plant species growing four different sites (polluted and unpolluted)

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