Biological Forum – An International Journal **16(7): 164-167(2024)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Assessment of Atmospheric Leaf Dust Accumulation of Indoor Plants

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(Received: 28 April 2024; Revised: 17 May 2024; Accepted: 11 June 2024; Published: 15 July 2024)
(Published by Research Trend)

ABSTRACT: The present investigation entitled "Assessment of Atmospheric Leaf Dust Accumulation of Indoor Plants" was conducted at Greenhouse Complex, ASPEE College of Horticulture, Navsari Agricultural University, Navsari, Gujarat, during 2021-2022 and 2022-2023. In this study, 20 indoor plants were selected, and the atmospheric leaf dust accumulation was assessed and estimated using experimental design CRD. On the basis of atmospheric leaf dust accumulation *Zamioculcas zamiifolia, Epipremnum aureum* and *Diffenbachia camille* were found maximum atmospheric leaf dust accumulation and best for removing fine particles from the indoor environment.

Keywords: Dust pollution**,** indoor plants, urban landscape, indoor pollution, air quality.

INTRODUCTION

Leaf dust accumulation is a common issue affecting indoor plants, impacting their aesthetics and health. As plants reside in enclosed spaces, they collect dust, dirt, and other airborne particles on their leaf surfaces over time. This buildup can hinder the plant's ability to photosynthesize efficiently, potentially leading to reduced growth and an overall decline in plant health. Understanding the causes and effects of leaf dust accumulation, as well as implementing proper cleaning techniques, is crucial for maintaining thriving indoor plants. Air pollution can directly affect the plants via leaves. When exposed to airborne pollutants, most plants showed physiological changes before exhibiting visible damage to leaves (Liu and Ding 2008). Accumulation and deposition of gaseous pollutants and particulate matter depends upon the vegetation type (Bunzl *et al.,* 1989). Most of the effects of dust particles on plants include the potential to block and damage the stomata such that photosynthesis and respiration are affected one of their effects is shading which may lead to a reduction in photosynthetic capacity (Iqbal and Shafig 2001; Kovatas *et al*., 2021). The capability of plant species to remove fine particles from indoor environments in urban areas has been described in the work of Konczak *et al*. (2021) using phytoremediation. There are studies on the dust-holding capacities of the leaf surfaces of eight widespread garden plants in Hangzhou, China (Shao *et al.*, 2019). The dust deposited on the leaf surface of plants affects the leaf attributes of the plant species (Chaturvedi *et al*., 2013). Vegetation contributes to reducing dust concentration in the environment by acting as a sink for air pollutants. Generally exposed areas of a plant especially leaves act as constant absorbers for particulate matter (Samal and Santra 2002). Particulate pollutants can cause many lethal effects on plants like stomatal clogging, reduced photosynthetic activity, leaf fall, and death of tissues (Shrivastava and Joshi 2002). Accumulation of dust particles depends on internodal distance, petiole length, leaf area, orientation, margin, folding and arrangement, hair density, hair type, and size (Varshney, 1985; Varshney and Mitra 1993; Escobedo *et al*., 2008). Due to the surface characteristics of twigs, bark, and foliage of the plants, particulate matters are captured by them and remain there for an extended period. Leaf orientation and the sessile or semi-sessile nature of leaves play important roles in dust deposition as they determine the surface available for dust deposition. Air movement easily disturbs leaves having thin lamina, smooth surfaces, and long petioles. Consequently, such leaves can hold lesser amounts of dust while thick leaves have rough surfaces or hairs on the surface and short petioles can hold large amounts of dust and hence, are better collectors of dust. The selective response of leaves toward dust may be used for monitoring air dust pollution (Prusty *et al*., 2005). Air quality along national highways can be improved by planting trees (Freer Smith *et al*., 2005).

MATERIAL AND METHODS

Area of Study. The present investigation was carried out during the years 2021-22 and 2022-23 at the greenhouse complex, Department of Floriculture and Landscape Architecture, ASPEE College of Horticulture, Navsari Agricultural University, Navsari. Geographically, Navsari is situated at the coast of the Arabian Sea at 20°57′North latitude and 72°54′East longitude at an altitude of about 11.98 meters above the mean sea level.

Collection of Samples. The study was conducted for the evaluation of different indoor plants based on their atmospheric leaf dust accumualtion. In this experiment, 20 indoor plants were grown in pots under fifty percent shade net house at the greenhouse complex, Department of Floriculture and Landscape Architecture, ASPEE College of Horticulture, during the years 2021-22 and 2022-23. The pot size comprised a height of 13cm, a top diameter of 19cm, bottom diameter of 11cm, and the potting media consisted of 2 parts of garden soil + 1 part sand + 1 part coco peat. The data were taken 6 months after the establishment of the experiment in each year. Indoor plants selected for the present study were *Aglaonema commutatum, Anthurium andraeanum, Begonia rex 'Cultorum', Chlorophytum comosum, Dieffenbachia Camille, Dracaena reflexa, Epipremnum aureum, Howarthia fasciata, Nephrolepis exaltata, Peperomia obtusifolia, Peperomia* 'Scandens Green', *Philodendron erubescens, Philodendron* 'Golden Goddess', *Portulacaria afra, Rhapis excelsa, Sansevieria trifasciata, Sansevieria masoniana, Spathiphyllum wallisii, Syngonium podophyllum, Zamioculcas zamiifolia.* To study atmospheric leaf dust accumualtion from the selected 20 indoor plant species were collected 6 months after the establishment of the experiment each year as per the following standard procedure.

Leaf dust accumulation (mg/m^2). Fully matured leaves of the selected plant species were taken randomly for the present studies. The upper surfaces of the leaves were cleaned with fine brushes and identification marks were put on them and were left as such for 24 hours for dust accumulation. There, after dust was collected in the pre-weighed butter paper bags with the help of a fine brush. The amount of dust accumulated on leaves was weighed on top pan electronic balance and calculated by using the equation:

Dust content (mg/m^2) = $W_2 - W_1/A$

Where,

W = Dust content (mg/m^2)

W_1= Initial weight of butter paper bag

W_2= Final weight of butter paper bag with dust

A = Total area of the leaf (m^2)

Statistical analysis. The experiment was designed in a completely randomized design pooled analysis with 3 repetitions. All the data were analysed statistically using the OPSTAT software. Data recorded were subjected to statistical analysis and analysis of variance (ANOVA) was used to test the significance of genotypic differences (Panse and Sukhatme 1985).

RESULT AND DISCUSSION

Leaf dust accumulation (mg/m^2). *Zamioculcas zamiifolia* showed maximum leaf dust accumulation (mg/m^2) after 3 months (0.53 mg/m^2, 0.52 mg/m^{2}and 0.53 mg/m^2) and 6 months (0.57 mg/m^2, 0.56 mg/m^2 and 0.57 mg/m^2) of interval which was found statistically at par with *Epipremnum aureum* after 3 months (0.53 mg/m^2, 0.52 mg/m^2 and 0.52 mg/m^2) and 6 months (0.55 mg/m^2, 0.54 mg/m^2 and 0.55 mg/m^2) followed by *Diffenbachia camille* after 3 months (0.50 mg/m^2, 0.49 mg/m^2 and 0.50 mg/m^2) and 6 months (0.54 mg/m^2, 0.53 mg/m^2 and 0.54 mg/m^2) of interval during both the years and pooled analysis, respectively. *Howarthia fasciata* showed minimum leaf dust accumulation (mg/m^2) was recorded after 3 months (0.09 mg/m^2, 0.08 mg/m^2 and 0.09 mg/m^2) and 6 months (0.10 mg/m^2, 0.11 mg/m^2 and 0.11 mg/m^2) of interval during both the years and pooled analysis, respectively. As per pooled analysis, interaction between plant species and year (P × Y) and (Y) was found non-significant.

The highest dust accumulation on the leaves of *Zamioculcas zamiifolia, Epipremnum aureum,* and *Diffenbachia camille* may be due to coarse leaf texture, thick leaves, hairs on the surface, and short petioles that can hold a large amount of dust therefore, they are better collectors of dust. Prusty *et al*. (2005); Thakar and Mishra (2010); Gholami *et al.* (2016); Vora and Bhatnagar (2011) also reported that plant morphological characters also play a significant role in dust accumulation. Further, Madan and Chauhan (2015) have reported that plants having leaves of broad and thick leaves, hairs on the surface, and short petioles accumulate more dust from the air.

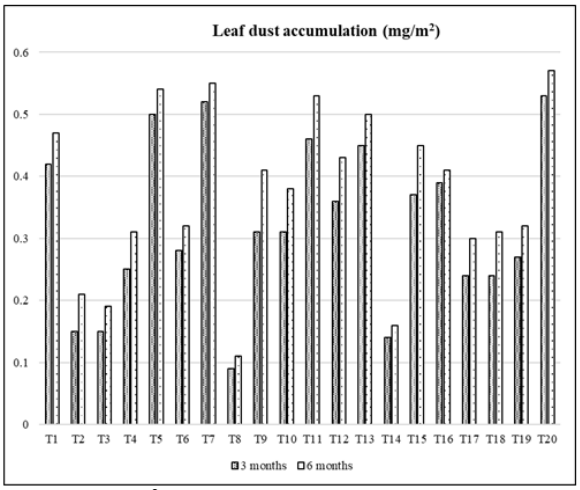

Fig. 1. Leaf dust accumulation (mg/m^2) of selected indoor plant species recorded at different interval.

Table 1: Leaf dust accumulation (mg/m^2) of selected indoor plant species recorded at different interval (Pooled data).

Sr. No.	Genotype	3 Month					6 Month				
		2020-21	2021-22	Pooled			2020-21	2021-22	Pooled		
1.	*Aglaonema commutatum*	0.41	0.42	0.42			0.46	0.47	0.47		
2.	*Anthurium andraeanum*	0.14	0.15	0.15			0.21	0.21	0.21		
3.	*Begonia rex 'Cultorum'*	0.15	0.15	0.15			0.18	0.19	0.19		
4.	*Chlorophytum comosum*	0.25	0.25	0.25			0.30	0.31	0.31		
5.	*Dieffenbachia camille*	0.50	0.49	0.50			0.54	0.53	0.54		
6.	*Dracaena reflexa*	0.27	0.28	0.28			0.32	0.32	0.32		
7.	*Epipremnum aureum*	0.53	0.52	0.52			0.55	0.54	0.55		
8.	*Howarthia fasciata*	0.09	0.08	0.09			0.10	0.11	0.11		
9.	*Nephrolepis exaltata*	0.31	0.31	0.31			0.41	0.42	0.41		
10.	*Pepromia obtusifolia*	0.31	0.31	0.31			0.38	0.38	0.38		
11.	*Pepromia* 'Scandens Green'	0.46	0.46	0.46			0.52	0.53	0.53		
12.	*Philodendron erubescens*	0.36	0.37	0.36			0.43	0.43	0.43		
13.	*Philodendron* 'Golden Goddess'	0.45	0.44	0.45			0.50	0.50	0.50		
14.	*Portulacaria afra*	0.13	0.14	0.14			0.16	0.17	0.16		
15.	*Rhapis excelsa*	0.37	0.38	0.37			0.45	0.45	0.45		
16.	*Sansevieria trifasciata*	0.38	0.39	0.39			0.41	0.42	0.41		
17.	*Sansevieria masoniana*	0.24	0.25	0.24			0.29	0.30	0.30		
18.	*Spathiphyllum wallisii*	0.23	0.24	0.24			0.30	0.31	0.31		
19.	*Syngonium podophyllum*	0.27	0.27	0.27			0.32	0.32	0.32		
20.	*Zamioculcas zamiifolia*	0.53	0.52	0.53			0.57	0.56	0.57		
	Mean	0.32	0.32	0.32			0.37	0.37	0.37		
		G_{21}	G_{22}	G	Y	G×Y	G_{21}	G_{22}	G	Y	G×Y
S.Em.±		0.01	0.01	0.007	0.002	0.01	0.01	0.01	0.008	0.003	0.011
CD 5%		0.03	0.03	0.02	NS	NS	0.03	0.03	0.02	NS	NS
CV %		5.60	5.28	5.44			5.25	5.45	5.35		

CONCLUSIONS

The indoor plants with leaf dust accumulation have more chances of survival and growth performance, with more indoor air pollution. In the present experiment, indoor plants like The plant species like *Zamioculcas zamiifolia*, *Epipremnum aureum,* and *Diffenbachia* have maximum leaf dust accumulation and are thus capable of removing fine particles from the indoor environment.

Acknowledgement. The authors are grateful to the Department of Floriculture and Landscape Architecture, ASPEE College of Horticulture, Navsari Agricultural University, Navsari, for providing necessary facilities to conduct this study.

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How to cite this article: Dinesh Kumar, Alka Singh, S.L. Viyol, H.P. Shah, D.R. Bhanderi and A.K. Shrivastava (2024). Assessment of Atmospheric Leaf Dust Accumulation of Indoor Plants. *Biological Forum – An International Journal, 16*(7): 164-167.