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\section*{Abstract}

Plants play a crucial role in mitigating air pollution, which can be evaluated by examining their biochemical characteristics, including ascorbic acid, total chlorophyll content, pH, and relative water content. These traits provide valuable insights into plants’ capacity to counteract atmospheric pollutants. Moreover, combining air pollution tolerance and Suspended Particulate Matter (SPM) retention potentials could lead to an adequate assessment of plant species for greenbelt development. This study assessed biochemical characteristics and SPM retention potential of six selected plant species (\textit{Ficus benghalensis} \textit{L}, \textit{Ficus religiosa} \textit{L}, \textit{Polyalthia longifolia} (Sonn.) Thwaites, \textit{Azadirachta indica} A.Juss, \textit{Ficus benjamina} \textit{L}, and \textit{Bougainvillea glabra}) at polluted (Okhla Phase-2) and non-polluted (Siri Fort) sites in Delhi, India, during pre- and post-monsoon. In addition, based on biochemical characteristics, the Air Pollution Tolerance Index (APTI) of selected plant species has been calculated. Also, the impact of changes in independent variables such as the relative water content, ascorbic acid, pH, and total chlorophyll content on the APTI of different plant species was assessed using linear regression. The study found that \textit{A.indica} exhibited the highest APTI of 9.43 and \textit{F.benghalensis} the lowest APTI of 8.3 during pre- and post-monsoon. Also, the maximum and minimum recorded values of the total SPM adhesion on the leaves of \textit{F. benghalensis} and \textit{F. religiosa} during pre- and post-monsoon were 1305.46 g/cm\textsuperscript{2} and 185.51 g/cm\textsuperscript{2}, respectively. Additionally, in the statistical analysis, the highest linear regression coefficient ($R^2 = 0.93$) was observed between ascorbic & total chlorophyll content with APTI, indicating a substantial impact on the APTI calculation of these biochemical parameters. This study demonstrated that plants with elevated biochemical parameters, APTI, and SPM retention potential can effectively reduce air pollutants from the atmosphere. These findings highlight the importance of considering specific biochemical characteristics and SPM retention potential when selecting plant species for greenbelt development.

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Introduction

The air quality of cities has deteriorated in recent years because of rapid urbanization, increased vehicular and industrial emissions (Anake et al., 2022; Peng et al., 2022). Dispersion of pollutants in the atmosphere and associated risk can be lowered by implementing plants as a green barrier that functions as pollutant sinks and natural filters (Abhijith et al., 2017; Eisenman et al., 2019). Plants mitigate pollutants via sedimentation, diffusion, and interception (Beckett et al., 2000). The leaf characteristics like surface roughness, size, and longevity impact the adherence of pollutants on the leaves. Activation of antioxidant machinery helps plant species combat the environmental stress such as air pollution. The capability of plants to reduce air pollution depends on their physio-biochemical parameters and antioxidative defense mechanisms (Kwak et al., 2020). The boundary layer plays a significant role as a barrier that pollutants must traverse before reaching the leaf surface (Jean-Pierre, 2019), as illustrated in Figure 1. The thickness of the boundary layer is influenced by factors such as the shape and size of leaves, the presence of trichomes on leaves, and the speed of the wind.

Methodology

- Six Plant species such as Ficus benghalensis L., Ficus religiosa L., Polyalthia longifolia (Sonn.) T. Wtwaites, Azadirachta indica A. Juss, Ficus benjamina L. have been selected from Okhla Phase-2 and Siti Fort in Delhi, India.
- Biochemical parameters such as ascorbic acid, total chlorophyll content, relative water content, and pH were calculated (Tripathi and Nema, 2023).
- Pollutants content, relative water content, and pH were calculated (Tripathi and Nema, 2023).
- Coarse SPM (8-10 µm) ranged from 10.84 to 103.16 µg/cm², and 7.87 to 63.08 µg/cm² respectively. Fine SPM (< 2.5 µm) ranged between 3.86 to 67.03 µg/cm², and 3.15 to 34.07 µg/cm², respectively.
- Significant linear regression were observed between ascorbic acid and chlorophyll content (R² > 0.70) with the APTI in both seasons, as illustrated in Figure 3.
- During the pre-monsoon, there was a notable 8.98% increase in APTI compared to the post-monsoon. Among the plant species, F. benjamina displayed the highest APTI value of 10.26 in the pre-monsoon, as shown in Figure 4.

Results

- Based on biochemical characteristics, Air pollution tolerance index (APTI) of plant species were measured.
- Moreover, Suspended Particulate Matter (SPM) retention potential of plant species have been determined (Figure 2).
- Seasonal variation in the SPM accumulation on the selected plant species in the pre-monsoon (a & c) and post-monsoon (b & d). 1 and 2 denotes the pre- and post-monsoon seasons.
- Seasonal variation in APTI was observed in this study, signifying the impact of air pollution on biochemical traits.
- Among the species studied, F. benghalensis emerged as the most tolerant species with the highest potential for capturing SPM.

Conclusion

- The research findings indicated that the process of choosing appropriate plant species for urban green belts necessitates the consideration of various factors.
- These factors include biochemical parameters such as ascorbic acid, chlorophyll, relative water content, and pH, as well as the APTI, leaf morphology, and SPM retention potential.
- Also, seasonal variation in APTI was observed in this study, signifying the impact of air pollution on biochemical traits.
- The seasonal variation of biochemical parameters and Suspended particulate matter (SPM) retention potential of selected plant species was studied.

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References