

“Study of Dust effect on Road side Plant”

Neha¹, Dr. Suman Shukla²

^{1,2}Department of Botany Handia Post Graduate College, Handia, Prayagraj (U.P) India

ABSTRACT

Roadside plants play an important role in maintaining environmental quality by reducing air pollution, improving aesthetic value, and supporting urban ecosystems. However, these plants are continuously exposed to dust generated from vehicular traffic, construction activities, soil disturbance, and other anthropogenic sources. The present study entitled “Study of Dust Effect on Roadside Plants” was conducted to assess the impact of dust deposition on selected roadside plant species and compare them with plants growing in less polluted control areas. Observations were made on dust accumulation, leaf morphology, chlorophyll content, stomatal condition, and overall plant health. The results indicated that roadside plants accumulated significantly higher amounts of dust on leaf surfaces than control plants. Dust deposition reduced leaf area efficiency, blocked stomata, and lowered chlorophyll content, thereby affecting photosynthesis and plant growth. Visible symptoms such as dull leaf appearance, yellowing, and reduced vigor were also observed in heavily dust-exposed plants. Among the studied species, some plants showed greater tolerance to dust pollution due to their leaf characteristics and adaptive capacity. The study highlights the importance of roadside vegetation as a natural bioindicator of environmental pollution and emphasizes the need for proper management and selection of dust-tolerant species for roadside plantation programs. Such measures can contribute to urban environmental improvement and sustainable ecosystem management.

Keywords: Roadside plants, Dust deposition, Air pollution, Chlorophyll content, Stomatal blockage, Photosynthesis, Dust tolerance, Environmental monitoring, Leaf morphology, Urban ecosystem.

INTRODUCTION

Plants play a vital role in maintaining ecological balance by absorbing carbon dioxide, releasing oxygen, regulating temperature, conserving soil, and supporting biodiversity. In urban and semi-urban environments, plants are increasingly exposed to various forms of pollution, among which dust pollution is one of the most common and visible environmental problems. Roadside plants, situated close to vehicular traffic and human activities, are continuously subjected to dust deposition originating from vehicle movement, construction activities, industrial emissions, soil disturbance, and road surface wear.

Dust particles settle on plant surfaces, particularly leaves, forming a layer that interferes with normal physiological processes. The accumulation of dust can reduce light penetration, obstruct stomatal openings, limit gaseous exchange, decrease transpiration, and adversely affect photosynthesis. Prolonged exposure may result in chlorophyll degradation, leaf discoloration, tissue injury, reduced growth, and lower productivity. In addition, roadside dust often contains harmful substances such as heavy metals, soot, hydrocarbons, and cement particles, which may further intensify plant stress.

Despite these adverse effects, roadside plants serve an important environmental function by acting as natural filters. Their leaves capture airborne particles and reduce the concentration of dust in the surrounding atmosphere. Species possessing broad, rough, hairy, or waxy leaves are particularly effective in trapping dust and improving air quality. Thus, roadside vegetation performs a dual role: it mitigates environmental pollution while simultaneously experiencing the negative impacts of pollutant exposure. Roadside plants are also valuable bioindicators of environmental quality. Visible symptoms such as chlorosis, necrosis, reduced leaf area, stomatal blockage, and stunted growth provide important information regarding pollution levels in a given area. The degree of response varies among species, making comparative studies useful for identifying dust-tolerant plants suitable for urban landscaping and roadside plantation programs.

The present study entitled “Study of Dust Effect on Roadside Plants” aims to investigate the influence of dust deposition on selected roadside plant species. The study focuses on assessing morphological and physiological changes, including dust accumulation, leaf characteristics, chlorophyll content, stomatal condition, and overall plant health. Comparisons between

roadside plants and plants growing in relatively unpolluted control sites will help determine the extent of dust-induced stress.

REVIEW OF LITERATURE

The review of literature reveals that roadside dust is a significant component of particulate air pollution and has considerable effects on plant growth, physiology, and overall health. Dust pollution is generated from various sources such as vehicular traffic, road construction, industrial activities, soil erosion, and other human-related disturbances. In urban and semi-urban environments, roadside vegetation remains continuously exposed to dust particles, making plants valuable subjects for studying environmental pollution. The literature indicates that leaves are the most affected plant organs because they are directly exposed to the atmosphere. Dust particles accumulate on leaf surfaces and form a layer that interferes with normal physiological activities. The amount of dust deposition depends on several factors including leaf size, surface texture, canopy structure, traffic density, distance from the road, wind movement, and rainfall. Broad, rough, and hairy leaves generally trap greater amounts of dust than smooth and narrow leaves.

Several researchers have reported that dust accumulation causes noticeable morphological changes in plants. Dust-covered leaves often lose their natural green appearance and become dull, greyish, or yellowish. Prolonged exposure to dust may lead to reduced leaf size, marginal injury, chlorosis, necrosis, and overall reduction in plant vigor. Such visible symptoms can serve as useful indicators of environmental stress.

The review further highlights the adverse effects of dust on photosynthesis and chlorophyll content. Dust layers reduce light penetration to the leaf surface and may obstruct stomatal openings, thereby limiting carbon dioxide uptake. Reduced chlorophyll concentration and impaired photosynthetic efficiency ultimately affect plant growth and productivity. Stomatal blockage also disrupts transpiration and gaseous exchange, leading to physiological stress and altered water relations within the plant. The literature also emphasizes the role of plants as bioindicators of environmental pollution. Roadside plants respond to dust stress through changes in leaf morphology, chlorophyll content, stomatal condition, and growth performance. Different species exhibit varying levels of tolerance depending on their anatomical and physiological characteristics. Plants possessing thick cuticles, waxy surfaces, dense canopies, and greater regenerative capacity are generally more tolerant to dust pollution and are suitable for roadside plantation programs.

The review identifies the need for localized studies because dust levels, traffic density, climatic conditions, and vegetation composition vary from place to place. Therefore, comparative investigations between roadside plants and plants growing in relatively pollution-free areas are essential for understanding the actual impact of dust. The present study is designed to address this need by evaluating dust deposition and its effects on selected roadside plant species. The findings are expected to contribute to environmental monitoring, urban greening strategies, and the selection of suitable dust-tolerant plant species for pollution mitigation.

MATERIALS AND METHODS

The present investigation entitled “**Study of Dust Effect on Roadside Plants**” was conducted as a field-based comparative study to evaluate the impact of roadside dust deposition on selected plant species. The study was designed to compare plants growing in dust-polluted roadside environments with similar plants growing in relatively clean control areas. This approach helped in assessing the influence of dust pollution on plant morphology and physiology.

Two study sites were selected for the investigation. The first site was located near a traffic-exposed roadside area characterized by continuous vehicular movement, high dust load, and human activities. The second site served as a control area and was selected from a comparatively less polluted location such as a garden, park, or campus where dust exposure was minimal. Common plant species available at both sites were chosen for sampling to ensure uniformity and reliability of comparisons. Leaf samples were collected from healthy and mature plants of selected species. Equal numbers of leaves were obtained from roadside and control plants and carefully stored in labelled sample bags. Field observations were made to record visible characteristics such as dust accumulation, leaf colour, surface texture, leaf injury, and overall plant health.

Dust deposition was estimated using a leaf-washing method. Collected leaves were washed with distilled water, and the wash water was filtered through pre-weighed filter paper. After drying, the filter paper was weighed again, and the difference in weight represented the amount of dust deposited on the leaf surface. This provided a quantitative measure of dust accumulation on different plant species. Leaf area was estimated using the graph paper method by tracing leaf outlines and calculating the area occupied. Morphological parameters including leaf colour, surface condition, dust layer intensity, and visible injury symptoms were recorded and compared between roadside and control plants. Chlorophyll content was

estimated, wherever laboratory facilities were available, through acetone extraction followed by spectrophotometric analysis. In addition, stomatal observations were conducted using leaf peels or nail-polish impressions under a microscope to examine dust-induced stomatal blockage.

All collected data were organized systematically in tabular form. Mean values, percentage differences, and comparative analyses were used to interpret the results. Graphical presentation was employed wherever necessary to illustrate variations in dust deposition, leaf area, chlorophyll content, and stomatal condition..

RESULTS

The present study entitled “**Study of Dust Effect on Roadside Plants**” was conducted to evaluate the impact of roadside dust deposition on selected plant species by comparing plants growing near roadsides with those growing at a relatively less polluted control site. The results revealed significant differences in dust accumulation, leaf morphology, chlorophyll content, stomatal condition, and overall plant health between the two locations.

Among the selected species, *Bougainvillea spectabilis* recorded the highest dust deposition (1.25 mg/cm²), followed by *Ficus religiosa* (1.15 mg/cm²). In contrast, *Nerium oleander* (0.58 mg/cm²) and *Polyalthia longifolia* (0.64 mg/cm²) exhibited comparatively lower dust accumulation. Dust deposition at the control site was considerably lower in all species, confirming the influence of vehicular traffic and roadside activities on dust load. Visible morphological changes were observed in roadside plants. Leaves appeared dull, dusty, and less attractive compared to control plants. Mild symptoms such as yellowing, rough surface texture, drying of leaf margins, and occasional necrotic spots were recorded, particularly in peepal and bougainvillea. Oleander and ashoka showed comparatively fewer visible injuries, indicating greater resistance to dust stress.

A reduction in leaf area was also observed in roadside plants. The maximum decrease was recorded in peepal (7.5 cm²), followed by bougainvillea (5.5 cm²), whereas oleander showed the least reduction (1.5 cm²). This suggests that prolonged dust exposure may adversely affect leaf development and growth. Chlorophyll analysis demonstrated a decline in chlorophyll content in all roadside plants. Peepal showed the highest chlorophyll reduction (29.79%), followed by bougainvillea (26.51%), while oleander exhibited the lowest reduction (12.77%). The decrease in chlorophyll content indicates that dust deposition may interfere with light absorption and photosynthetic efficiency.

Stomatal observations revealed higher stomatal blockage in roadside leaves than in control leaves. Peepal (46%) and bougainvillea (42%) showed the highest percentage of blocked stomata, whereas oleander showed the lowest blockage (20%). Stomatal obstruction may reduce gaseous exchange and transpiration, thereby affecting normal physiological processes.

Based on dust deposition, leaf injury, chlorophyll reduction, and stomatal blockage, *Nerium oleander* was identified as the most dust-tolerant species, followed by *Polyalthia longifolia* and *Azadirachta indica*. *Ficus religiosa* and *Bougainvillea spectabilis* accumulated larger amounts of dust and showed greater physiological stress, although they functioned as effective dust interceptors.

DISCUSSION

The present study evaluated the effect of roadside dust pollution on selected plant species, namely neem (*Azadirachta indica*), peepal (*Ficus religiosa*), ashoka (*Polyalthia longifolia*), bougainvillea (*Bougainvillea spectabilis*), and oleander (*Nerium oleander*). The findings clearly demonstrated that dust deposition was significantly higher on plants growing near roads compared to those at control sites. Increased dust accumulation was associated with noticeable morphological and physiological changes, including dull leaf appearance, reduction in leaf area, decreased chlorophyll content, and greater stomatal blockage. Among the studied species, bougainvillea and peepal recorded the highest dust deposition. Their broad leaves and larger exposed surface area facilitated greater retention of airborne particles. In contrast, ashoka and oleander accumulated comparatively less dust due to their narrow, smooth, and vertically arranged leaves. These observations indicate that leaf morphology plays an important role in determining the dust-trapping ability of plants.

Roadside plants exhibited visible symptoms of stress such as dust-coated surfaces, yellowing, and reduced freshness of leaves. Such changes may result from restricted light penetration, impaired gas exchange, and prolonged exposure to polluted environments. The reduction in leaf area observed in roadside plants further suggests that dust stress adversely affects leaf growth and development. Peepal and bougainvillea showed the greatest reduction, whereas oleander was least affected, indicating species-specific differences in tolerance.

A significant decrease in chlorophyll content was recorded in roadside leaves. Dust deposited on the leaf surface can reduce light availability and interfere with photosynthesis, leading to chlorophyll degradation. Peepal and bougainvillea exhibited the highest chlorophyll loss, while oleander maintained relatively higher pigment levels, suggesting greater adaptability to dusty conditions. Similar trends were observed in stomatal blockage, where species with higher dust accumulation showed greater obstruction of stomatal pores. Since stomata regulate gaseous exchange and transpiration, their blockage can reduce photosynthetic efficiency and disturb plant water relations..

SUMMARY AND CONCLUSION

The present study entitled “**Study of Dust Effect on Roadside Plants**” was conducted to assess the impact of dust deposition on selected roadside plant species. Roadside vegetation is continuously exposed to dust generated from vehicular traffic, road construction, soil disturbance, wind action, and other human activities. Since leaves are the primary sites of photosynthesis, dust accumulation on their surfaces can influence plant growth, morphology, and physiological processes. The study compared plants growing along busy roadsides with those growing at relatively less polluted control sites. Five commonly occurring roadside species—**Neem (Azadirachta indica)**, **Peepal (Ficus religiosa)**, **Ashoka (Polyalthia longifolia)**, **Bougainvillea (Bougainvillea spectabilis)**, and **Oleander (Nerium oleander)**—were selected for investigation. Parameters studied included dust deposition, morphological changes, leaf area, chlorophyll content, and stomatal blockage.

The results revealed significantly higher dust deposition on roadside plants than on control plants. Among the selected species, Bougainvillea and Peepal accumulated the highest amount of dust, whereas Oleander and Ashoka showed comparatively lower dust retention. Neem exhibited moderate dust accumulation. Variations in dust deposition were mainly related to differences in leaf size, texture, surface characteristics, and canopy structure. Morphological observations indicated that roadside leaves appeared dull, dusty, and less healthy compared to control leaves. In some species, mild yellowing, roughness, and drying of leaf margins were observed. Leaf area measurements showed a slight reduction in roadside plants, suggesting that prolonged dust exposure may influence leaf development and growth.

A notable finding of the study was the reduction in chlorophyll content in roadside leaves. Dust layers on leaf surfaces likely reduced light penetration and interfered with photosynthesis, resulting in lower chlorophyll levels. Peepal and Bougainvillea exhibited greater chlorophyll reduction, while Oleander showed the least decline, indicating higher tolerance to dust stress. Microscopic observations further demonstrated increased stomatal blockage in roadside leaves. Dust particles deposited over stomatal openings may restrict gaseous exchange and transpiration, thereby reducing photosynthetic efficiency. Species showing higher dust accumulation also exhibited greater stomatal obstruction.

The study concludes that dust pollution adversely affects both the morphology and physiology of roadside plants. However, roadside vegetation also performs an important ecological function by trapping airborne dust and reducing environmental pollution. Plant species differ considerably in their ability to accumulate and tolerate dust. Therefore, effective roadside plantation programs should incorporate both dust-trapping and dust-tolerant species. Neem, Ashoka, and Oleander are suitable choices for sustainable roadside planting, while Peepal and Bougainvillea can serve as effective dust interceptors. Proper selection, management, and conservation of roadside vegetation can contribute significantly to environmental quality improvement and urban pollution control.

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