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The Impact of Green Cover on Air Pollution Reduction: Article Review

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Abstract. The purpose of this research is to learn which plant species can best survive in polluted urban environments. Increasing the number of parks and other green areas has been found to greatly enhance air quality. Depending on a number of criteria, including the climatic conditions of the region and the amount and density of vegetation, green spaces have the potential to minimize industrially produced pollutants, and the use of vegetation cover can increase environmental quality. Growing more parks and other green areas in cities can help cut down on pollution caused by cars and factories. Important implications for selecting plant species for vegetative cover may be found in this study. The creation of green spaces and the use of afforestation in public locations within cities are two examples of the nature-based measures that many countries are embracing to reduce air pollution. The purpose of this essay was to investigate how tolerant various plant species are to air pollution in suburban and urban environments. Different plant species play a substantial role in lowering environmental pollutants such as NO_2 and O_3. Plants have been shown to minimize air pollution, although this benefit may come at the expense of the plants themselves. Planners are paying more attention to greenery planting as a technique of mitigating air pollution due to the proliferation of pollution sources. Trees and shrubs in these landscapes are chosen for their ability to thrive in the region's unique climatic, soil, and water conditions, as well as their other desirable qualities, such as their height, crown shape, root type, leaf structure, heat and cold resistance, and adaptability to a range of conditions. The hazards associated with pollution emissions are reduced, and air quality is enhanced, thanks to this.

Keywords. Green Cover , Air Pollution , Tree and shrubs.

1. Introduction

The increased risk of respiratory, cardiovascular, and circulatory disorders is just one reason why air pollution is such a serious environmental threat to human health. The purpose of this research is to learn which plant species can best survive in polluted urban environments. Increasing the number of parks and other green areas has been found to greatly enhance air quality. Depending on a number of criteria, including the climatic conditions of the region and the amount and density of vegetation, green spaces have the potential to minimize industrially produced pollutants, and the use of vegetation cover can increase environmental quality. Growing more parks and other green areas in cities can help cut down on pollution caused by cars and factories. Important implications for selecting plant species for vegetative cover may be found in this study. increasing air pollution over the past few decades has

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been linked to increasing rates of respiratory illness, cardiovascular disease, asthma, and premature death [1]. Human health is a major problem, and the rising air pollution caused by industrial operations is a major cause for concern. Nearly ninety-seven percent of the world's population currently resides in polluted areas, where levels of particulate matter with a dynamic aerodynamic diameter of less than 2.5 microns are consistently higher than those recommended by the World Health Organization. Ninety percent of the world's population lives in a country with significant toxicity risks [2-4]. From 2000 to 2012, the number of deaths attributed to air pollution rose from one million per year to 3.1 million [2-5]. The average human needs to breathe in about 10 cubic meters of air every day [6], making it clear how important it is to reduce pollution levels. Encroachment on agricultural lands and an insufficient distance between companies and residential areas are destroying plant and animal ecosystems near industrial sites around the world. This causes pollution levels in the area to rise over acceptable levels, putting the health of locals at risk. It also pollutes water, soil, and the environment, which has negative effects on the health of all forms of life [7-9]. The creation of green spaces and the use of afforestation in public locations within cities are two examples of the nature-based measures that many countries are embracing to reduce air pollution [10]. As a result, this has positive effects on many fronts, including the environment, society, culture, economy, and aesthetics [11]. Positive effects on human health have been linked to the ability of green areas to reduce air temperature, slow the progress of storms and hurricanes induced by meteorological disturbances, absorb carbon dioxide (CO_2), release oxygen (O_2), increase and conserve biodiversity, and generally better the environment. Additionally, increasing urban greenery helps move the world closer to its sustainable development targets [12]. It's important to stress that preserving and expanding green areas while decreasing pollution levels requires integrated management and constant maintenance when designing green spaces [13,14]. The purpose of this essay was to investigate how tolerant various plant species are to air pollution in suburban and urban environments.

2. Air Pollution Sources and Plant Species

Pollutants from urban traffic and industry have increased, which is the most serious environmental pollution due to the rapid construction of residential buildings and factories in communities. Air pollution is dangerous to people and other forms of life, and it also plays a role in global warming (and hence, 8). Cities are major sources of air pollution, with detrimental impacts on human health from substances like nitrogen dioxide (NO2), sulfur dioxide (SO2), polycyclic aromatic hydrocarbons (PAHs), particulate matter (PM), and ozone (O3). Planting trees and developing green spaces in urban areas is an important and cost-effective strategy to improve the environment and reduce the risk of numerous diseases while also mitigating air pollution. It is also important to pick plants that can absorb or trap pollutants and stop them from spreading [8-15]. Vegetation density is inversely proportional to air pollution. Therefore, it is crucial to establish adequate plants in urban settings by thinking about the planted species, their growth rate throughout the year, vegetation density, and plant services (including timely pruning) [16]. Pollutant absorption is improved when plant cover is increased [8, 17–20], especially when the right plant species are used. The stomata of trees have been found to absorb airborne particles, which contributes directly to lowering air pollution levels. By lowering temperatures and preventing the production of secondary pollutants, they also have an indirect effect on the atmosphere [16].

varying tree species have vastly varying absorption capacities for PM 2.5 [21]. Particles, dust, and other air pollutants are typically absorbed by the leaves of many different types of trees. Trees that have large, irregularly shaped cells on their leaf surfaces are better able to take in and filter out harmful air pollutants of varying sizes. Air quality is improved by other tree species as well, particularly those with rough surfaces and parallel veins on their leaves. Since the small holes on the leaf surface promote gas exchange through the plant's physiological functions [22], some tree species are able to absorb a large quantity of pollutants from the upper leaf surface, albeit at lower levels, due to their smooth leaf texture. Some plant species have trichomes instead of stomata, and these trichomes are not as efficient at filtering out pollutants [21]. Large, rough leaves with complex and diverse forms and possessing numerous surface pores [21] are generally the most desirable attributes for plants to prevent air pollution. When comparing evergreen conifers and broad-leaved deciduous

trees, it was shown that the conifers have a higher dynamic diameter for particle absorption. Among the parameters determining the diameter of particles absorbed by the leaves is the microstructure of leaf surfaces and the length of dust lingering in the environment [22].
When one or more pollutants persist in the atmosphere in such amounts and for long enough to threaten human health or the biological functions of plants and animals [23], this is called air pollution. According to the World Health Organization [24-26], air pollution is a leading cause of early death globally, posing a serious threat to both humans and other forms of life. Particulate matter, a complex mixture of microscopic solid particles and liquid droplets hanging in the atmosphere and created by a wide range of activities, is one of the most dangerous air pollutants. It has the ability to spread across great distances and has both immediate and delayed negative effects [24, 27]. Vulnerable populations (children, the elderly, people with heart and lung diseases, and pregnant women) are particularly at risk from the increased concentration of particles, especially PM10, due to factors like industrial activities, population growth, and fuel consumption, especially during peak hours [24, 28]. Air pollution has been lowered to some degree due to the stringent execution of national and international legislation in recent years. However, it's difficult and expensive to get rid of these toxins entirely [24]. Ozone (O_3) is a harmful secondary contaminant mainly because of its oxidizing potential. Damage to the respiratory system, bronchitis, asthma, decreased lung function, and other lung illnesses are just some of the negative outcomes of prolonged exposure to this substance. Injury to the leaves, stunted development, and fewer flowers and fewer fruits are just some of the negative effects of this hazardous pollutant on plant health. NO2, a pollutant with a reddish-brown color and a strong odor that results from both natural and human activity, is another major factor. Sulfur dioxide (SO_2) is another pollutant entering the atmosphere due to human activities, mainly through burning coal and petroleum, affecting visibility due to the sulfur content in all types of fuel, and it degrades air quality, contributes significantly to the greenhouse effect, and is an irritant to the respiratory system [29]. The environment and living things are negatively impacted [1]. The risk of respiratory disorders in vulnerable populations is raised when SO_2 combines with particulate matter and moisture droplets, a process known as synergistic effects [1]. Many organic air pollutants, such as polycyclic aromatic hydrocarbons (PAHs), are released into the air when fossil fuels are burned incompletely in vehicles. These pollutants have detrimental effects on human health and the environment, including stunting plant growth, causing mutations, and inducing cancer in humans. Heavy metals are another class of harmful pollutants. Even at low concentrations, these metals are toxic, and they accumulate in the human body, causing serious health issues such as cardiovascular disease, lung disease, nervous system disorder, eye irritation, asthma, impaired lung function, and an increased long-term risk of cancer [7, 30]. Damage to natural water sources, nutrient leaching from soil, decreased crop production, forest damage, and changes in natural vegetation cover are just some of the negative outcomes of acid rain (pH less than 5), which is comprised of pollutants like sulfur dioxide and nitrogen oxides produced by a wide range of industrial activities.

3. Impact of Different Pollutants on Plant Species

The ability of various tree species to absorb PM 2.5 varies greatly [21]. Leaves of many tree species have the ability to collect dust, particles, and other air pollutants. Leaves of trees with large, irregular circular cells on their surfaces can take in more of the harmful air pollutants that blow past them. Other tree species, especially those with rough surfaces or leaves with parallel veins, are also capable of absorbing large amounts of pollutants and thereby improving air quality. Because the tiny pores on the leaf surface allow gas exchange through the plant's physiological functions [22], some tree species are able to absorb a large quantity of pollutants off the upper leaf surface, albeit at lower levels, than other species. Trichomes, while present in many plant species, are not as efficient as stomata in trapping airborne toxins [21]. Large, rough, complexly shaped leaves with a high number of surface pores [21] are ideal for trees that aim to reduce air pollution. The dynamic diameter of coniferous (evergreen) trees is greater for particle absorption than that of broad-leaved (deciduous) trees, according to a study comparing the two types of trees. The diameter of particles absorbed by the leaves is affected by a number of parameters, including the microstructure of leaf surfaces and the length of time dust remains in the environment [22, 23].

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Air pollution has become a major global health concern in recent years; widespread tree planting is one of the most effective ways to lessen its impact. Trees may clean the air by absorbing toxins from the surrounding environment, as seen by the number 32. Determining which pollutants are being released into the air and where they're coming from is the first step towards minimizing air pollution. The next step is to quickly make plans to reduce the emission of these gases and particles [31-36]. Depending on the spatial layout, tree type planted, temperature conditions, and distance between vegetation cover and pollution sources [32], different plant species play a substantial role in lowering environmental pollutants such as NO_2 and O_3. Plants have been shown to minimize air pollution, although this benefit may come at the expense of the plants themselves. Pollutants in the air have different effects on different plant species due to their unique biological make-up, but in general, they impair plant functions and can even cause death, especially at high concentrations. Trees can be negatively impacted in a number of ways by various contaminants [7, 37]. Vegetation cover's ability to mitigate air pollution and enhance air quality is contingent on a number of variables, including local climate, tree density, and pollutant absorption capacities [32,38]. Pollutants in the form of gaseous particles fall on different areas of trees and are absorbed through the pores of the leaves, causing numerous biological reactions [32]. Pollutant accumulation on the leaves of trees in an ecosystem with poor ventilation is detrimental to plant life [32,39,40]. Some research suggests that open airflow mitigates air pollution in plant- and tree-free areas by boosting particle kinetic energy and aiding the swift transit of contaminants, as contrasted to forested areas [32]. Some plant species' tolerance, moderate tolerance, and sensitivity to O_3 pollution is shown in the table below.

Table 1. Tolerance of Plant Species to O_3 (Ozone) Pollution.

Sensitive	Moderately Tolerant	Tolerant
Catalpa spp.	Acer negundo	Abies balsamea
Fraxinus Americana	Cercis Canadensis	Abies concolor
Fraxinus pennsylvanica	Liquidambar styraciflua	Acer saccharum
Gleditsia triacanthos	Pinus echinata	Betula pendula
Juglans regia	Pinus sylvestris	Cornus florida
Liriodendron tulipifera	Quercus coccinea	Ginkgo biloba
Malus spp	Quercus velutina	Ilex spp
Pinus nigra	Syringa spp.	Juglans nigra
Pinus strobes	Ulmus parvifolia	Nyssa sylvatica
Pinus taeda		Picea abies
Pinus virginiana		Picea pungens
Platanus occidentalis		Pinus resinosa
Quercus alba		Pseudotsuga menziesii
Quercus palustris		Quercus robur
Salix babylonica		Quercus rubra
Sorbus aucuparia		Taxus spp
		Thuja spp
		Tilia Americana
		Tilia cordata

Planners are paying more attention to greenery planting as a technique of mitigating air pollution [17, 41–43] due to the proliferation of pollution sources. Trees and shrubs in these landscapes are chosen for their ability to thrive in the region's unique climatic, soil, and water conditions, as well as their other desirable qualities, such as their height, crown shape, root type, leaf structure, heat and cold resistance, and adaptability to a range of conditions. The hazards associated with pollution emissions are reduced, and air quality is enhanced, thanks to this [13].

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Table 2. Some Plant Species Tolerant, Moderately Tolerant, and Sensitive to NO_3.

Tolerant	Moderately Tolerant	Sensitive
Acer saccharinum	Acer negundo	Amelanchier spp
Ginkgo biloba	Acer rubrum	Betula spp
Juniperus spp	Pinus nigra	Fraxinus pennsylvanica
Picea pungens	Populus deltoids	Pinus strobes
Quercus palustris	Quercus alba	Populus nigra
Quercus rubra	Sorbus aucuparia	Salix nigra
Thuja spp.	Syringa spp	Ulmus parvifolia
Tilia cordata	Tilia Americana	Ulmus americana

Continuous absorption of these particles nonetheless causes severe damage to plants, even if retention of 10 PM and 2.5 PM by the leaf stomata leads to lower concentrations in the environment [17, 41, 44]. Due to their symbiotic association with algae and fungi and their propensity to concentrate contaminants, lichens have been employed as bioindicators to assess air pollution. The ability of lichens to filter out airborne contaminants has made them a useful indicator of environmental health [10, 45]. Pollutants in the air can be removed by planting trees and green spaces in extremely polluted urban areas, according to studies, and the resulting pockets of clean air can be trapped between the trees. Because of this, polycyclic aromatic hydrocarbon concentrations may rise relative to ambient levels. Deposition and absorption of O_3 by trees in urban forests have been linked to reduced O3 levels compared to non-vegetated regions, mitigating the harmful health impacts of this pollutant [32].

Conclusion

Pollutants in the air can be removed by planting trees and green spaces in extremely polluted urban areas, according to studies, and the resulting pockets of clean air can be trapped between the trees . Trees and shrubs in these landscapes are chosen for their ability to thrive in the region's unique climatic, soil, and water conditions, as well as their other desirable qualities, such as their height, crown shape, root type, leaf structure, heat and cold resistance, and adaptability to a range of conditions .

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