ENVIRONMENTAL POLLUTANTS-EFFECT ON PLANTS AND ANIMALS

Dr. Rakesh Kumar Dubey

Assistant Professor, Department of Chemistry, Govt. College, Gangapur City Rajasthan, India

ABSTRACT

Environmental pollutants—such as sulfur dioxide, nitrogen oxides, ground-level ozone, acid rain, and heavy metals—severely damage the physiological, morphological, and reproductive health of both plants and animals. [1, 2]

Effects on Plants

- Photosynthesis and Gas Exchange: Pollutants clog or shrink stomata (leaf pores), which blocks carbon dioxide uptake and slows down photosynthesis. [1, 2]
- Leaf Damage and Chlorosis: Ground-level ozone and acidic gases cause yellowing (chlorosis), tissue death (necrosis), and early leaf drop. [1, 2]
- Root and Nutrient Impairment: Acid rain and soil pollution leach out essential nutrients while releasing toxic aluminum ions that damage root structures. [1, 2]
- Stunted Growth and Crop Loss: Oxidative stress damages plant cells and DNA, resulting in reduced agricultural yields for staples like wheat and soybeans. [1, 2]
- Species Imbalance: Excess nitrogen deposition favors fast-growing, tolerant weeds and mosses while choking out sensitive native plants, lichens, and fungi

Effects on Animals

- Respiratory and Organ Damage: Airborne particulates and toxic gases (like carbon monoxide and ammonia) irritate respiratory tracts, cause lung stress, and lead to organ damage. [1, 2, 3]
- Reproductive Failure and Endocrine Disruption: Chemical pollutants and pesticides act as endocrine disruptors, altering mating habits, lowering fertility rates, and causing birth defects. [1, 2, 3]
- Aquatic Ecosystem Collapse: Acid rain and heavy metal runoff lower water pH and introduce toxic aluminum, killing fish, amphibians, and aquatic invertebrates. [1, 2]
- Bioaccumulation: Persistent toxins (such as mercury, lead, and organochlorines like DDT) build up through the food chain, causing neurological disorders and death in top predators. [1, 2, 3]
- Habitat Destruction and Plastic Ingestion: Land and marine pollution (especially plastics) cause physical blockages, starvation, and large-scale biodiversity loss. [1, 2]

KEYWORDS- environment pollutants,plants,animals, effect, health

INTRODUCTION

1. Altered animal behavior

Pollutants have been shown in a growing number of studies to cause strange behavior in animals. Endocrine disruptors, heavy metals, and PCBs have a direct impact on animal social and mating behavior.

2. Diseases and Mortality

The impact is usually indirect, but it gradually kills animals by altering biological systems. Pollutants in the air impair endocrine function, harm organs, and reduce reproductive success. Long-term exposure to contaminants can boost neurodegenerative disease disorders.

3. Biodiversity loss

The fundamental structure and function of ecosystems are being altered by air pollution. Excess nitrogen deposition in the form of ammonia is one of the most significant stressors on biodiversity. Biodiversity is important for animals since its loss can trigger changes in the food chain and the extinction of some species. Moreover, the loss of biodiversity can potentially raise the danger of infectious illnesses.[1,2,3]

4. Change in species distribution

A shift in the abundance of a species can be caused by industrial air pollution. For example, increasing aluminum levels may cause:

Extinction of some fish species
Allowing bug species to thrive
Benefit ducks that feed on insects.
However, eagles, ospreys, and other fish-eating creatures may suffer as a result of this loss.

5. Eating Plants with Pollutants

When animals eat particulate-coated plants, they get Arsenic poisoning. In pets, lead poisoning causes pneumonia and a loss of appetite. Moreover, pesticides can cause difficulties breathing, drowsiness, muscular spasms, vomiting, and loss of coordination in animals.

Environment refers to the totality of all external factors and conditions that have an impact on a living thing's survival and growth. The effects of pollution on wildlife and human health are complex and affect many ecosystems and facets of civilization. Urbanization, industrialization, and the indiscriminate and improper use of chemicals, such as pesticides, have all accelerated environmental degradation and contamination, which has a negative impact on living things' health and created issues with residues in animal-derived foods. The impact of pollution on biotic components has been highlighted by recent developments in environmental-related toxicity in humans and animals as well as the rising frequency of chemical residue detection in food products. To solve the complex problems caused by environmental contamination, innovation and new mitigation techniques are essential.[4,5,6] The creation and use of cutting-edge technology, such as diverse bioremediation methods, are included. In order to bring about change and promote successful mitigation methods, public participation and awareness are essential. Governments, businesses, communities, and people must work together to address the problems that environmental degradation has created. We

can lessen pollution's harmful impacts on wildlife and human health, guaranteeing a healthier and more sustainable future for both the ecosystem and people, by implementing creative mitigation measures and giving sustainable practices priority.

DISCUSSION

Effects of Pollution on Plants

1) Reduced Photosynthesis and Growth

Photosynthesis, the very cornerstone of plant life, ensures growth and nourishment. This process is imperilled by particulate matter, ozone, sulphur dioxide, and nitrogen oxides. These agents often hamper the chlorophyll's absorption capability, derailing the natural process of converting light to chemical energy.

Furthermore, studies have illuminated that a 10% reduction in photosynthesis can lead to a consequential 5-8% decline in crop yield. For instance, nutrient-rich crops like soybeans have significantly reduced yield, even in mildly polluted environments. This highlights a concerning paradox, as plants help outdoor air quality while simultaneously being harmed by the pollutants they absorb.

2) Damage to Leaf Structure and Function

Air pollutants' insidious nature means they can settle onto the leaf surfaces, initiating a sequence of deleterious effects. The visible symptoms are manifold, from necrotic spots and premature leaf drop to yellowing and stippling. These damages disrupt essential functions like transpiration, making plants vulnerable to heat stress, nutrient deficiencies, and subsequent illnesses.[7,8,9]

3) Changes in Reproductive Success

From the larger perspective of an ecosystem's vitality, air pollution's effect on plant reproduction is severely unsettling. Pollutants can distort the structural integrity of pollens, debilitating their function. With compromised pollen health, plants face daunting challenges in reproduction. A cascading effect ensues, with herbivores facing food shortages, further affecting the predators that depend on them.

Examples of plant species affected in the US

In the US, certain plant species, like the Black Cherry, have displayed extensive foliar injury in areas with dense ozone concentrations. Another species, the Eastern White Pine, bears witness to the devastating effects of sulphur dioxide, with its needles showing evident signs of discolouration and damage.

In animals

Effects of Air Pollution on Animals

1) Respiratory Issues and Lung Damage

Drawing parallels to humans, animals too are victim to the respiratory onslaught posed by air pollutants. Chronic exposure can evoke myriad ailments, from bronchitis and asthma to irreversible lung damage. This has been observed across species, from pigeons in metropolitan areas to deer in more semi-urban locales.

2) Neurological Problems and Skin Irritations

As the realm of research broadens, evidence suggesting the neurotoxicity of certain air pollutants in animals is mounting. Urban birds, for example, have manifested alterations in their songs, which could impede mating rituals. On the dermatological front, particulate matter can trigger skin irritations, reducing the creature's overall fitness.

3) Disruption of Endocrine Function
Endocrine-disrupting chemicals (EDCs) in polluted air pose another grave threat. Animals exposed to these agents can experience hormonal imbalances, impacting reproduction, development, and survival. Notably, amphibians have displayed alarming vulnerabilities, with observed skewed sex ratios and limb deformities.

4) Increased Vulnerability to Diseases
The weakening of animal immune systems due to pollutants increases susceptibility to various diseases. A quintessential example lies in the amphibian populations of the US. With compromised immunity, these animals have succumbed to fungal diseases at an unprecedented rate, leading to sharp population declines.[10,11,12]

Examples of wildlife affected in the US
The US paints a grim portrait of wildlife affected by air pollution. Birds like sparrows and kestrels inhabiting urban territories have exhibited diminished hatch rates. Aquatic ecosystems haven't been spared either. Fish populations in areas like Chesapeake Bay grapple with the after-effects of nitrogen oxide emissions, leading to algal blooms and the subsequent depletion of oxygen, endangering marine life.

RESULTS

Ecosystems can become imbalanced from air pollution
Pollution particulates eventually fall back to earth, contaminating the soil
Air pollution creates acid rain, which can damage plants.
Acid rain also changes soil chemistry, which can alter plant growth.
Animals also get affected by air pollution – reproduction may get damaged, and reproductive anomalies may occur.
Furthermore, air pollution can also cause health and respiratory issues for animals.
Air pollution is also one of the major causes of global warming
Global warming can also lead to more destructive natural calamities such as storms and cyclones.[13,14,15]
Burning certain substances may release potentially carcinogenic substances.
Plants grown under air pollution respond to many changes—structural, functional, and morphological. Air pollutants reduce leaf area, yield of flowers, leaf length, and seed germination. Air pollution predominantly affects plant morphology and physiology [8].
Morphological Effects Related to Root, Seed, and Productivity
Zafar et al. [31] examined the impact of vehicle pollutants from diesel generators on Vinca rosea and Rue tuberose growth. After exposure to exhaust, pollutants significantly affected the root length, seed germination, seedling growth, and dry weight of seedlings of both species. Khalid et al. [32] studied the effect of air pollution on Calotropis procera characteristics. The inhibitory effect measured was related to photosynthetic pigments, stomatal conductance, and transpiration rate. Bell and Power [33] examined the impact of air pollution released from vehicle emissions on urban wild

species. NO2 is a toxic element that has a drastic effect on plant functions. NOx and ozone O3 adversely affect seed germination, radicle length, and stomatal conductance. Urban road dust consists of different types of heavy metals that affect many processes like transpiration, root, biomass, plant productivity, and total soluble protein of plants.

Morphological Effects on Leaf

Gaseous pollutants and PM absorbed by the plant leaf may clog the stomata. Air pollution also disturbs the seed germination rate, stomata, and pedicle length and affects plant growth [34]. Automobile pollution absorbed by the leaf surface causes necrosis and chlorosis in morphological regions and decreases the anatomical layer thickening by surviving under traffic stress [35]. Roadside plants exposed to air pollutants from vehicles can show reduced leaf area, stomatal function, and leaf numbers and increased epidermal cell numbers, branch length, and trichome length in plants [36]. Plant morphological damage is shown in the form of different diseases containing chlorosis, necrosis, and leaf burning in the plants at highly polluted stress areas. Significant reductions were demonstrated in leaf length, leaf width, leaf area, petiole length, and leaf attributes at polluted sites [37]. Many other effects, like reduction in leaf size, thinness in the cuticle of the leaf, and decreased stomatal density of Platanus orientalis due to air pollution, have been observed [38]. Plants' exposure to ozone causes leaf injury and white spots on the leaves, converting into brown necrosis spots. There are many symptoms shown by ozone absorption, including wilting, bleaching, and bronzing patterns in interveinal patches and the development of exceptional patterns on leaves [39]. Gaseous pollutants and PM affect the morphology of plants. Both leaf length and breadth were reduced under air pollution compared to non-polluted areas [38]. Morphological traits like leaf length, leaf area, stem length, branch number, stomatal damage, leaf injury, and leaf width were decreased in Malva parviflora at polluted sites compared to healthy environments. A reduction in leaf area was observed in plants located in unclean areas [40]. Shafiq et al. [41] examined the status of air pollutants on the productivity of trees. Some internal injuries and changes in physiological processes might alter plants at anatomical and morphological levels. Dry weight of leaves of Alstonia scholaris, Paullinia pinnate, Senna saimea, and Peltophorum ptrocaprum was reduced in a polluted environment. There are many morphological changes due to air pollution[16,17]

Pollution can cause morphological, physiological, biochemical, and genetic effects in plants. The tolerance ability of different plant species depends upon their biochemical processes. Air pollution absorbed by plants through leaves and soil predominantly affects these biochemical processes, and is reflected in plant morphology. Many biochemical, morphological, and genetic effects in plants have been noted in this review. Some plants can endure stress-polluted conditions. This review provides APTI values for plant species in air-polluted environments. The different plant species that have tolerance based on their APTI values are used to develop green belts in urban areas and mitigate air pollution. This study also contributes to our knowledge of the effects of pollution on plants and curing plant species using different strategies in the future

CONCLUSIONS

Effects of Pollution on People, Animals, and Plants

Pollution negatively impacts all forms of life, including humans, animals, and plants, in several ways:

Effects on People
Health Problems: Exposure to air, water, or soil pollution can cause respiratory diseases (like asthma), cardiovascular problems, allergies, and even cancer.
Contaminated Food and Water: Pollutants can enter the food chain causing food poisoning and other illnesses.
Mental Health: Noise and chemical pollution can lead to stress and mental health issues.
Effects on Animals
Habitat Damage: Pollution can destroy or degrade natural habitats, making it difficult for animals to survive.
Toxic Exposure: Ingesting or coming into contact with pollutants can cause sickness, reproductive failure, or death.
Food Chain Disruption: Pollutants accumulate up the food chain, affecting predators and prey.
Effects on Plants[18,19]
Growth Inhibition: Soil and air pollution can damage plant tissues and stunt growth.
Reduced Photosynthesis: Pollutants like smog reduce sunlight penetration, affecting photosynthesis.
Soil Contamination: Pollutants in soil can reduce nutrient availability and harm plant roots.
In summary, pollution harms living organisms by degrading their environments and directly causing health problems or death.

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