

Air Pollutants and their Impact on Plants

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ABSTRACT

In the modern world, more than 300 air polluting substances are emitted into the air which are increasing in number day by day due to the introduction of new manufacturing processes and technologies. The most common pollutants which causes injury in plants are ozone, sulfur dioxide, fluorides, chlorine, peroxy-acetyl nitrate (PAN), and ethylene. The impact of air pollutants on plants depends on the physiological and biochemical characteristics of the affected plant, the type of the pollutants. Due to toxic concentration of pollutant in air reductions of growth parameters in plants occur, such as height, diameter, leaf and root biomass, leaf area length and width of stomata, length of the stomatal pore, and stomatal density. These pollutants affect plants even at low concentrations (0.1 to 55 ppm) by causing chronic or acute injury.

INTRODUCTION

Environmental pollution is a product of anthropogenic activities. Any aerial substances that cause adverse effects on plants, animals or cultural assets are called air pollutants. In the modern world, more than 300 substances are emitted into the air and are recognized as air pollutants and they are increasing in number day by day due to the introduction of new manufacturing processes and technologies. A major source of pollutants is Airports, highways, and streets where motor

vehicle traffic is heavy, incinerators and refuse dumps, pulp and paper mills, as well as coal, gas, and petroleum-burning furnaces. The more important pollutants are ozone, sulfur dioxide, fluorides, chlorine, peroxy-acetyl nitrate (PAN), and ethylene. Other air pollutants include various fumes, odours, particulates (solids in smoke and dust), aerosols, salt spray, organic and inorganic acids, ammonia, carbon monoxide, hydrogen sulfide, aldehydes, oxides of nitrogen, tars, manufactured or illuminating

gas and the vapours or spray drift from hormone-type herbicides such as 2,4-D (Gheorghe and Barbu, 2011).

Impact of air pollutants on plant

Air pollutants impact the ecosystem by altering species composition and structure, rate of decomposition, growth and morphology, physiological processes, leaf function and foliar bioaccumulation of toxic chemicals (Agrios, 1969). The impact of air pollutants on plants depends on the physiological and biochemical characteristics of the affected plant, the type of the pollutants. Reductions in growth parameters such as height, diameter, leaf and root biomass, leaf area length and width of stomata, length of the stomatal pore, and stomatal density were recorded at sites with higher air pollution load.

These pollutants can also interact with biotic agents and plants and can influence the development of biotically caused plant diseases. First, air pollutants tend to decrease the incidence and severity of plant diseases caused by obligate parasitic biotic agents (rust, downy and powdery mildew fungi, many bacterial diseases, and viruses). Second, air pollutants tend to increase the incidence and severity of plant diseases caused by facultative biotic parasites (Ahmed, 2007). Certain root rots, trunk rots and leaf diseases that normally occur at low levels in young actively-growing vegetation are the most likely to increase in incidence due to interaction with sulfur dioxide and ozone (Laurence, 1980).

The extent of the damage caused by air pollutants depends on various factors such as:-

- a. Kind and concentration of the pollutant,
- b. Distance from the source,
- c. Length of exposure
- d. Meteorological conditions such as temperature, humidity, light and soil-moisture deficit,
- e. City size and location,

- f. Land topography and air drainage,
- g. Soil moisture and nutrient supply,
- h. Maturity of plant tissues,
- i. Age of Plant,
- j. Species and varieties (cultivars) of plants.

Symptoms caused by air pollutants

Damage symptoms caused by air pollutants vary with plants, which is used to determine the nature of air pollutants. All known pollutants that affect plants are sensitive even in low concentrations (0.1 to 55 ppm). Plant symptoms caused by air pollutants are expressed as chronic or acute, depending upon the extent of the injury. A chronic injury does not usually kill tissue while acute injury kills all or a portion of a leaf or needle.

S. No.	Air pollutant	Symptom	Damaging conc.	Resistant plant	Susceptible plant
1.	Ozone	Flecks (irregular spots of less than 1 mm diameter), stipples (small darkly pigmented areas of approximately 2-4 mm diameter), bronzing and reddening occur on leaf. Leaves appears as mottled spots which may be yellow, black or brown. Stunted Growth, flowering and bud formation are depressed.	0.02 to 0.04 ppm or more.	cotton, cucumber and pepper,	alfalfa, broccoli, carrot, citrus, marigold, oat, onion, peanut, potato, safflower, sweet potato, tobacco and tomato
2.	Sulphur dioxide	Dry, papery blotches of white to tan or straw-colour appear on leaves,	0.25-0.50 ppm or more	while cabbage, castor bean, citrus, corn, cucumber, onion, potato, rose and sorghum	amaranthus, apple, barley, carrot, cotton, eggplant, okra, mustard,

		In chronic injury brown to reddish-brown or black interveinal blotches occur. In case of acute injury greyish green water-soaked areas which later convert into marginal or inter-veinal areas of dead tissues occur on leaves			chilli, sunflower, pea, sweet potato, tomato and wheat
3.	Fluorides	Yellowish mottle to a wavy, reddish-brown or tan "scorching" at the leaf margins and tips of broadleaved plants, and a "tip burn" of grasses and conifers. Prematurely fruit drop in apple, apricot, citrus, fig, peach, plum, and prune. Fruits are softened or become necrotic at the blossom end.	10 to 150 ppm or more	cabbage, carrot, cotton, cucumber, eggplant, onion, potato, rose, soybean, spinach, sugarcane, tobacco and tomato.	alfalfa, apple, barley, corn, buckwheat, citrus, sorghum sweet potato and tulip
4.	Chlorine (Cl ₂)	In broadleaved leaves necrotic, bleached, or tan to brown lesions formed at	0.1 to 4.67 ppm or more	Begonia, chrysanthemum, cowpea, rye, eggplant, soybean and tobacco,	Alfalfa, amaranth, apple, grape, cucumber, sunflower, tobacco,

		leaf margins, tips, and between the principal veins. In grasses grasses, progressive streaking formed towards the main vein.			tomato and tulip.
5.	Peroxyacetyl Nitrate (PAN)	Collapse of tissue on the lower leaf surface. Leaf bronzing or silverying occurs which turns into bands or blotches	0.01 to 0.05 ppm for an hour or more exposure.	Apple, begonia, broccoli, cabbage, cauliflower, cotton, cucumber, onion, rye, sorghum, wheat.	Alfalfa, aster, carnation, celery, fennel, mint, mustard, potato, rose, spinach, sunflower, tobacco, tomato.
6.	Ethylene (H ₂ C-CH ₂)	Modifies the activities of plant hormones and growth regulators, affecting developing tissues and normal organ development without causing leaf-tissue collapse and necrosis. In broadleaved plants bud abscission, downward curling of the leaves and shoots (epinasty), followed by stunting of growth are occur.	-	Acacia, cabbage, calendula, clover, lettuce, oats, onion, radish, ryegrass, sorghum.	cotton, cowpea, cucumber, pea, peach, pepper, potato, sunflower, pea, sweet potato, tomato and tulip etc.

CONCLUSION

Air pollution is real, and it is adversely affecting human and plant health and jeopardizing the ecosystem. The causes are multidimensional due to increasing population, urbanization, and industrialization accompanied with increased energy consumption and economic growth along with weak regulation, deforestation, and climate change. Diseases and disorder, whether due to

biotic or abiotic factors pose a great threat to food security in all over world. This article highlighted major disorder symptoms and or signs resulting from major air polluting agents. There is no doubt that most of the symptoms caused by air pollutant are complex and morphologically similar to the symptoms caused by different biotic agents. That is why it becomes very important to know the difference between disease and disorder. So, we can

mange air pollution in sustainable manner and make environment clean.

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