

Impact of air pollution on vegetable crops

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Opinion

The importance of vegetables in human diet is well known. They are rich and comparatively cheaper source of vitamins and minerals. Their consumption in sufficient quantities provides taste, palatability and increases appetite and provides fair amount of fibers. Due to these reasons, the vegetables are rightly considered as 'Protective foods'. With the increasing awareness among people regarding importance of vegetables in 'Balanced diet', the consumption levels are increasing day by day. This coupled with ever increasing population of the country as a whole, result in scarcity of fresh vegetables in sufficient quantities to meet the overall demand of the people especially in urban/metro cities. Moreover, vegetables being perishable in nature need to be produced near the area of consumption. Therefore, in cities vegetables are grown in small kitchen gardens, pot, boxes or in open areas in the close vicinity of the cities. The common vegetables grown are being the ones in which freshness is of great importance from the stand point of edibility and food value, for example, tomato, beans, cabbage, lettuce, spinach, chilies, capsicum, knoll kohl, and root crops like carrot, radish etc. The main purpose of growing vegetables in homes and areas adjacent to the cities is to obtain fresh, clean and organic vegetables free from any residual toxic effects. Every effort had been made by the vegetable grower to ensure his kitchen garden produce free of chemicals. However, despite all the pain and care taken by the grower, the vegetables get affected by the environment which is polluted to a great extent. As a result of industrialization, urbanization and vehicular pollution, the concentration of toxic gases has reached at dangerous proportions thereby damaging human, animals as well as plants. The effects of air pollution gases on tender succulent vegetables are even more pronounced.

The vegetables may be injured following exposure to higher concentrations of various atmospheric pollutants. Prolonged exposure to lower concentrations may also result in plant damage. Injury appears progressively as leaf chlorosis (yellowing), necrosis (death), and restricted growth and yields. On occasion plants may be killed, but usually not until they have suffered persistent injury. However, plant damage by pollutants depends on meteorological factors leading to air stagnation, the presence of a pollution source, and the susceptibility of the plants. Less visible but still important is the fact that plants grown in polluted areas have fewer leaves and a smaller root system than do plants with healthy air. They also have reduced yields and often drop their leaves earlier in the season than healthier plants do. Symptoms of air pollution damage vary with the individual crops and plant age, specific pollutant, concentration, duration of exposure and environmental conditions.

Main air pollutant gases affecting vegetable crops are

I. Ozone: Ozone is formed by the action of sunlight on products of fuel combustion. It is moved from areas of high concentration (cities, heavy traffic areas) to nearby fields by wind. With continuing ozone exposure the symptoms of stippling, flecking, bronzing, and reddening are gradually replaced with chlorosis

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and necrosis. Common symptoms of O₃ injury are very small irregularly shaped spots that are dark brown to black or light tan to white on the upper leaf surface. Injury is usually more pronounced at the leaf tip and along the margins. Early ozone foliar damage can resemble severe spider mite injury. With severe damage, symptoms may extend to the lower leaf surface.

II. Peroxyacetyl nitrate: PAN is second most important source of pollution causing injuries to vegetable plants. PAN is most toxic to small plants and younger leaves, but leaves just forming and starting to open and the most mature leaves are less susceptible to PAN injury. Typically, it affects the under leaf surface of newly matured leaves and causes bronzing, glazing or silvering on the lower surface of sensitive leaf areas. Complete tissue collapse is diffuse band across the leaf is helpful in identify PAN injury.

III. Sulphur dioxide: SO₂ causes acute and chronic plant injury. Chronic injury is characterized by brownish-red, turgid or bleached white areas on the leaf are very sensitive. Damage symptoms to crops caused by SO₂ and its by-product sulphuric acid usually result in dry, papery, white or straw colored blotches. On some species, chronic injury causes brown to reddish brown or black blotches. Both the upper and lower leaf surfaces are affected. Leaf veins remain green. Young and middle-aged plants and leaves are most sensitive. Sensitivity is highest during days with bright sunlight and high relative humidity.

IV. Ethylene: Ethylene pollution influences the activities of plant hormones and growth regulators, which affect developing tissues and normal organ development, without causing leaf-tissue damage. Injury to broad-leaf plants occurs as a downward curling of the leaves and shoots (epinasty), followed by a stunting of growth. In high tunnels, which burn propane, kerosene or use motors that burn gasoline, that have poor or no ventilation, even minute amounts of this pollutant can cause severe damage to tomatoes. Tomato plants exposed to ethylene can develop plant twisting, defoliation, and bloom drop.

V. Chlorine: Injury from chlorine is usually of an acute type and is similar in pattern to SO₂ injury. Foliar necrosis and bleaching are common.

VI. Ammonia: Field injury from NH₃ has been primarily due to accidental spillage.

VII. Hydrochloric acid: It causes on acid-type burn. The usual

acute response is a bleaching of tissue. Leaves of lettuce, endive and escarole exhibit a tip burn that progresses toward the centre of the leaf and soon dries out. Tomato plants develop interveinal bronzing.

Air pollution injury in susceptible vegetable varieties develops under the following conditions or situations:

- I. Higher ozone levels (above 70 ppb) for a day or two when vegetable foliage is at a susceptible stage of growth.
- II. High levels of automobile exhausts. Crop injury is often visible on fields in close proximity to roads, especially with heavy summer weekend traffic.
- III. Humid conditions with cloudy, hazy overcast days and little breeze.
- IV. High concentration of pollutants at ground level and in low lying areas.
- V. Foggy conditions and heavy dews.

Relative sensitivity of vegetable crops to air pollution

S No.	Pollutant	Sensitive	Tolerant
1	Sulphur dioxide	Beans, Broccoli, Onion, Potato, Radish, Spinach, Sweet corn, Tomato	Beet, Cucumber, Lettuce, Carrot
2	Ozone	Beans, Broccoli, Onion, Potato, Radish, Spinach, Sweet corn, Tomato	Cucumber, Onion, Sweet corn, Pea, Cabbage
3	PAN	Bean, Celery, Lettuce, Pepper, Spinach, Tomato	Broccoli, Cabbage, Cauliflower, cucumber, onion, Radish, Squash
4	Chlorine	Onion, Radish, Sweet corn	Eggplant, Pepper, Bean, Tomato
5	Ammonia	Mustard	Tomato

Remedial measures to avoid injury to the vegetables from air pollution

- I. The key to avoiding air pollution injury is to grow only those vegetables in a prevailing environment which are found to be tolerant to specific air pollutant gases present in the area or locality.
- II. Certain fungicides such as thiophanate methyl (Topsin and others) offer some protection against ozone damage. Antioxidants such as ascorbic acid and EDU (ethylene diurea) have been tested as protectants against ozone damage and results are found to be promising.
- III. The people doing the vegetable gardening in a less-than-ideal place, the best thing they can possibly do is try to situate their kitchen garden as far away from a busy street or road as they can.
- IV. Plant some kind of hedge or build a fence to provide a physical barrier between kitchen garden and the source of pollution (this will also block out some noise and give you a bit of privacy, which is also nice).

V. Select only those varieties of vegetables that are tolerant to most common air pollutant gas in the prevailing area.

VI. Always remember to thoroughly wash any vegetables you use from a garden that has air quality problems before you eat them. Experts say your best bet is a one percent solution of plain old white vinegar diluted in water (that would be about a tablespoon in three pints of water).

VII. Dunk your veggies in the solution, then wash it off and enjoy. This way you can still grow vegetables in your less-than-ideal garden and don't have to worry about any potential health effects.

VIII. This way we can minimize the damaging effects of poor quality environment not only on vegetables we consumed, but also protect ourselves from the toxic gases entering our food chain (Figure 1) & (Figure 2).



Figure 1 Ozone injury on Potato and Watermelon.



Figure 2 Leaf burnt due to air pollution.

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None.

Conflicts of interest

The author declares there is no conflict of interest.