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Air pollution has adverse effects on vegetation including agricultural crops, ornamental plants and forest trees. Injury to plants by various air-borne pollutants such as suspended particulates, sulphur dioxide, hydrogen fluoride and photochemical oxidants, which are injected into the atmosphere from industrial operations aimed at the technological revolution have repercussions far beyond their immediate damaging effects. Vegetation on earth surface which is constantly exposed to contaminated air pervades not only cities but suburban and rural areas as well. Much has been made of man's contamination of his environment and the threat it poses to the very existence of the crops he depends upon for food and other necessities.

The life of plants is normally adapted to the environmental conditions. They live as the most appropriate forms, both evolved and survived under conditions of natural stresses. The normal plant's response to natural stresses change when an additional stress factor, such as air pollution, is imposed upon it. The relationship between plants and pollution is complex. The plant's response to a pollutant is an integrated response influenced by a number of environmental components - soil types, nutrient content of the soil, diseases, insects, climate, etc. The varied dimensions of the plant-pollutant relationship are continually unfolding as the problem is searched and attempts made to understand it.
Plants are stationary out-door individuals constantly exposed to various environmental hazards. They absorb and accumulate pollutants in their organs to a considerable extent. Many of these pollutants are toxic to the living cells and interfere to modify the regular metabolic pathway leading to large scale destruction of the vegetation and contribute to a major change in vegetation pattern and species richness in the industrial vicinity. The damaging effects of air pollutants on human beings and other animals too are far reaching, even though the animal systems tend to ameliorate the diverse effects of environment and internalize their effects to produce a stable internal environment with their balanced homeostatic mechanism that regulates the body function. Thus our mad rush towards the 'development' backfired and resulted in environmental contamination, to become a major menace to the survival of flora and fauna of our land and water.

Vegetation is ultimately responsible for the sustenance of life on our planet. Human beings indeed depend on agriculture for the production of food and cash crops from the onset of our civilization. However, agricultural production is day by day affected heavily by the adulterated environment. This is reflected in the low nutrient quality of the plant products and consequent ill effects on the health of the people and animals who depend upon these crops. The basic problem is to obtain satisfactory yield of uncontaminated agricultural products. There is, therefore, a need to
recognize the factors influencing the uptake of pollutants by
the plants and to understand the interference mechanisms by
which these phytotoxicants modify the normal metabolism of the
plant which ultimately affect the yield. Concern about the
impact of phytotoxic air pollutants on agricultural productivity
has increased markedly in the developed and developing
countries during the past several decades.

Large amounts and varieties of pollutants are introduced
into the air. The major pollutants, studied for their harmful
effects on various components of vegetation are sulphur
dioxide, suspended particulate matter, ozone, oxides of
nitrogen, peroxyacetyl nitrate and hydrogen fluoride. The most
phytotoxic contaminants are gaseous in nature. They may be
primary pollutants, toxic in the form in which they are emitted
from a source, or secondary, that is, created in the air as
a result of photochemical or other atmospheric chemical
reactions. Sulphur dioxide is probably the chief offender among
the primary and ozone among the secondary gaseous pollutants
(Leone, 1979).

Sulphur dioxide (SO\textsubscript{2}) is a pollutant gas to have adverse
effects on plant growth. And it is portrayed by many workers
that this phytotoxic gas interferes with plant metabolism and
causes acute injury which leads to severe crop loss (Haase
\textit{et al.}, 1980; Heggestad and Bennett, 1981; Marchwinska and
Kucharski, 1987). It is this pollutant whose effects have been
most thoroughly investigated (Mansfield, 1983).
**SO**₂ is one of the principal constituents of air pollutants. It is a non-inflammable, non-explosive, colourless gas that causes a taste sensation from 0.03 to 1.0 ppm concentration in air. At concentrations above 3.0 ppm the gas has a pungent irritating odour. Sulphur dioxide is partly converted to sulphur trioxide or sulphuric acid and its salts by photochemical and catalytic processes in the atmosphere. The oxides of sulphur in combination with particulate matter and moisture produce the most damaging effects attributed to atmospheric pollution.

The main source of this pollutant gas is the combustion of fossil fuels, especially coal for domestic purposes and power generation. The relative contributions to the sulphur emission from different sectors vary from country to country according to the fuel consumption pattern and sulphur content of the fuels. Another common source is the industrial sector. Emission of sulphur dioxide from industrial processes comes mainly from the metallurgical operations, the manufacturing of sulphuric acid and the paper and pulp industry. Among these anthropogenic sources, burning of fossil fuels for power generation alone contributes 60-70% of **SO**₂ to the atmosphere (Rao and Rao, 1989).

Sulphur dioxide is also a major contributor to acidification of our environment. Large quantities of sulphur dioxide in the atmosphere along with oxides of nitrogen react with moisture in the air to form sulphuric and nitric acids.
which fall as acid precipitation, the phenomenon known as 'acid rain'. In many parts of Scandinavia, Western Europe, Canada and U.S.A., rain becomes increasingly acidic. In India, incidents of acid rain have been reported from Bombay and Pune. The ecological impact of acid rain is quite serious as it affects vegetation and soil in many ways. Acid rain causes damages to leaves, accelerates leaf surface erosion and affects germination of seeds (Evans, 1984; Amthor, 1984). Similarly, the affected soil may become sterile since the plant nutrients such as potassium are gradually leached out of the soil and the population of beneficial micro-organisms and earthworms in the soil is reduced. These effects result in consequent vanishing of greenery.

The selective action of $SO_2$ on plant crops is very strong. It is phytotoxic at concentrations above 0.1 to 0.2 ppm. The gas produces two types of injury on the leaves of plants - acute and chronic, depending on the concentration and period of exposure. The acute injury burns marginal and interveinal areas of the affected leaves. These areas will develop a dull, water soaked appearance immediately after the exposure and subsequently they dry up and bleach to an ivory colour or brown to reddish brown colour in some species. Chronic injury is caused by the slow, long and continued absorption of sublethal amounts of the gas. Below about 0.04 ppm, it tends to be oxidized in the cells as rapidly as it is absorbed. Above about 0.4 ppm, acute injury occurs.
Sometimes temporary interference with photosynthesis, which is termed as 'invisible injury' may result (Rao and Rao, 1989). However, the actual mechanism by which sulphur dioxide affects the plant has not yet been thoroughly understood, though various explanations have been put forth by many workers (Malhotra and Khan, 1984; Saxe and Anderson, 1985).

Plants show varied response and tolerance to sulphur dioxide. Several attempts to establish sensitivity variation to sulphur dioxide pollution have been made through integrated field as well as laboratory exercises (Guderian and Stratmann, 1968; Boralkar and Chaphekar, 1980; Rao et al., 1981; Duek et al., 1987). The research results obtained from these studies are derived from field trials/surveys and through greenhouse studies under controlled conditions. It has proven difficult to isolate the effects of sulphur dioxide alone in field studies since the gas sometimes combines with other pollutants in the atmosphere. Therefore, as an effort to isolate the impacts of a single pollutant gas, like SO₂ with greater accuracy, laboratory fumigation of plants is desirable.

Evaluation of the effects of sulphur dioxide on several plants has been done by many workers from time to time (Bell et al., 1979; Agarwal et al. 1982, 1983; Heck, 1984). Reduction in growth is related to altered metabolism (interference with photosynthesis, respiration, lipid and protein biosynthesis etc.) exhibited by the plants resulting from the entry of this pollutant gas into the leaves through stomata (Pandey and
Rao, 1977). Also SO₂ is capable of forming certain phytotoxic chemicals such as sulphite ions in the mesophyll tissue, and thereby destroying the photosynthetic pigments. Degradation of chlorophyll pigment causes reduction in the rate of photosynthesis, which ultimately affects the growth and development of plants and ecological productivity including that of crops.

Many of our crop ecosystems are located on either side of highways, where heavy motor vehicles emit SO₂ into their surroundings. Also the agricultural fields in the urban boundaries and the industrial vicinity face a major threat from sulphur dioxide and acid rain as we switch to the use of sulphur-containing fuels in the power generation process. Thus concern about the impact of sulphur dioxide pollution on crop physiology and agricultural productivity has increased markedly the recent years.

The present study is an investigation of the impacts of sulphur dioxide on growth behaviour and physiology of a major cereal crop, wheat (*Triticum aestivum* L. var. Sonalika) and an oil seed crop, Mustard (*Brassica juncea* (L.) Coss. var. Pusabold). Both the crops, apart from their cultivation in the rural agricultural fields, are also cultivated in the open fields of the urban vicinity as well as sub-urban regions, where problems of sulphur dioxide pollution is prevailing. An investigation of the effects of sulphur dioxide alone is difficult since the plants are constantly exposed to a mixture
of different pollutants in those areas, for example as in case of the Ahmedabad scene. Hence, as a part of the impact assessment, fumigation experiments were carried out to isolate the effects of sulphur dioxide in greenhouse conditions.

The plants were raised in microplots (1 m² area) in greenhouse and fumigated with two concentrations, that is 1 ppm and 2 ppm of SO₂ on alternate days using a close-top fumigation chamber (1 m³ volume), starting from 30th day to 90th day of the plants growth. Analyses were made at regular intervals of time, through random sampling, to evaluate the morphological (both external and internal), physiological and biochemical alterations caused by the pollutant gas.