AIR POLLUTION IN VIRGINIA

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Air pollution, like sin and taxes, appears to have become a permanent part of our life.

In recent months, we have heard voices raised about possible damage to the ozone layer in the upper atmosphere by fluorocarbons and nitrogen fertilizers; we've heard gracious plenty about needed changes in the current laws governing vehicle-emission systems; and we've heard that 90% of the cancers of humans are caused by environmental factors, implying that everything we eat, drink, breathe or wear is contaminated. The concept of "spaceship earth" has focused attention on the fact that there are limitations on the ability of our environment to absorb and neutralize noxious pollutants.

Our primary concern, of course, is man and his continued existence. But man depends on plants directly and indirectly for his sustenance and comfort. Air pollution not only affects man directly but can cause considerable losses to both crop and other living plants.

The relationship of air pollution and plant damage did not receive much attention, except for occasional extreme cases such as the Copper Basin in Tennessee, until the mid-'40's. Damage from air pollutants in Los Angeles in the '50's really focused attention on the place of the automobile, the photochemical smog it produced and the resultant plant damage. Ozone was, and continues to be, the major problem in the Los Angeles area and similar problems are appearing in the industrial northeastern United States.

Ozone is one of two major air pollutants which will continue to cause problems in and around the industrial areas of the world. Nitrous oxide (NO) in exhaust fumes from gasoline-burning vehicles interacts with hydrocarbons and sunlight to produce nitrous dioxide, which is unstable, breaks down to permit a free atom of oxygen to produce O_3 or ozone. Ozone is a powerful oxidant, and as such, can burn tender tissue, both plant or animal.

Ozone is also a natural component of the upper atmosphere. Occasionally, turbulent storms can turn this layer down to touch the earth's surface, scorching sensitive plants if their leaves are in the right growth stage to be susceptible.

Sulphur dioxide is the other major air pollutant causing extensive plant damage across the United States. It has been estimated that more than 20 million tons of sulphur are discharged into the air every year in the United States, mostly in the form of sulphur dioxide.

It has only been in recent years that plant pathologists have begun to learn the full impact of these two air pollutants on plant growth. By enclosing test plants in outdoor chambers and filtering the air which enters

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the chamber, a striking thing happens - the plants growing in chambers where pollutants are excluded grew much taller and were considerably healthier than those growing in similar chambers where the ambient air persisted. Chronic air pollution, that is, the exposure of a plant to persistent, but low, levels of ozone or SO_2 over a long period of time, caused significant growth loss. Acute damage, caused by an unusually high level of air pollutant over a short period of time, in contrast, is almost immediately evident, since tissues are killed rapidly.

Coal-burning plants, which produce most of our SO_2, are also involved in a phenomenon known as "acid rain," where sulphuric and nitric acids, resulting from SO_2 and NO_2 in the air, has raised the acidity of rainfall and snowfall in Norway and Sweden, for example, to the point where some lakes and streams have become toxic to fish and other organisms. Recent investigations in the northeastern United States have indicated that similar changes are taking place in ponds and lakes there.

One of the more interesting developments of air pollution studies in the past few years is that samplers are finding high (often well above the 0.08 ppm National Air Quality Standard) ozone levels far from urban or industrial centers. They are also finding high levels of ozone at night, a pattern which was not expected to occur. Apparently, clouds of nitrous oxides and dioxides are carried at high levels from urban or industrial centers where they are produced, out of touch with the land surface, where they would disintegrate. En route, sunlight converts these gases to ozone and since all the nitrous oxides are utilized, and the ozone layer does not touch the earth, the ozone does not break down, and is carried great distances to rural areas.

What impact can the air pollutants and acid precipitation have on the nurseryman in the Northeast?

Acid precipitation can raise the pH of the nursery soils and in occasional cases, (where you may be close to a point source of SO_2) can cause growth retardation - plants take longer to grow to marketable size. Obvious spotting or burning of tender tissue - as most of you have seen at one time or another in Eastern white pine - can and does occur to seedlings in the nursery beds.

How does one determine air pollution damage?

1. Talk to someone with knowledge of local air pollution problems and symptoms.

   a. Photographic and written descriptions of symptoms desirable.

2. Check symptoms with publications - do they conform?

3. Microscopic examination of damaged tissues (eliminate possibility of insect or disease damage.

4. Checking nearby plants known to be susceptible to various pollutants (lichens, mosses, certain weeds) and garden plants. (Sensitive plants might be used as indicators - white pine varieties for ozone, gladiolus for fluorides).

5. Consider monitoring for suspected air pollutants by instruments.

6. Build a structure to exclude possible pollutants or move affected plants out of the area and see if they recover.

7. Move new plants, of known sensitivity to problem area, into the area to see if they are similarly affected.

8. Check weather records to determine patterns of cold fronts and large air mass transfer.

9. Consider foliar analysis as last resort (limited to metallic ions, sometimes to sulphur from SO_2).

Remember that local environmental conditions influence the degree of plant damage from air pollution: high humidity increases damage; poor vigor, due to drought, reduces damage; high soil calcium tends to reduce damage as does a high level of soil nutrients (particularly phosphorus in the case of O_3 in conifers). Also: interaction (synergism) between two different air pollutants (like O_3 and SO_2) can increase damage considerably.

Recent Developments: Better air pollutant monitoring instruments are being developed; DuPont has developed an anti-oxidant which can be sprayed on susceptible plants for protection (Du Pont DPX4891); recent studies have shown that damaging pollutants can be carried as far as several hundred miles; a list of indicator plants has been developed; extensive greenhouse fumigations have confirmed dose necessary to cause damage and to clarify attendant symptom expression; work started toward selecting resistant cultivars.

Problems Remaining: Determining "normal" background levels of ozone (it appears that .08 parts per million of ozone set as a national standard may be very close to the "normal" level of ozone in the air); future of air pollution abatement, in spite of efforts by EPA and industry, it appears that we will be unable to reduce the level of pollutants much below the current level in the foreseeable future without additional technological breakthroughs.