TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE WYOMING SOIL CONSERVATION SERVICE

Biology No. 34 December 1985

Subject: EFFECTS OF AIR POLLUTION ON VEGETATION[1/]

Plants may be used as air pollution detectives. Air pollution injury to plants generally becomes evident before visible effects can be noted on animals or materials such as paint, cloth, or metal.

Trees, shrubs, and other vegetation are nature's air fresheners. Enormous amounts of oxygen are released from plants to the air. By breathing in carbon dioxide and releasing it in the form of oxygen, plants sweeten the air. There is also a cooling effect to the atmosphere caused by loss of water from vegetation through transportation and evaporation.

Plants are dust traps. Twelve million tons of particulate matter—dust, grit cinders—are released into the atmosphere of the U.S. every year. The hairy leaf surfaces of plants catch falling particles and keep a steady rain of dust and dirt from saturating the air. In one large city, the dust count on the sheltered side of a planted area was 75% lower than a similar count on the windward side. Pores in the leaves also filter gaseous pollutants from the air.

Plants will not be harmed by the dust-catching and air-filtering functions up to a certain point. Plants that are tolerant to certain pollutants can be used close to the source to help reduce harmful chemicals from the air. We can make use of plants in urban and industrial planning, not only for beautification purposes, but also to combat pollution.

Following is a listing of air pollutants, showing sources, symptoms of plant injury, and plant response. This list should not be taken as an absolute basis for assessing plant responses to pollutants. Local variation must be anticipated because of genetic and other environmental factors.

1/ Taken in part from SCS Arizona Technical Note #1, 1973

SULFUR DIOXIDE (SO_2)

Sources:

Gases from smokestacks of industrial plants, particularly copper and iron smelters, chemical factories, and coal or oil burning electric power plants.

Symptoms:

Broad-leaved plants have dry, white to straw-colored marginal or interveinal blotches in leaves. Veins remain green. Yellowing and gradual bleaching is common. Conifers show brown of reddish-brown necrosis at tips of needles, with adjacent chlorosis. Grasses develop light tan to white streaks on either side of midvein. Sulfur dioxide injury may occur up to 20 to 30 miles or more from source, and at concentrations as low as 0.3 to 0.5 parts per million (ppm).

Plant Response:

Sensitive	Tolerant
Alfalfa	Austrian pine
American Elm	Black locust
Apple	Boxelder
Barley	Corn
Birch	English holly
Blackberry	English oak
Cabbage	Eastern cottonwood
Catalpa	Green ash
Cotton	Juniper
Douglas-fir	Onion
English walnut	Potato
Hawthorn	Privet
Jack pine	Quaking aspen
Lombardy poplar	Red maple
Pear	Red oak
Petunia	Sugar maple
Ponderosa pine	Western red cedar
Texas mulberry	White cedar
Tulip	White spruce
Western larch	
Wheat	
Willow	
Verbena	
Zinna	

FLOURIDES

Sources:

Emitted from the stacks of aluminum, fertilizer, and ceramics factories and spread by diffusion or carried by air currents. Usually very localized areas.

Symptoms:

Necrosis of the margins of broad-leaved plants and "tipburn" of grasses and conifer needles. A sharp reddish-brown band or yellowish line some-times occurs between living and dead tissue. Corn leaves develop a yellow mottling prior to typical burning. Stone fruit leaves develop "shot holes." Flourides will build up inside the plant, even in low air concentrations, until damage results. Some very sensitive plants (corn, peach, tulip) can be injured at very low concentrations, as low as 0.1 to 0.2 parts per billion.

Plant Response:

Sensitive	Tolerant
Barley	American elm
Black locust	Cotton
Citrus	Cornelian cherry
Corn	Flowering plum
Douglas-fir	Juniper
Flowering apricot	Modesto ash
Gladiolus	Rose
Grape	Russian olive
Green ash	Squash
Iris	Tomatoes
Larch	White spruce
Lombardy poplar	Willow
Peach	
Ponderosa pine	
Scotch pine	
Quaking aspen	
Tulip	

CHLORIDES

Sources:

Emitted from stacks of factories.

Symptoms:

Similar to sulfur dioxide injury in being marginal and interveinal. Broad-leaved plants have necrotic areas between veins that tend to be near leaf margins. Grasses have progressive streaking toward main vein in region between tip and point where grass leaf bends. Most susceptible plants will show symptoms when exposed for one hour at concentration from 0.46 to 4.67 ppm.

Plant Response:

Sensitive	Tolerant
Alfalfa	Arborvitae
Apple	Austrian pine
Ash	Balsam fir
Cherry	Birch
Corn	Black cherry
Onion	Norway maple
Radish	Norway spruce
Sunflower	Pear
White pine	Red oak
Zinna	Sugar maple

NITROGEN DIOXIDE (NO_2)

Sources:

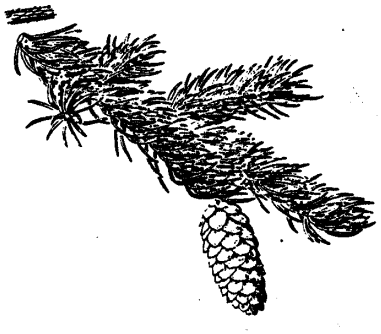
Produced by hot combustion sources (open fires, furnaces, automobile combustion chambers).

Symptoms:

Bleaching of marginal and interveinal tissues, similar to sulfur dioxide injury. Nitrogen dioxide in concentrations of two to three ppm causes bleaching.

Plant Response:

Sensitive	Tolerant
Apple	European larch (intermediate tolerance)
Austrian pine	
Beans	
Black locust	
Colorado spruce	
Dwarf mugho pine	
European elder	
Norway maple	
Pear	
Tomatoes	
White spruce	



OZONE (O_3)

Sources:

Produced by exhaust of automobiles and other internal combustion engines, coal, or other petroleum fuels. Sunlight is necessary for its formation; pollution generated ozone is often called a "photo chemical product."

Symptoms:

Causes tissue collapse, necrosis, and "stipple" markings on upper leaf surface (pigmented red-brown to black), flecking (bleached straw to white) and chlorosis or bronzing. Growth may be stunted, bud formation and flowering depressed, and early leaf drop may occur. Ozone injury is often in combination with oxidant damage or "smog." Levels are usually highest about mid-day and relatively low at night.

Plant Response:

Sensitive	Tolerant
Alder	Arborvitae
Alfalfa	Balsam fir
Aster	Black walnut
Austrian pine	Citrus
Beans	Colorado spruce
Black locust	Douglas-fir
Carnation	European mountain ash
Carrot	Geranium
European larch	Gladiolus
Gambel oak	Mint
Grape	Norway maple
Grasses	Norway spruce
Green ash	Pepper
Honey locust	Red Maple
Jack pine	Red oak
Lilac	Red pine
Onion	Singleleaf pinyon pine
Petunia	Sugar maple
Ponderosa pine	Sugar pine
Quaking aspen	Torrey pine
Radish	Western juniper
Scotch pine	White fir
Tomato	White spruce
Weeping willow	
White oak	

SMOG (PEROXYACETYL NITRATE) (PAN)

Sources:

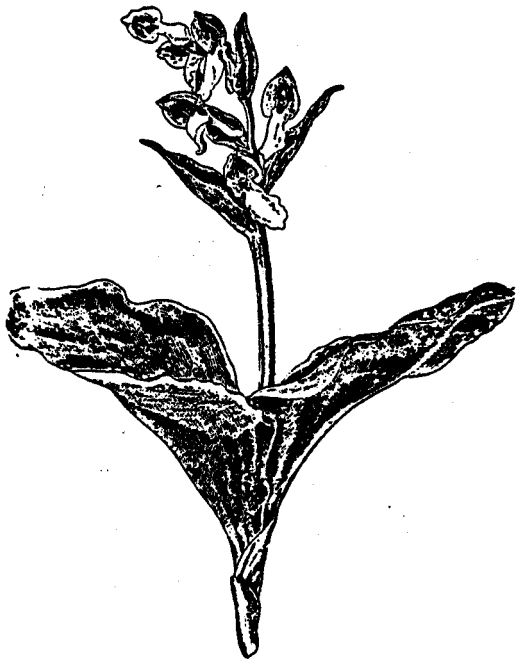
Serious air pollutant in areas of heavy vehicular traffic.

Symptoms:

Produces collapse of tissue of lower leaf surface. Broad-leaved species show silvering, glazing, or bronzing. Conifer leaves turn yellow. Grasses show bleaching. Stunting, early maturity, and leaf drop are common. Concentrations above 0.2 ppm are known to cause plant injury.

Plant Response:

Sensitive	Tolerant
Arborvitae	Grasses
Carnation	Lettuce
Cotton	
Cowpea	
Japanese holly	
Marigold	
Narcissus	
Orchids	
Roses	
Snapdragon	
Sweet pea	
Tomato	



PARTICULATE MATTER

Sources:

Plants near roads or factories introducing large amounts of dust particles into the air.

Symptoms:

Materials often interfere with the carbon dioxide absorption of the leaves by forming crusty deposits. Affected plants may become chlorotic, grow poorly, and even die.

Plant Response:

Broad-leaved plants with larger surfaces may be injured more than grasses, but particular location and plant species are variable.

Note: Parts of the material in this technical note were adapted from an article written by Einar Palm that was published in the January 1971 CROPS AND SOILS magazine.

Reference:

1. "Agriculture and the Environment"; Northeastern Pesticide Coordinators in cooperation with U.S. Department of Agriculture.

2. "Effects of Air Pollution on Vegetation"; Walter W. Heck.

3. "Facts From Our Environment"; Potash Institute of North America.

4. "Green Survival and the Environmental Crisis"; The American Association of Nurserymen, Inc.

5. "Our Air"; Forest Service, U.S. Department of Agriculture.

6. "What Air Pollution Does to Your Plants"; Crops and Soils Magazine, January 1971.

Prepared by:
Robert L. Tresler, SCS Agronomist (Retired)
Revised by:
Richard C. Rintamaki, State Biologist

State Resource Conservationist