TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE Boise, Idaho SOIL CONSERVATION SERVICE

TN - ENVIRONMENTAL QUALITY - 7 September 10, 1974

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EFFECTS OF AIR POLLUTION ON VEGETATION

Air pollution may result from natural phenomena such as forest fires, dust from windstorms, and ozone formation by lightning. Man contributes to pollution through industrial dusts and stack exhausts, automobile and engine exhausts, drifting and volatilizing pesticides. Air pollutants exist as gasses, vapors or particulates. They may affect the land, stunt or destroy crops, make livestock ill or reduce meat and milk production, and may cause extensive damage to many growing plants, and be injurious to the health and comfort of people.

"Air is our most vital resource, and its pollution is our most serious environmental problem," President Nixon said. Air pollution causes an estimated $500,000,000 in plant losses each year.

Planners need to be well informed on how to help with environmental problems. This technical note is a guide to help you in planning for vegetation in areas where air pollution is a hazard.

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 a 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 the 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 compendium of air pollutants, showing sources, symptoms of plant injury, and plant response. This came from personal observations and reports of many internationally known scientists. 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.

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 or 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	American elm
Apple	Austrian pine
Barley	Black locust
Birch	Box elder
Blackberry	Corn
Cabbage	English holly
Catalpa	English oak
Douglas fir	Eastern cottonwood
	Green Ash

Sensitive	Tolerant
English walnut	Juniper
Hawthorn	Onion
Lombardy poplar	Potato
Pear	Privet
Petunia	Quaking aspen
Ponderosa pine	Red maple
Tulip	Red oak
Wheat	Sugar maple
Willow	Western red cedar
Verbena	
Zinnia	

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 sometimes 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	Flowering plum
Corn	Juniper
Douglas-fir	Modesto ash
Flowering apricot	Rose
Gladiolus	Russian olive
Grape	Squash
Green ash	Tomatoes
Iris	Willow
Lombardy poplar	

Sensitive	Tolerant
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. Broadleaved 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
Zinnia	Red oak
	Sugar maple

NITROGEN DIOXIDE (NO_2)

Sources:

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

Plant Response: (Cont.)

Sensitive	Tolerant
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:

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

CHALLENGE FOR CONSERVATIONISTS

All of us need clean air. It is vital to our health, vital to agricultural production, and vital to a quality environment.

How then can we as resource conservationists, as practicing ecologists, contribute to resolving the problems in this area of great public concern? We can keep well informed, review our conservation practices, and assume leadership. We do not have to wait for something new. We can use knowledge and technology already available.

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

References:

1. "Agricluture and the Environment", Northeastern Pesticide Coordinators in cooperation with U.S. Dept. of Agriculture.
2. "Effects of Air Pollution on Vegetation", Walter W. Heck.
3. "Facts from Our Environment", Potash Institute of North America

References: (Cont.)

4. "Green Survival and the Environmental Crisis", The American Association of Nurserymen, Inc.
5. "Our Air", Forest Service, U.S. Dept. of Agriculture.
6. "What Air Pollution Does to Your Plants", Crops and Soils Magazine, January 1971.

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Roses	
Snapdragon	
Sweet pea	
Tomato	

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