Air Pollution

What Role Do Trees Play in Cleansing the Air?

By BRUCE R. ROBERTS and ALDEN M. TOWNSEND, Agricultural Research Service, U.S.D.A., Delaware, Ohio

Table 1. Foliar uptake of sulfur dioxide by woody plant species fumigated at 1.0 ppm for 1 hour.*

Species	SO_2 uptake (mg) Per unit area	Per unit weight
Red Maple	0.088[a]	0.260[a]
White birch	0.086[a]	0.268[a]
Sweetgum	0.074[ab]	0.267[a]
Firethorn	0.072[ab]	0.213[ab]
Privet	0.068[ab]	0.134[bc]
Rhododendron	0.056[ab]	0.079[c]
White ash	0.046[b]	0.118[c]
Azalea	0.044[b]	0.072[c]

***Values followed by different letters in the same column are significantly different at the 5% level.**

ONE DETRIMENTAL side-effect of the increasing energy demand in this country is the possibility of higher levels of air pollution. With more and more industries converting to coal as an alternative source of energy, the concentration of certain atmospheric pollutants, particularly sulfur dioxide (SO_2), will increase proportionately. Thus, despite our efforts now and in the future, a certain degree of air pollution is inevitable. The problem then becomes one of maintaining pollution at some acceptable level. This can be accomplished in two ways: (1) by controlling the source of pollution through proper legislation and surveillance; and (2) by maintaining an adequate and effective reservoir for existing pollutants. Much has been said and written about the former approach; let us look briefly at the latter possibility.

There are three naturally-occurring reservoirs for atmospheric contaminants: soil, water, and vegetation. Only in the past few years have scientists considered the potential ability of plants to influence air pollution levels. Recent

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research at the U.S. Department of Agriculture's Shade Tree and Ornamental Plants Laboratory has been directed at helping to understand the role of woody plants in influencing air quality.

Container-grown seedlings of white birch, red maple, white ash, sweetgum, rosebay rhododendron, kurume azalea, privet and firethorn were fumigated with SO_2 for one hour at a concentration of 1.0 ppm (Table 1). Fumigations were performed in a specially designed chamber under carefuly controlled environmental conditions. The results of this research indicate that maple, birch and sweetgum are capable of removing greater quantities of SO_2 from the air than are rhododendron, ash, and azalea. Privet and firethorn show an intermediate response.

Another investigation with the same group of plants shows that there is variation in SO_2 uptake at different pollutant concentrations. For example, white ash does not respond differently to SO_2 levels of 1.0, 0.5, and 0.2 ppm, whereas white birch takes up significantly less SO_2 at 0.2 ppm compared with uptake at higher concentrations. This variation probabaly reflects differences in stomatal response to SO_2, and is a problem which needs additional research. Significant variation was also demonstrated in the amount of ozone (O_3) absorbed by leaves of white oak, white birch, coliseum maple, sugar maple, redvein maple, red maple, Ohio buckeye, sweetgum and white ash (Table 2). Seedlings of each species were fumigated at 0.2 ppm in a plastic chamber contained inside a controlled environment room. In these experiments it was found that oak and birch remove the largest quantities of O_3 and red maple and ash, the least. The remaining species show an intermediate response.

Differences in O_3 uptake were also found to be significant among red maple seedlings from Pennsylvania, Minnesota, Maine, and Alabama. Seedlings from the Pennsylvania source demonstrated higher rates of O_3 uptake than red maple seedlings from the other locations. This information illustrates that it may be possible to select certain plants within a species which exhibit exceptional potential in removing gaseous pollutants from the air.

Although all of our research to date suggests that woody plants do, indeed, absorb contaminants from the air, the practical significance of this phenomenon is not yet clear. Despite predictions to the contrary, it seems unlikely that vegetation can significantly reduce high gaseous pollutant levels for long periods of time. However, it does seem probable that certain trees can have an influence on air quality if pollution levels are not too high. Thus, the strategic location of greenbelt plantings containing especially effective "sink" species may be an effective way to achieve acceptable air quality levels in localized areas.

Table 2. Rates of ozone uptake by various shade tree species from an atmosphere containing 0.2 ppm O_3.*

	O_3 uptake (mg)	
Species	Per unit area	Per unit weight
White ash	0.635[a]	1.318[b]
White birch	0.536[ab]	2.347[a]
Colesium maple	0.502[b]	0.991[c]
Sugar maple	0.371[c]	0.863[c]
Ohio buckeye	0.362[c]	0.927[c]
Redvein maple	0.285[cd]	0.911[c]
Sweetgum	0.278[cd]	0.854[c]
Red maple	0.272[cd]	0.555[d]
White ash	0.239[cd]	0.555[d]

***Values followed by different letters in the same column are significantly different at the 5% level.**