RESEARCH LABORATORY TECHNICAL REPORT

BARTLETT TREE EXPERTS
SCIENTIFIC TREE CARE SINCE 1907

Ozone

Air Pollution

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Ozone (O_3) is an air pollutant created by the action of sunlight on automobile and industrial exhaust, or from natural sources such as lightning. It is the most common air pollutant in the country and is especially prevalent within fifty miles of major cities. However, due to air quality regulations, levels of ozone are decreasing or remaining steady as compared to levels a decade ago.

Plant damage can occur when ozone levels are above sixty to eighty parts per billion (ppb) for four hours. Health alerts for people are usually issued when levels reach 100 to 120 ppb.

Figure 1: Ozone damage on a tulip poplar

Symptoms

Symptoms on broad-leaved trees vary with the degree of exposure and species. Moderate ozone levels typically result in chlorotic spotting or stippling (small spots) on the upper surface of the leaf between the smallest veins. Higher exposures result in red or purplish stippling on the upper leaf surface (Figure 1).

Symptoms typically do not include major veins and leaf margins and are more pronounced when leaves are in direct sun (Figure 2). If leaves overlap, the covered portion of the lower leaf may have fewer symptoms. Very severe symptoms include necrotic (brown or white) stippling, spots or blotches on sides of the leaf. Affected leaves frequently display fall colors early and drop prematurely.

The youngest fully expanded leaves are most susceptible. However, all mature leaves may be affected. Symptom severity depends on plant species (Table 1), weather conditions and ozone levels. There is more damage if the soil is moist and humidity is high during ozone exposure.

Table 1 – Sensitivity of trees and shrubs to ozone

Sensitive	Intermediate	Tolerant
American Sycamore	Dogwood	Oak (most species)
Blackberry	Hickory	Arborvitae
Tulip Poplar	Boxelder	Pine (most species)
Ash	White Oak	Spruce
Sweetgum *(Liquidambar)*	Pin Oak	Maple
Sassafras	Willow	Birch
Black Walnut	Ailanthus	
Bigleaf Linden	Linden	
'Imperial' Honeylocust	Hawthorne	
Fastigiate English Oak	Cotoneaster	
'Bloodgood' London Plane	Black Elder	
	Kentucky Coffeetree	
	Zelkova	

Diagnosis

Diagnosis of ozone injury is based solely on visible symptoms of damage. If leaf stippling is present on susceptible species, inspect indicator plants (Table 2) for symptoms. If symptoms are present on indicator plants, ozone is the likely causal agent (Figure 3). Also check for evidence of mites or sucking insects such as aphids, leafhoppers and lacebugs that can produce similar symptoms. Send leaf samples to the Bartlett Tree Research Laboratories for confirmation of your diagnosis.

Table 2 – Indicator plants for ozone

Tulip poplar
Sweetgum
Blackberry
Milkweed
Black cherry

Figure 3: Blackberry with ozone damage

Figure 2: Ozone injury on magnolia – notice the discoloration between the veins

Treatment

There are no specific treatments available for ozone damage. Maintaining high soil fertility levels may help suppress ozone symptoms. For very high value plantings, spraying sensitive plants with water during or immediately after exposure may reduce injury. In areas of chronically high ozone levels, consider planting resistant species.

Founded in 1926, The Bartlett Tree Research Laboratories is the research wing of Bartlett Tree Experts. Scientists here develop guidelines for all of the Company's services. The Lab also houses a state-of-the-art plant diagnostic clinic and provides vital technical support to Bartlett arborists and field staff for the benefit of our clients.