Ozone Air Pollution Effects to Native Plants of Southern Switzerland

Characteristics:
- **Objective:** To assess the sensitivity of different plant species to ambient air and determine and validate visible foliar ozone symptoms.
- To examine the seasonal long-term and cumulative ozone exposures required to induce visible foliar injury on native tree, shrub, and herb species in southern Switzerland.
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**Materials and Methods**

**Species investigated in 2000**
- Clematis spp.
- Crataegus monogyna
- Populus nigra
- Ribes alpinum
- Tilia cordata
- Viburnum lantana
- Viburnum opulus

**Planting design**
The sites are comprised of 12 plots:
- 4 Open Plots (100% ambient air)
- 4 Non-filtered Plots (96% ambient air)
- 4 Filtered Plots (54% ambient air)

Each plot contains three replications of each of the 12 species, totaling 36 plants per plot in the 2000 season.

**Ozone Monitoring**
Ozone concentrations were monitored from May 9 to October 25, 2000. Two minute air samples were taken from open plot 5 and each of the open top chambers using a Monitor Labs Model 8810 Ozone Analyzer.

**Data Collection**
The 2000 observation period began on May 5th and ended on August 24th. Initial leaf maturity dates following bud break were recorded for each species. The plants were examined frequently throughout the observation period to determine the date of initial visible foliar symptoms. All plants were observed macroscopically and potential symptoms were further examined using a 10x hand lens. Symptoms were mainly characterized as upper surface, intercellular stippling or reddening usually occurring on the eldest, lower leaves of the plant. Plants showing symptoms in non-filtered and ambient plots were compared to plants growing in the filtered chambers to confirm ozone as the cause of foliar injury. It is expected that the plants in the filtered chambers (54% ambient) would show symptoms later in the growing season as compared to the open and non-filtered plots.

**Results and Discussion**

**Ozone Monitoring**
Ozone concentrations were successfully monitored and the open-top chambers delivered 91% and 54% ambient air in the non-filtered and filtered chambers, respectively. A peak hourly ozone concentration of 128.5 ppb was recorded on June 3 during the 15:30-16:29 hour. Other frequent episodes during the growing season occurred with 24 hr average ozone exposures approaching 80ppb. Cumulative, hourly and daily values of ozone exposure were generated from the monitoring data.

**Symptom Progression**
Several species began expressing ozone-induced symptoms in the ambient and non-filtered treatments beginning in early to mid July. Symptoms of ozone were observed on 11 of 12 species evaluated in the 2000 season. The typical differences in “greensness” observed among the plants growing in the open and non-filtered treatments versus the filtered treatments were clearly evident as illustrated within figures 3-5.

It is important to note that symptom development during the first year of seedling establishment is difficult to evaluate due to the variety of stresses experienced by developing seedlings. Although symptoms were difficult to evaluate, the symptoms that did occur were very typical of ozone-induced injury. In addition, significant differences in “greensness” observed among the plants growing in the open and non-filtered treatments versus the filtered treatments were clearly evident as illustrated within figures 3-5.

**Literature Cited**

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**Figure 1.** Ozone Concentrations in Switzerland. Highest concentrations occur in southern Switzerland.

**Introduction**
Southern Switzerland experiences some of the highest concentrations of ozone in Europe (figure 1). Previous surveys in Canton Ticino have found ozone-like foliar symptoms on a variety of native trees, shrubs, and herbs (Skelly et al. 1999). Previous studies were conducted using the open-top chamber site at Vivaio Lattecaldo Cantonal Forestry Nursery in Ticino, Switzerland (figure 2). The site is located at 660m a.s.l. in the lower slopes of the Alps and is exposed to high ozone concentrations due to ideal meteorological and topographic characteristics. During the 1997 and 1998 field seasons, VanderHeyden et al. (2001) had confirmed visible ozone-induced foliar symptoms on 14 species of trees, herbs, and shrubs native to southern Switzerland.

As a follow-up, the current project at Lattelcaldo will evaluate 13 additional species of trees, shrubs, and herbs derived from surveys conducted by Skelly et al. (1999). This study began in May of 2000 and will continue throughout the 2001 growing season.

**Figure 2.** Open-top chamber site at Vivaio Lattecaldo Cantonal Forestry Nursery in Ticino, Switzerland.