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ATTACHMENTS:

**Project Leaders:**

| STATE | MEMBER | INSTITUTION | EXPERTISE |
|---|---|---|---|
| MA | W. Manning | U. of MA. (SAES) | Whole plant responses, growth analysis, EDU plant/$O_3$ interactions |
| MD | C. Mulchi | U. of MD. (SAES) | $CO_2/O_3$ interactions, carbon allocation/partitioning |
| NJ | B. Zilinskas | Rutgers U. (SAES) | Plant antioxidant systems, molecular biology, gene expression |
| NY | M. McGrath | Long Island (SAES) | Whole plant responses, $O_3$/disease interactions |
| PA | E. Pell | Penn. State (SAES) | Rubisco protein, senescence, gene expression, molecular biology |
| VA | B. Chevone | VA TECH (SAES) | Antioxidants, gas exchange processes, defense/repair proteins |
| MD | E. Lee<br>M. Robinson[1] | USDA/Beltsville | Antioxidant chemicals, natural antioxidants in plants; C/N relationships, ascorbate metabolism and intracellular transport |
| NC | J. Miller | USDA/N.C. State, Raleigh | $CO_2/O_3$ interactions, gas exchange, antioxidant systems, phenolic metabolism |

**Proposed New Members**

| | | | |
|---|---|---|---|
| AL | A. Chappelka | Auburn U. (SAES) | Whole plant responses, photosynthate allocation, ecosystem responses |
| MN | S. Krupa | U. Minn. (SAES) | Pollutant uptake, atmospheric transfer processes, exposure-response modeling |
| TX | R. Flagler | Texas A&M U. (SAES) | Carbon partitioning, gas exchange processes, EDU-plant/$O_3$ interactions |
| NY | J. Laurence[2]<br><br>J. Jacobson<br>D. McLean<br>M. Topea<br>D. Weinstein | BTI at Cornell U. | Whole plant and ecosystem responses, modeling plant responses to $O_3$, carbon partitioning and translocation, gas exchange processes, photosynthetic responses |
| OR | C. Andersen | USEPA at Corvallis | Whole plant responses, root physiology, mycorrhizal associations |

[1]Designated voting member

[2]Designated voting member and group contact

RESOURCES

## COOPERATING AG EXPERIMENT STATIONS

| State | SY | PY | TY |
|---|---|---|---|
| Massachusetts | 0.3 | 1.0 | 0.0 |
| Maryland | 0.7 | 0.3 | 0.9 |
| New Jersey | 0.15 | 0.0 | 0.5 |
| New York(C) | 0.2 | 0.0 | 0.2 |
| Pennsylvania | 0.4 | 0.0 | 0.5 |
| Virginia | 0.2 | 0.0 | 0.1 |
| Minnesota* | | | |
| Texas | 0.25 | 0.1 | 0.1 |
| Alabama | 0.1 | 0.1 | 0.0 |
| TOTAL | 2.3 | 1.5 | 2.3 |

*Decision delayed until end of fiscal year.

## COOPERATING INSTITUTES AND FEDERAL AGENCIES

| Unit | SY | PY | TY |
|---|---|---|---|
| ARS, Beltsville, MD | 2.2 | 1.0 | 3.5 |
| ARS, Raleigh, NC | 0.5 | 0.0 | 0.5 |
| USEPA, Corvallis, OR** | | | |
| Boyce-Thompson Institute, Cornell, NY** | — | — | — |
| TOTAL | 2.7 | 1.0 | 4.0 |

**Response pending.

Critical Review:

1. Work accomplished under the original project.

Review of Objective I: Characterize whole plant responses to ozone.

Whole plant experiments were conducted at several of the cooperating research stations since the initiation of NE-176 in October, 1990. At Maryland and USDA/Raleigh, open-top chambers were utilized in field experiments to investigate the interactive effects of ozone and elevated $CO_2$ on the growth and physiology of several crop species. At Maryland, soybean and wheat plants were grown to maturity in atmospheres containing increasing $CO_2$ concentrations ranging from ambient (350) to 500 ul $L^{-1}$ and ozone concentrations (7-hr mean) of 30 to 60 nl $L^{-1}$. High ozone levels reduced yields up to 20%, however, increased $CO_2$ concentrations alleviated the negative impact of ozone. At Raleigh, a similar protective effect of elevated $CO_2$ against ozone exposure was observed for soybean cv. Essex and white clover. The physio-logical basis for the $CO_2$-enhanced defense against ozone does not appear to be limited to stomatal closure alone. Rates of leaf photosynthesis were stimulated when plants were grown in $CO_2$-enriched atmospheres, even in the presence of moderate levels of ozone. Ozone exposure resulted in only a minimal disruption of photosynthate translocation form leaves to other plant organs as evidenced by increased plant biomass and yield in response to elevated $CO_2$ in the presence of ozone.

A number of plant species of economic importance to the northeastern U.S. and other native species were studied for genetic variability in response to ozone at Massachusetts. Species included strawberry, cranberry, turfgrass, tomato, morning glory, browailia, white pine, aster, blackberry, and white clover. Plants were exposed to moderate concentrations of ozone, ranging from 50 to 100 ul $L^{-1}$, for durations of up to 60 days in greenhouse fumigation facilities or in field chambers. For most species investigated, a considerable range of ozone sensitivity was observed. In turfgrass, planting density affected ozone response. Greater intensity of ozone injury occurred for the sensitive cultivars when grown in a typical density than when grown in a sparse density.

Ethylene diurea (EDU) studies were continued at Massachusetts to further document the effect of the chemical on plant growth and it's protective capacity against ozone exposure. W. Manning (MA) is responsible for obtaining the current supply of EDU (not available commercially), conducting dose-response studies, and providing information on proper application for it's use by other scientists in NE-176. The urea portion of EDU was compared to the whole molecule for efficacy against ozone injury, using Bel-W3 and Bel-B tobacco seedlings. EDU protected all plants, whereas urea did not provide any protection and, instead, resulted in ozone injury on Bel-B tobacco, an ozone tolerant cultivar. A single foliar application of EDU (300 mg $L^{-1}$) protected leaves of several ozone-sensitive genotypes from injury for a 7-day period at peak ozone concentrations of 50 to 100 nl $L^{-1}$.