Editorial

A Role for Plant Pathologists in Global Climate Change Research

ROBERT I. BRUCK, Associate Professor, and STEVEN R. SHAFER, USDA-ARS, Assistant Professor, Department of Plant Pathology, North Carolina State University, Raleigh

Opportunities for plant disease research within programs dealing with global climate change was a major topic of discussion at the 1990 meeting of the APS Committee on Environmental Quality and Plant Health in Grand Rapids, Michigan. This area of scientific interest is so broad that every facet of plant science, from molecular biology to field ecology to applied crop production, can advance. The plant pathologists who take a broad view of their science will be among those to make significant contributions.

The prospect of global climate change has captured the attention of scientists and the informed public throughout the world. Human activities since the industrial revolution, particularly during the last 50 years, have changed the chemical characteristics of the earth's atmosphere. These alterations in turn may already be changing the climatological characteristics. Combustion of fossil fuels, deforestation, livestock and rice production, and other industrial and agricultural activities contribute to the buildup of carbon dioxide, carbon monoxide, nitrogen oxides, and methane in the troposphere. These and certain other gases are involved in the "greenhouse effect"—temperature increase caused by the trapping of radiant energy near the earth's surface. At the same time, chlorofluorocarbons released from aerosol products, refrigerants, and certain manufacturing processes not only may contribute to global warming but also may deplete the concentration of ozone in the stratosphere, permitting an increase in ultraviolet radiation (UV-B) at ground level. This UV-B may have deleterious effects on plant and animal life, as well as enhance the photochemical reactions that produce ozone in the troposphere, where it is a pollutant. Some climatological models predict net global warming of 2.8–5.2 C and an increase in global precipitation of 7.1–15.8% due to a doubling of atmospheric carbon dioxide, accompanied by a rise in sea level and changes in the temporal and spatial patterns of precipitation. Tropospheric pollutants could also increase. Clearly, the models are accompanied by uncertainties in many details, and alternative interpretations of climatological data suggest much smaller changes. If environmentally significant changes do occur, however, understanding the new environment will be a major scientific challenge. Changes in climate could have profound influences on the current distribution and characteristics of natural and agricultural ecosystems. Managers and policymakers will be faced with major reevaluations of previous decisions. Plant pathologists should be aggressive in providing reliable information upon which important agricultural and societal decisions will be based.

Consider not only a possible change in the geographic distribution of the world's crops, but a warmer environment as well, with changes in where and when the rain falls. Epidemiologists have long studied the impact of temperature, humidity, and rainfall on diseases. What are the implications of changes in these factors on a regional or global scale? For example, will the distribution of various races of wheat rusts necessarily coincide with a more northern wheat belt? Will the weeds that are often hosts for important plant parasites, as well as insects that are pathogen vectors, be more or less important than they are now? If parasites and their hosts are affected differently by the changes in the environment, what new problems might arise? How will pathogens modify plant responses to the environmental changes, and vice versa? What will be the impact on pesticide usage? Answers to such questions are critical to decisions that must be made—answers that will be developed from research on effects of trace gases, drought, UV-B, acid deposition, temperature, humidity, and a myriad of other factors on the molecular biology, growth, physiology, and ecology of plants and their interactions with pathogens and pests. Regardless of any ultimate change (or lack of change) in global climate, such efforts will clearly contribute to our understanding of plant responses to stress. These topics will be explored during a symposium on "Global Change and Plant Health" at the August APS meeting in St. Louis.

Plant pathologists are uniquely trained to study plant-parasite-environment relationships as integrated systems and must be prepared to guide research if these topics are to be fully understood. This preparation will, of course, require funds for research. In the United States, such funds may become available from the U.S. Department of Agriculture, the National Science Foundation, the Department of Energy, the Department of the Interior, the Environmental Protection Agency, the National Oceanic and Atmospheric Administration, and the National Aeronautics and Space Administration. Other governmental sources and private foundations will also be involved.

The venue of this research will be broader than that of "traditional" agricultural research. Private universities, national research laboratories, foundations, and industries, as well as researchers at the land-grant institutions and agricultural research stations, will be taking a close look at ecosystem research, including agroecosystem research. For example, the Department of Energy recently funded 19 plant science research initiatives addressing the effects of carbon dioxide enrichment on crop plants. Only one of these grants was awarded to a land-grant university. Research addressing pathogen and insect population dynamics and behavior must be represented in comprehensive studies of ecosystems. Therefore, plant pathologists must be full members of the research teams.

Although plant pathologists should be among the leaders in research on the impact of global climate change on ecosystems, caution should be exercised as we become involved. Our science is like all others—"hot" topics come and go. Politics and public perception affect the direction and funding of our science and its potential contributions to society. Funding for new directions in research may be increased at the expense of established and productive research in other topics, leaving talented scientists with diminished support. Plans for new allocations in the federal budget for specific research programs are susceptible to rapid change based on nonscience priorities. Many researchers are uneasy with such instability and may hesitate to offer their expertise. Moreover, some large "theme" research programs with specific objectives and reporting goals can hinder the expression of originality and talents of individual investigators. Thus, each plant pathologist who sees research and funding opportunities in the global climate change area should weigh his or her interests and possible contributions against the potential drawbacks of participating in committee-defined research. But unquestionably, research on the impact of climate change on plant diseases and their management in a changing environment will be conducted, and policy decisions and disease control strategies may be based in part on the results. Plant pathologists are obliged to see that the work is conducted and interpreted correctly.

Social, political, and economic changes in a "greenhouse world" will largely reflect shifts in national and global agricultural markets. The contributions to be made by plant pathologists could have major benefits to society. Many funding initiatives in global climate change are conducive for development of broad areas of cooperative, interdisciplinary, interinstitutional research. Professional plant pathologists should make the initial steps toward a proper role in understanding what is likely to be a major environmental issue of the 21st century.