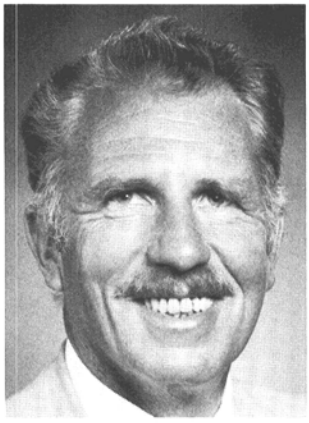
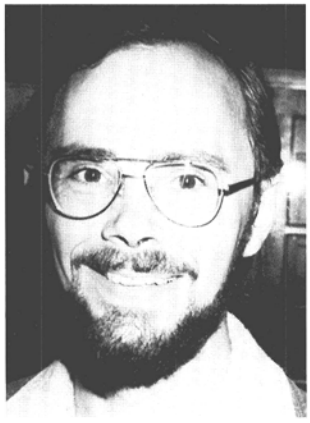
Editorial

The Education of Plant Pathologists in Biotechnology

A. R. WEINHOLD and T. J. MORRIS, Department of Plant Pathology, University of California, Berkeley



Dr. Weinhold



Dr. Morris

The training of plant pathologists is a challenge because of the breadth and diversity of the field. The development and increasing importance of biotechnology add to the complexity but do not significantly alter a fundamental set of problems that has existed for many years. The central consideration is how to ensure that a student has a functional understanding of the principles and practices of plant pathology and sufficient familiarity and skill with the latest research methods and approaches to bring to bear on essentially the same research problems faced by previous generations of plant pathologists. The student not only must master new research skills but also must apply those skills to a research problem in a subdiscipline of the field of plant pathology. This specialization usually entails applying the concepts and technology of another area of science to the problems and systems that constitute plant pathology.

In approaching this issue, we must appreciate that plant pathology is a distinct discipline that occupies a key position in both applied and basic biological science. The applied focus is derived from the fact that plant pathology plays a key role in the scientific effort to provide food and fiber for the world's population. Plant pathology also provides unique opportunities for fundamental research because it involves the interaction between at least two biological systems, the higher plant and the microbial or viral pathogen.

Because of the great potential for basic research in plant pathology to impact directly on problems of plant health and food production, plant pathology is one of the leading disciplines in the application of biotechnology. The opportunities and novel directions provided by the "new technology" necessitate some definition of the methodology and its potential applications to the field of plant pathology. The application of recombinant DNA methods to the study of plant pathogens and the study of host-pathogen interactions is a good example. Such methods have allowed plant pathologists to begin to elucidate the genetic basis of pathogen virulence and host resistance. Plant pathologists are now beginning to unravel the molecular basis of pathogenicity for bacterial, viral, and fungal pathogens. With better plant cell culture and fungal and plant transformation techniques, it should be only a matter of time before plant pathologists begin to witness the applied benefits of this basic research effort in the form of new disease-resistant plants. In the same context, monoclonal antibody and recombinant DNA methods have already begun to transform the area of pathogen detection and diagnosis. This, combined with improved computer-assisted data collection and analysis, means plant pathologists can expect a further revolution in the ecological and epidemiological areas as we begin to apply molecular techniques to better understand the basis for organism interaction.

The challenge, to the progressive plant pathologist, is to embrace these technological innovations and apply them with a sound understanding of important problems. The problem faced by plant pathology departments becomes one of balancing the necessity for traditional training in plant pathology with the need to incorporate exposure to and understanding of the latest methods in biotechnology without significantly altering the time frame of graduate study. The approach selected by the Department of Plant Pathology of the University of California at Berkeley is probably similar to that of many departments throughout the country. The first stage in developing a curriculum is to decide what constitutes the minimum core offering in plant pathology every student must take to qualify for a Ph.D. degree in the field. The second stage is to design courses in the appropriate subdisciplines that can be chosen by students according to their interests and career goals. Requirements for courses within the department must not be so heavy as to curtail opportunities to take courses and do research in an area of specialization.

We have recently restructured our course offerings to provide two four-unit semester courses that offer instruction on principles and general methodology of plant pathology and on fungi, bacteria, and viruses as plant pathogens. These two courses plus a three-unit course on epidemiology and control of plant disease and a four-unit course on diagnosis of plant disease constitute the plant pathology core. We also offer one- or two-unit courses on physiology of plant disease, genetics of plant-microbe interactions, advanced plant virology, advanced soil microbiology, molecular basis of plant disease, plant-pathogenic bacteria, and forest pathology. A student wishing to specialize in the molecular biology aspects of plant pathology would take the core courses plus courses on genetics of plant-microbe interactions, molecular basis of plant disease, and probably physiology of plant disease. This would constitute 20 semester units, and, depending on the adequacy of preparation, a student should not encounter any serious difficulties in taking additional courses in other disciplines, such as molecular biology, immunology, and computer science.

Essentially two avenues can be pursued in preparing a researcher to exploit the potential of biotechnology as a means of addressing central problems in plant pathology. One is to obtain a degree in plant pathology, with course work and research emphasis in biotechnology; the other is to obtain a degree in molecular biology or a related field. There is, of course, no clearly best answer, and one's preference depends on viewpoint and philosophy. We are biased toward the importance of training in plant pathology because without this background, identifying significant problems and keeping research in the proper plant pathology perspective can be difficult. Because graduate programs in molecular biology seldom include exposure to plant pathology and because molecular biology cannot be studied in depth in a plant pathology department, we believe that in many instances a team approach toward research is most likely to be successful. In our department, such research teams often include postdoctoral fellows trained in molecular biology. This significantly increases the breadth of the program, and plant pathology graduate students obtain substantial benefit from interaction with these researchers.

One of the primary purposes of a plant pathology graduate program with specialization in the biotechnology area is to prepare individuals to effectively participate in a cooperative program. We do not feel that the purpose of our program should be to train biotechnologists. If they are to be competitive, however, all plant pathology students must be exposed to the latest methodologies. We are convinced that departments with graduate programs in plant pathology should not lose sight of the distinct features of the discipline and its position as a bridge between basic and applied research.