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Foreword

Plant Disease Epidemiology: Facing Challenges of the 21st Century

Plant disease epidemiology deals with diseases in plant populations. During the past century, it has become a vibrant field of science, achieving significant conceptual innovations with important impact on the management of plant diseases. Plant disease epidemiology mobilises concepts and methods from ecology, genetics, environmental physics, botany, and mathematics. It deals with cultivated and non-cultivated plants in environments where human activities have had large, or lesser, impact. As in many other fields of science, plant disease epidemiology faces important, sometimes new, questions. By and large, many of these questions emerge from changes in human societies and changes in the status of the planet on which we live.

Global climate is changing at a rapid rate: will it render plant diseases more, or less, harmful to man-made and spontaneous ecosystems? There is much debate on this issue, because global climate has varying, sometimes very large effects on the local environment of growing plant canopies, and because the physical micro-environment and its variation strongly influence plant diseases and their consequences on ecosystem functioning and performance; in addition, changes in global climate trigger many profound changes in the way ecosystems, cultivated or not, are managed. Interestingly, much of the early literature on botanical epidemiology dealt with climate-disease or climate-pathogen relationships – in fact these kinds of relationships have long been perceived as the bulk of epidemiological research by many. Plant disease epidemiologists thus have a strong scientific tradition in studying climate-pathogen-disease relationships. Can such an asset be mobilised by the epidemiological community to answer questions about the effect of climate change on plant diseases?

Global trade, and thus, trade of plant products, have increased at an unprecedented rate during the 20th century, and will continue to expand in the next century. Exchanges of plant materials at very different scales, local to global, have profound effects on plant diseases. Plant disease epidemiologists have become experts in assessing the risk of irruption of novel pathogens in plant communities, the consequences it may have on ecosystems, and ways to manage such perturbations. The concepts related to biological invasions or population displacements certainly are not new to plant pathologists: the epidemiological community in fact contributed to craft them in the past century. New threats may now also exist, whereby exotic or novel plant pathogens would intentionally be introduced: these threats must be dealt with. The consequences of plant pathogen transport are many: on local performances of spontaneous ecosystems and agricultural ecosystems; on farmers' livelihoods; on local, national, and regional economies; and perhaps more importantly, they can have adverse consequences on trade regulation. Will plant disease epidemiologists provide answers to such pressing questions?

Biodiversity, a buzzword of the past century, is also of global concern. The decline in global biodiversity that is currently taking place has been referred to as the sixth great extinction process our planet has experienced during its history, but this time, it is man-made. Generations of plant pathologists, and especially of plant disease epidemiologists, have been dealing with biodiversity. The huge diversity of life that resides in the rhizosphere and the phyllosphere are causes both of diseases in plants, and of their suppression. Much current research is addressing ways of harnessing such biodiversity not as enemies – of which pathogens are an inherent part – but rather as important biological allies to control disease epidemics. The diversity of plants is another facet of global biodiversity, and there are concerns about the decline in the genetic diversity of crop plants. It is from this diversity that possibly the most potent

instrument for disease management has been developed by plant pathologists: genetic host plant resistance. Will we run short of resistance genes against major plant pathogens? Host plant diversity, and the disease resistance genes it harbours, can be deployed over time and space, according to epidemiological principles. In-depth knowledge of the characteristics of individual pathogens causing specific diseases that must be controlled has been mobilised to develop appropriate strategies at the plant population, field, landscape, and sub-regional levels. Major successes have been achieved using such strategies, and the end of the past century has seen their recognition by the scientific community. Will epidemiologists succeed in the future in fully sharing these technologies with the farmer so that they are more fully utilised?

Food security was a central concern of the global agricultural research community in the middle of the 20th century, but apparently, not anymore. However, the world population still increases, and is expected to do so for several decades. One out of six human beings living on earth today suffers from lack of food. Many of today's poor live in cities, with no access to land and agriculture, and most of the projected increase in the world population will take place in the world's largest cities. Pests, including plant pathogens, cause losses in pre-harvest yield in the range of 20–40%; estimates of post-harvest losses are inadequate, but it is a fair assumption that they are often higher than 10 or 20%. Why are our estimates – the raison d'être of plant pathology – still so vague today? Seldom do economists currently address the issue of food security – why? Is it so that globalised exchanges, novel biological technologies, and the self-regulating mechanisms of trade, will be sufficient to fulfil the needs of future generations? Will these not have negative side-effects, and will they truly prevent the current over exploitation of natural resources, water and land in particular?

Sustainable production and crop protection systems need to be devised, which could exploit scarcer resources sparingly, and if possible enhance the resource base. Can these production and protection systems be designed so that they generate healthy, high-quality products that would find niche markets both locally and globally, and so provide farmers with the income they require, and offer consumers products that suit their needs and their incomes? Plant disease epidemiologists alone cannot provide answers to such questions, but certainly could significantly contribute to these new strategies.

The five-day International Plant Disease Epidemiology Workshop (held 10–15th April, 2005, in Landernau, France, the ninth of a series) reported in this special issue of the European Journal of Plant Pathology, obviously could not address all of these issues, and others, with all the depth good science demands. However it provided a unique opportunity for scientists interested in this field to meet and face challenging questions, contribute to animated debates, and reflect on the future development of the science of plant disease epidemiology.

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