

# Foreword

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Organic farming has its roots in ancient farming systems yet incorporates modern technology in its quest to feed, clothe, and shelter people while simultaneously preserving and protecting the planet. While the focus of consumer demand, and that of regulators defining organic standards, has often been on restricting pesticide use, in some cases leading farmers to focus on direct substitutes, the underlying principles of organic farming have placed much greater emphasis on system redesign and agroecology, or agroecosystem management, as approaches to regulate pests and diseases. This perspective can be applied from the large scale (field or habitat) down to the small scale (leaf surface or rhizosphere) when it comes to thinking about how ecological processes can help regulate pathogens and ensure soil and plant health.

Organic systems are difficult to study because the components are highly interconnected and vary in time and space. Therefore, much of what is known about modern organic farming comes from tradition and local experimentation by individual farmers. Agricultural scientists have arrived somewhat late to the party as interest during the last several decades has shifted from a focus on prescriptions to tackling intricate and difficult systems. This is particularly important for pest management, because pests are often a major constraint to the sustainability of organic farms. A great deal has been learned in the past 40 years about the biology, ecology, and management of weeds, insect pests, and pathogens in organic systems.

Substantive knowledge is scattered among many books, websites, videos, magazines, and other sources of information. Conjecture, unsubstantiated opinion, and questionable products and practices are also widespread. It is important to bring substantive information, derived through knowledgeable observation and formal and informal experimentation, together in one place above the noise of our current information age. This book is a comprehensive treatment of past and current knowledge of diseases in organic production systems and approaches to manage them sustainably.

This book covers the subject from several angles. For example, the topic of suppressive soils to control soilborne diseases has been explored by a number of researchers but is less well recognized in production practice. If soilborne pathogens can be controlled by other soil microorganisms (antagonists) in a biologically rich soil ecosystem, then their potential to cause a significant disease outbreak can be reduced. The addition of microbe-rich composts to soils has been shown to enhance disease suppressiveness and is actively used by some organic growers to control soilborne diseases, particularly in protected culture of crops like cucumbers and tomatoes in which rotational options are limited. The use of this soil ecosystem management approach is much more consistent with organic principles than soil sterilization to control disease buildup, even if acceptable sterilization options such as steam can be identified.

A particular focus is the use of biodiversity, including functional and genetic diversity, as a strategy to reduce disease pressures and maintain crop health. While rotations are traditionally seen as important in organic crop production, they are effective in controlling primarily soilborne rather than airborne pathogens, although they may have some role in separating sensitive crops at a landscape level. The use of species mixtures (polycultures), cultivar mixtures, and composite cross populations to slow pathogen spread, by placing plants with differing resistance in close proximity to each other, shows particular promise for disease management.

Crop nutrition also has a major influence on disease susceptibility and resistance. While the literature is often more focused on diseases resulting from deficiency of specific nutrients, a situation that can occur on organic farms where input use is restricted, there has been less focus on diseases caused, directly or indirectly, by the oversupply of nutrients. In some cases, this may be because the oversupply of a major nutrient such as potassium in fertilizers and manures may suppress uptake of other nutrients and trace elements. In others, the uptake and storage by plants of surplus nitrogen in nitrate form can provide a ready nutrient reserve for pathogens to access and reproduce more rapidly. The increased requirement for fungicides under high nitrogen fertilizer regimes is well established. Less well recognized is the reduced pathogen incidence in organic crops caused by the restrictions on nitrogen fertilizer use.

Some disease problems, such as late blight (caused by *Phytophthora infestans*) in potatoes, have proved more intractable, and copper-based fungicides are still widely used to manage them on organic farms. Several research projects have attempted to identify alternatives to the use of copper because of its negative impacts on the environment and potentially on animal health. Agroecological approaches, including the use of microbial-rich compost extracts to modify the leaf-surface ecology and suppress the pathogen, field-level strategies to modify the microclimate by varying spacing and row direction, and the use of resistant cultivars, have not proved fully effective. Anecdotal reports of reduced spread of *P. infestans* in potatoes grown in agroforestry alleys have yet to be investigated more fully. Many of these management options are covered in the sections focusing on individual

crops, but there is also information on how to minimize copper use, where it does still need to be used, through improvements in timing, dose rates, and sprayer efficiency. Despite this, the search for alternative solutions needs to continue, because the prospect of a complete regulatory prohibition on copper compounds in organic farming remains high.

It is clear from this book that there has been a substantial development of the knowledge of disease control in organic crop production, much of which is highly relevant to other agroecological and even conventional management systems. Bringing this together in a single volume is a great achievement, but the challenge now is to ensure that the information can be shared with the hundreds of thousands of practitioners globally. The use of modern digital media to distribute information in targeted, bite-sized chunks, will be an essential companion to the richness of information contained here.