The disease DILEMMA

New gene data suggests various plant diseases are becoming more infectious, but chemical losses are forcing researchers to think outside the box when looking for new ways of controlling them. Fred Searle reports

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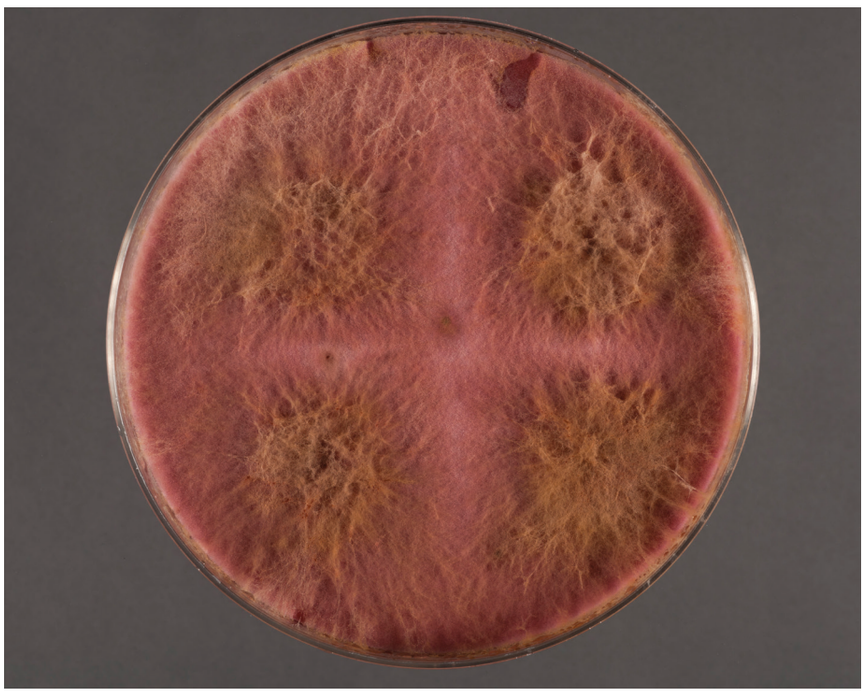


Whether you agree with various pesticide bans or not, crop protection is undoubtedly getting more complicated for many growers. The recent losses of widely used pesticides and herbicides such as chlorothalonil and diquat have forced the fresh produce industry to seek alternative products and control methods, and according to new research, the risk posed by some crop diseases is growing.

According to Rothamsted Research, which manages the world's only specialist database on the disease-causing genes of micro-organisms, discoveries of single mutations that increase microbe infectiousness have quadrupled since 2015. Far more microbes are one step away from becoming dangerous than was previously thought.

The scientists at Rothamsted say there has been a sharp rise in the number of laboratory studies showing how just a single mutation can create highly infectious or 'hypervirulent' strains of disease-causing bacteria, fungi and water moulds.

ABOVE—The soil-borne fungal disease Fusarium is problematic in a number of crops
OPPOSITE—PhD student Dion Garrett has been helping G's improve their aphid monitoring systems

These include the microbes responsible for human diseases such as TB and salmonellosis, as well as economically important crop diseases of fruits, vegetables and cereals. Writing in the journal Nucleic Acids Research, the team report that the number of such hypervirulence genes that have been found has risen from 112 in 2015, to the current total of 475.

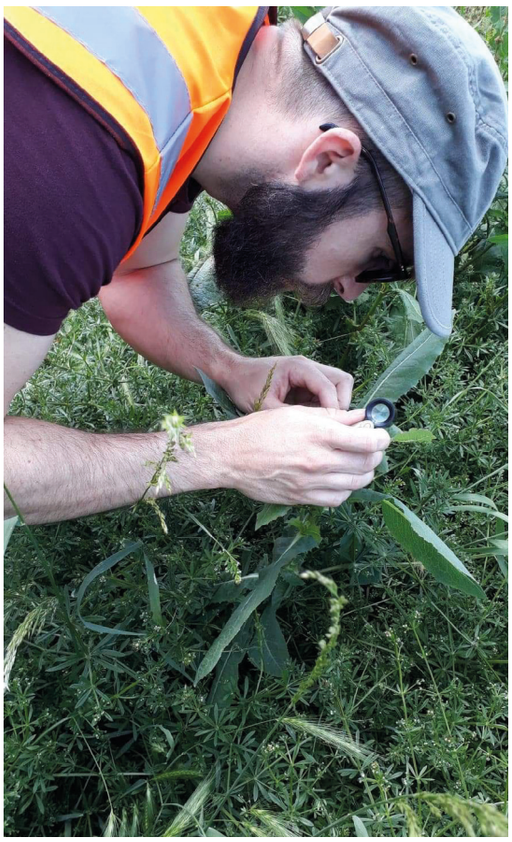
Plant pathologist and geneticist Dr Kim Hammond-Kosack, who oversees the database, says: "The increasing number of hypervirulent interactions indicates that scientists have identified many new factors occurring during infection. These genes need close monitoring if we are to halt the emergence and spread of severe disease outbreaks."

Infectious diseases are a consequence of the battles played out between the molecules produced by disease-causing organisms such as bacteria, fungi and water moulds – which allow them to overcome or evade host immune systems – and the host's own molecular defences, such as antibodies.

The increase in hypervirulence genes being discovered is partly down to genetic testing being faster and cheaper than ever before, allowing scientists to study more genes and more diseases in even greater detail.

But along with their colleagues in Cambridge, UK and Bangalore, India, the Rothamsted team also blame the increasing effects of climate change, human migration, and the global trade of fresh goods on the rise of disease problems.

In horticulture there is a whole range of research projects currently tackling some of these yield-battering diseases, however the solutions aren't always straightforward. The Waitrose Collabora-



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tive Training Partnership links leading fresh produce suppliers with academia to find solutions for growers in three main areas: sustainable crop production, sustainable soil and water, and biodiversity and ecosystems services in agriculture.

One project in the scheme is an investigation of current lettuce aphids by PhD student Dion Garrett. Working with G's in Cambridgeshire, he is exploring the genetics of aphid populations with the aim of discovering how the pest has evolved to overcome host plant resistance. "Dion's also been helping G's improve their monitoring systems for aphids in their salad crops, particularly in their organic production because aphids are harder to manage there," says Collier.

Another study, undertaken by University of Warwick student Tracey Moreton, together with plant pathologist Dr John Clarkson, is examining integrated control of Sclerotinia disease in celery and lettuce. The aim is to find alternative control methods to pesticides, of which there are few available to growers that are effective against this particular fungal pathogen.

Working with G's in Spain, one of the approaches Moreton is testing is solarisation – laying clear polythene across the soil to raise its temperature and potentially kill off the disease. In the lab she is also looking at the response of Sclerotinia to different temperatures. "Tracey is looking at the different strains of Sclerotinia in different places because they may be genetically different and may respond to different growing conditions in varying ways," says Warwick's Professor Rosemary Collier.

Likewise, AHDB says that "with the continuing loss of plant protection products for pest, disease and weed management", it is also placing a growing emphasis on integrated pest management (IPM) to ensure that crop yield and quality can be maintained while reducing environmental impacts. "Rather than a set of management prescriptions, we view IPM as a coordinated strategy of measures to prevent, detect and control crop pests, weeds and diseases," says AHDB's Paul Neve.

Prevention relies on approaches such as choosing pest and disease-resistant crop varieties; designing rotations to limit the build-up of pest and disease populations; environmental and habitat manipulation to limit pest pressure; and hygiene and biosecurity measures to limit pest introductions.

Meanwhile, detection involves the use of novel sensors, diagnostics and forecasting and prediction models to ensure early detection of pest and disease problems so that control strategies are timely and directed to where they are needed.

"Where detection technologies indicate that control is necessary chemical pesticides will remain a critical tool, but we see a greater role for biopesticides and other novel technologies, so that control does not become overly reliant on any single product or approach," Neve says.

With this is mind, AHDB has also been continuing with its SCEPTREplus research programme, which aims to identify new products or adapt the application methods or timing of existing ones to control particularly problematic pests and diseases. Those products could either be conventional pesticides or biopesticides. Some are totally new, while others might have so far only been approved for use on cereal crops.

Now in its fourth year, SCEPTREplus focuses on high-priority disease, pest and weed problems and each year crop associations are consulted on the key issues that need to be tackled. For its part, the University of Warwick – which is involved in the programme alongside RSK ADAS, NIAB EMR and Stockbridge Technology Centre – has explored control methods for aphids, asparagus beetle, onion thrips in leeks, Tuta absoluta (tomato leafminer) in greenhouses and bean seed fly.

"We've been having a lot of problems with bean seed fly because the most effective way of controlling it is with a seed treatment and there just aren't any new alternatives available at the moment," says Collier. "We're looking at alternative approaches in trying to manage it such as leaving it longer before you sow the crop since the flies are very attracted to newly cultivated soil." FPJ