HSPI The Open Access Publisher

JPSP JOURNAL OF PLANT SCIENCE AND PHYTOPATHOLOGY
ISSN 2575-0135

Opinion

Mitigation and adaptation to climate change of plant pathogens

Francesco Lops*

Department of Agriculture, Food, Natural Resources and Engineering (DAFNE), University of Foggia, Italy

More Information

***Address for Correspondence:** Francesco Lops, Department of Agriculture, Food, Natural Resources and Engineering (DAFNE), University of Foggia, Italy, Email: francesco.lops@unifg.it

Submitted: August 26, 2022
Approved: September 06, 2022
Published: September 07, 2022

How to cite this article: Lops F. Mitigation and adaptation to climate change of plant pathogens. J Plant Sci Phytopathol. 2022; 6: 101-102.

DOI: 10.29328/journal.jpsp.1001082

The impact of climate change on plant diseases poses a serious threat to food security [1-4]. Climate change has a direct effect on the occurrence and severity of disease in crops. Global plant health assessment and crop loss estimation due to pests and diseases has been made especially for cropping regions defined by the major crops of wheat, rice, maize, potato and soybean [5].

The literature shows that different pathosystems respond in different ways to climate change. Changing climate can affect plant-pathogen interactions by altering the life cycle of pathogens, expression of host resistance, disease epidemiology and severity of outbreaks, development of new races, virulence and distribution of geographical area of pathogens. Bebber, et al. [6] made a comprehensive review of reported latitudinal trends of the first reports of plant pests (in the broad sense) since 1960. In most cases there were movements poleward for arthropod pests, fungi, oomycetes and bacteria; exceptions seem to be nematodes and viruses, which appear to have moved to the equator. In the case of viruses, the trend seems to be reversed. Many viruses are vectored by insects in the Hemiptera and Thysanoptera where movement is most definitely poleward and one interpretation of these trends is that the movement of viruses lags behind that of their vectors [7].

Climate change not only has a direct effect on the occurrence and severity of disease in crops, but it also has a serious impact on global food security. The presence of mycotoxins in food is a major problem associated with food security and climate change in temperate countries. Paterson RRM and Lima N [8], argue that rising temperatures in developed countries with temperate climates, such as regions of Europe and the United States, can create favorable conditions for increased levels of mycotoxins in food.

For example, aflatoxins are carcinogenic mycotoxins produced by *Aspergillus flavus* and *A. parasiticus*, fungi found in areas with hot and humid climates. Rising temperatures and humidity linked to climate change contributed to the emergence of aflatoxins in southern Europe in the early 2000s and their continued spread northward ever since.

Successful biological invaders often show improved performance upon introduction to a new region. The traditional explanation for this phenomenon is that natural enemies (eg competitors, pathogens and predators) present in the native range are absent from the introduced range [9].

The increase in plant pests and diseases will lead to an increase in the use of plant protection products and consequently a greater risk of high exposure to pesticides through residues in food products [10,11]. Therefore, the risk of human exposure to high pesticide residues raises concerns that are expected to become more prevalent in the coming years.

The particular geographical location of some countries, (Italy for example), exposes them to be potentially profoundly affected by the effects of climate change, as demonstrated by the studies conducted [12] with serious consequences on agriculture and food safety in general.

The problem of climate change adds a further element of uncertainty to a production system that is already fragile by its nature. Knowledge of the influence of climate change on plant diseases is still limited, and most of the information derives from studies under controlled conditions relating to the role of individual meteorological variables or atmospheric components on the host, the pathogen, or on their interactions.

The evidence agrees that climate change can modify the infection process and the pathogen-plant relationships with predictable changes in the geographic distribution of the species, as well as host hopping phenomena "*Spillover*" of pathogens. This latter aspect is increasingly frequent following climate changes that weaken plants at the expense of natural resistance. Slippers B, et al. [13] report a classic example of "*host jumps*" which highlights the rapidity of diffusion of the wasting syndromes caused by Botryosphaeriaceae species, further accentuating the danger leading to consider them as real "*new phytosanitary emergencies*".

Furthermore, a warmer climate favors the survival of alien parasites against which plants have fewer defense mechanisms than native species. The example of the *Xylella fastidiosa* bacterium, studied for decades as a pathogen of vines and citrus fruits, is widely known but has recently been found to be responsible for a devastating epidemic of Apulian olive trees.

Therefore, especially in the most ecologically fragile areas, it becomes necessary to study the behavior and adaptation of pathogens to avoid further threats and propose the application of IoT alert systems, capable, through the use of low-energy technologies and long-range data transfer, to notify the arrival of the pest and minimize the risk of infections [14].

References

1. IPCC. Climate change 2007: Synthesis Report. Contribution of Working Group I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Pachauri RK, Reisinger A, (Eds) IPCC, Geneva, Switzerland. 2007.
2. Strange RN, Scott PR. Plant disease: a threat to global food security. Annu Rev Phytopathol. 2005;43:83-116. doi: 10.1146/annurev.phyto.43.113004.133839. PMID: 16078878.
3. Gregory PJ, Johnson SN, Newton AC, Ingram JS. Integrating pests and pathogens into the climate change/food security debate. J Exp Bot. 2009;60(10):2827-38. doi: 10.1093/jxb/erp080. Epub 2009 Apr 20. PMID: 19380424.
4. Chakraborty S, Newton AC. Climate change, plant diseases and food security: An overview. Plant Pathology. 2011; 60:2-14.
5. Savary S, Willocquet L, Pethybridge SJ, Esker P, McRoberts N, Nelson A. The global burden of pathogens and pests on major food crops. Nat Ecol Evol. 2019 Mar;3(3):430-439. doi: 10.1038/s41559-018-0793-y. Epub 2019 Feb 4. PMID: 30718852.
6. Bebber D, Ramotowski M, Gurr S. Crop pests and pathogens move polewards in a warming world. Nature Clim Change 3. 2013; 985–988. https://doi.org/10.1038/nclimate1990
7. Jeger MJ. The impact of climate change on disease in wild plant populations and communities. Plant Pathology. 2022; 71:111-130. https://doi.org/10.1111/ppa.13434
8. Paterson RRM, Lima N. How will climate change affectmycotoxins in food? Food Research International. 2010; 43:1902-1914.
9. Wolfe LM. Why alien invaders succeed: support for the escape-from-enemy hypothesis. Am Nat. 2002 Dec;160(6):705-11. doi: 10.1086/343872. PMID: 18707459.
10. Ghini R, Impacto potencial das mudanças climáticassobre o controle químico de doenças de plantas. In: Ghini R,Hamada E (Eds) Mudanças climáticas: Impactos sobre doençasde plantas no Brasil. Brasília DF. Embrapa. 2008; 323-331.
11. Miraglia M, Marvin HJ, Kleter GA, Battilani P, Brera C, Coni E, Cubadda F, Croci L, De Santis B, Dekkers S, Filippi L, Hutjes RW, Noordam MY, Pisante M, Piva G, Prandini A, Toti L, van den Born GJ, Vespermann A. Climate change and food safety: an emerging issue with special focus on Europe. Food Chem Toxicol. 2009 May;47(5):1009-21. doi: 10.1016/j.fct.2009.02.005. PMID: 19353812.
12. Spano D, Mereu V, Bacciu V, Marras S, Trabucco A, Adinolfi M, Barbato G, Bosello F, Breil M, Coppini G, Essenfelder A, Galluccio G, Lovato T, Marzi S, Masina S, Mercogliano P, Mysiak J, Noce S, Pal J, Reder A, Rianna G, Rizzo A, Santini M, Sini E, Staccione A, Villani V, Zavatarelli M. "Analisi dei rischi. Cambiamenti climatici in Italia". 2020. DOI: 10.25424/cmcc/analisi_del_rischio.
13. Slippers B, Stenlid J, Wingfield MJ. Emerging pathogens: fungal host jumps following anthropogenic introduction. Trends Ecol Evol. 2005 Aug;20(8):420-1. doi: 10.1016/j.tree.2005.05.002. PMID: 16701409.
14. Lops A, Labellarte A, Rotolo P, Sivo A, Lops F, Xylellaware: An Internet of Things system for early detection of Xylella fastidiosa in olive trees using sap flow sensors. Institute of Electrical and Electronics Engineers (in press). 2022.