THE SCIENCE WORLD
A Monthly e Magazine
ISSN:2583-2212
Popular Article
January, 2026 Vol.6(1), 286-290

Impact of Climate Change on Plant Disease Resistance

Alex Khalkho[1*], Shailbala Sharma[2], Manish Shyam[3], Jawade Chetali Prakash[4]
[1,2&4]Department of Plant Pathology, GB Pant University of Agriculture and Technology, Pantnagar (263145), Uttarakhand, India.
[3]AICRP on Small Millets, Regional Agriculture Research Station, Dindori, Madhya Pradesh – 481880, India.
DOI:10.5281/ScienceWorld.18453615

Abstract
Abiotic Stresses currently pose a great threat to agriculture, whereby the population to feed will reach up to 9 billion by 2050. It is very much of urgent need that this field should be given equal importance regarding the management strategies. The cutting down of trees is a crucial factor in regulating the global climate and should be taken as urgency criteria to reduce global warming and climate change.

Introduction

Climate change basically refers to the long-term change in weather patterns which includes temperature, precipitation, *etc.* which often refers to approximately 30 years of average (Dietz *et al.*, 2020). Recently, in the year 2018, the US National Climate Assessment concluded with the statement that "Earth's climate is now changing faster than at any point in the history of modern civilization, primarily as a result of human activities" (Jay *et al.*, 2018). Plant diseases impact food security and food safety. It was estimated that food production needs to increase by 50% to feed 9.3 billion people who will populate the Earth by 2050 (Alexandratos and Bruinsma, 2012). The climate of the globe has been changing drastically, CO_2 have been reported to have increased by 30%, and the temperature is also being reported to have increased by 0.3ºC to 0.6ºC, similar trends have been reported in the increasing amount of methane (CH_4) and nitrous oxide (N_2O) (Chakraborty *et al.*, 2000 and Ghini *et al.*, 2008). Changes in the hydrosphere, biosphere and other atmospheric compositions and their interacting factors. The major factors which regulate the occurrence of disease are; temperature, light, water and air. Climate change affects the vigour, rate of multiplication, survival, sporulation, direction, and distance of dispersal of inoculums, rate of spore germination and penetration of pathogens into the hosts. Climate change can also drive shifts in the geographical ranges of both pathogens and their host plants, thereby facilitating the spread of plant diseases into previously unaffected regions (Burdon *et al.,* 2020). Anthropogenic processes such as air, water and soil pollution may also enhance disease incidence, while long-distance introduction of exotic species and urbanization is also responsible for the same. Changing of the weather patterns can induce severe plant disease epidemics, which threaten food security if they affect staple crops present in that region and can damage landscapes if they affect amenity species (valued plant or animal species) (Ahanger *et al*., 2013).

Effect of Climate Change on Host and Plant Pathogen Interactions

By gene expression of the plant, they react to the environmental changes accordingly. Direct effect of climate change may be seen in the biology of the host, which may include, nitrogen and phenolic contents, starch contents, root and shoot biomass, number and size of leaves, amount and composition of wax on leaves, changes in stomatal densities, conductance and root exudation, early senescence, *etc.* Any changes in the above-mentioned contents/areas may influence the infection of the pathogen and also may enhance its colonization (Colhoun, 1972). The presence of genes in both host and pathogen, as in the gene-for-gene interaction, is affected drastically by climate change now. Abiotic stresses, activate and sometimes deactivate resistance, which in turn makes the host susceptible to specific pathogens (Elad and Pertot, 2014).

Major Factors for Abiotic Stresses

1. **Humidity Level**

Many fungal diseases depend on high humidity for successful spore germination and subsequent infection of host plants. Infection rates of *Sclerotinia sclerotiorum* in lettuce and the stem rot pathogen *Phytophthora sojae* are significantly higher under conditions of increased humidity (Singh *et al.,* 2023). Moisture on plant surfaces provides a favourable environment for pathogens to thrive and hinder crops (Nega, 2025).

2. **Elevated Temperature**

Temperature has a direct impact on pathogen life cycles, increasing growth and reproduction rates and increasing risk of disease outbreaks. Examples: wheat rust (*Puccinia triticina*) and coffee rust (*Hemileia vastatrix*), thrive in warm and humid environments, and their life cycles accelerate with the degree of rise in the temperature range (Nega, 2025).

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published 30/01/2026

3. Rainfall Pattern

Changes in rainfall patterns, including droughts and excessive rainfall. Drought stress weakens plants' defence system, which compromises their natural defence system and makes them more vulnerable to aggressive pathogens. The severity of several plant diseases including pea root rot (*Aphanomyces euteiches*), onion white rot (*Sclerotium cepivorum*), wheat take-all (*Gaeumannomyces graminis* var. *tritici*), wheat crown rot (*Fusarium* spp.), brassica black leg (*Leptosphaeria maculans*), and grapevine black foot (*Ilyonectria/Dactylonectria* spp.) increases with prolonged and more frequent drought conditions (Singh *et al.,* 2023).On the contrary, excessive rainfall and the resulting high humidity provide ideal conditions for the development and spread of fungal diseases (Nega, 2025).

4. Wind

As a natural dispersal agent, wind makes it easier for pathogen's spores to travel far. Therefore, the spatial distribution of these agricultural risks may be greatly impacted by changes in wind patterns brought by the climate change. As wind-driven dispersal increases their reach, areas that were previously unfit for specific pests or diseases and also because of temperature or other limiting conditions may become exposed (Nega, 2025)

5. Elevated carbon dioxide

Atmospheric CO_2 influences plant immune responses and phytohormone signalling pathways, thereby modulating plant–pathogen interactions. Variation in disease incidence under elevated carbon dioxide (CO_2) concentrations indicates that pathogen and host responses to CO_2 are highly specific. Increased CO_2 levels have been reported to enhance the severity of powdery mildew in cucurbits caused by *Sphaerotheca fuliginea*, as well as head blight and leaf blotch in wheat caused by *Fusarium* spp. and *Septoria tritici*, respectively (Singh *et al.,* 2023)

Classic Examples of Plant Diseases and Pests due to Climate Change

S. No.	Host	Causal Organism	Reason
1.	Rice	*Magnaporthe grisea*	High temperature
2.	Oak	*Phytophthora cinnamomi*	Elevation in temperature and precipitation.
3.	Coffee	*Leucoptera coffeella*	Elevated temperature
4.	Red Mapple	*Phyllosticta minima*	Elevated CO_2
5.	*Stylosanthes scabra*	*Colletotrichum gloeosporioides*	Elevated CO_2
6.	Wheat	*Puccinia recondita* f. sp. *tritici*	Elevated CO_2

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published 30/01/2026

7.	Potato	*Phytophthora infestatans*	lower C/N-ratio, and higher N-concentrations
8.	Cotton	*Rhizoctonia solani*	Elevated CO_2
9.	Coffee	*Hemileia vastatrix*	Warm and humid conditions
10.	Maize	Maize Lethal Necrosis Virus	Low humidity or drought
11.	Pepper	Fusarium oxysporum var. vasinfectum	Rising temperature and uneven rainfall
12.	*Arabidopsis*	*P. syringae*	Higher humidity

(Ghinni *et al.,* 2008 and Nega, 2025)

Management of Climate-Change Impacts on Plant Health

1. Use of landraces and wild types.
2. Plant protection organizations of a country, a state or a region should be prepared for outbreaks with proper management aspects.
3. The **surveillance, monitoring** and response to a pathogen affected by climate change is essentially the same as that to any pathogen of concern.
4. Breeding and Genetic Solutions: breeding and the use of modern gene-editing techniques like CRISPR, are providing crops with improved and durable resistance to emerging and established diseases that are gaining attention in new regions as the climate warms. Maintenance of biodiversity in crops and promoting genetic diversity across agricultural landscapes further reduces susceptibility to disease epidemics (Kumar and Mukhopadhyay, 2025).

References

Ahanger, R. A., Bhat, H. A., Bhat, T. A., Ganie, S. A., Lone, A. A., Wani, I. A., Ganai, S.A., Haq, S., Khan, O.A., Junaid, J.M. and Bhat, T.A. (2013). Impact of climate change on plant diseases. *International Journal of Modern Plant and Animal Sciences*, 1(3), 105-115.

Alexandratos, N., & Bruinsma, J. (2012). World agriculture towards 2030/2050: the 2012 revision.

Burdon, J. J. & Zhan, J. Climate change and disease in plant communities. *PLoS Biol.* 18, e3000949 (2020).

Chakraborty, S., Tiedemann, A. V., & Teng, P. S. (2000). Climate Change: potential impact on plant diseases. *Environmental pollution,* 108(3), 317-326.

Colhoun, J. C. (1972). Effects of environmental factors on plant diseases. *Annu. Rev. Phytopathol.,* 11: 343-364.

Dietz, T., Shwom, R. L., & Whitley, C. T. (2020). Climate change and society. *Annual Review of Sociology*, 46(1), 135-158.

Elad, Y., & Pertot, I. (2014). Climate change impacts on plant pathogens and plant diseases. *Journal of Crop Improvement*, *28*(1), 99-139.

Ghini, R., Hamada, E., & Bettiol, W. (2008). Climate change and plant diseases. *Scientia Agricola*, 65, 98-107.

Ghini, R., Hamada, E., & Bettiol, W. (2008). Climate change and plant diseases. *Scientia Agricola*, *65*, 98-107.

Jay A, Reidmiller DR, Avery CW, Barrie D, DeAngelo B. (2018). Overview. *In* Impacts, Risks, and Adaptation in the United States: *4th National Climate Assessment*, Vol. 2, ed. DR Reidmiller, CW Avery, DR Easterling, KE Kunkel, KLM Lewis, *et al.*, pp. 33–71. Washington, DC: *US Glob. Change Res. Program*.

Kumar, D., & Mukhopadhyay, R. (2025). Climate change and plant pathogens: Understanding dynamics, risks and mitigation strategies. *Plant Pathology*, 74(1), 59-68.

Nega, A. (2025). Climate change impacts on agriculture: A review of plant diseases and insect pests in Ethiopia and East Africa, with adaptation and mitigation strategies. *Advances in Agriculture*, *2025*(1), 5606701.

Singh, B. K., Delgado-Baquerizo, M., Egidi, E., Guirado, E., Leach, J. E., Liu, H., & Trivedi, P. (2023). Climate change impacts on plant pathogens, food security and paths forward. *Nature Reviews Microbiology*, *21*(10), 640-656.