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A REVIEW ON EFFECTS OF CLIMATE CHANGE ON PLANT DISEASES

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ABSTRACT

Increasing greenhouse gas emission to the atmosphere are causing global warming. The observed climate changes on the world during the last 50 years are mostly due to human activities. As the atmosphere's temperature and carbon dioxide levels increase, plants' physiological responses change, and crop disease severity worsens. As a consequence of host plant migration to new places, warming may promote agroclimatic zone alterations, leading in the establishment of novel disease complexes. Global temperatures have increased by around 0.9°C in the previous century, but by 2100, they are expected to climb by 0.8 to 3.6°C. Not only would such changes have an influence on crop growth as well as cultivation, but they will also have had an impact on the reproduction, distribution, or severity of a variety of plant diseases. To include more detailed climatic forecasts at different levels, several plant disease models have been created. Plant or pathogen population adaptation capacity may out to be one of most significant indicator of extents of weather change impacts at the population level. With appropriate examples, this paper emphasizes different impacts of weather changes on plants diseases or their consequences.

KEYWORDS:*Climate Changes, CO_2 GHG, Plants Diseases, Plant Pathogen, Temperature*.

1. INTRODUCTION

Climate changes are a significant ecological issue that affects the whole global Water vapours, carbon dioxide, methane, nitrous oxide, hydrofluorocarbons or ozone are examples of greenhouse gases (GHGs) that trap reflected energy and warm the earth's surface. Human activities have a large role in accelerating global climate changes, which has direct impacts on the environment. Global warming has been seen in India's west coast, middle India, interior peninsula, and northeast. As per the Intergovernmental Panel on Climate Changes, the earth's climate is changing, or atmospheric CO2 is a significant greenhouse gas (GHG) that has grown by over 31percentage points increasing temperature by 0.4-0.8°C. Climate change occurs for a multitude of causes. Impacting the disease triangle's three key components: Pathogen, host, and environment High atmospheric CO2 concentration, temperatures, fluctuations in precipitation patterns, the regularity of extreme weather events, and the prevalence of pathogens may all have a significant influence on crop growth and productivity. When diseases with short half - lives are present in the host, reproductions rate are high, so dispersion mechanism react rapidly or adapt to climatic change (1).

Climate change, in conjunction with human activities like as air, water, or soils pollutions, long distance introductions of alien species, or urbanizations, would have an impact on plant diseases. These factors lead to illnesses like sudden oak death spreading. Increased temperature or CO_2 concentrations have an effect on plants disease interactions, making late blight of potatoes and blast or sheath blight (Rhizoctonia solani) of rice seem to be more dangerous. Pharma in rape seed was detected as a result of the climate changes using a model that predicts temperature or rainfall below CO_2 emission situations for 2020 or 2050s in the UK, as well as sporulation's of the teleomorphs on the climate changes. Disease control methods should be reoriented in a changing environment for sustainable agricultural production. Plant diseases, on the other hand, play an essential part in agriculture. There is just a little quantity of data on the possible effects of the climate changes on plants diseases (2).

Temperature has an impact on plant diseases. Plants and diseases both need a certain minimum temperature to thrive. For many diseases, temperature has an impact on the sequence of event in the disease cycles, including like survival, dispersion, penetrations, growth, or reproduction rates. The rust fungus Puccinia substrata's spore germination increases as the temperature rises. Cercospora beticola, a sugar beet leaf spot, shifted northward in southern Germany owing to an increase in annual means temperature of 0.8-2°C. Temperature changes favour overwintering of the sexual propagule, increasing a population's evolutionary potential. High moisture and warmth favour and begin disease development, as well as the germination and multiplication of fungal spores of many illnesses. Powdery mildew conidia have the potential to grow even at 0% relative humidity (RH) Conidia of Erisiphe cichoracearum sprout at temperatures ranging from 7 to 32 degrees Celsius, with relative humidity levels ranging from 60 to 81 percent. Erysiphe nicator spores thrive at temperatures ranging from 6 to 23°C and relative humidity values of 33 to 90% (3).

Temperature influences the susceptibility of cereal crops to rust infections. Pg3 and Pg4 resistance genes for oat stem rust fail at temperatures over 21°C. Lr217, Lr210, and Lr2a, for example, are temperature sensitive wheat leaf rust resistance genes. Above 25°C, only the Lr2a gene is temperature resistant. Lignification of fodder crops, on the other hand, increases when the temperature rises. Fungal development that produces plants disease thrives in a temperate environment. When temperatures are between 7.3°C and 27.8°C, Phytophthora infectants, the early blight of potato or tomato, infects but rather perpetuates most effectively. Increased soil temperatures of 12-30°C produce Phytophthora cinnamomi infection in Eucalyptus sp. Temperature affects bacterial illnesses including Ralstonia solanacearum, Acidovorax avenue, because Burkholderia glumea, but instead bacteria flourish in places where air temp diseases were never seen before. Virus as well as other vector-borne diseases may have a fluctuating prevalence. Warmer winters make it easier for aphids to survive, leading in the spread of viruses like the Barley Yellow Dwarf Virus (BYDV) including potato or sugar beet viruses (4).

Moisture's impact on plant disease Various climate change models anticipate more frequent and severe rainfall events as well as greater impressive water vapours concentration as temperatures rise. These encourage crops to grow larger but also healthier canopies that retain moistures as leaf wetness or relative humidity for extended period of time, allowing pathogens including diseases such as late blights but also powdery mildews to thrive. In high moisture settings, Phytophthora, Pythium, R. solani, or Sclerotium, as well as other soil-borne pathogens, thrive. Drought stress affects viruses like the Maize dwarf mosaic virus (MDMV) as well as the Beet yellows virus (BYV). The impact of CO2 on plant disease Increased CO2 levels have a number of effects on both the host and the pathogen. The size of plant organs, leaf area, number of leaves, the leaf number on an unit, the total leaf area/plant, and the width of stems and branches have all grown as CO2 levels have risen. Under a thick canopy, diseases including rust, powdery mildew, Alternaria blight, Stemphylium blight, or anthracnose flourish. When CO2 levels are greater, more fungal spores are generated. CO2 enhances leaf area, plants height, increasing crops yield, as well as improving photosynthesis, boosting water use efficiency, or reducing ozone damage. CO2 increases produce physiological changes in the host plants, that might lead to greater disease resistance.

1.1.Microbial Interactions And Climate Change:

Increased CO_2 level in atmosphere have a significant impact on carbon cycling or ecosystem function. The amount of nitrogen deposited, CO2 content, or temperature all have an impact on soil microbial populations. Changes in abiotic environments, both short- and long-term, influence not just plant development and production, but also the population of microorganism that live on the plants surface. Any alteration in the phyllo sphere microflora has an impact on plant development and the capacity of plants to resist pathogen assault.

1.2.Climate Change's Impact On Vectors Borne Illnesses:

Plants virus works in tandem with the hosts plant or vector to achieve their goals. The climatic needs of disease vectors restrict the danger of vector borne illness at local s well as a regional level. Climate change affects both host plants and insect vectors population, which transmit plant viruses. The initial infection of host, the propagation of illness inside the hosts, or horizontal transfer of the virus to additional hosts via the vectors are all influenced by global warming. Climate changes affects the host phenology or physiology, which affects the virus's susceptibility and capacity to infect. As a result, changes in host physiology may have an impact on the host's attraction to vector or viral transmissibility. Climate change has a variety of impacts on vectors, including changes in phenology, overwintering, density, movement, and stability. Elevated CO2 levels have a little impact on insect herbivores' natural adversaries. By altering the size or compositions of insect prey populations, increased CO2 has an indirect impact on the third trophic level (5).

1.3.Models Of Plant Patho Systems

To better understand the consequences of climate change on plant pathogens or diseases, patho systems are being studied. For a few plant-pathogen systems, predictive models have been constructed. Powdery mildew is one of the most common grapevine diseases, as well as the European grapevine moth is among Europe's and the Mediterranean's more destructive vineyard pests. Grapevine phenological models were combined with grape downy mildew as well as the European grapevine moth phenological models, and the designs have been used to anticipate climate change in the western Italian Alps, including probable changes in interactions between some of these organisms. They resemble a decrease in the severity of powdery mildew outbreaks, especially in years when sickness symptoms appear later and temperatures are greater.

1.4.Plant Disease Situation In The North-East:

This area has a subtropical climate and receives a lot of rain. and a variety of agricultural diseases with different degrees of occurrence Many illnesses harm cereals, spices, and vegetables when the environment changes. Paddy brown spot, paddy bacterial blight, and blast Curvularia leaf blight, king chilli anthracnose as well as fruit rot, turmeric plant blotch and leaf blight, powdery mildew but not downy mildew of crops, leaf spot curl, sigatoka or anthracnose of bananas, as well as citrus canker diseases are all more frequent in Colocasia leaves. Drought or flood are two other severe climatic conditions caused by a lack about or excess of precipitation, which both cause considerable crop damage (6).

1.5.Adapting To Climate Change's Impact On Plant Diseases:

The growth of disease is the result of a number of variables affecting both host or the pathogens. Microbial populations or control agents may also affect plant pathogen associations. Climate change has a variety of effects on plant pathogen systems. Crops need more fungicide spray treatments with higher application rates due to the adverse weather conditions, which increases farmer costs, consumer prices, and the danger of fungicide resistance. Because annual crops are more responsive to new cultivars or cultural approaches than perennials, they have a competitive advantage. To prepare for climate change, present physical, chemical, and biological management approaches might be evaluated, as well as new instruments and procedures established. Weather conditions have a significant impact on the lifespan of plant protection compounds in the phyllosphere. Variations in the length, intensity, or regularity of precipitation events might affect the effectiveness of chemical pesticides. Pharmacological breakdown, plant breeding, including morphology are all affected by temperature, as are systemic fungicide absorption, transport, duration, or action mechanisms (7).

2. LITERATURE REVIEW

Kumar Singh and his colleagues looked into it. Arid and semi-arid areas throughout the globe have seen an unusual and severe environment, as well as a steady increase in temperature and CO_2 concentration, affecting agricultural, livestock, and fisheries output and productivity. As a result of changing climatic circumstances, some minor pest species have gained significant status in recent years, with increased insect occurrences potentially resulting in a 40% decline in agricultural productivity by 2100 across South Asia, including India. By 2100, global average temperatures are predicted to have increased by 1–2 degrees Celsius. As a result, higher temperatures, storms, and droughts are expected more often, as well as a large rise in pesticide usage, a shift in virulence patterns, and the spread of diseases to new places. In a climate change scenario, abiotic stress resistant cultivars and coordinated pest management have increased yield and production. In the face of climate change, a new pest management innovation and a commitment to anticipatory research using interdisciplinary techniques to address emerging diseases may be preferable options (8).

Gautam et al investigated the Climate change is the greatest danger to humanity, causing approximately 0.4 million lives per year and costing the global economy more than US$ 1.2 trillion. Due to a 0.74°C average global temperature rise in the past 100 years and an increase in atmospheric CO_2 concentration from 280ppm in 1750 to 400ppm in 2013, climate change is impacting our agriculture. Such change will have a significant impact on the development and production of many crops throughout the world. Simultaneously, those changes will have an impact on the reproduction, spread, and severity of numerous plant diseases, putting our food security at risk. Stem rust resistance owing to Sr31 is also under danger from the Ug99 race of stem rust produced by Puccinia graminis f. sp. tritici, which is driven by climate change. Temperature and CO2 concentrations are also increasing the danger perception of late blight (Phytophthora infestans), a potato disease, including two major rice diseases. The necessity for further research on such models that can forecast the severity of key diseases of major crops in real-field settings has been emphasized by the changing disease situation as a result of climate change. Simultaneously, disease control methods should be reoriented under changing circumstances, including new sustainable food production strategies (9).

Haggag and his colleagues looked into it. However, there is currently no systematic assessment of how climate change may effect the spread of plant diseases and primary production in most agricultural environments. There have been few research on the influence of climate change on disease transmission in field crops. Plant diseases, which may be caused by biotic or abiotic pathogens, are an essential part of plant and ecosystem health. Organisms such as fungus, bacteria, viruses, nematodes, phytoplasmas, and parasites cause plant biotic illnesses. Abiotic illnesses, on the other hand, have long been linked to chemical and physical climatic elements including temperature and moisture extremes, as well as agricultural challenges like nutrient shortages, mineral toxicities, and pollution. It is now feasible to detect responses to a variety of biotic and abiotic stimuli, as well as potential trade-offs in responses, thanks to developments in genomic technology for high-throughput gene expression investigations. Most plant disease models employ different climatic variables than global climate models and operate on a different geographical and temporal scale. The present study examines environmental parameters that influence the severity of agricultural disease epidemics in order to estimate the effects of climate change on plant development and harvest, as well as disease epidemic severity. In view of shifting worldwide opinions on future environmental needs, the effects of climate change on chemical and biological plant disease management are also examined (10).

Wakelin and his colleagues investigated Droughts are anticipated to become more common and last longer in many places of New Zealand as a result of climate change. Plant pathogen lifecycles, host susceptibility to infection or disease manifestation, pathogen natural ranges, and pathogen population genetic change rates might all be affected. These factors are expected to affect a number of pathosystems critical to New Zealand's productive usage. Drought is likely to increase illness manifestation in most patho systems. Drought, on the other hand, may make certain diseases less severe, such as kiwifruit Scelerotina rot and radiata pine red needle cast. The red needle cast of radiata pine is used as a case study to demonstrate how drought may impact several components of the host-pathogen-environment relationship. We believe that New Zealand's ground-based productive sectors should better prepare for the negative consequences of greater drought for plant diseases, as well as the possible advantages (11).

3. DISCUSSION

Climate change is a huge environmental issue that affects everyone on the planet. Water vapour, carbon dioxide (CO2), methane nitrous oxide, hydrofluorocarbons (HFCs), and ozone (O3) are examples of greenhouse gases (GHGs) that trap reflected energy and warm the earth's surface. Human activities have a major role in the acceleration of global climate change, which has a direct impact on the environment. Global warming has been seen in India's west coast, middle India, interior peninsula, and northeast. Rising greenhouse gas (GHG) concentrations in the atmosphere are causing global climate change. The observed climate changes on the world during the last 50 years are mostly due to human activities. In the preceding century, global temperatures rose by around 0.8°C, and by 2100, they are anticipated to rise by 0.9 to 3.5°C. Such alterations would have an effect not just on crop development and cultivation, but also on the reproduction, spread, and severity of a number of plant diseases. To include more detailed climatic forecasts at different levels, many plant disease models have been constructed. The focus now has to move away from impact assessment and toward the creation of adaptation and mitigation strategies and options. Existing physical, chemical, and biological management measures, including disease-resistant cultivars, must be evaluated in the context of climate change, and any research targeted at producing new tools and tactics must take into account future climatic situations. To understand how an anticipated alteration in the environment may affect plant illnesses, disease risk assessments based on host pathogen interactions, as well as studies on host response and adaptability, should be done.

4. CONCUSION

Climate change is a serious environmental issue that affects everyone on the planet. Water vapour, carbon dioxide, methane, nitrogen dioxide, hydrofluorocarbons, and ozone (O3) are examples of greenhouse gases that absorb reflected radiation and warm the earth's surface. The acceleration of anthropogenic climate change, which has a direct impact on the environment, is mostly due to human activity. Global warming has affected the west coast, central India, the interior peninsula, and the northeast of India. Rising greenhouse gas (GHG) concentrations in the atmosphere are causing global climate change. Climate change has been seen all across the globe. The impact of climate change on plant diseases in the field, as well as disease management in the context of climate change, has gotten little attention. Specific assessments for a few countries, localities, plants, and illnesses that affect food security are already available. The attention must now shift from impact assessment to the development of adaptation and mitigation methods and solutions. Existing physical, chemical, and physiological management methods, especially disease-resistant cultivars, must be reviewed in light of climate change, and any study aimed at developing new tools and strategies must take future climatic conditions into consideration. Disease risk assessments based on host–pathogen interactions, as well as research on host response and adaptation, should be conducted to understand how a predicted change in the environment may influence plant diseases.

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