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The Influence of Changing Climate on Emergence and Proliferation of Plant Diseases in Africa: A Synthesis

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Abstract: *Little efforts has been made to document the influence of climate change and plant disease development globally. The availability of water, the quality of the soil, and agricultural production can all be impacted by a variety of catastrophic occurrences that may take place over a long period of time and area. yields, infestations, and pest and pathogen vulnerability. A pathogen's specific interactions with its host or hosts, as well as the effects these interactions have on the relationships between the host and other species in the community. In order to evaluate the type and extent of plant and pathogen evolutionary adaptability as well as the fate of plants in the face of future climate change, a study encompassing multiyear trends is required.*

Keywords: Agriculture, Growth, Integrated, Nature, Plants, Soil, Weather, Yield

1. Introduction

Climate-related changes have a substantial influence on crop productivity, disease susceptibility, and the persistence of plant illnesses. Additionally, it influences agricultural health by influencing how susceptible crops are to pests and diseases (Garrett et al. 2021). To deal with their consequences and avoid a fall in productivity, these changes force variations in farming practises (Zayan 2018).

Changes in the environment are strongly related to changes in illness severity and losses as a result of it because it plays such a big role in disease development (Elad and Pertot, 2014). The environment may have an impact on a plant's disease susceptibility genetics, succulence, and availability (Agrios, 2005). Consequently, the impact of climate change on agricultural production is very great. The consequences of climate change, however, will be extremely regionalized and variable.

Climate change conditions may have an effect on both the host and the pathogen. For instance, some temperatures can increase the host's resistance to infectious diseases, whilst other temperatures can promote the development of pathogens. An illustration of these occurrences is the relationship between temperature and the susceptibility of wheat and oats to rust infections and the greater resistance of particular forage species (Coakley et al., 1999). Furthermore, many pests may experience one to five additional lifecycles per season as a result of temperature variations as slight as CO_2 fluctuations, which improves their capacity to overcome plant resistance.

According to Nazir et al. (2018), it has been discovered that increasing atmospheric CO_2 levels have an impact on plant physiology, morphology, and biomass (Nazir et al., 2018). Some research suggest that increased CO_2 stimulates higher glucose concentrations within host tissue, which results in the emergence of plant diseases like rusts (Manning and Tiedemann, 19950). Increased CO_2 may alter the microenvironment and enlarge the leaf canopy, leading to crop losses from foliar diseases (Chakraborty et al., 2003). Increased CO_2 levels, according to Manning and Tiedemann (1995), would enhance canopy area and density, producing more biomass with good nutritional quality. Plants respond to rising CO_2 levels by changing their C: N ratio (Ball, 1997).

Moisture and temperature increases can make the host more vulnerable to infection (McElrone et al., 2001). Water stress affects photosynthesis, reduces leaf growth, closes stomata, and changes the root/shoot ratio. It also modifies the architecture of the shoot (Elad and Pertot, 2014). Increased aggressiveness in isolates of stripe rust (Puccinia striiformis) at higher temperatures suggests that rust fungi can adapt to and benefit from higher temperatures (Mboup et al., 2012). Our ability to mitigate such changes in natural systems is far less than it is in agricultural systems.

Humans can influence the number and severity of disease populations in agriculture through breeding, agronomy, nutrient and moisture management, and the application of chemical treatments. None of these acts are environmentally or practically appropriate in plant communities. The Figure also demonstrates how community change brought on by climate change results in variety in plant diseases (Garrett et al. 2021).

Figure 1 illustrates how changes in host fitness brought on by an increase or decrease in illness or by the introduction of new pathogens may have a beneficial or negative impact on the community structure of wild plants.

IMPLICATIONS OF CLIMATE CHANGE AND EXTREME WEATHER EVENTS ON FOOD PRODUCTION, PLANT DISEASES AND PESTS BY ROSENZWEIG *ET AL*., 2001.

Climate has an impact on agricultural pests as well. Because temperature, light, and water are three key factors in the growth and development of insects, weeds, and illnesses, climate has a significant impact on their spatial and temporal distribution as well as their profusion. Eight significant crops' global production from 1998 to 1990 is shown in table 1, along with expected losses due to pests and geography (Rosenzweig et al. 2001).

According to Turyasingura & Rogers (n.d.), climate also affects the effectiveness and durability of pesticides used to prevent and control insect outbreaks. Temperature and light also affect pesticide persistence through chemical alteration (Leach, Mehta, and Prabhakaran 2015). According to most analyses, pests may become more active and widen their geographic range under a warmer climate, leading to increased use of agricultural chemicals and related health, ecological, and economic repercussions.

Some diseases, like powdery mildews, may endure hot, dry conditions as long as dew forms at night. Weather factors have an impact on post-harvest pest damage as well (Zayan 2018). For instance, high temperatures and humidity during harvest encourage the buildup of mycotoxin (made by Fusarium spp.). Muscle spasms and vomiting can occur in those who consume mycotoxin with meals.

The emergence of wheat scab in important Great Plains agricultural regions over the past ten years may be related to rising temperatures. Aspergillus flavus, the fungus that causes the fungus in the damaged crop, grows more readily during droughts, which leads to an increase in aflatoxin. The losses caused as a result of agricultural diseases, weeds, and pests are shown in Table 1 (Oerke et al., 1995).

Table 1: Estimated losses for the eight crops and their global production.

Crop	Actual Crop Production (Billions of US$)	US$ (Billions) Losses due to			
		Pathogens	Insects	Weeds	**Total**
Rice	106.4	33.0	45.4	34.2	112.5
Wheat	64.6	14.0	10.5	14.0	38.5
Barley	13.7	1.9	1.7	2.0	5.7
Maize	44.0	7.8	10.4	9.3	27.4
Potatoes	35.1	9.8	9.6	5.3	24.8
Soybeans	24.2	3.2	3.7	4.7	11.6
Cotton	25.7	4.3	6.3	4.9	15.5
Coffee	11.4	2.8	2.8	2.0	7.6
Region					
Africa	13.3	4.1	4.4	4.3	12.8
N. America	50.5	7.1	7.5	8.4	22.9
Latin America	30.7	7.1	7.6	7.0	21.7
Asia	162.9	43.8	57.6	43.8	145.2
Europe	42.6	5.8	6.1	4.9	16.8
Former Soviet Union	31.9	8.2	7.0	6.7	22.1
Oceania	3.3	0.8	0.6	0.5	1.9

Source: Oerke *et al.*, 1995

2. Case Studies in Africa

The climatic variable with the strongest correlation to the occurrence of bacterial wilt in Nigeria's two research seasons was the total number of rainy days. It supports the findings of Ranamukhaarachchi (2010), who claimed that years with above-average rainfall are when illness intensity is at its highest. Weather factors have also been discovered to play significant roles in the development of various illnesses in a number of other agricultural plants, hence prediction equations have been developed to calculate the disease severity in these crops taking weather factors into account (Awasthi and Kolte 1994). According to Srikantaswamy et al. (2006), the most significant weather conditions for the development of rust disease in mulberry were the number of rainy days and cumulative rainfall combined with advanced crop age. In this investigation, information regarding tomatoes was acquired that was similar to that presented by Srikantaswamy et al. (2006). Farmers had previously thought that excessive rainfall made tomatoes more susceptible to bacterial wilt and impeded crop growth and productivity.

Millions of East Africans depend heavily on cassava in their meals. Cassava viruses are a threat to a consistent cassava supply (Legg et al., 2015). When the cassava mosaic disease first arose in Uganda in the 1980s, cassava production fell precipitously, limiting access to a crucial food source (Legg et al., 2015). In East Africa, the cassava mosaic virus (CMV) costs roughly $1 billion in losses and lowers annual yields of cassava by 13 million tonnes (Legg et al., 2015). Conflict, civil unrest, and drought have all made the issue worse.

3. CONCLUSION

Any one of the following three fundamental prerequisites must be met in order for a disease to emerge: (1) a suitable environment, with the quantity and frequency of rain or heavy dews, the relative humidity, and the air and soil temperatures being the most crucial environmental factors; (2) the presence of a virulent pathogen; and (3) a susceptible host. One of the key elements influencing the occurrence of bacterial infections such Burkholderia glumea, Acidovorax avenae, and Ralstonia solanacearum is temperature. As a result, bacteria might grow in places where temperature-dependent diseases have not yet been noticed. When the temperature rises, the length of winter and the pace of pathogen growth and reproduction may both fluctuate. Climate change alone is responsible for the acceleration of extinction and development of new infections, including such changes as (e.g. direct elimination, reduction and alteration of habitats (Turyasingura et al., 2022), among a few others). Climate change brought on by global warming affects the spread of pandemic diseases that impact both plants and animals (Turyasingura & Chavula, 2022). Some outbreaks might cause the viruses' genetic diversity and population number to decline. Plant diseases have been a significant factor in agricultural production for many generations (Turyasingura, n.d.).

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