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Impact of Global Climate Change on the Formation and Occurrence of Nitrosamines in the Environment: Current Findings and Future Perspectives

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Abstract

The severe effects of global warming expected on crops will ultimately have an influence on not just food security but also feed and food safety, with mycotoxins being one of the most serious food safety issues impacted by climate change. This is because reduced yields lead to decreased food availability. It is projected that future changes in temperature, precipitation, and atmospheric CO_2 concentration may increase the danger of mycotoxin contamination of cereal crops in the field and may have an impact on the distribution of particular cereals, mycotoxigenic fungus, and their mycotoxins.

Keywords: Nitrosamines • CO_2 • Mycotoxin

Introduction

Despite rising political tensions and attempts to dismiss overwhelming facts, global warming is a universally acknowledged truth. According to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, the Earth's climate has been warming, particularly since the middle of the 20th century, as shown by changes in the global water cycle, increases in global mean sea level, and increases in global mean air and ocean temperatures. Anthropogenic greenhouse gas (GHG) emissions, which are at their highest levels ever, have led to a considerable rise in the atmospheric concentrations of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). It is believed that these gases are the main causes of global warming [1,2].

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Numerous studies have looked at the impacts of changes in temperature, precipitation, and atmospheric CO_2 concentration on agricultural yields in an effort to forecast the future availability of food. Because they make up approximately half of the world's food energy consumption and are farmed on roughly 42% of cropland worldwide, wheat, rice, and maize in particular have drawn special attention. Northern latitudes may have either positive or negative effects, while low latitudes, which are home to poor countries, are likely to consistently face negative climate effects on agricultural productivity. In the case of wheat, rice, and maize crops, rising temperatures from climate change will negatively impact productivity at the global level without CO_2 fertilization, adequate adaptation, and genetic development, however this will differ for crops and livestock. Numerous studies have looked at the impacts of changes in temperature, precipitation, and atmospheric CO_2concentration on agricultural yields in an effort to forecast the future availability of food [3]. Because they make up approximately half of the world's food energy consumption and are farmed on roughly 42% of cropland worldwide, wheat, rice, and maize in particular have drawn special attention. Northern latitudes may have either positive or negative effects, while low latitudes, which are home to poor countries, are likely to consistently face negative climate effects on agricultural productivity. In the case of wheat, rice, and maize crops, rising temperatures from climate change will negatively impact productivity at the global level without CO_2 fertilization, adequate adaptation, and genetic development; however this will differ for crops and livestock [4].

Literature Review

Some of the so-called emerging toxins that have recently received increased attention include enniatins, beauvericin, fusaproliferin, and moniliformin because some of them are found in high amounts in food and feed and because the harmful effects of some of them are starting to be known. Fusarium species primarily produce these poisons on grain crops. The relationship between quantifiable "free mycotoxins" (the fundamental mycotoxin structures formed by fungi), "modified mycotoxins," which are conjugated forms of Fusarium toxins produced in the plant or fungus, and "matrix-associated mycotoxins," which can be covalently or non-covalently attached to specific molecules that in turn make up the "matrix," is another crucial issue that has recently attracted significant attention from the scientific community, governments, and regulatory [5,6].

It may be predicted that increases in pest reproduction rates will lead to increased crop damage (during anthesis in wheat and silking in maize), as well as higher infections with mycotoxigenic fungus and mycotoxin contamination. This is true even though no mycotoxigenic fungi were included in this modelling technique. Therefore, global warming may contribute to the growth in mycotoxins pollution.

The effects of global warming and GHG on mycotoxin formation and fungal infection on plants have only been the subject of a small number of studies investigated the effects of high CO_2 on the interactions between maize

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and the *F. verticillioides*, a fumonisin producer. Increases in GHG emissions make maize more susceptible to *F. verticillioides* colonization, with CO_2 levels rising to nearly 800 ppm (almost double the current CO_2). It's interesting to note that none of these interactions affected the generation of fumonisin B1. Similar results were observed when CO_2 levels were doubled for the Fusarium head blight in wheat caused by Fusarium graminearum. More recent studies have been undertaken to examine how increased CO_2 (750 ppm CO_2) affects wheat's resistance to Fusarium culmorum and mycotoxin contamination [7].

Discussion

Nitrosamines are a group of carcinogenic compounds that are formed in the environment due to the interaction of nitrite and amines. They have been identified as a significant environmental contaminant and are of particular concern due to their harmful effects on human health. The formation and occurrence of nitrosamines in the environment are strongly influenced by various environmental factors such as temperature, pH, and the presence of other chemical compounds. Global climate change has been identified as one of the significant environmental factors that can impact the formation and occurrence of nitrosamines in the environment [8].

Current findings suggest that global climate change can have a significant impact on the formation and occurrence of nitrosamines in the environment. Changes in temperature and precipitation patterns can lead to changes in soil pH, which can alter the availability of nitrite and amines in the environment. These changes can subsequently impact the formation of nitrosamines in the environment [9,10]. Moreover, changes in temperature can also impact the growth and distribution of microorganisms that are responsible for the conversion of nitrite and amines into nitrosamines. The altered distribution of these microorganisms can impact the occurrence of nitrosamines in the environment.

Future perspectives suggest that there is a need for extensive research to understand the impact of global climate change on the formation and occurrence of nitrosamines in the environment. Studies should focus on the effect of temperature, precipitation, and other climatic factors on the formation of nitrosamines in various environments such as soil, water, and air. In addition, there is a need for the development of risk assessment frameworks that can estimate the potential impact of global climate change on the occurrence of nitrosamines in the environment. This information can be used to design effective strategies to mitigate the impact of global climate change on the formation and occurrence of nitrosamines in the environment.

Global climate change can significantly impact the formation and occurrence of nitrosamines in the environment. The interaction of nitrite and amines is highly dependent on environmental factors such as temperature, pH, and the presence of other chemical compounds [11]. Understanding the impact of global climate change on the occurrence of nitrosamines in the environment is critical for the development of effective strategies to mitigate the risk of these compounds to human health. Future research should focus on developing risk assessment frameworks that can provide information on the potential impact of global climate change on the occurrence of nitrosamines in the environment.

Some of these fungi display extraordinary physiological plasticity, which has helped them adapt to and colonise a variety of ecological niches, including those of many staple foods, such as cereals. In actuality, cereals are the primary source of mycotoxin contamination in the human food chain, whether indirectly through the consumption of milk and other animal products derived from livestock fed contaminated feeds or directly through the consumption of contaminated food. In addition to these foods, mycotoxins can be found in animal feeds as spoiled stored fodder (like silage), cereal by-products used in feed processing, and grapes, coffee, cocoa, groundnuts, tree nuts, some fruits, and other food commodities [8].

Conclusion

Mycotoxins are inevitable naturally occurring compounds in the field because the fungi that create them are frequently components of the epiphytic and endophytic microflora in staple crops. Climate change and global warming may cause some plants, like maize, and mycotoxigenic fungi, like *A. flavus*, to alter their geographic distribution, which would lead to a larger concentration of the mycotoxins they produce in different latitudes. The risk of aflatoxin generation in the field is increased by climate change and drought conditions, which may make it simpler for *A. flavus* to infect crops in some regions. Elevated CO_2 levels are expected to further contribute to increased mycotoxin production in crops infected by Aspergillus and Fusarium species by increasing fungal colonisation.

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Conflict of Interest

There is no conflict of interest by author.

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