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Effects of Climate Change on Nitrosamines

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Abstract

By reducing yields and thereby food availability, the significant effects of global warming projected on crops will ultimately have an impact on not only food security but also feed and food safety, with mycotoxins being one of the most significant food safety risks impacted by climate change. Future shifts in temperature, precipitation, and atmospheric CO_2 concentration are anticipated to increase the risk of mycotoxin contamination of cereal crops in the field and may have an effect on where specific cereals, mycotoxigenic fungi, and their mycotoxins are distributed

Keywords: Mycotoxins • Climate • Cereal • Contamination

Introduction

Global warming is a widely accepted fact, despite political tensions that are escalating and attempts to ignore compelling evidence. The Fifth Assessment Report of the Intergovernmental Panel on Climate Change asserts that the Earth's climate has been warming, especially since the middle of the 20th century, as evidenced by observed rises in global mean air and ocean temperatures, modifications to the global water cycle, decreases in snow and ice cover, and an increase in global mean sea level. The concentrations of carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) in the atmosphere have increased significantly as a result of anthropogenic greenhouse gas (GHG) emissions, which are currently at their highest levels ever. These gases are thought to be the primary contributors to global warming [1].

Extremes and variability in the climate have a big impact on agriculture. Thus, it is anticipated that climatic changes will have a significant impact on the productivity and quality of crop and livestock production systems, raising concerns about the availability of enough nutritious food for the growing global population in the twenty-first century. The effects of changing climatic conditions on plants, pathogens that cause pests and diseases, and host-pathogen interactions will all have an impact on crop productivity and quality. One of the most significant risks to food safety that climate change is likely to bring about is the contamination of food with mycotoxins, which are secondary metabolites produced by filamentous fungi and are dangerous to both humans and animals [2].

In an effort to predict the availability of food in the future, numerous studies have examined the effects of changes in temperature, precipitation, and atmospheric CO_2 concentration on crop yields. Wheat, rice, and maize in particular have received special attention because they account for about half of the world's food energy intake and are grown on about 42% of cropland worldwide. Low latitudes, which are home to developing nations, will likely experience consistent negative climate effects on crop production, whereas northern latitudes may experience either positive or negative effects. Without CO2 fertilisation, effective adaptation, and genetic advancement, rising temperatures from climate change will adversely affect production at the global level in the case of wheat, rice, and maize crops, though this will vary for crops and livestock.

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Literature Review

Enniatins, beauvericin, fusaproliferin, and moniliformin are just a few of the so-called emerging toxins that have recently drawn more attention because some of them are found in high concentrations in food and feed and their toxic effects are beginning to be understood. These toxins are primarily produced on cereal crops by Fusarium species. The relationship between quantifiable "free mycotoxins" (the basic mycotoxin structures formed by fungi), "modified mycotoxins," which are conjugated forms of Fusarium toxins formed in the plant or fungus, and "matrix-associated mycotoxins," which can be covalently or non-covalently attached to certain molecules which in turn make up the "matrix," is another important issue that has recently drawn significant attention from the scientific community, governments, and regulators Although no mycotoxigenic fungi were included in this modelling approach, it can be assumed that increases in pest reproduction rates would result in more crop damage (during anthesis in wheat and silking in maize) as well as more mycotoxigenic fungi infections and mycotoxin contamination. Therefore, the increase in mycotoxins contamination could be caused in part by global warming [4].

Only a small number of studies have looked at the effects of global warming and GHG on mycotoxin accumulation and fungal infection on plants. Examined how elevated CO_2 affected the interactions between maize and the fumonisin-producing F. verticillioides. Increases in GHG emissions, such as CO_2 to approximately 800 ppm CO_2 (roughly twice the current CO_2), made maize more vulnerable to F. verticillioides colonisation. Interestingly, none of these interactions had an impact on fumonisin B1 production. Similar to this, increased disease levels for the Fusarium head blight in wheat brought on by *Fusarium graminearum* were also noted when CO_2 was doubled conducted research on the impact of elevated CO_2 (750 ppm CO_2) on wheat's resistance to *Fusarium culmorum* and mycotoxin contamination more recently [5].

Discussion

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 [6,7].

Conclusion

Due to the fact that the fungi that produce them are frequent elements of the epiphytic and endophytic microflora in staple crops, mycotoxins are unavoidable naturally occurring substances in the field. Some plants, like maize, and mycotoxigenic fungi, like A. flavus, may change their geographic distribution as a result of climate change and global warming, which would result in a higher concentration of the mycotoxins they produce in other latitudes. Climate change and drought conditions may also make it easier for A. flavus to infect crops in some areas, which raise the danger of aflatoxin production in the field. By promoting fungal colonisation, elevated CO2 levels are likely to further contribute to increased mycotoxin production in crops infected by Aspergillus and Fusarium species.

According to recent quantitative estimates, increased DON and aflatoxin B1 contamination in cereals is anticipated due to global warming in some parts of Europe. To fully understand how global warming affects the mycotoxin risk of food and feeds globally, similar research is required for other regulated and unregulated mycotoxins, as well as in other crops and nations.

Acknowledgement

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Conflict of Interest

There is no conflict of interest by author.

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