

The Effects of Molecular and Climatic Variability on the Occurrence of Aspergillus Species and Aflatoxin Production in Commercial Maize from Different Agro-climatic Regions in South Africa

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Abstract : Introduction Most African research reports on the frequent aflatoxin contamination of various foodstuffs, with researchers rarely specifying which of the Aspergillus species are present in these commodities. Numerous research works provide evidence of the ability of fungi to grow, thrive, and interact with other crop species and focus on the fact that these processes are largely affected by climatic variables. South Africa is a water-stressed country with high spatio-temporal rainfall variability; moreover, temperatures have been projected to rise at a rate twice the global rate. This weather pattern change may lead to crop stress encouraging mold contamination with subsequent mycotoxin production. In this study, the biodiversity and distribution of Aspergillus species with their corresponding toxins in maize from six distinct maize producing regions with different weather patterns in South Africa were investigated. Materials And Methods By applying cultural and molecular methods, a total of 1028 maize samples from six distinct agro-climatic regions were examined for contamination by the Aspergillus species while the high performance liquid chromatography (HPLC) method was applied to analyse the level of contamination by aflatoxins. Results About 30% of the overall maize samples were contaminated by at least one Aspergillus species. Less than 30% (28.95%) of the 228 isolates subjected to the aflatoxigenic test was found to possess at least one of the aflatoxin biosynthetic genes. Furthermore, almost 20% were found to be contaminated with aflatoxins, with mean total aflatoxin concentration levels of 64.17 ppb. Amongst the contaminated samples, 59.02% had mean total aflatoxin concentration levels above the SA regulatory limit of 20ppb for animals and 10 for human consumption. Conclusion In this study, climate variables (rainfall reduction) were found to significantly ($p < 0.001$) influence the occurrence of the Aspergillus species (especially Aspergillus fumigatus) and the production of aflatoxin in South Africa commercial maize by maize variety, year of cultivation as well as the agro-climatic region in which the maize is cultivated. This included, amongst others, a reduction in the average annual rainfall of the preceding year to about 21.27 mm, and, as opposed to other regions whose average maximum rainfall ranged between 37.24 - 44.1 mm, resulted in a significant increase in the aflatoxin contamination of maize.

Keywords : aspergillus species, aflatoxins, diversity, drought, food safety, HPLC and PCR techniques

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