Characterization of *Fusarium* species on maize (*Zea mays*) and determination of their mycotoxins in Eastern province of Kenya

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ABSTRACT

Maize (*Zea mays* L.) is an important staple and mycotoxin susceptible food crop in Kenya. *Fusarium* and *Aspergillus* species are major fungal genera associated with maize infestation and mycotoxin contamination. *Fusarium* species cause stalk and ear rot of maize reducing yields and produce fumonisins. Fumonisin toxins are produced by several closely related species of *Fusarium* that can grow within maize tissues without causing visible symptoms of disease. Consumption of fumonisins has been shown to cause leucoencephalomalacia in horses, pulmonary edema in swine, experimental liver and kidney cancer in rodents, and has been epidemiologically associated with esophageal cancer in humans. The objectives of this study were to isolate *Fusarium* species from maize collected in selected farmers fields in Eastern province of Kenya, to identify the *Fusarium* species isolated using morphological and molecular characters, and to extract and quantify fumonisin mycotoxin produced by the fungi. Maize samples were collected from selected farmer in Aflatoxin 'hot' zones of Eastern province of Kenya. Samples were collected from Kitui and Kibwezi districts in May to June 2008. *Fusarium* species were isolated and identified using morphological characteristics at the Mycology Laboratory, Kenya Medical Research Institute. Fumonisin quantification was done using ELISA (RIDASCREEN® ELISA test kit (Art. No.: R3401) at Bora Biotech, Nairobi. Maize kernels were also analyzed for damage.

Results of kernel damage showed Makueni district had the highest percentage of damaged kernels (10.95 ± 0.78), compared to Kitui districts (6.62 ± 0.57). *Fusarium* species isolated in kernels with highest degree of damage also had the highest colony count (CFU).

Colony forming Units (CFU) counts indicated that apart from *Aspergillus* a common contaminant in maize, *Fusarium* species infestation was also high. The most common species

being *F. verticilloids* isolated at (39.9 %) in the two districts. Other isolated *Fusarium* species included, *F. proliferatum* (15.1 %), *F. solani* (9.0 %), *F. anthophilium* (9.0 %), *F. oxysporium* (15.1 %), and *F. lateritium* 12.1 %). In general, the most isolated species were of the section Liseola. Fumonisin contamination in the two districts was high (mean 1.04 mg / kg). Makueni district had the highest mean fumonisin compared to Kitui district (1.17 ± 0.08 mg / kg and 0.91 ± 0.133 mg / kg, respectively). High fumonisin concentrations were seen in sample plates where the isolated species is a high fumonisin producer. The mean fumonisin concentration however varied significantly ($p < 0.05$) in the two locations and between *Fusarium* species isolated per isolated sample plates. Correlation studies indicated a significant correlation between damaged kernels (%) and *Fusarium* species count (CFU) ($R^2 = 0.348$) ($p < 0.05$). In addition, there was a significant correlation between damaged kernels (%) and fumonisin levels ($R^2 = 0.279$). Similarly, significant correlation was observed between fumonisin levels and *Fusarium* Colony count (CFU) ($R^2 = 0.015$), though it was not strong. In an attempt to characterize *Fusarium* species using primers obtained from the ITS gene region of some *Fusarium* species, no amplification fragments were observed in any of the PCR assays. This may have been attributed to the lack of specificity of the selected primers to the targeted DNA regions in the *Fusarium* genomes. These findings indicates a wide spread infection and contamination of maize by *Fusarium* species and fumonisins. This study demonstrates a high level of *Fusarium* and fumonisin exposure in the high risk population necessitating urgent intervention measures to curb the long term health consequences in the population.