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Effets des Saisons de Culture, des Pratiques Agricoles et Post-
Récoltes sur la Contamination d'Aflatoxines du Maïs (*Zea mays*
L.) à Torbeck, Haïti"

Junior ARISTIL

Mars 2020

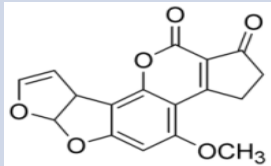
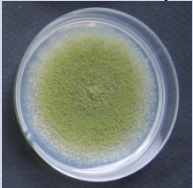
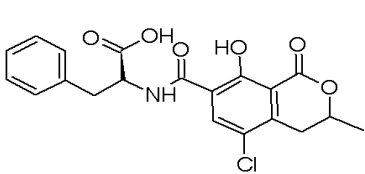
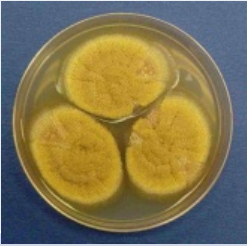
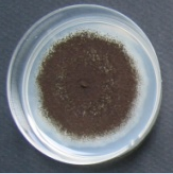
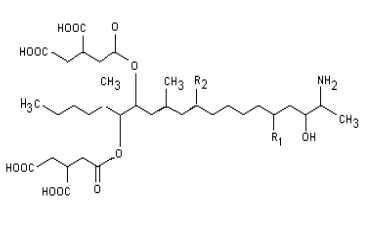
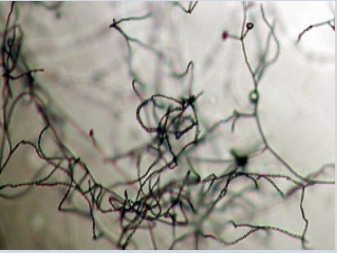


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Mycotoxines: Problèmes



Champignons Toxinogènes: Mycotoxines

Mycotoxines	Toxigeniques taxa	Produits contaminés
AFLATOXINES 	<i>Aspergillus</i> section <i>Flavi</i>	Cereals, oleiferous seeds, nuts  
OCHRATOXINES 	<i>A. ochraceus</i> (A. section <i>Circumdati</i>), <i>A. carbonarius</i>, A. section <i>Nigri</i>, <i>Penicillium verrucosum</i>	Cereals, oleiferous seeds, nuts   
FUMONISINES 	<i>Fusarium fujikuroi</i> clade (FFC): <i>Fusarium verticillioides</i>, <i>F. proliferatum</i>	Maize  



Maïs: Importance-Haïti



Maïs- Haïti :

- ✓ 2^e céréale la plus consommée;
- ✓ céréale la plus cultivée en Haïti;
- ✓ Haïtien: 2^e consommateur avec 50 g/jr/personne après Cuba avec 66g/jr/personne dans la Caraïbe.



Aflatoxines: Haïti-Historique

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Sud d'Haïti : AF- Potentielles souches toxiques

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Research Note

Occurrence of Toxigenic Fungi and Aflatoxin Potential of *Aspergillus* spp. Strains Associated with Subsistence Farmed Crops in Haiti

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ABSTRACT

Subsistence farming and poor storage facilities favor toxigenic fungal contamination and mycotoxin accumulation in staple foods from tropical countries such as Haiti. The present preliminary study was designed to evaluate the occurrence of toxigenic fungi in Haitian foodstuffs to define the mycotoxin risk associated with Haitian crops. The objectives of this research were to determine the distribution of toxigenic fungi in the Haitian crops maize, moringa, and peanut seeds and to screen *Aspergillus* section *Flavi* (ASF) isolates for production of aflatoxins B₁ and G₁ in vitro. Maize, moringa, and peanut samples were contaminated by potential toxigenic fungal taxa, mainly ASF and *Fusarium* spp. The isolation frequency of *Aspergillus* spp. and *Fusarium* spp. was influenced by locality and thus by farming systems, storage systems, and weather conditions. Particularly for ASF in peanut and maize samples, isolation frequencies were directly related to the growing season length. The present study represents the first report of contamination by toxigenic fungi and aflatoxin in moringa seeds, posing concerns about the safety of these seeds, which people in Haiti commonly consume. Most (80%) of the Haitian ASF strains were capable of producing aflatoxins, indicating that Haitian conditions clearly favor the colonization of toxigenic ASF strains over atoxigenic strains. ASF strains producing both aflatoxins B₁ and G₁ were found. Understanding the distribution of toxigenic ASF in Haitian crops and foodstuffs is important for determining accurate toxicological risks because the toxic profile of ASF is species specific. The occurrence of toxigenic fungi and the profiles of the ASF found in various crops highlight the need to prevent formation of aflatoxins in Haitian crops. This study provides relevant preliminary baseline data for guiding the development of legislation regulating the quality and safety of crops in this low-income country.

Key words: Aflatoxins; *Arachis hypogaea*; *Aspergillus* spp.; *Moringa oleifera*; *Zea mays*



Aflatoxine: Haïti, Sud



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Short Communication

<http://ajol.info/index.php/ijbcs>

<http://indexmedicus.afro.who.int>

Aflatoxin contamination of baby food flour sold on Haitian markets

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instruction. Results reveal that AF contaminations of substrates range from 2.7 and 119.0 ppb. Cereals products were more AF contaminated compared to tuber and moringa. Maize flour samples were more AF contaminated than rice. AF contaminations of maize seem to depend on provenance ($p < 0.05$). AF contaminations of maize from Iron and *Relais* markets are respectively 5.2 and 32.1 ppb. Moreover, AF contaminations of maize collected from street vendors represented almost seven times of that from Les Cayes supermarkets. Similar results suggest necessity to perform and develop programs for managing AF contaminations on baby food in Haiti.

Keywords: aflatoxin, flour, maize, cassava, moringa, rice.



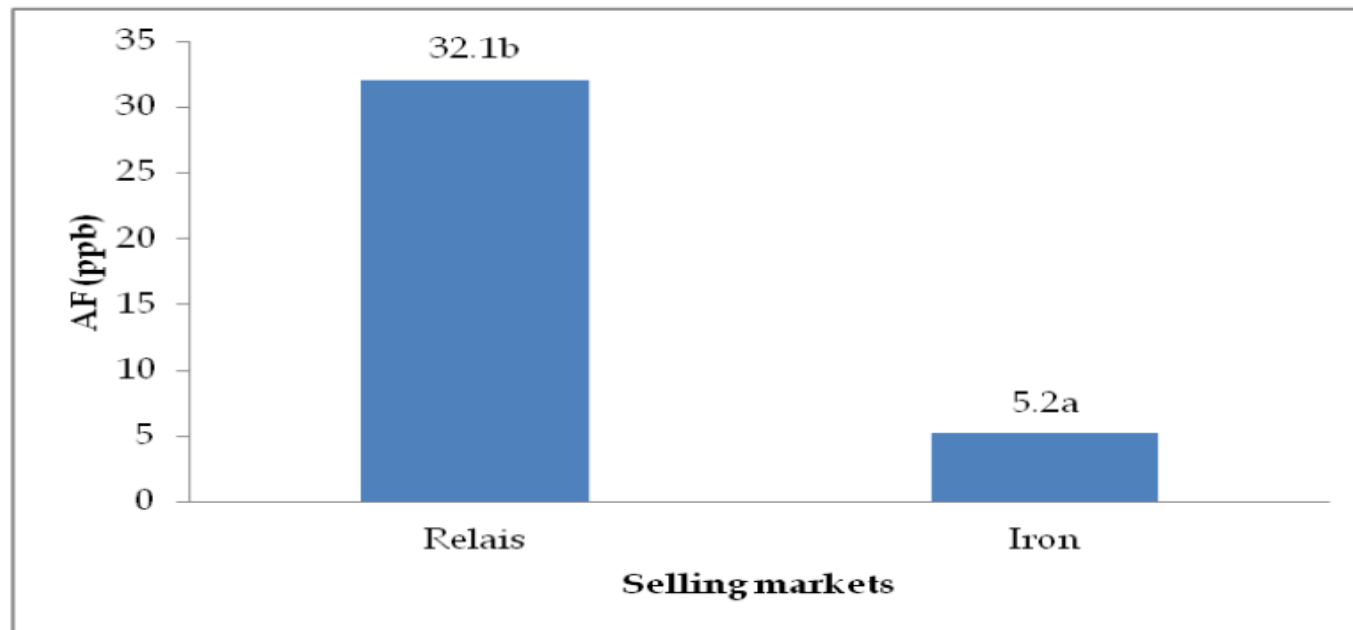


Figure 1. Aflatoxin (ppb) quantified in maize flour from *Relais* and *Iron* markets of Les Cayes. Bars with different letters indicate difference at $p < 0.05$.



AF: mais-moringa

Fungal contamination and aflatoxin content of maize, moringa and peanut foods from rural subsistence farms in South Haiti



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ABSTRACT

Mycotoxins are toxic, low molecular weight compounds produced by fungi. Among them, aflatoxins are the most carcinogenic and they mainly impact on rural communities of developing countries. The present study supplies data on mycobiota and aflatoxin contamination in the most common food products consumed in Haiti. The study concerns analyses performed on 49 samples of meals and seeds collected in South Haiti and tested for fungal occurrence and aflatoxin content by HPLC-DAD technique. The results revealed that three main fungal genera affected Haitian food products: *Aspergillus* spp. (Section *Flavi* and *Nigri*), followed by *Penicillium* spp. and *Fusarium* spp. Aflatoxin was present in more than half of the samples of maize (*Zea mays* L.) kernels (55%), maize meal (57%) and moringa (*Moringa oleifera* Lam.) seeds (64%), and in 25% of peanut (*Arachis hypogaea* L.) samples. The tested food products were mostly contaminated by aflatoxin B₁ (AFB₁) followed by aflatoxin B₂ (AFB₂), while no aflatoxins type G were detected. The total concentration of aflatoxins in the positive samples was 228 µg/kg on average, i.e., fifty-seven and eleven times higher than the maximum levels allowed in Europe and USA, respectively. Both the presence of aflatoxigenic fungi and aflatoxin contamination in maize kernels seemed to be related to agricultural practices, such as weed control, irrigation and growing cycle length. These findings suggest that the Haitian population is strongly exposed to aflatoxin risk. This risk could be reduced by exploiting simple and accessible farming strategies for minimizing mycotoxin contamination, at least for maize.

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A B S T R A C T

Mycotoxins are toxic, low molecular weight compounds produced by fungi. Among them, aflatoxins are the most carcinogenic and they mainly impact on rural communities of developing countries. The present study supplies data on mycobiota and aflatoxin contamination in the most common food products consumed in Haiti. The study concerns analyses performed on 49 samples of meals and seeds collected in South Haiti and tested for fungal occurrence and aflatoxin content by HPLC-DAD technique. The results revealed that three main fungal genera affected Haitian food products: *Aspergillus* spp. (Section *Flavi* and *Nigr*), followed by *Penicillium* spp. and *Fusarium* spp. Aflatoxin was present in more than half of the samples of maize (*Zea mays* L.) kernels (55%), maize meal (57%) and moringa (*Moringa oleifera* Lam.) seeds (64%), and in 25% of peanut (*Arachis hypogaea* L.) samples. The tested food products were mostly contaminated by aflatoxin B₁ (AFB₁) followed by aflatoxin B₂ (AFB₂), while no aflatoxins type G were detected. The total concentration of aflatoxins in the positive samples was 228 µg/kg on average, i.e., fifty-seven and eleven times higher than the maximum levels allowed in Europe and USA, respectively. Both the presence of aflatoxigenic fungi and aflatoxin contamination in maize kernels seemed to be related to agricultural practices, such as weed control, irrigation and growing cycle length. These findings suggest that the Haitian population is strongly exposed to aflatoxin risk. This risk could be reduced by exploiting simple and accessible farming strategies for minimizing mycotoxin contamination, at least for maize.

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AF- maïs: Investigation dans la phase productive

Short communication

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Morphological diversity among local and introduced maize (*Zea mays* L.) varieties in Haiti for yield improvement

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KeyWords Maize, yield, developing countries, Haiti



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Abstract

Maize, the cereal with the largest production in the world, is a staple crop in many developing countries including Haiti. Even if Haiti is the second maize consumer in the Caribbean region, its national yield is low and alleged of aflatoxin contamination. In order to increase grain yield, three introduced and two local maize varieties (these used as comparative control) were evaluated. Three field trials were carried out at Torbeck and Morne Briller (Port-Salut) during different growing seasons. Experiments were designed in a three-replicate randomized block. Each experimental plot was 3.50 m per 10.5 m with a gross area of 36.75 m² and 40 000 plants/ha densities. The trials were carried out according to local agricultural practices. The results revealed that the introduced varieties had a smaller yield than the local ones. Moreover, all varieties showed some aflatoxin content below the European Union limit (5µg/Kg). Statistical analyses showed a strong and direct correlation between yield and ear weight and an inverse correlation between yield and male and female flowering day after sowing. The broad phenotypic diversity suggested a rich reserve of alleles to exploit in a breeding program focused to improve food security in Haiti.



Investigation AF: Approche participative



Original Paper

Evaluation des paramètres productifs et quantification d'aflatoxine de sept variétés de maïs (*Zea mays* L.) testées en Haïti

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RESUME

Le maïs est la deuxième céréale la plus consommée en Haïti après le riz. Mais, le rendement (Rdt) national reste faible avec de risque élevé de contamination d'aflatoxines (AF). L'objectif de cette étude est d'évaluer les paramètres productifs de 7 variétés de maïs testées dans une approche participative à Torbeck et quantifier les AF. Deux des variétés proviennent de l'Université des Etudes de Milan (UNIMI), 2 de la Faculté d'Agronomie de l'Université Notre Dame d'Haïti et les 3 autres auprès des planteurs de Torbeck. Les résultats ont révélé que les Rdt maximal (4,36 t/ha) et minimal (3,14 t/ha) ont été détectés sur Tilevy, fournie par les producteurs et R4865, provenant d'UNIMI ($p < 0,05$). La corrélation maximale du Rdt a été notée avec la masse des 100 grains ($\rho = 0,485$) suivie du nombre grains par rang ($\rho = 0,477$). Les concentrations d'AF varient de Comayagua (Max : 7,6 ; moyenne : $5,6 \pm 1,8$ ppb) à Maquina (Max : 151 ; moyenne : $79,65 \pm 72,56$ ppb). R4865 provenant d'UNIMI a révélé des taux d'AF < 20 ppb, fixé par la législation américaine. Ainsi, la variété R4865 d'UNIMI peut être donneuse de pollen à Tilevy dans des programmes ayant pour but de produire de grandes quantités de grains de qualité en Haïti.



Objectifs de cette présente étude

- (i) Evaluer le rôle des saisons de culture sur les AF des grains;
- (ii) Identifier les pratiques agricoles et post-récoltes responsables de la contamination du maïs à Torbeck.



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Matériel et Méthodes

- ✓Echantillonnage: 600 échantillons de maïs
- ✓Masse unitaire: $\pm$ 500 grammes
- ✓Zone de collecte: Entrepôt des planteurs
- ✓Quantité par campagne: 300
- ✓Campagnes: Printemps et Été
- ✓Transport au laboratoire d'AgroLab d'UNDH à Torbeck;
- ✓Tester pour les aflatoxines dans moins de 3 jours.



Test laboratoire: Reveal Q+



- ✓ la quantification d'AF a été faite en suivant les procédures mises en place par la compagnie Neogen (*Reveal Q+*)
- ✓ Avec surtout une implication étudiante pour la pérennisation des actions de lutttes contre les aflatoxines en Haïti.



Matériel et Méthodes

Pratiques Pre-productive et Productive:

- ✓ la provenance des semences, variétés plantées, traitements de semences avant plantation, utilisation de fertilisants,
- ✓ contrôle des pestes (insectes ect), nombre de sarclage réalisé et condition climatique (précipitation) lors de la récolte.

Pratiques Post-Recoltes:

- ✓ Humidité de l'entrepot;
- ✓ Triage manuel de grains avant stockage;
- ✓ Identification de pestes dans l'entrepot;
- ✓ Présence de mites dans l'entrepot
- ✓ Pesticide utilisée contre les pestes.

Analyse statistique:

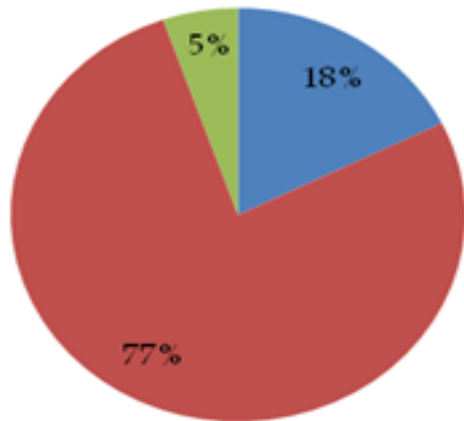
- ✓ Les données collectées et les aflatoxines obtenues ont été soumises des analyse descriptive et inférentielle suivant le cas:
 - ✓ Test t de Student, X2 et Analyse en composante Multiple (ACM) en utilisant le logiciel SPSS version 22.0



Résultats

Sprint maize growing season

■ ND ■ < 20 ■ > 20



Summer maize growing season

■ ND ■ < 20 ■ > 20

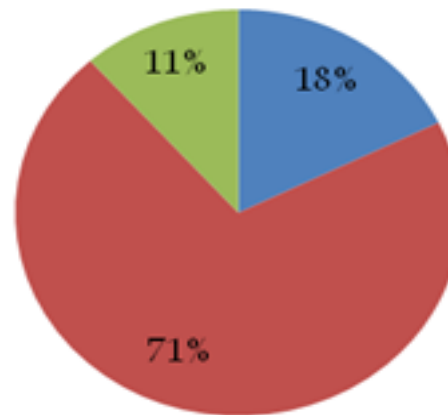


Figure 3: Variation de la contamination d'aflatoxine des grains par campagne agricole.

Note 1:

Les produits de la campagne d'été ont été relativement plus contaminés que ceux du printemps avec respectivement **11** et **5%**. Plus de 90% des produits des 2 campagnes ont été < 20 ppb fixés par USFDA (législation américaine).



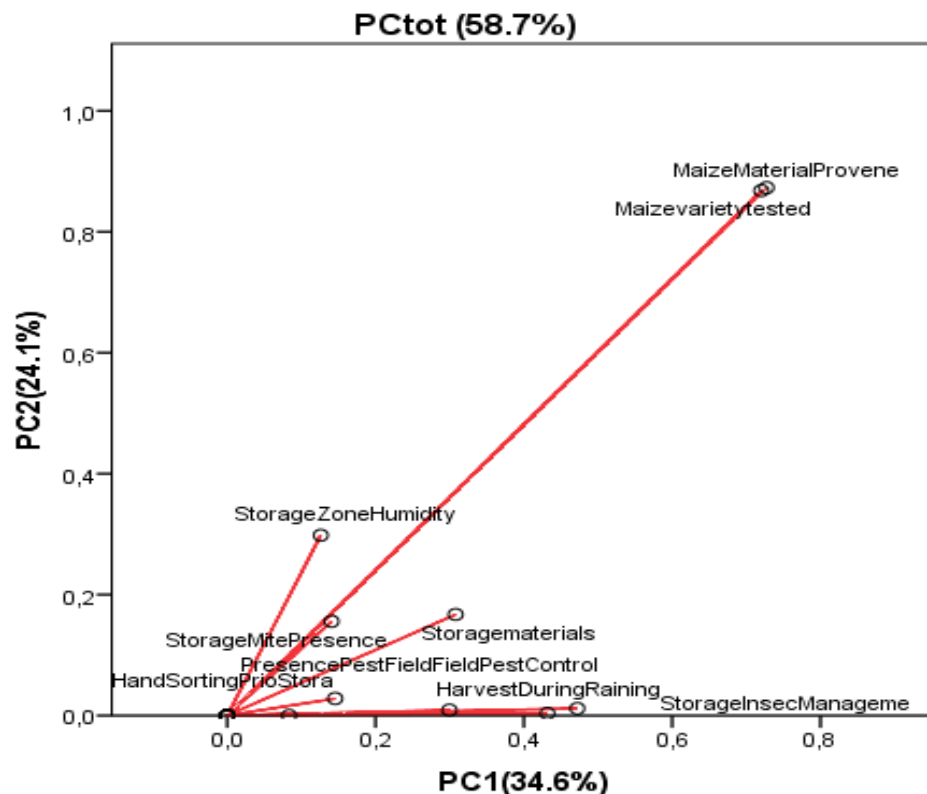


Figure 4: Fonctions discriminatoires caractérisant les 300 échantillons collectés durant la campagne d'été (août 2019).

Note 2:

Les PC1 et PC2 sont responsables de près de 60% de variation notée entre les 300 échantillons testés durant la campagne agricole pour les aflatoxines contenues. Les variétés testées ainsi que la provenance de ces dernières sont les principaux vecteurs responsables de cette dissimilarité avec respectivement 79,4 et 80% d'inertie.



Pratique et AF des grains

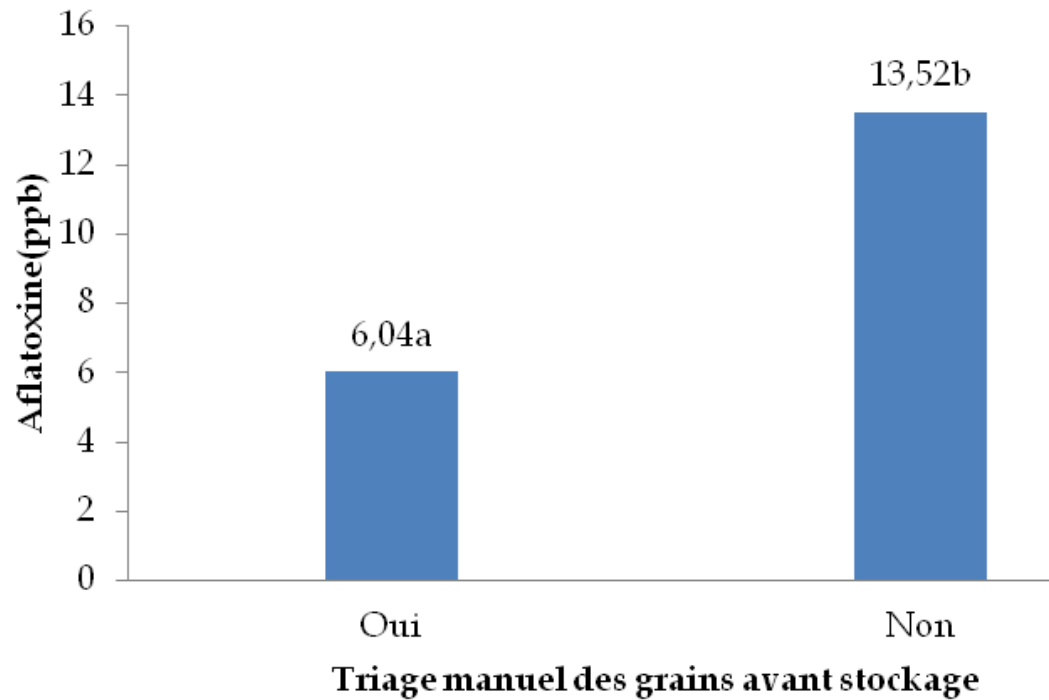


Figure 5: Effets du triage sur les aflatoxines des grains.

Note 3:

Le triage manuel de grains avant entreposage réduit significativement ($P=0,024$) la quantité d'aflatoxine des grains de maïs durant la campagne d'été.



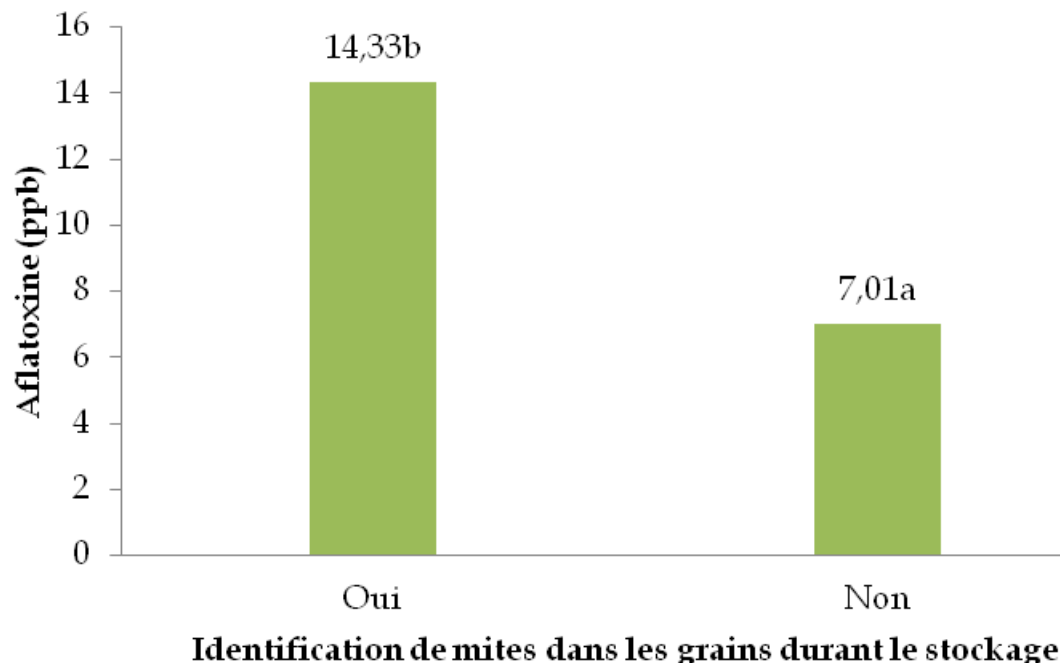


Figure 5: Effets des mites sur les aflatoxines des grains de maïs.

Note 4:

La présence de mites dans les zones d'entrepôt des grains affecte significativement ($P=0,004$) la quantité d'aflatoxine des grains de maïs durant la campagne d'été.

Mais aucune pratique agricole et pre-productive n'a d'effets sur la variation d'AF des grains ($p>0,05$).



Conclusion

Les résultats de cette investigation ont démontré:

- ✓ Le problème des AF d'Haiti n'est pas une fatalité;
- ✓ Plus de 93% des échantillons des 2 campagnes ont été < 20 ppb fixé par les USFDA;
- ✓ Près de 19% des produits n'ont aucune trace d'AF;
- ✓ Les périodes pluvieuses des mois d'aout peuvent avoir de légères conséquences sur les AF des produits de maïs à Torbeck;
- ✓ Des conditions de stockage inadéquate, la présence des mites dans les entrepôts et le non triage manuel des grains avant les entreposages peuvent affecter la qualité des produits;
- ✓ Des études sur les pratiques post-récoltes et la mise à la disposition des agriculteurs des structures comme silos communautaires devant mieux contrôler les mites seraient nécessaires à l'avenir.



Perspectives

- ✓ Développer des projets sur de nouvelles techniques de stockage des grains;
- ✓ Sensibiliser les acteurs (agriculteurs et étudiants) sur le contrôle des pestes dans les zones de stockage;
- ✓ Mettre en Place dans des zones clés de Torbeck de silos communautaires.





Merci



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