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Physiological and biochemical effects of toxigenic *Aspergillus flavus* on maize (*Zea mays*)

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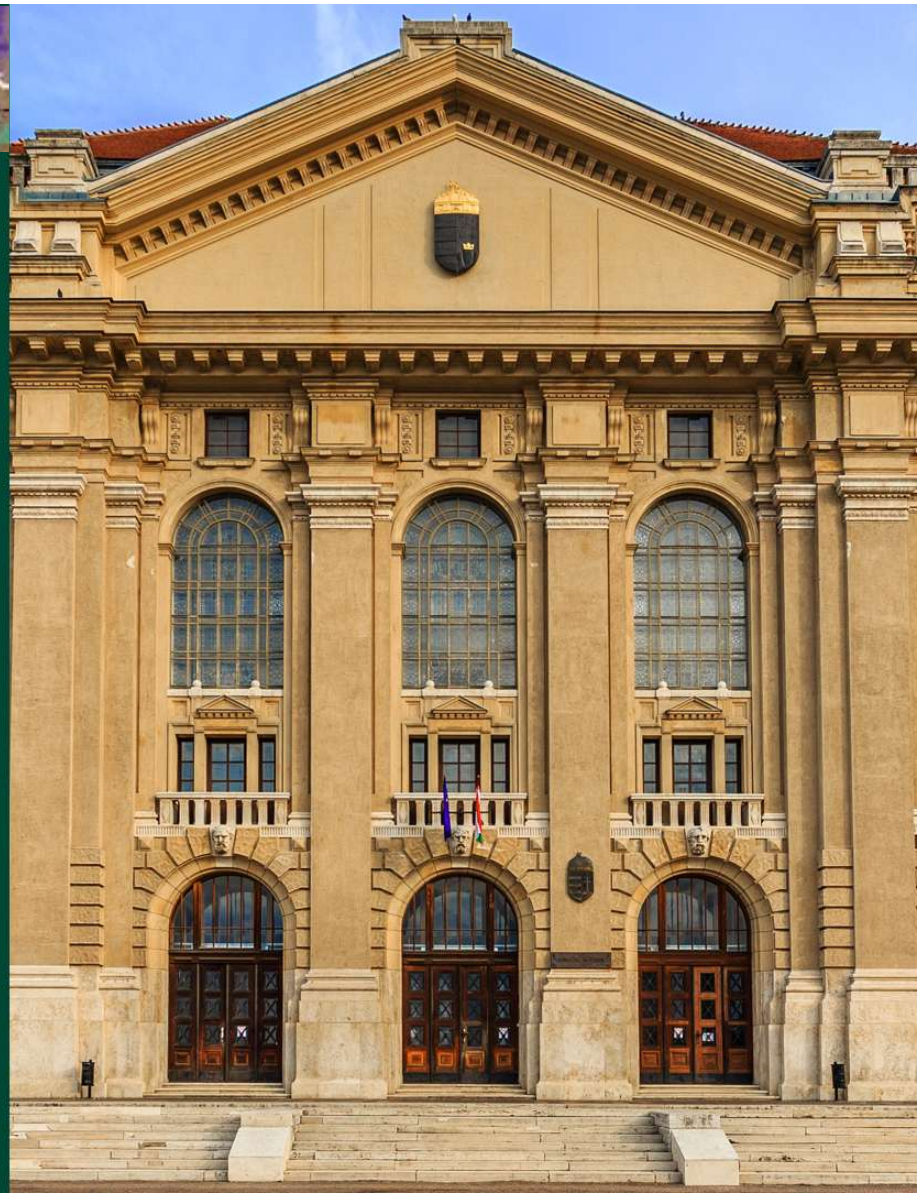
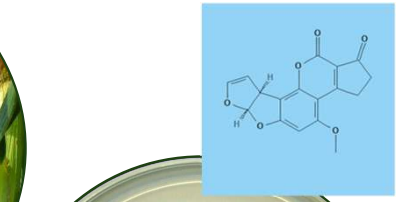


Introduction



Background

- Maize is crucial for global food security & nutrition.[1]
- *Aspergillus flavus* is a significant fungal pathogen affecting maize.[2]
- Produces aflatoxins which are carcinogenic.[2]
- Co-occurrence of fumonisins and aflatoxins in cereals – rising concern.
- Environmental conditions influence fungal proliferation and toxin biosynthesis.[3]

Research gap

- Limited knowledge on how *A. flavus* affects maize physiology, kernel formation and biochemical composition beyond mycotoxin accumulation.

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1. Sunitha et al. (2024), *Int. J. Environ. Clim. Change*, *14*, 75-82.
2. Gong et al. (2024), *Sustainability*, *16*(8), 3171.
3. Dövényi-Nagy et al. (2020), *Toxins*, *12*(12), 768.

Study aim and objectives

Aim

- To evaluate the physiological and biochemical responses of maize to *A. flavus* inoculation.

Specific objectives

- To assess impact of inoculation on kernel production.
- To quantify fungal colonization and mycotoxin accumulation.
- To determine the effect on biochemical parameters – starch, proteins, polyphenols.

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Materials and methods

Experimental design

- SY Orpheus (FAO 380) maize hybrid.[1]
- Field experiment: Inoculated (IN) vs. Control (CT).[2]
- Complete randomized design (CRD).[3]
- Maize ears inoculated by **toxigenic** *A. flavus* **strain AMK 4-16/IV** - punching method.

Measured parameters (response variables)

- Kernel yield – kernel number per ear length.
- Fungal load – mold count in log CFU/g.
- Mycotoxins – Aflatoxin (AFB1), fumonisin B1 (FB1), deoxynivalenol (DON), zearalenone (ZEA).
- Biochemical traits – starch, protein, polyphenols.

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1. Sygenta (2020), Agroforum (accessed on 12th April 2025).
2. Molnár et al. (2023), *Toxins*, *15*, 27.
3. Mwalugha et al. (2025), *Toxins*, *15*(7), 767

Materials and methods…

Analytical methods

- Kernel number – counting from photos taken ($n \geq 8$).
- Mold count – surface spreading method.[1]
- Mycotoxins – determined using HPLC analyses.[2]
- Starch – analyzed using standard polarimetry.
- Protein – Kjeldahl method.[3]
- Total polyphenols – Folin-Ciocalteu method – expressed as gallic acid equivalent.

Statistical analysis

- Significance determined at $p < 0.05$.

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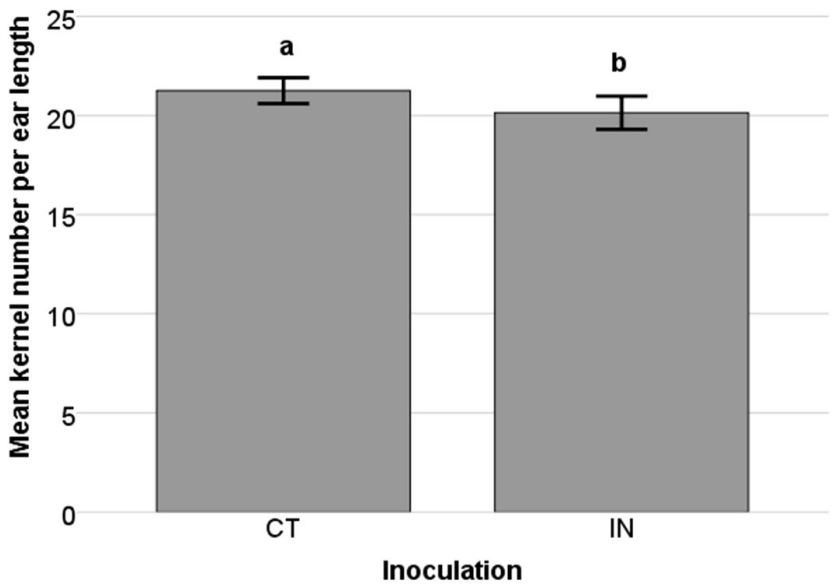
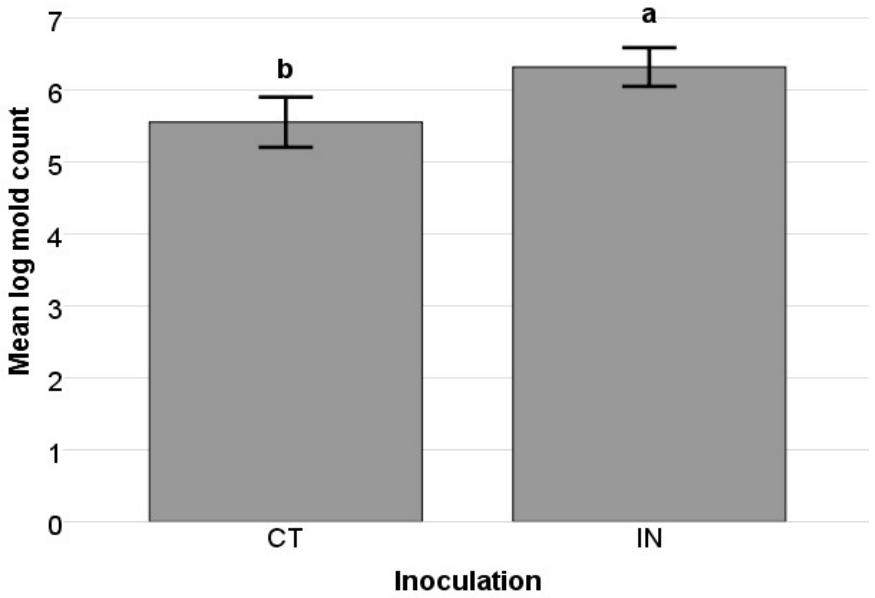
1. ISO 21527-2 (2008), International Organization for Standardization.
2. Adácsi et al. (2022), *Agriculture*, *12*, 421.
3. ISO 5983-2 (2009), International Organization for Standardization.

Results

Kernel number per ear length (*n* = 18; *p* < 0.05)



Mold count (*n* = 18; *p* < 0.01)



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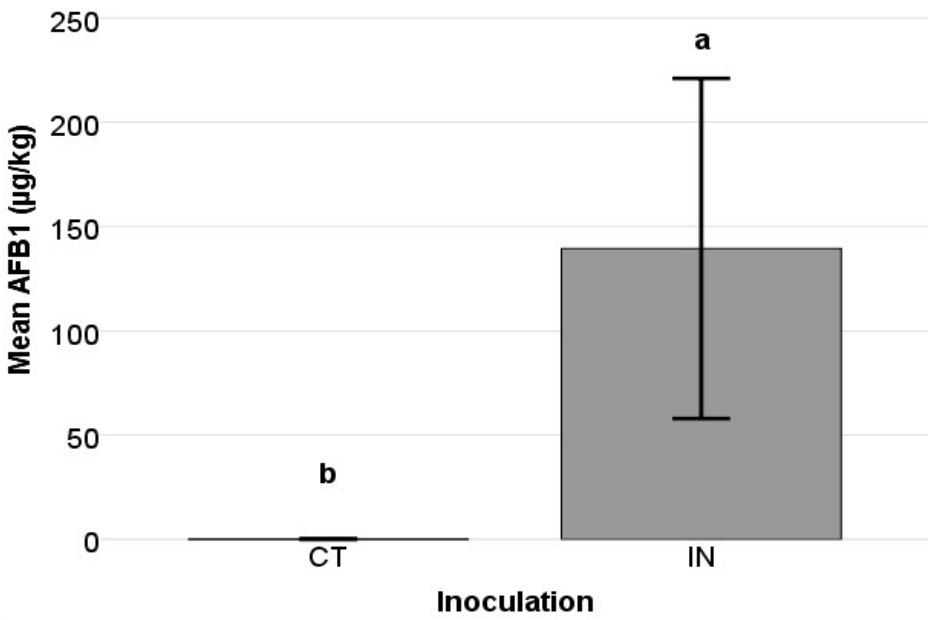
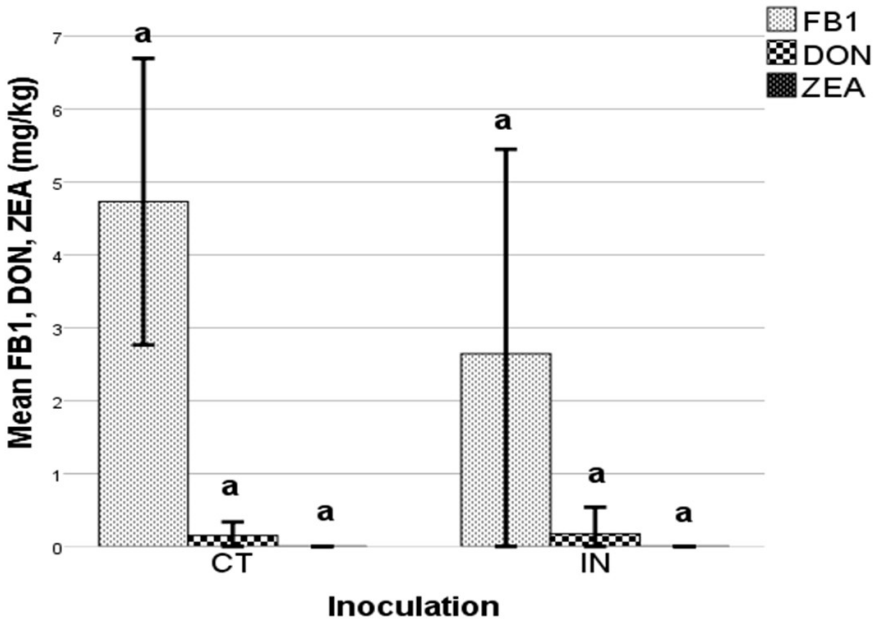
Results

AFB1 (*n* = 18; *p* < 0.01)



Other mycotoxins – FB1, DON, ZEA (*n* = 18; *p* > 0.05)



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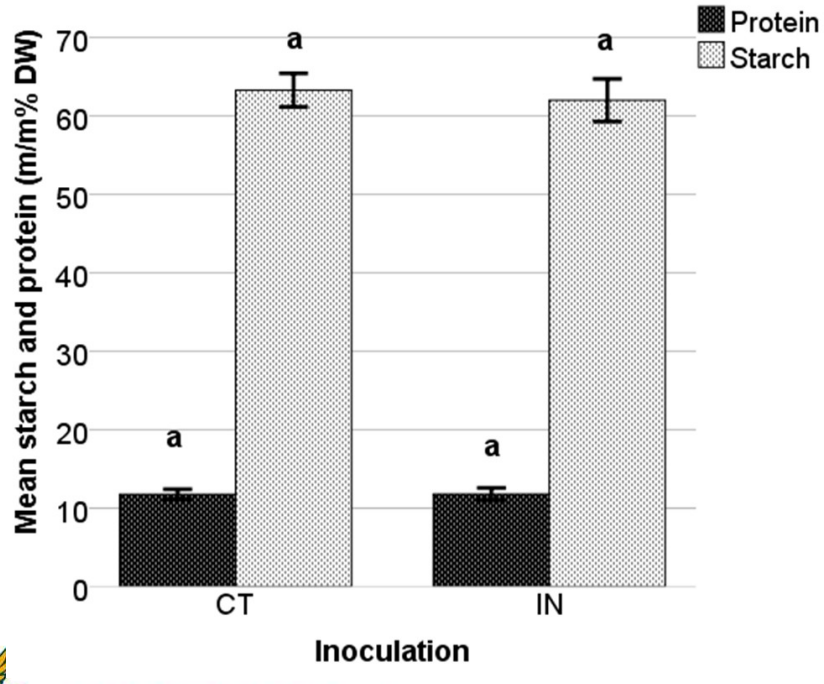
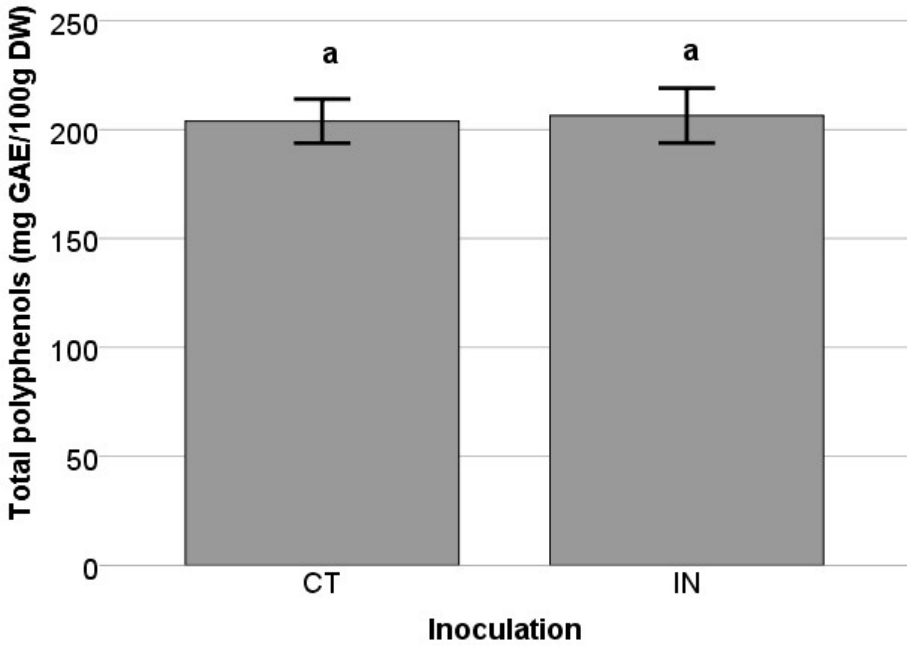
Results

Protein and starch (*n* = 18; *p* > 0.05)



Total polyphenols (*n* = 18; *p* > 0.05)



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Conclusions

New scientific findings

1. Inoculation by toxigenic *A. flavus* **significantly decreased** kernel production.
2. Inoculation **significantly increased** fungal colonization and AFB1 contamination.
3. In the short-term, inoculation **does not alter** biochemical composition.

Future research

1. Development of resistant maize hybrids
2. Biological control agents
3. Development of precision agricultural techniques

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Publication

agriculture

an Open Access Journal by MDPI

Irrigation, Nitrogen Supplementation, and Climatic Conditions Affect Resistance to *Aspergillus flavus* Stress in Maize

Heltan M. Mwalugha; Krisztina Molnár; Csaba Rácz; Szilvia Kovács; Cintia Adácsi; Tamás Dövényi-Nagy; Károly Bakó; István Pócsi; Attila Dobos; Tünde Pusztahelyi

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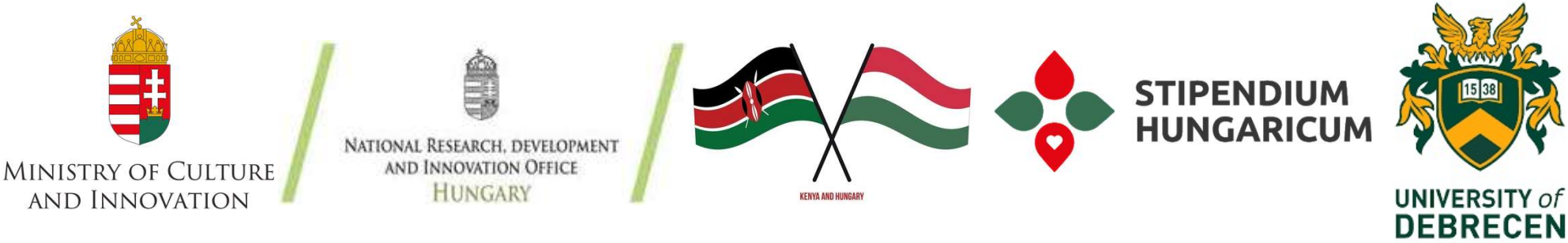
Acknowledgement



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