



Use of Satellite Imaging for Mycotoxin Prediction

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Introduction



- Europe is the fastest-warming continent, temperatures rising more than double the global average (climate.copernicus.eu)
- Droughts; European Corn Borer; Mycotoxins occurrence
- Yield reduction, aflatoxins in maize and milk → economic loss and health threats





Introduction



Research question:

Can we use
satellite imagery
to develop a prediction model
of major mycotoxins
in maize fields





Material and methods



Sentinel-2 satellite



pixel size 10 m x 10 m
revisits every 5 days
13 bands

Satellite vegetation indices *for plant health*

NDVI (Normalized Difference Vegetation Index)

EVI (Enhanced Vegetation Index)

RDVI (Renormalized Difference Vegetation Index)

GNDVI (Green Normalized Difference Vegetation Index)

OSAVI (Optimized Soil Adjusted Vegetation Index)

PSRI (Plant Senescence Reflectance Index)

VARIGreen (Visible Atmospherically Resistant Index green)

REHBI (Red Edge Head Blight Index)

REDSI (Red Edge Disease Stress Index)

NDMI (Normalized Difference Moisture Index)

NDVire (Red-Edge Normalized Difference Vegetation Index)



Material and methods



- Liquid chromatography–mass spectrometry (LC–MS) chemical analyses by FFOqSI

Emerging mycotoxins (beauvericin – BEA, moniliformin – MON, alternariol – AOH etc)

Major mycotoxins (**aflatoxin B1** and **fumonisin B1**)

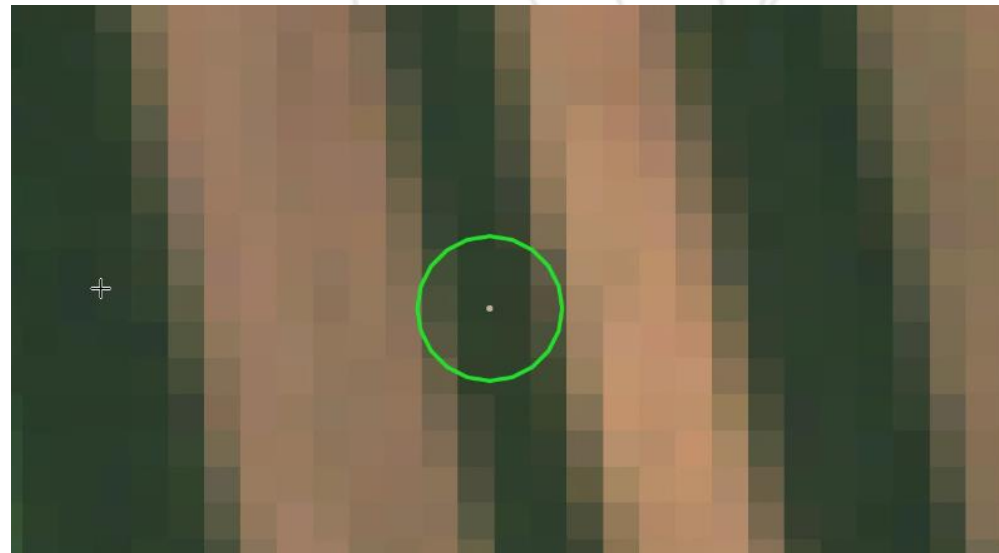
Aflatoxin B1 (0, 2177.3) $\mu\text{g}/\text{kg}$

Fumonisin B1 (0, 22416) $\mu\text{g}/\text{kg}$

- Satellite data
for maize fields



Google Earth Engine





Material and methods



Binary classification

Machine Learning models

Support Vector Machine (SVM)
Random Forest (RF)
eXtreme Gradient Boosting (XGBoost)

Thresholds (based on regulations)

Aflatoxin B1	20 $\mu\text{g}/\text{kg}$
Fumonisin B1	200 $\mu\text{g}/\text{kg}$

Python implementation

- Standard scaler for feature normalization
- Dataset was randomly split into a train and test (80:20)
- 5-fold cross validation was performed on training dataset
- Optimal hyper-parameters of the models were obtained using a grid search





Conclusions

- It is possible to classify infested maize fields using satellite data but with some limited accuracy
- Much more maize samples are required (georeferenced and analyzed)
- Aquisition process could be digitized



3:50 96%

Inventory of cultures

Crop
Select a crop

Previous Crop
Select a previous crop

Variety/hybrid

Date of sowing

Phenophase
Select a phenophase

General assessment of plant condition
 Poor Average Good

Presence
 Disease
 Weeds
 Pests
 Damage





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Thank you for your attention!