Case studies of mycotoxin contamination in organic maize stored and milled by smallholder farmers in southwest France

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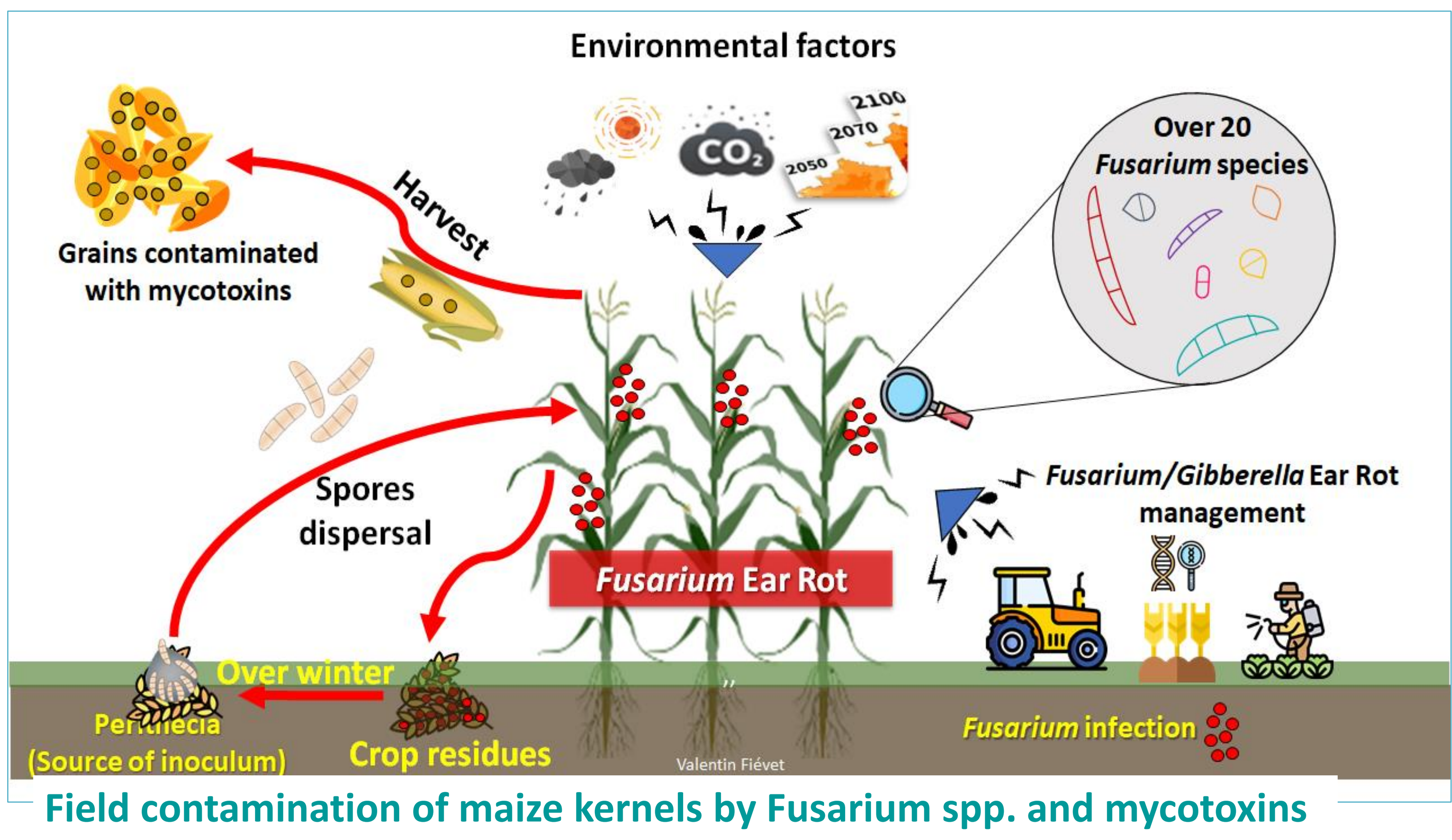
Drying and storage of Cobs in 'cribs'

End products

Background: Gibberella ear rot mainly caused by *Fusarium graminearum* or *F. culmorum* and Fusarium ear rot, mainly cause by *F. verticillioides* or *F. proliferatum* are the most common diseases associated with maize ears, and can be observed to at least a low degree of severity in nearly all corn fields at the end of the season. The fungi cause substantial damage to maize cobs and foliage, including mycotoxin contamination of grains. Small-scale farmers who grow, store and process maize into foodstuff on the farm rarely have their products tested for mycotoxins, and are generally unconcerned about these issues. In south-west France, organic farmers grow local open-pollinated varieties. After harvesting, the corn cobs are dried and stored from autumn until next spring or more in 'cribs' (screened cells used for open-air storage and drying of corn on the cobs) , and then corn cobs are threshed to recover the kernels before being ground into flour and semolina.

The **Objectives** of the research project Myc3C were (i) to collect reference data in their production conditions, making smallholder farmers aware of the mycotoxin risk and helping them to identify action levers to guarantee the sanitary quality of their products; (ii) to get better knowledge on fate of mycotoxins and microbiota throughout the life cycle of a maize kernel, from the seed to the food.



Field contamination of maize kernels by Fusarium spp. and mycotoxins

Methods

- ✓ Collection of Samples on 8 farms at harvest, after storage for 6 to 8 months as cobs in cribs (A, B, C, F, G, H) or as kernels in silos (D, E), and after milling into flour and semolina.
- ✓ Analysis by LC MS/MS of their contents in mycotoxins : Trichothecenes A & B, Zearalenone, Fumonisins, Aflatoxins and Ochratoxin A
- ✓ Evaluation of the contamination by *Fusarium* species by q-PCR with specific primer pairs.

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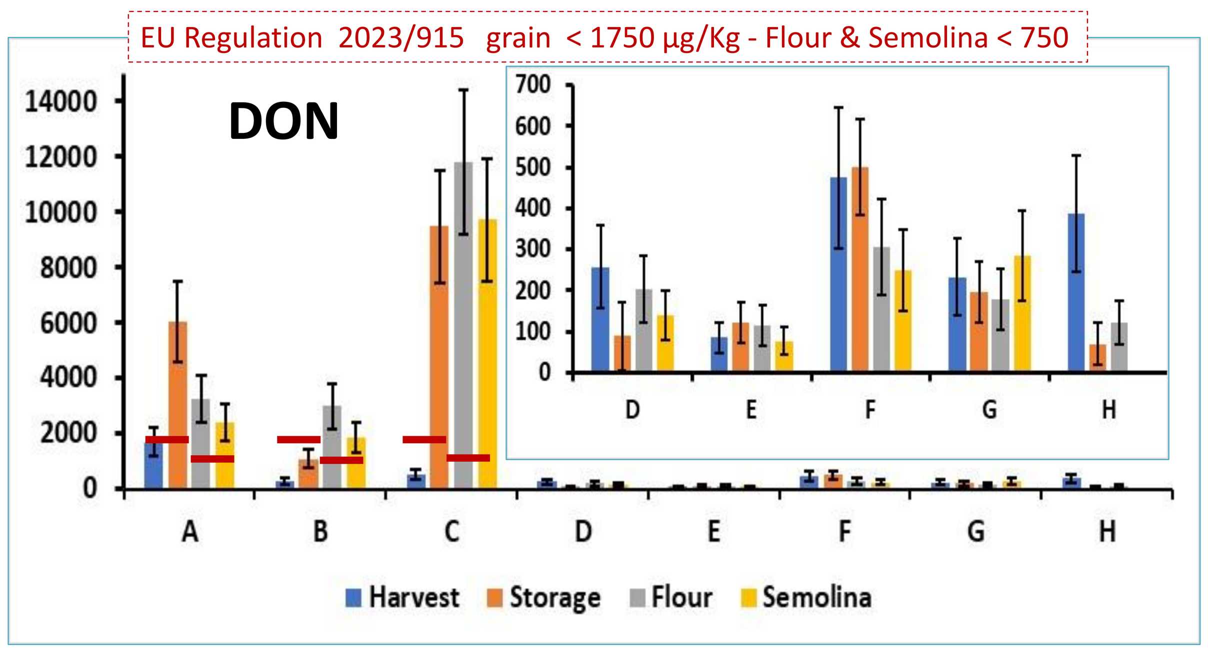
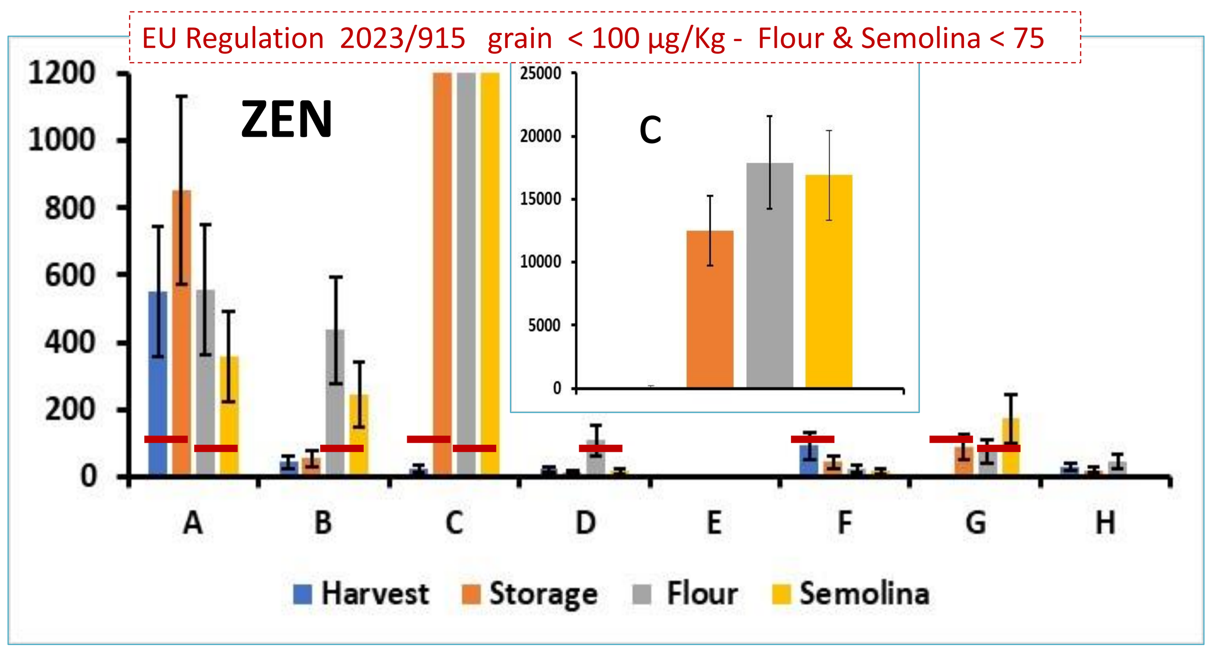
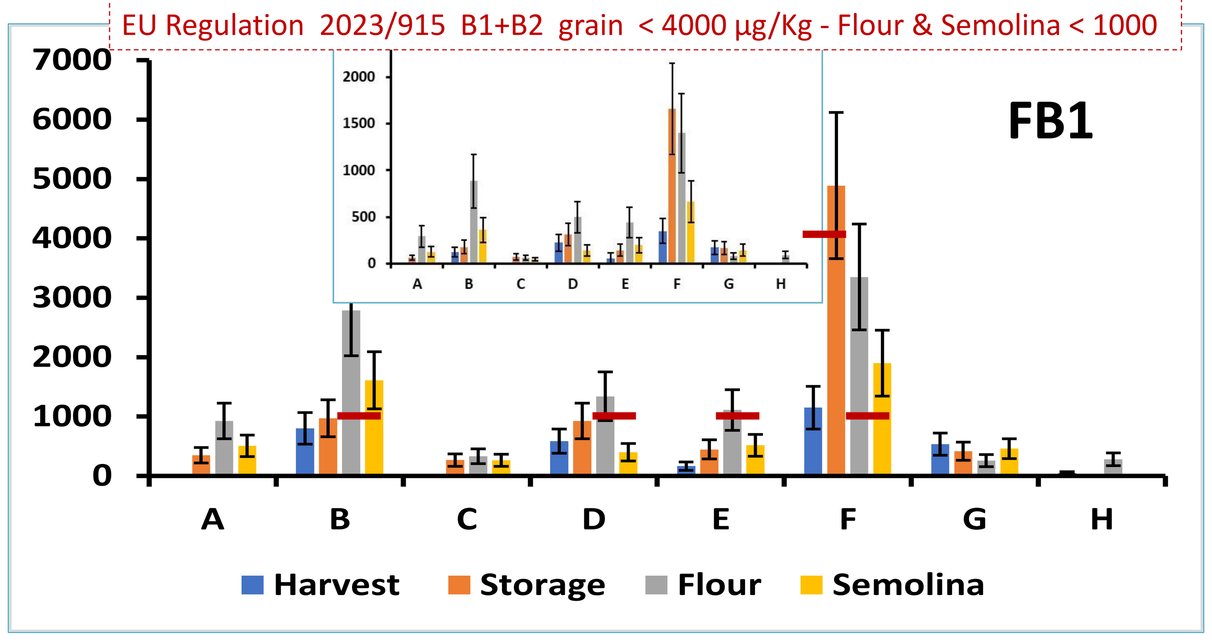
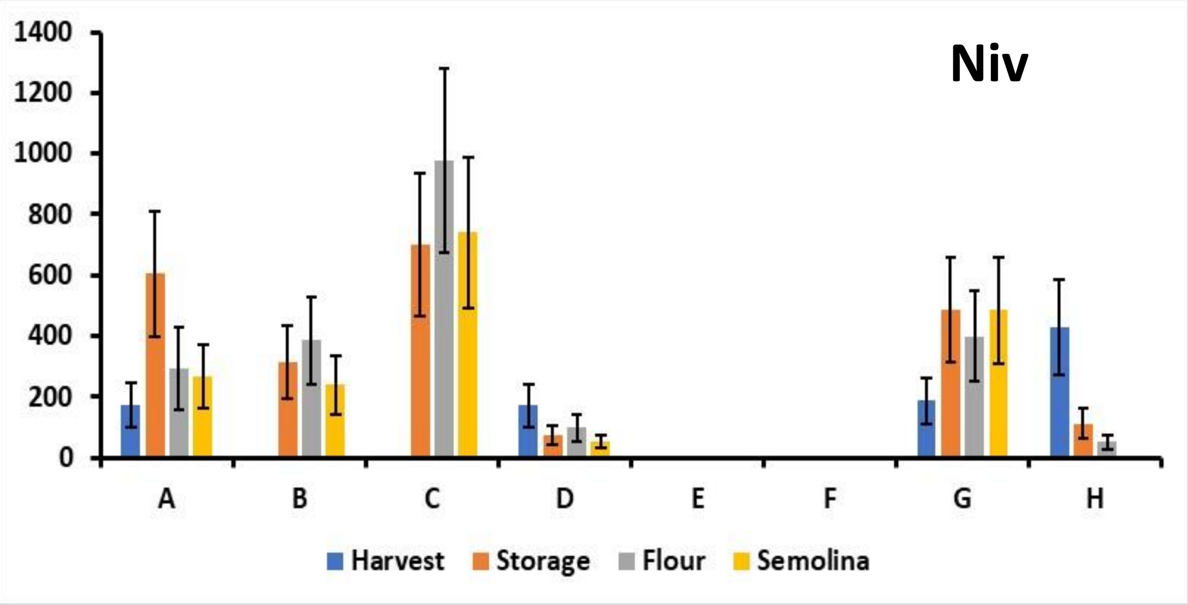
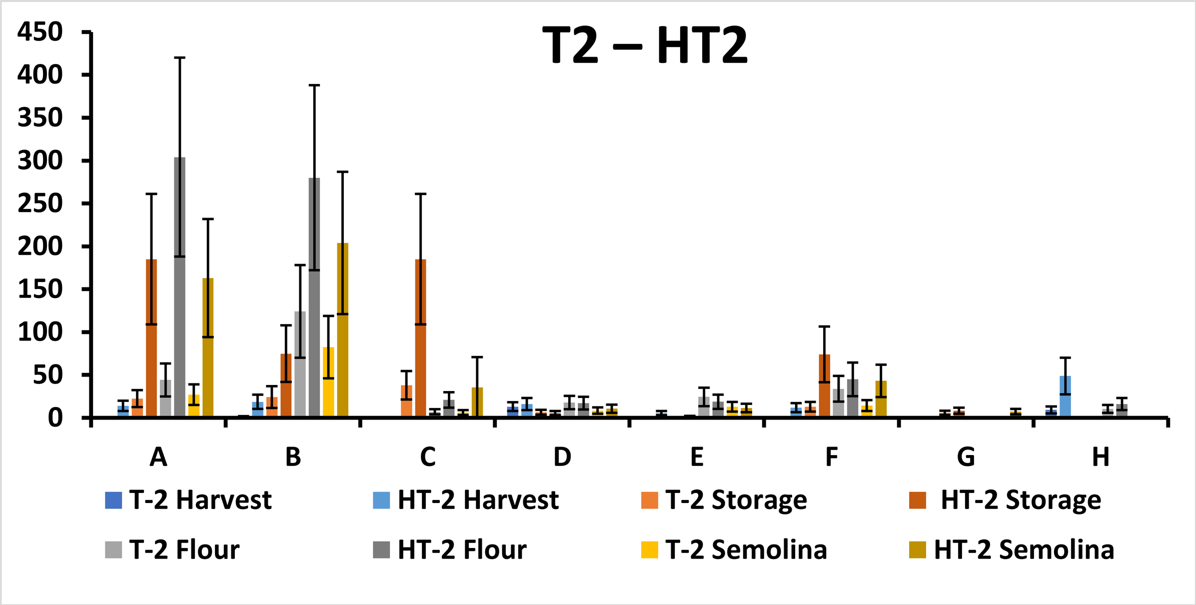
Results: Mycotoxins (µg / Kg)

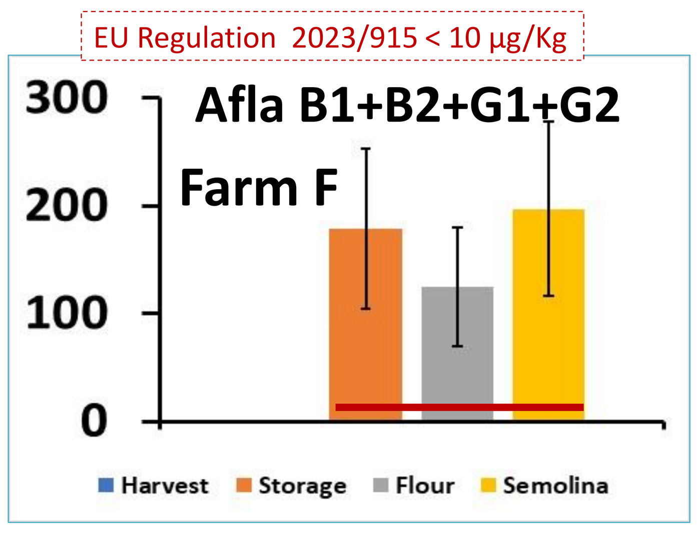












Aflatoxins only in F

No Ochratoxin A > LOQ

[Errors bars in the figures are +/- uncertainty]

Results: Contamination by *Fusarium* spp.

Samples	*Fusarium species*			
	F. graminearum	*F. poae*	*F. sporotri-chioides*	*F. verticil-lioides*
A-Harvest	++	0	0	0
A-Storage	++++	++	++	++
A-Flour	++++	++	++	++
A-Semolina	++++	++	++	++
B-Harvest	++	0	0	0
B-Storage	++++	++	0	++
B-Flour	++++	++	++	++
B-Semolina	++++	++	++	+
C-Harvest	++	++	++	+
C-Storage	++++	++++	++	+
C-Flour	++++	++++	+	0
C-Semolina	++++	++++	++	+
D-Harvest	++	0	0	0
D-Storage	++	0	0	0
D-Flour	++	++	++	+
D-Semolina	++	0	++	++
E-Harvest	++	0	0	+++
E-Storage	++	++	0	+
E-Flour	++	0	+	++
E-Semolina	++	0	0	++
F-Harvest	+++	++	0	0
F-Storage	+++	++	+	++
F-Flour	+++	++	++	++++
F-Semolina	++	++	0	++

F. graminearum => DON ZEA. F. verticillioides => FB1+FB2
F. poae => Niv *F. sporotrichioides* => T2 - HT2

Conclusions:

- ✓ DON and *Fusarium graminearum* were present in all samples. Significant correlation DON - Niv
- ✓ All samples taken at harvest complied with the EU regulations, but mycotoxin over-contamination occurred during storage in some farms, leading to unsaleable end products.
- ✓ Over-contaminations with TCTB, ZEA, TCTA and FB1 at storage were linked to apparent increases in *Fusarium* spp. colonisation levels.
- ✓ No over contamination in G and H where grains were stored in ventilated metal bins; but also no or low Trichothecenes contamination in half the farms (F, G, H) where ears were stored in cribs.
- ✓ Aflatoxins were detected in only 1 farm after storage, but at dramatic concentrations in a sample heavily contaminated with Fumonisins (F).
- ✓ Exclusion of over-contamination by Trichothecenes in case of over-contamination at storage by Fumonisins and Aflatoxins (F).
- ✓ A trend towards higher levels of contamination in Flour than in Semolina.

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