

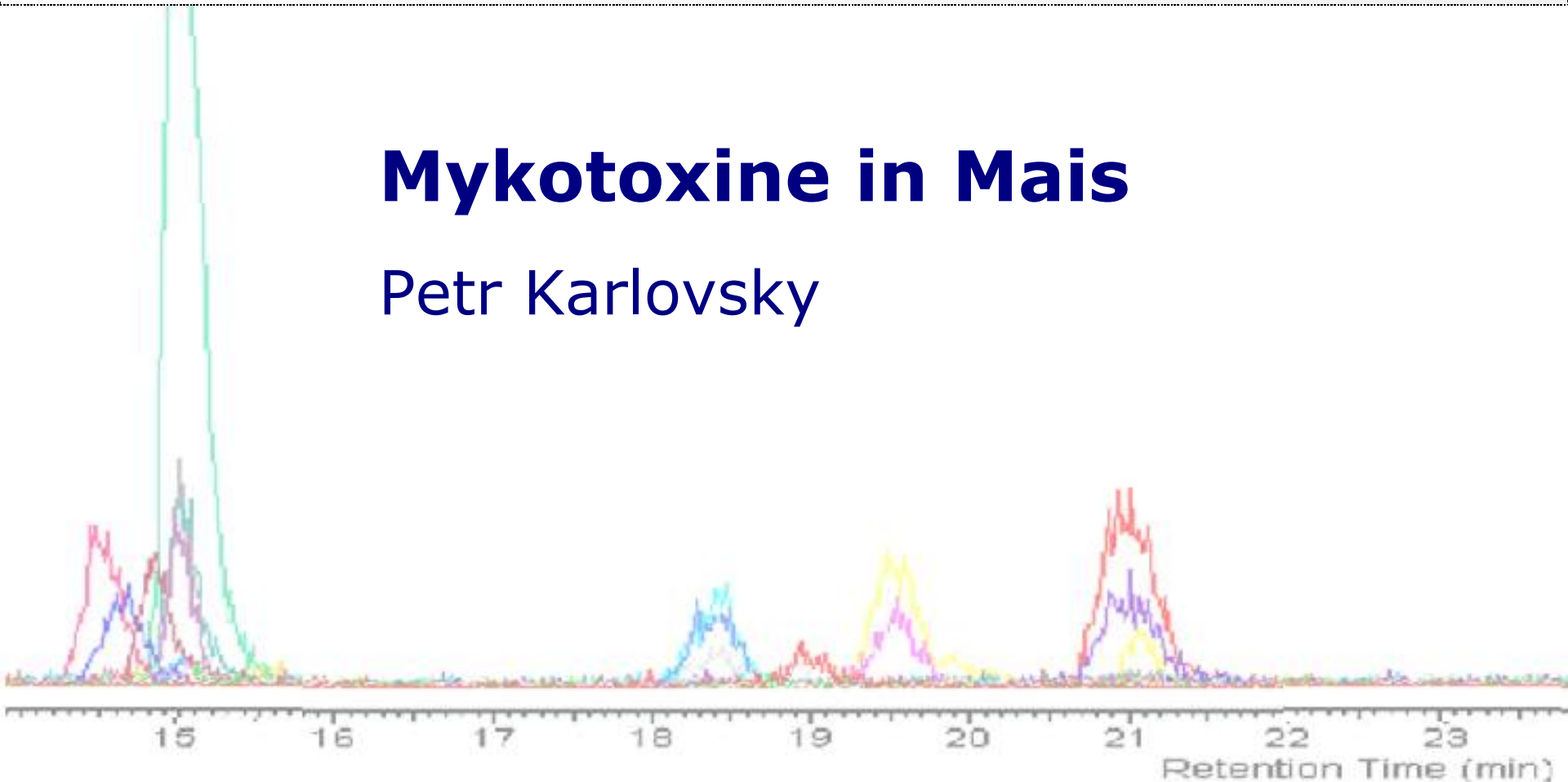


Georg-August-Universität Göttingen  
Department für Nutzpflanzenwissenschaften  
Abteilung Molekulare Phytopathologie und Mykotoxinforschung

[www.gwdg.de/~instphyt/karlovsky](http://www.gwdg.de/~instphyt/karlovsky)

# Mykotoxine in Mais

Petr Karlovsky





## Mykotoxine in Mais

- Trichothecene  
(DON, NIV, ADON, T2...)
- Zearalenon, Zearalenole...
- Fumonisine  
(FB1, FB2, FB3, FB4, FC, FP...)
- Aflatoxine
- Moniliformin, Fusaproliferin, Enniatine...



## Mykotoxine in Mais

## Fusarienarten

- Trichothecene
- Zearalenon

*F. graminearum*  
*F. culmorum*

- Fumonisine

*F. verticillioides*  
*F. proliferatum*  
***A. niger?***

- Aflatoxine

*A. parasiticus*  
*A. flavus*

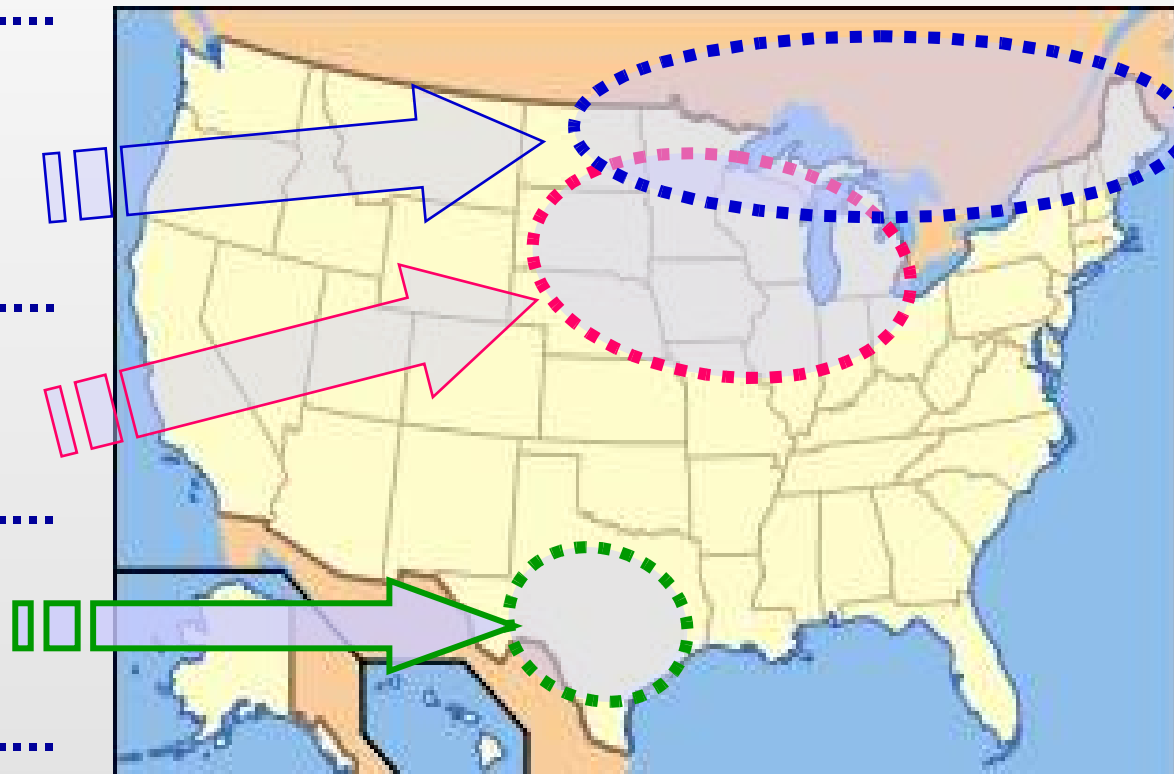
## Mykotoxine in Mais

■ Trichothecene

■ Zearalenon

■ Fumonisine

■ Aflatoxine



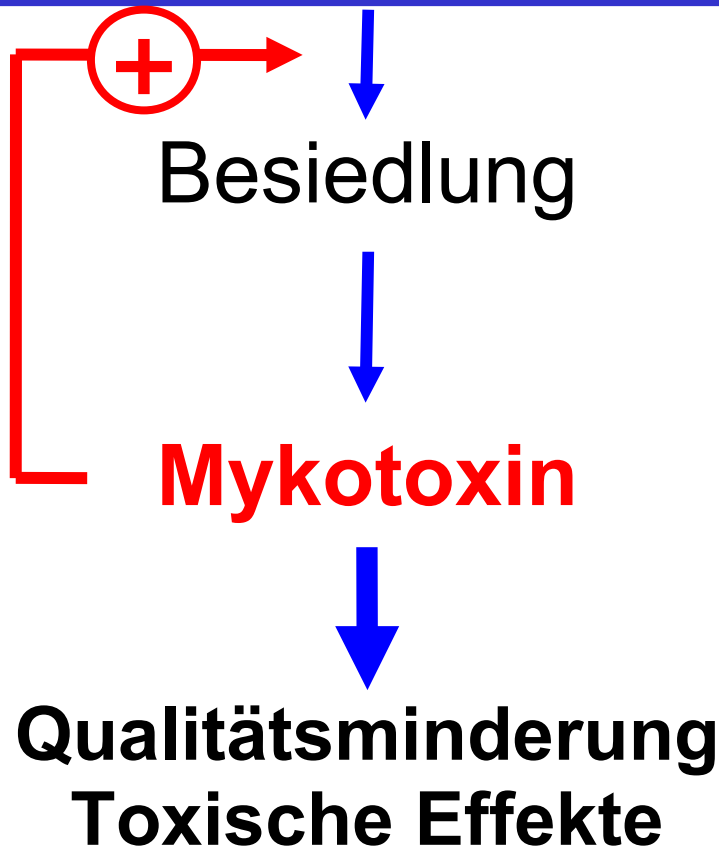


# Ausgewählte Mykotoxinprojekte

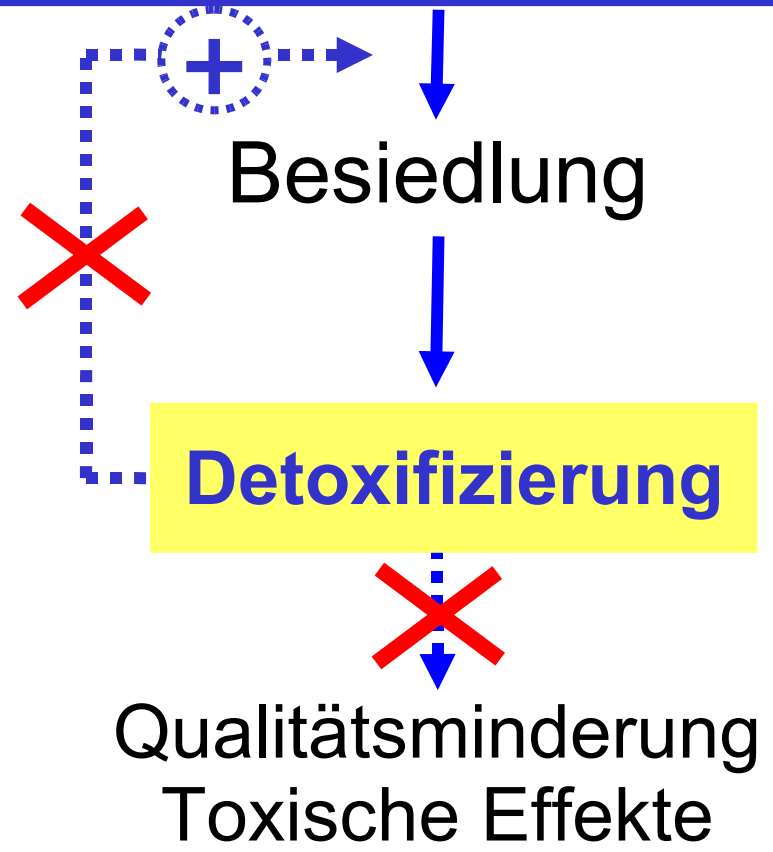
- Enzymatische Detoxifizierung
  - ▶ DON, FUM, ZEA
- Interaktionen zwischen Mykotoxinbildnern
- Belastung von Mais
  - ▶ Resistenzzüchtung (ERA-NET)
  - ▶ Verteilung in der Pflanze
  - ▶ Öko-Mais und Mykotoxine

# Detoxifizierung *in planta*

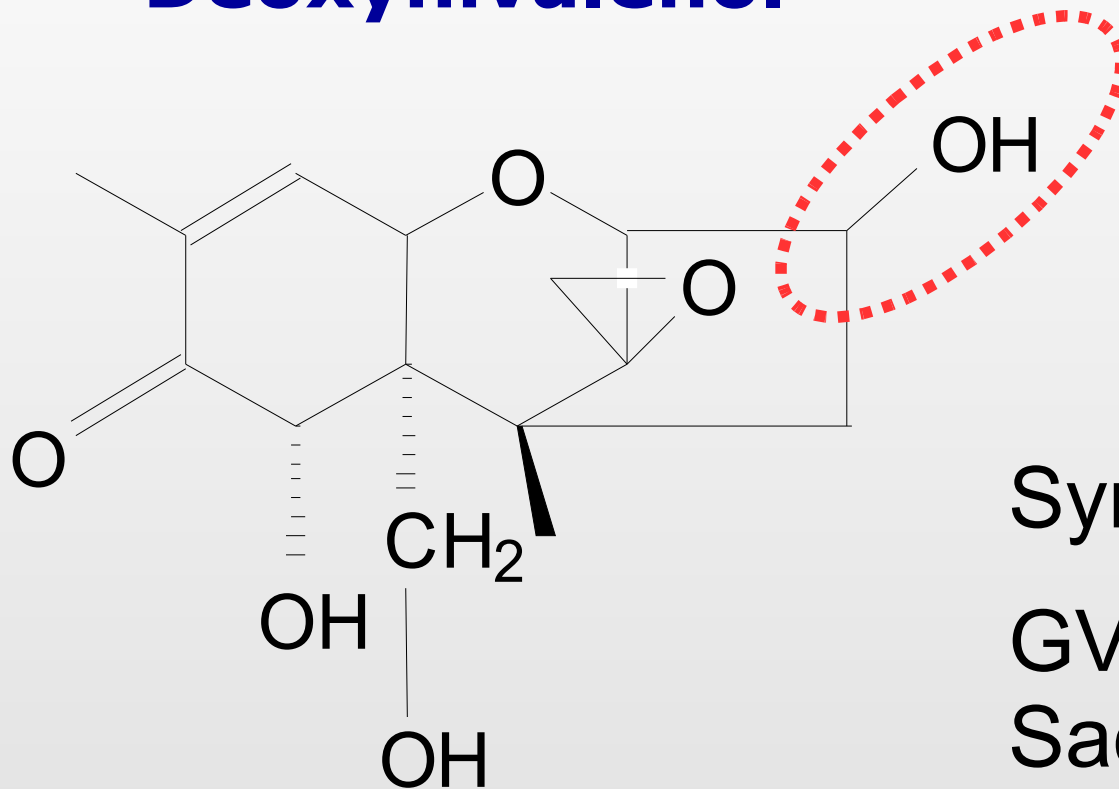
Wirtspflanze



Detox.-Wirtspflanze



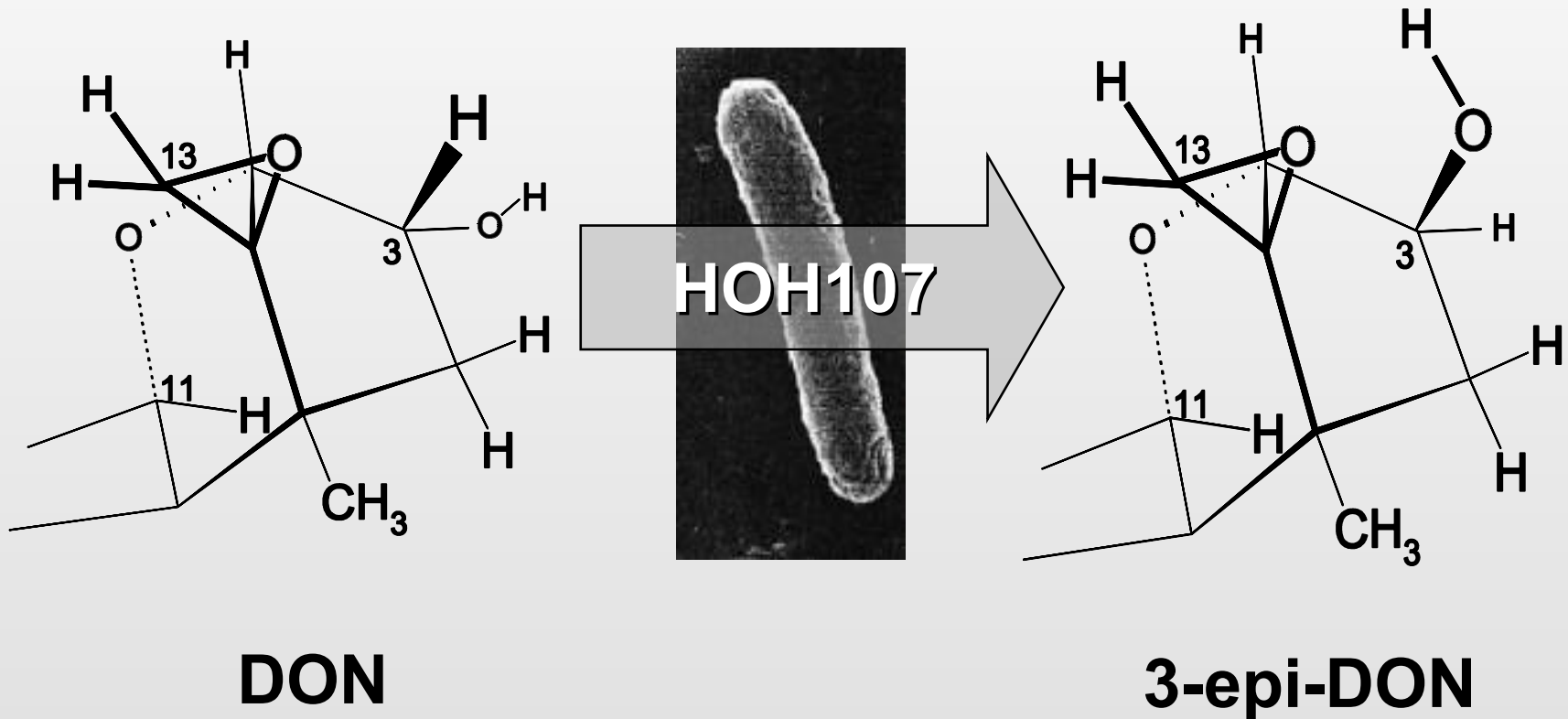
## Deoxynivalenol



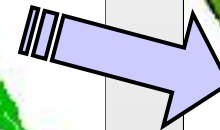
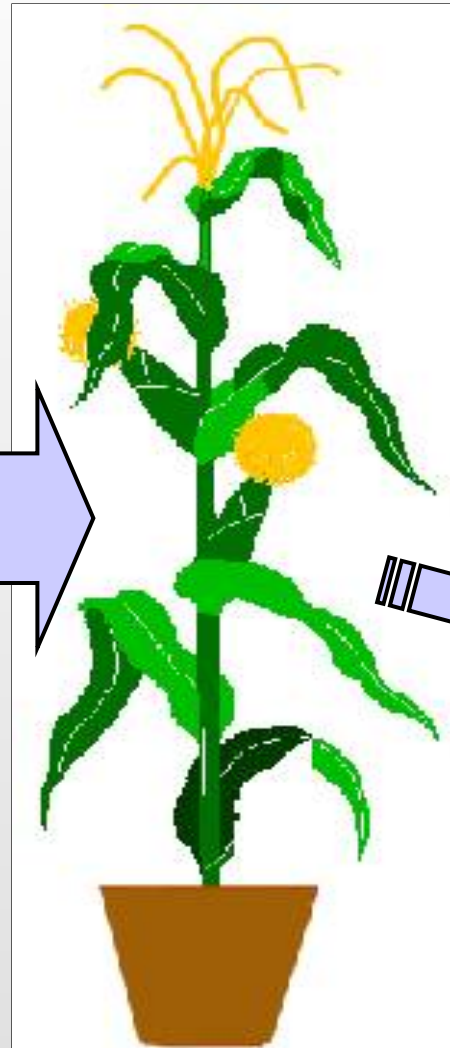
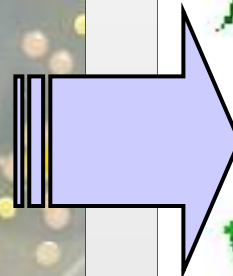
Syngenta

GVO-Weizen in  
Sachsen-Anhalt

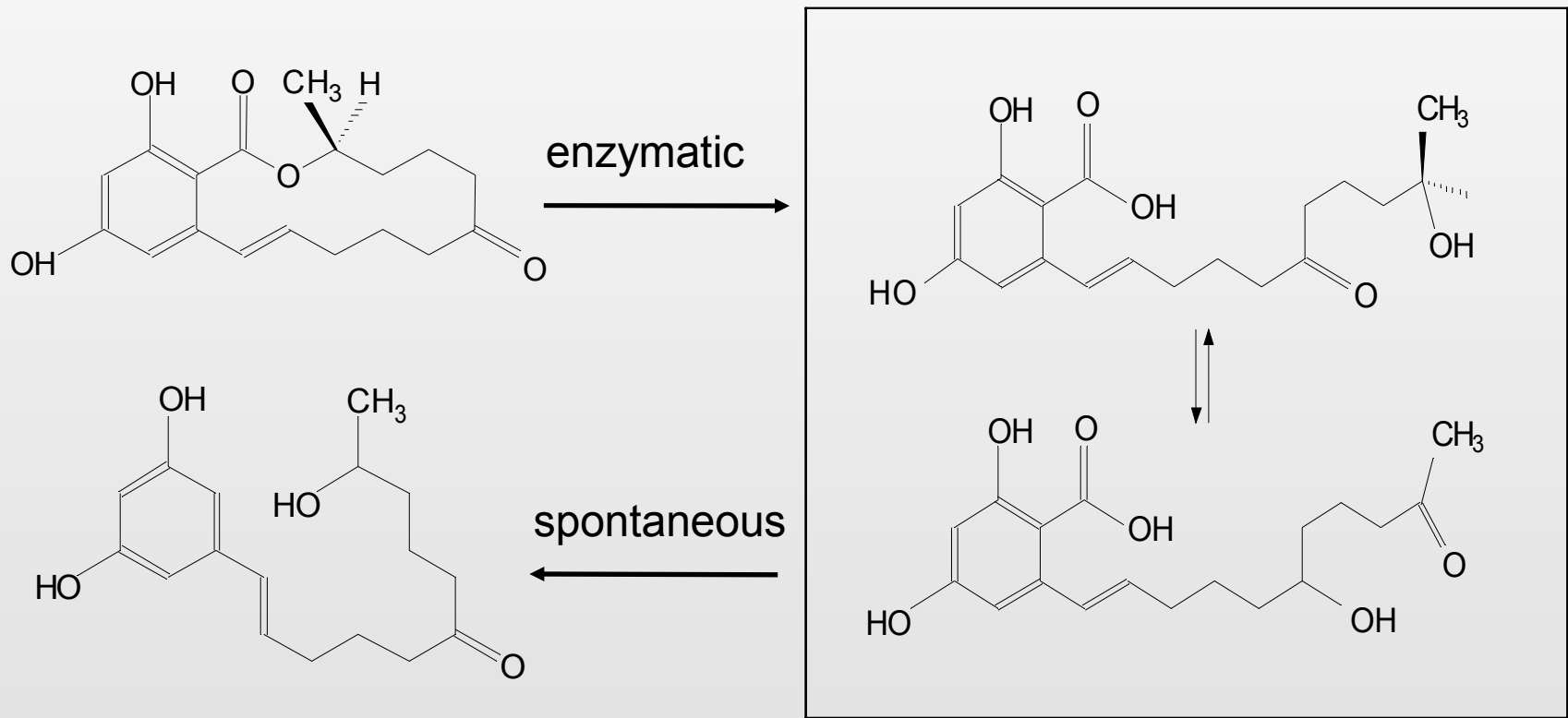
# Detoxifizierung von DON



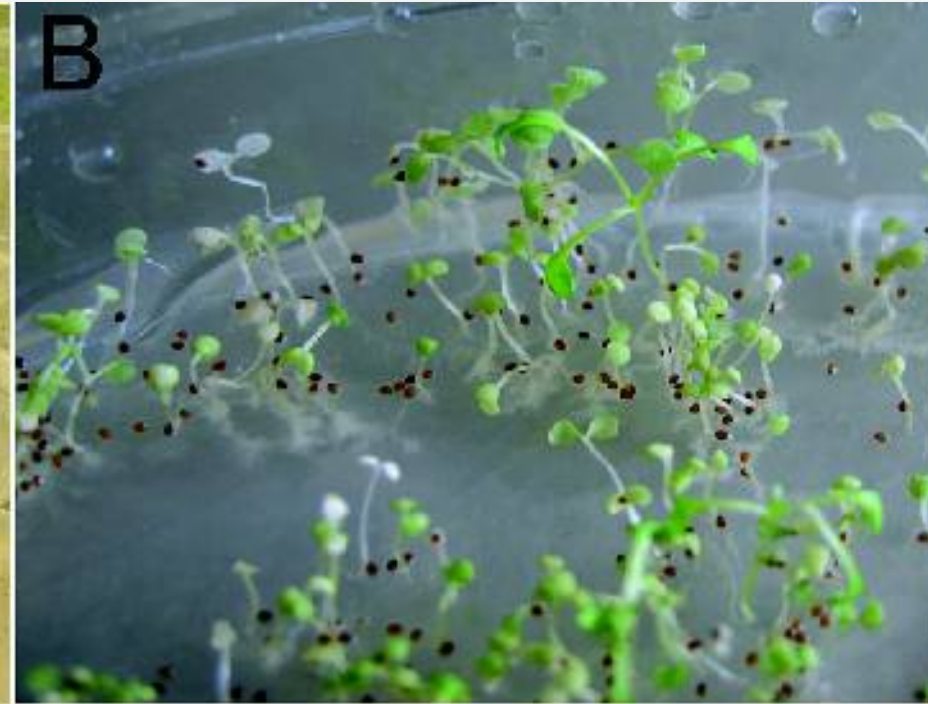
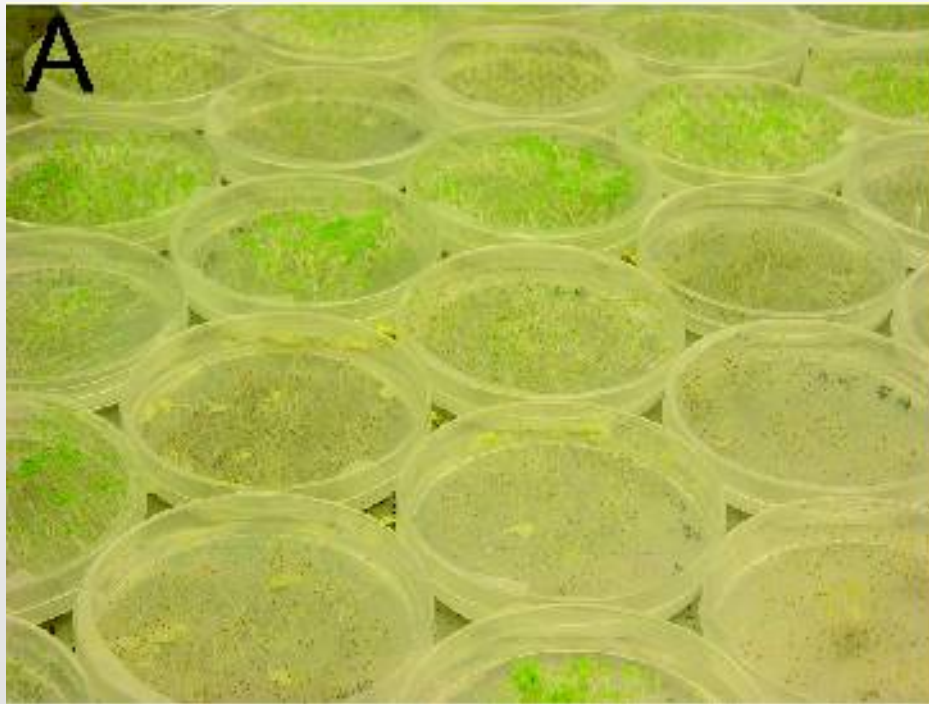




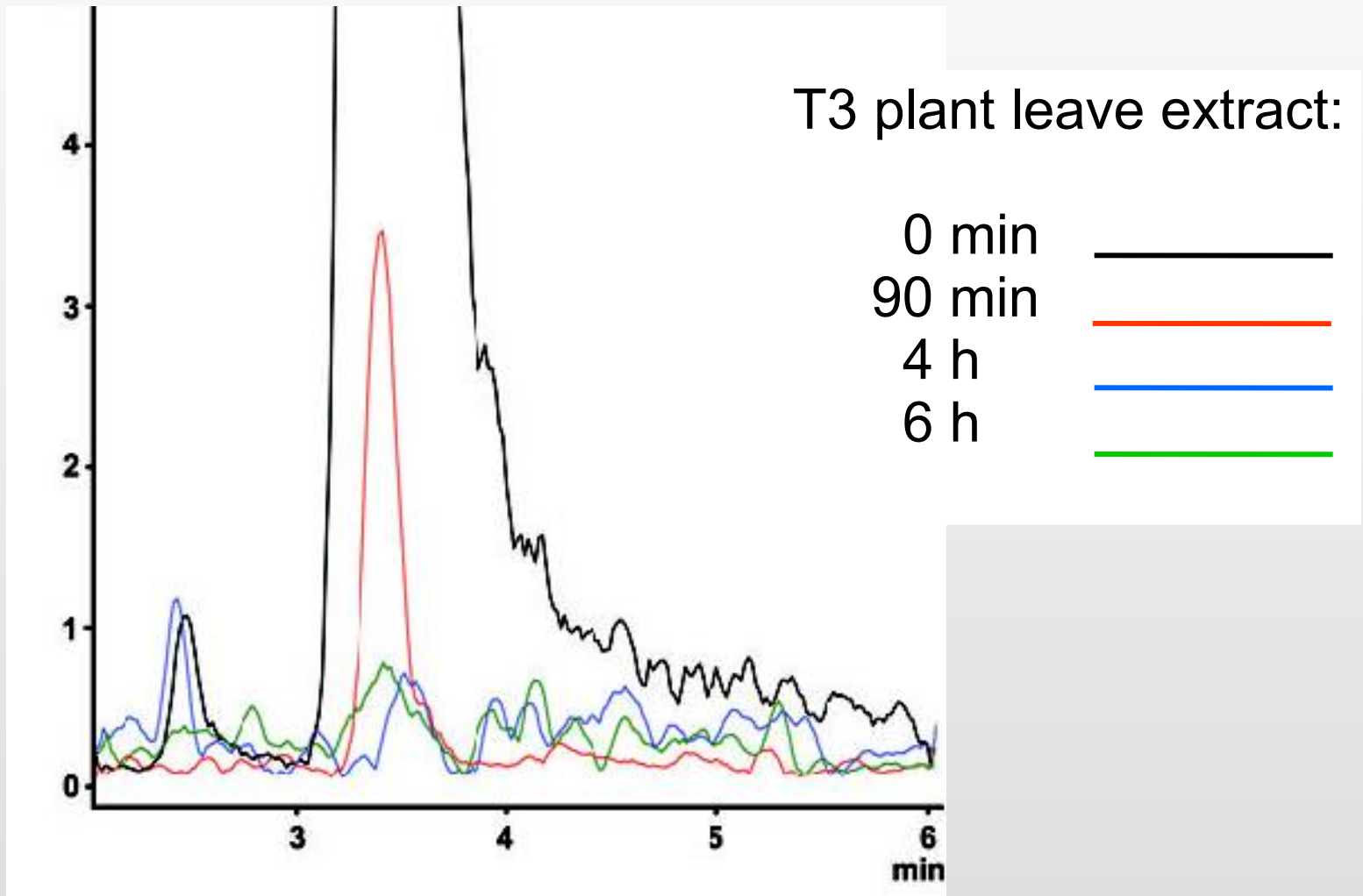
# Detoxifizierung von ZEN durch *G. roseum*



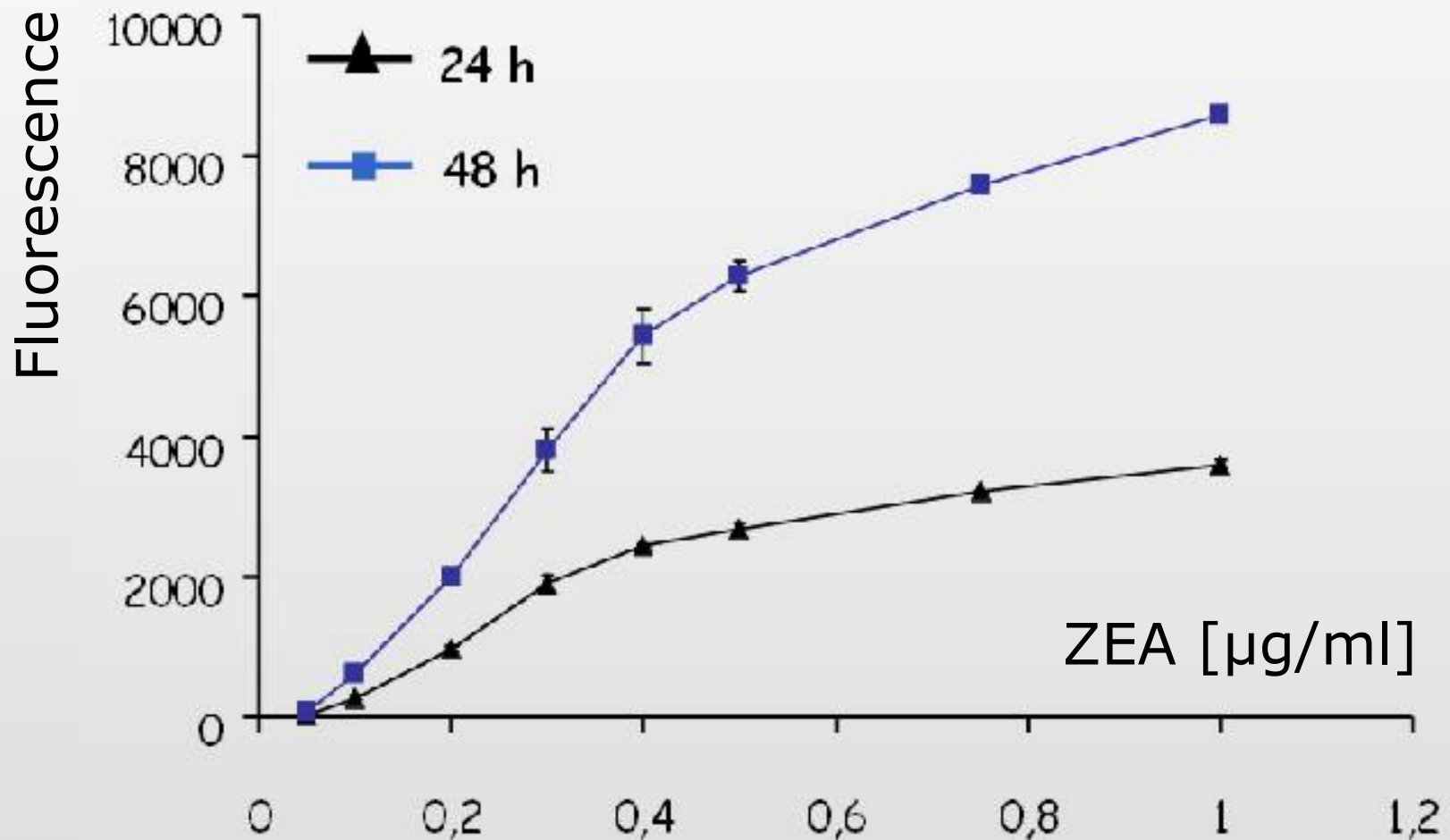
# Detoxifizierung von ZEN in *Arabidopsis*



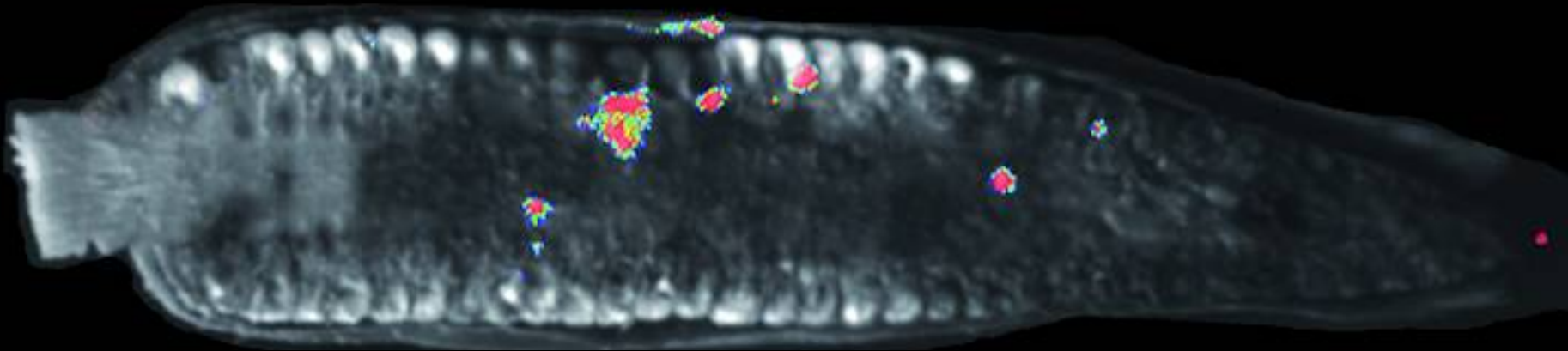
## Detoxifizierung von ZEN in *Arabidopsis*



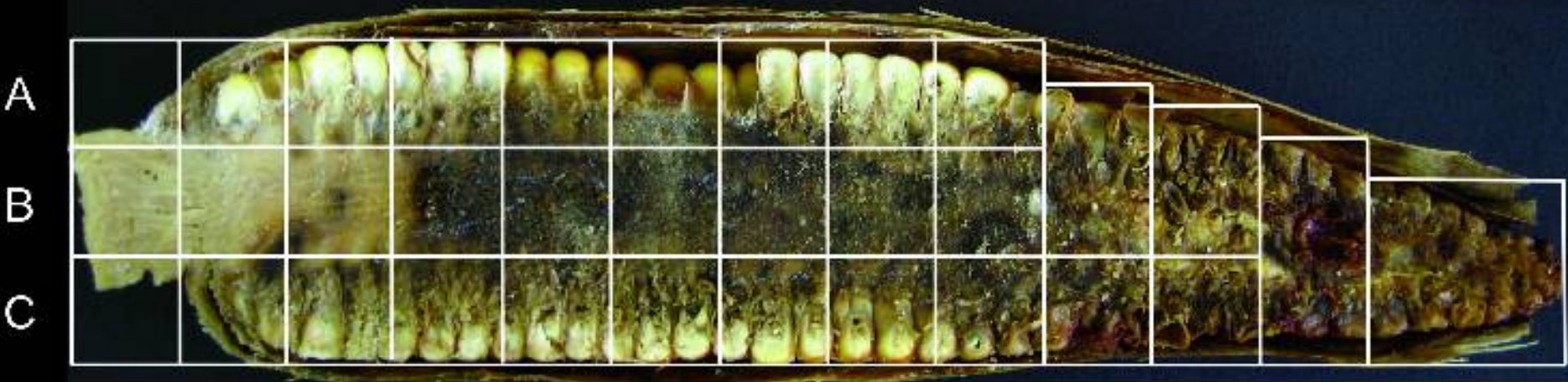
## Biosensor für Zearalenon



# Lokalisierung von Zearalenon in Mais



1 2 3 4 5 6 7 8 9 10 11 S1 S2

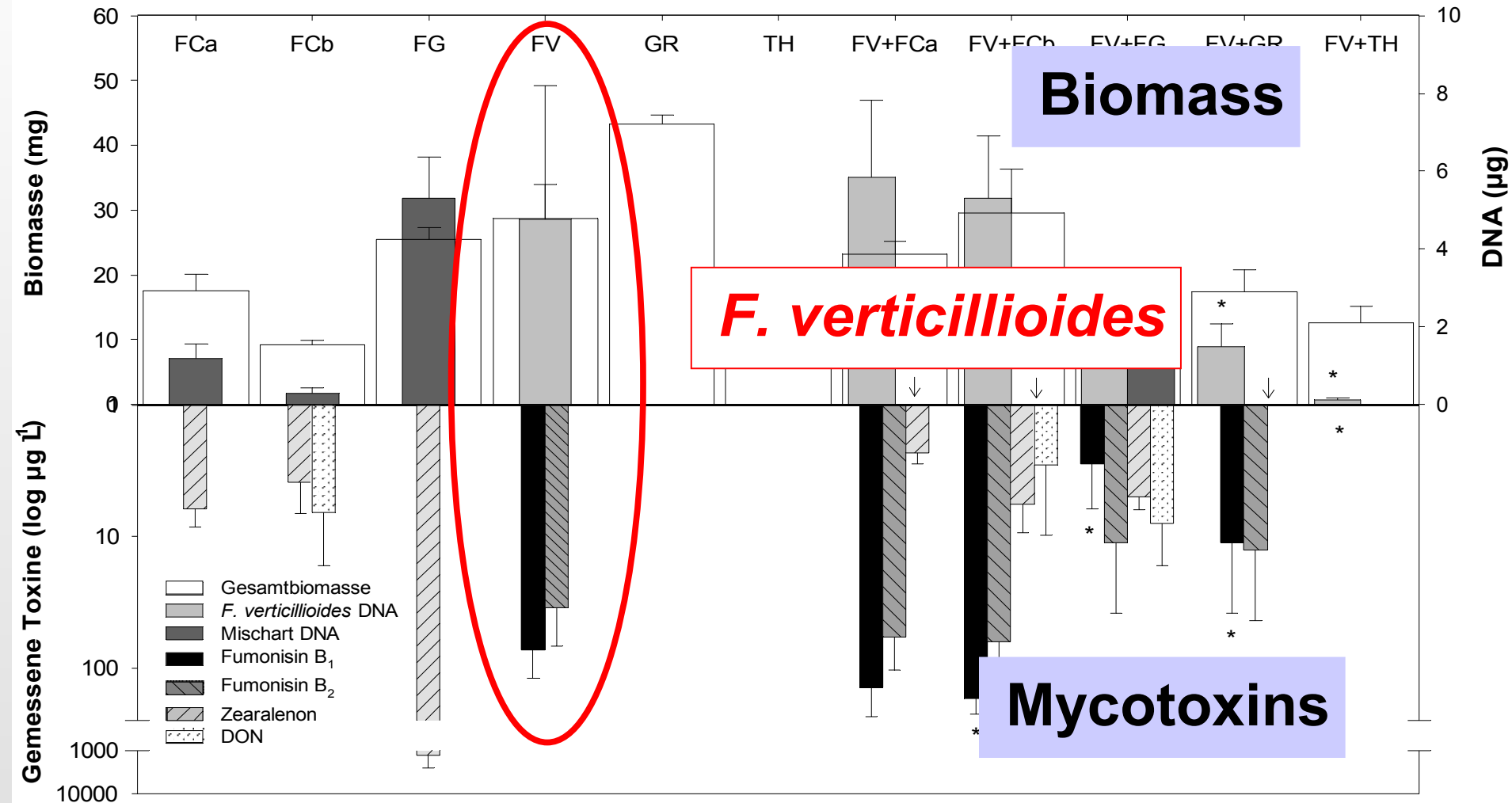




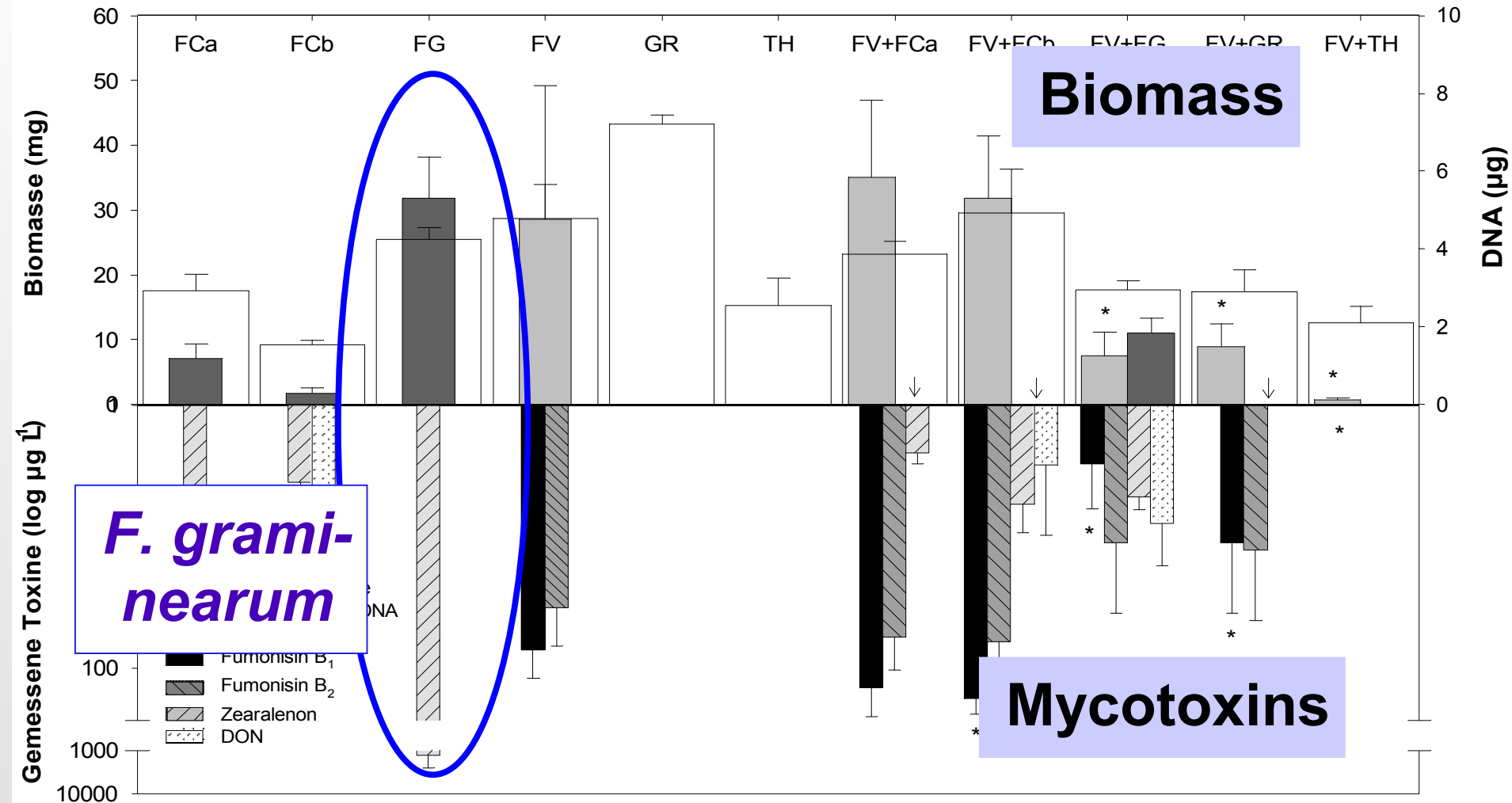
## Ausgewählte Mykotoxinprojekte

- Enzymatische Detoxifizierung
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- Interaktionen zwischen Mykotoxinbildnern
- Belastung von Mais
  - ▶ Resistenzzüchtung (ERA-NET)
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  - ▶ Öko-Mais und Mykotoxine

# Competition and mycotoxin production



# Competition and mycotoxin production

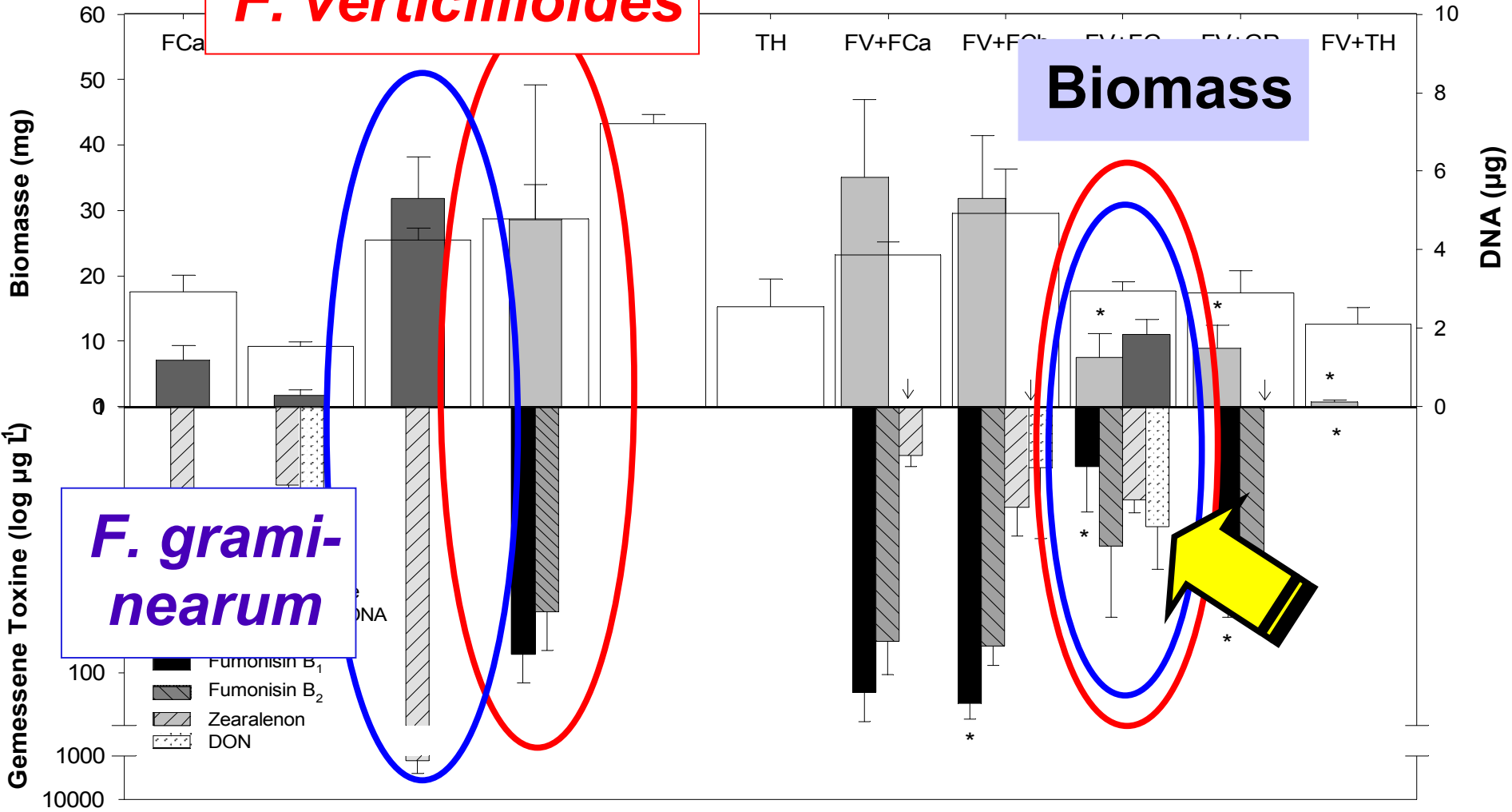


# Competition and mycotoxin production

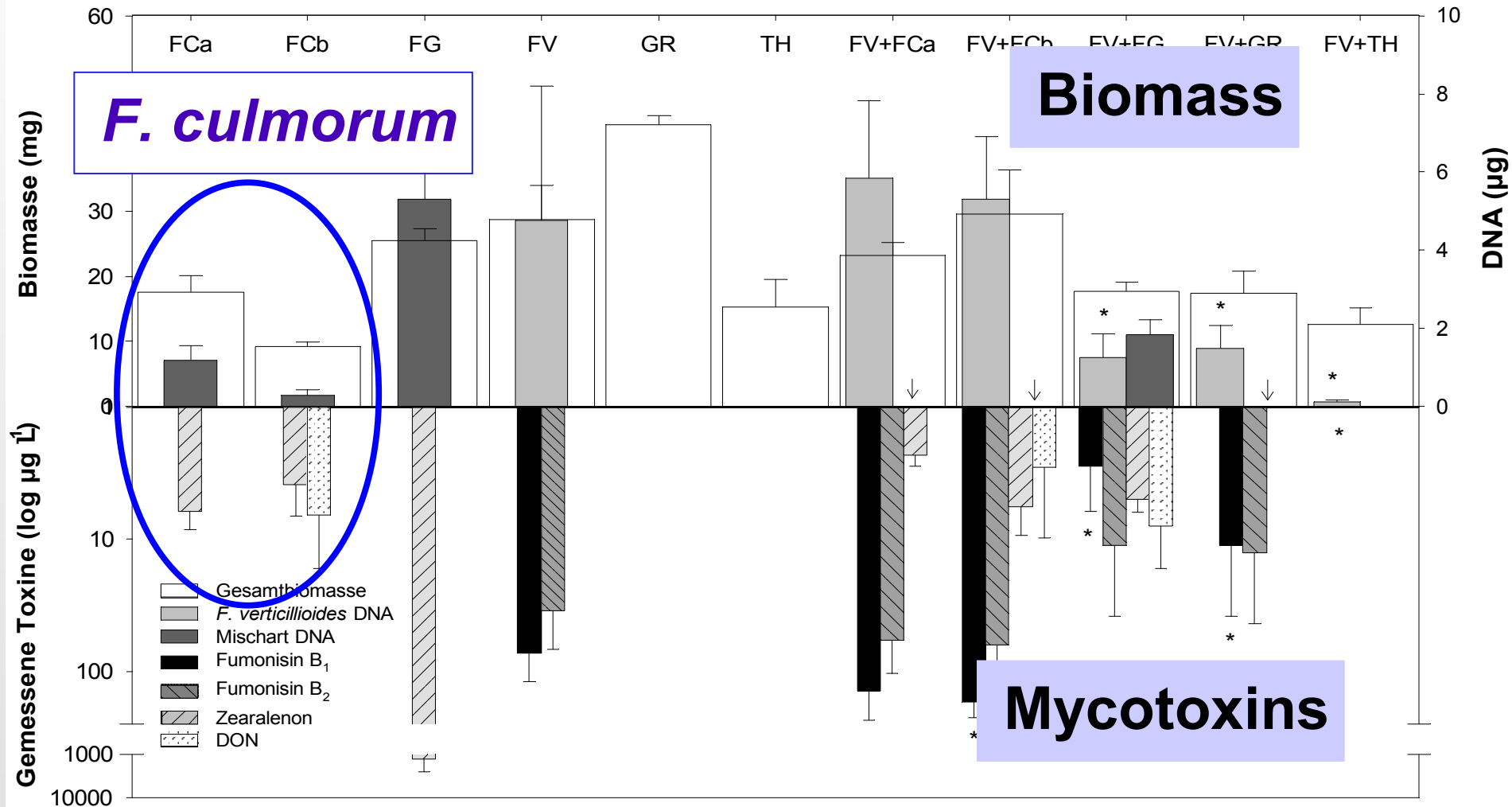
*F. verticillioides*

Biomass

*F. graminearum*



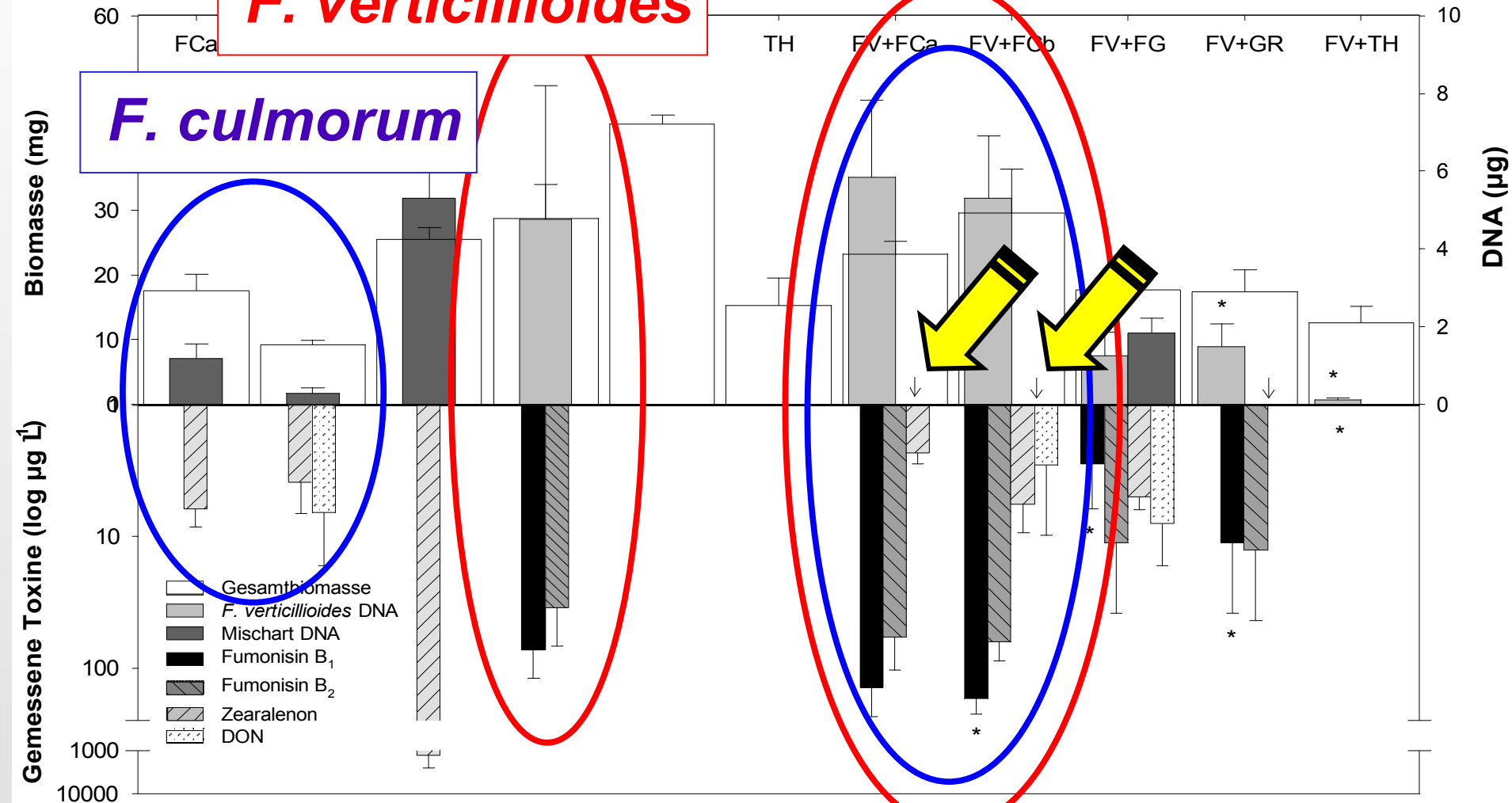
# Competition and mycotoxin production



# Competition and mycotoxin production

*F. verticillioides*

*F. culmorum*



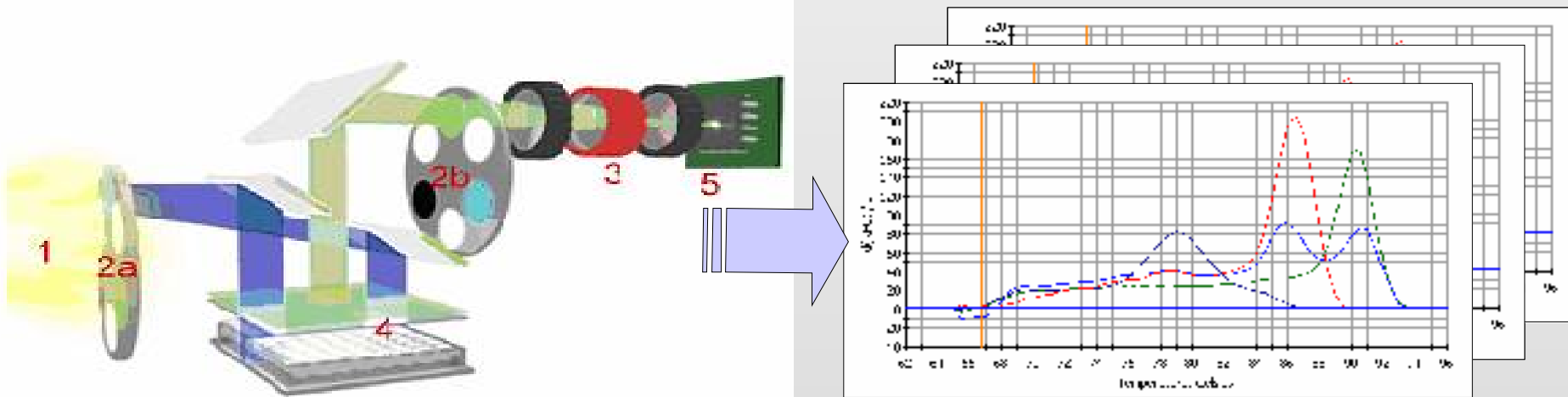


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## Real-time qPCR:

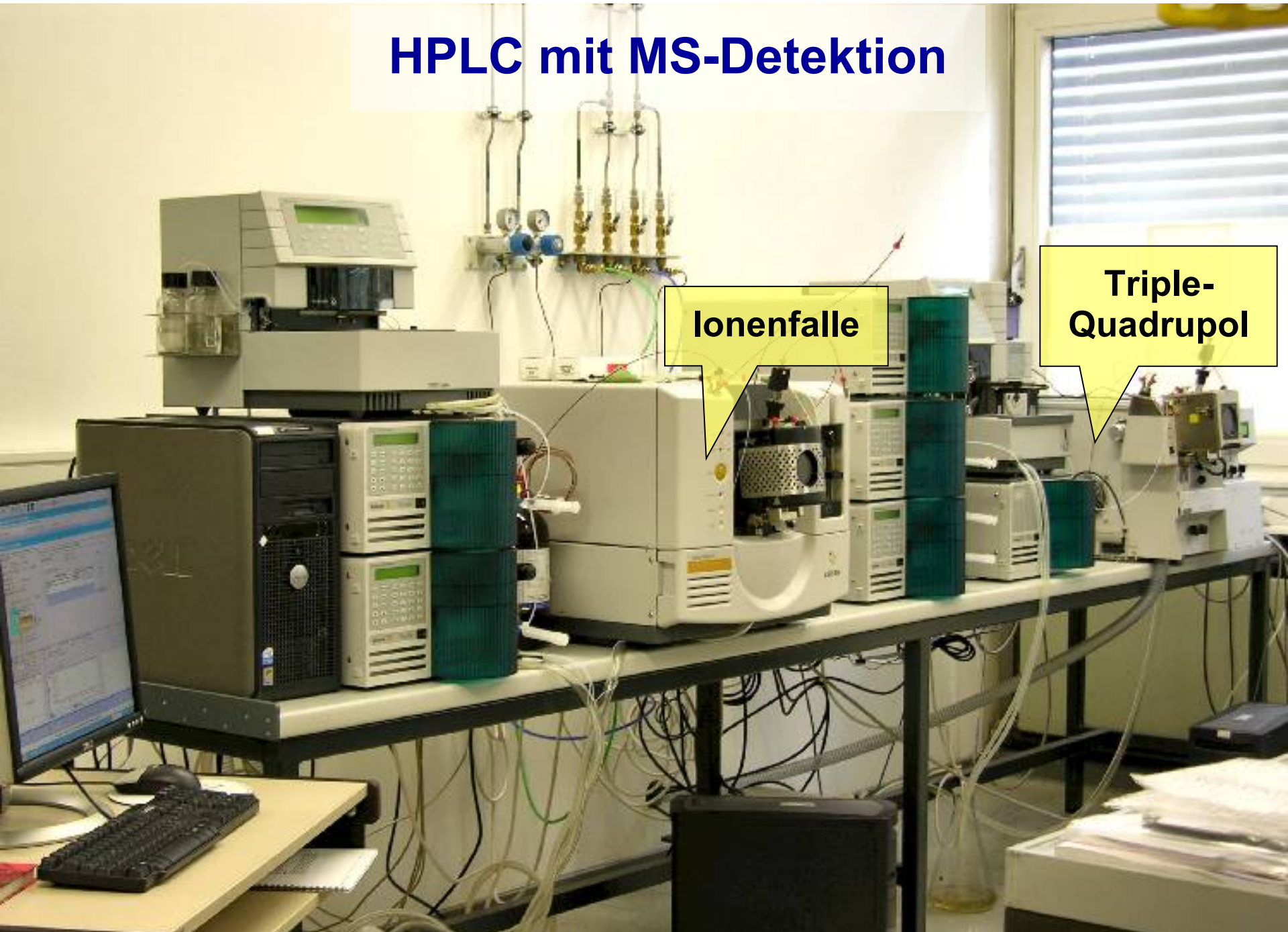
*F. graminearum*  
*F. culmorum*  
*F. verticillioides*  
*F. poae*  
*F. proliferatum*



# HPLC mit MS-Detektion

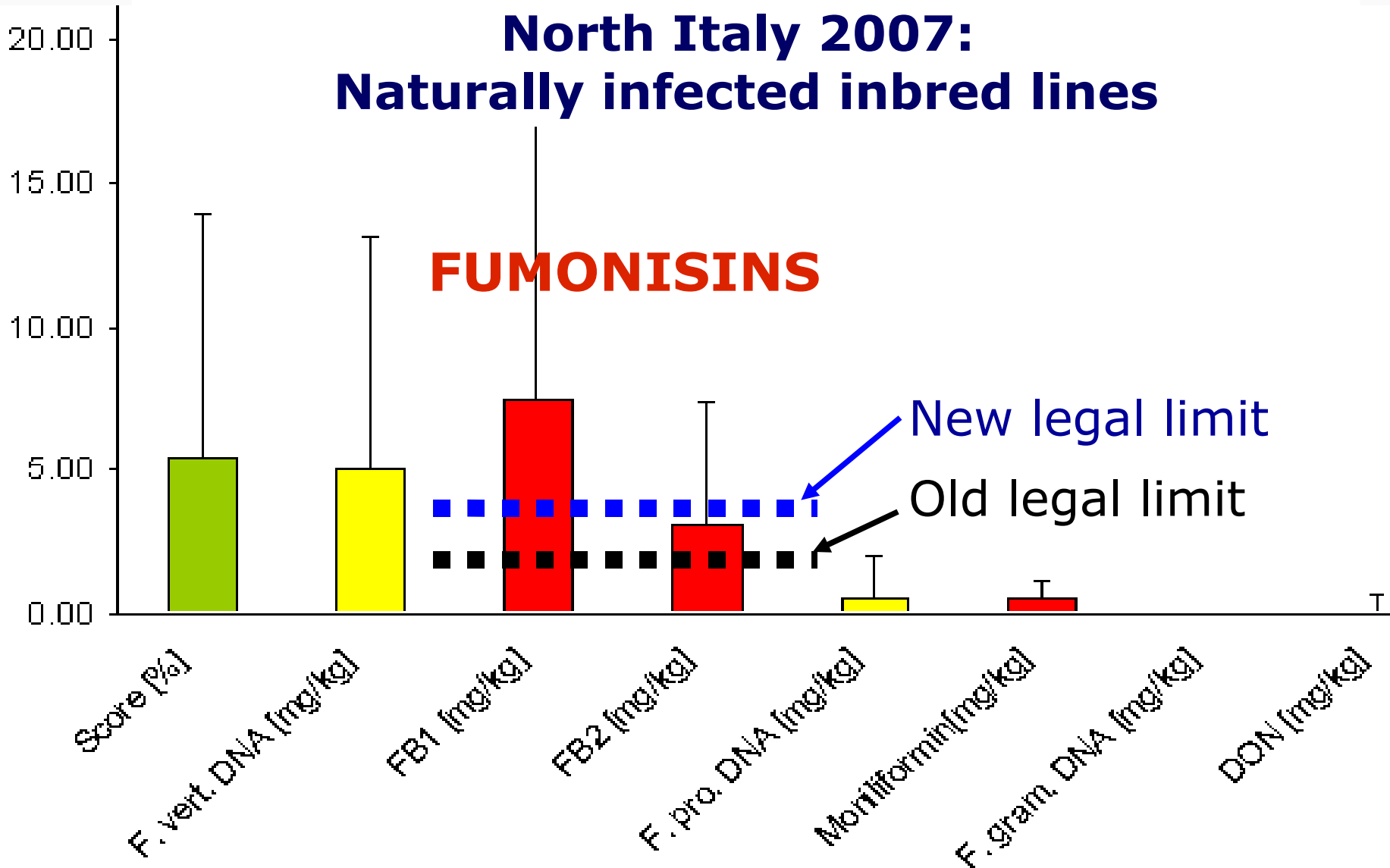
Ionenfalle

Triple-  
Quadrupol



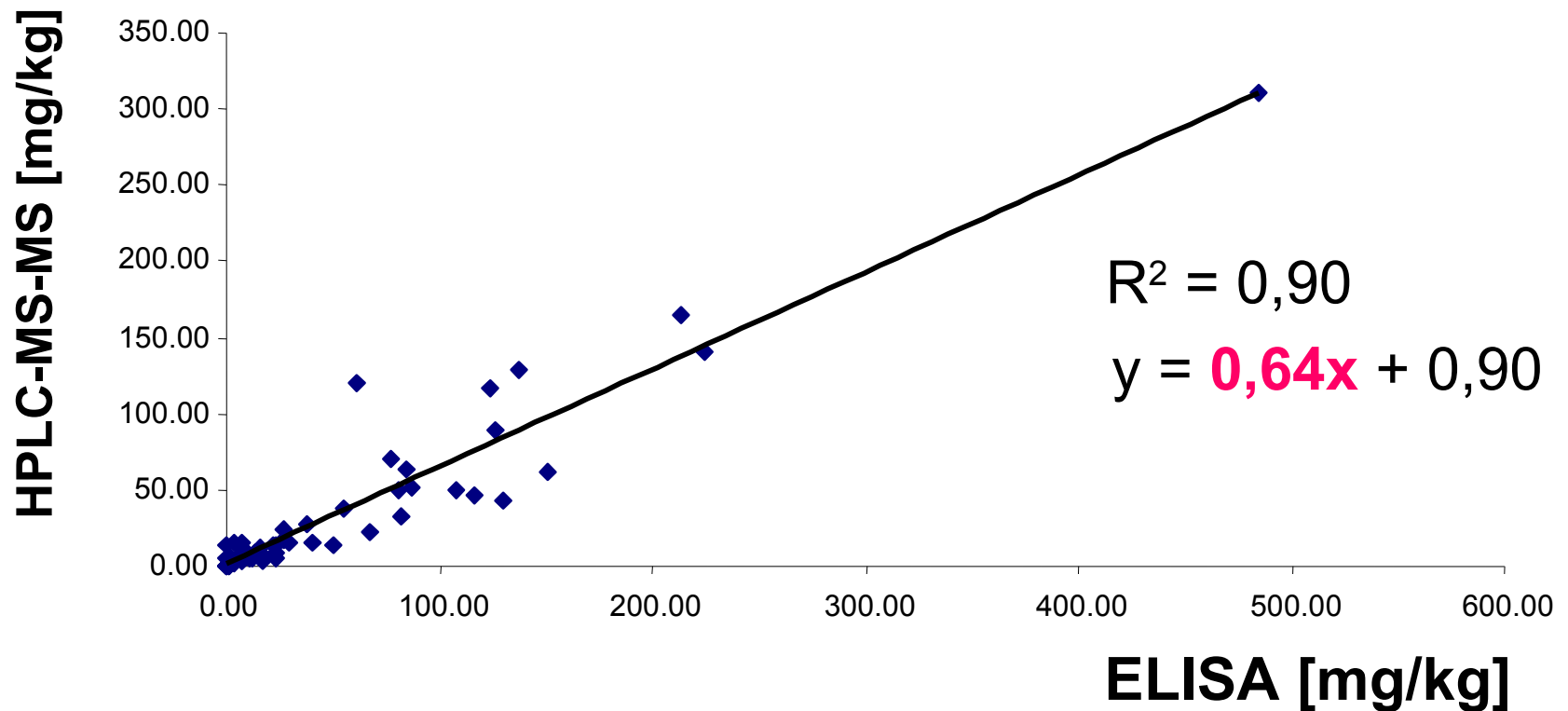


## North Italy 2007: Naturally infected inbred lines



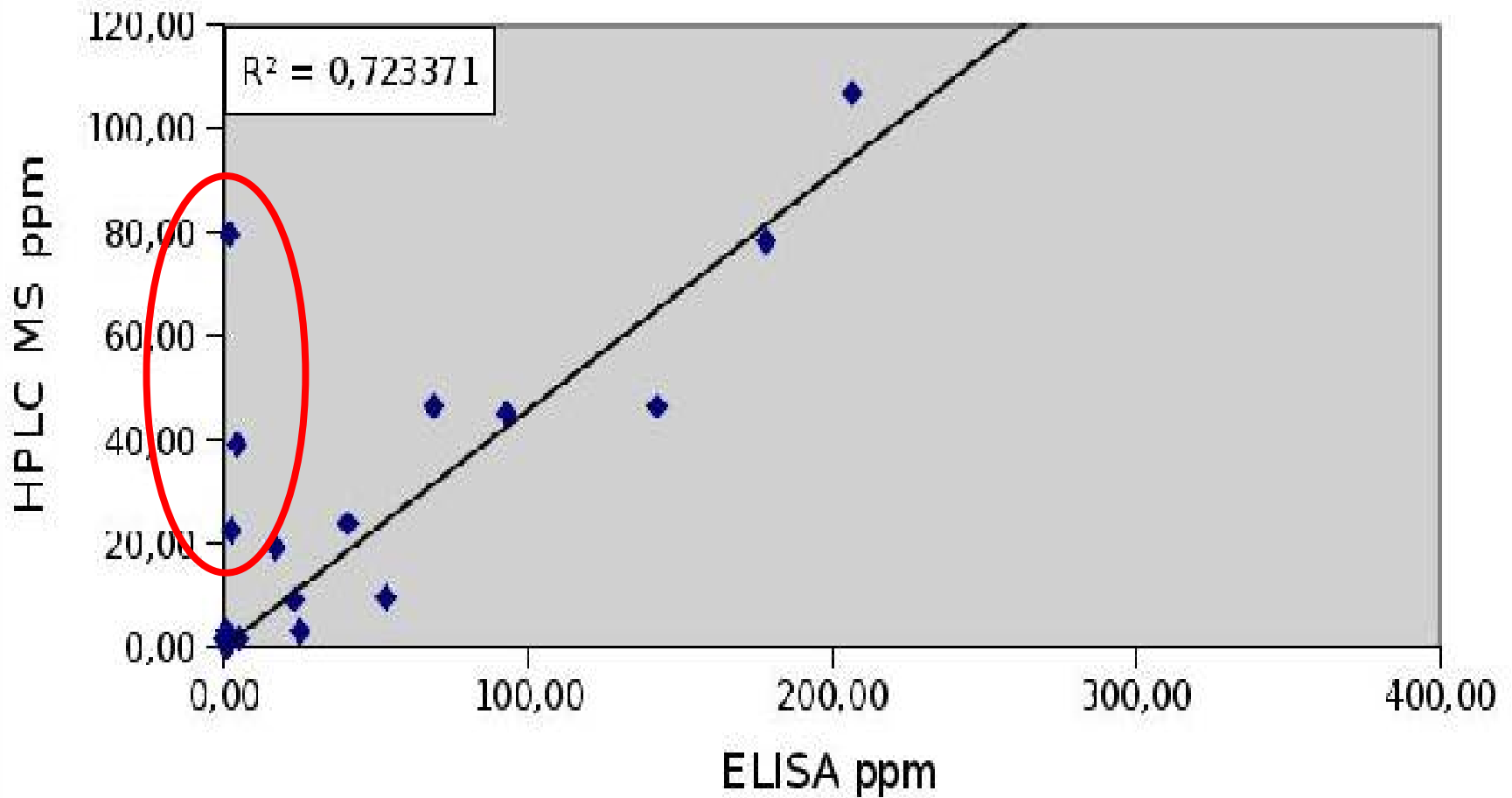


## Kalibrierung von ELISA: Fumonisine B1+B2



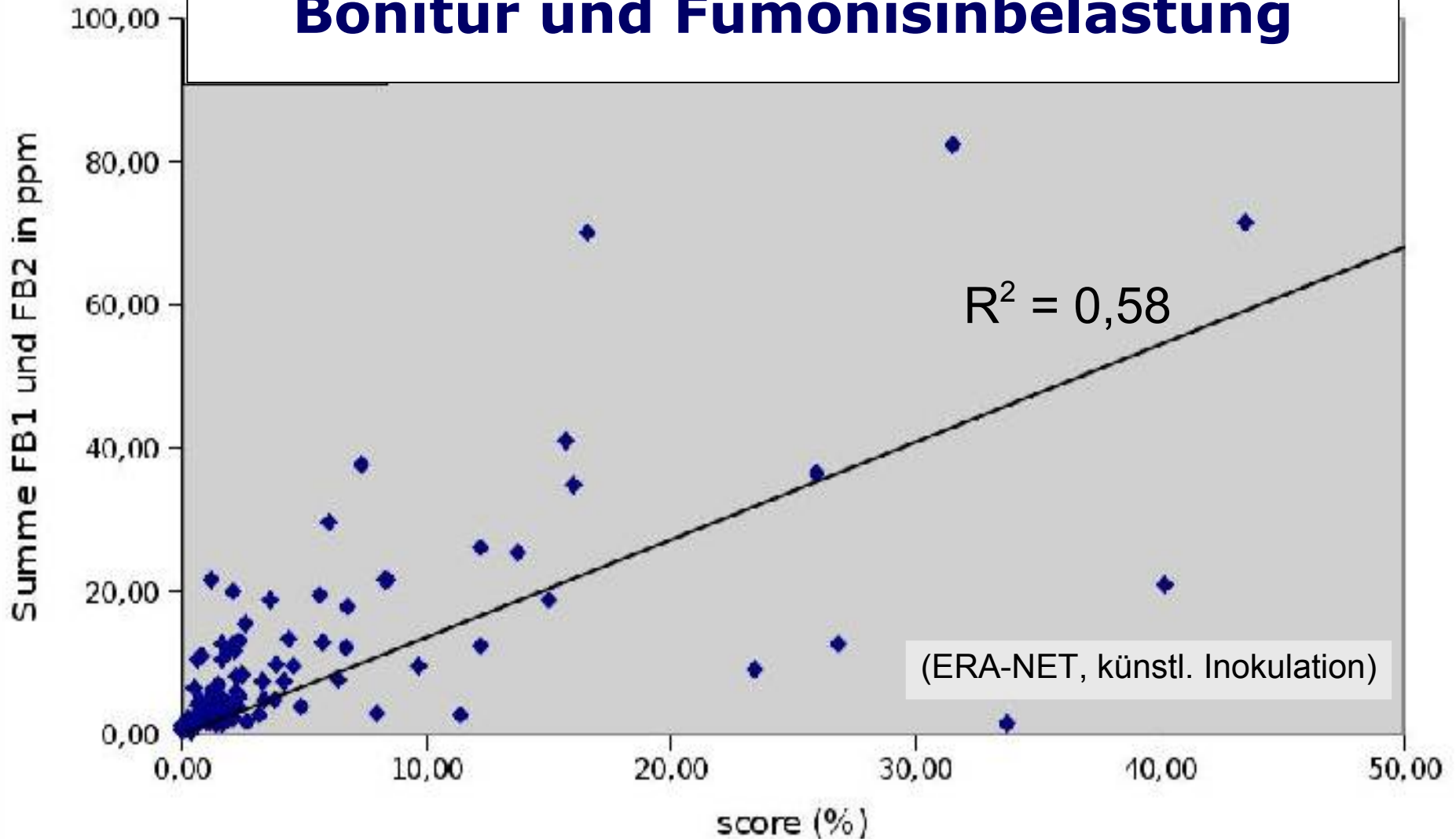


## FUM ELISA vs Summe der Einzelextraktionen





## Bonitur und Fumonisinbelastung





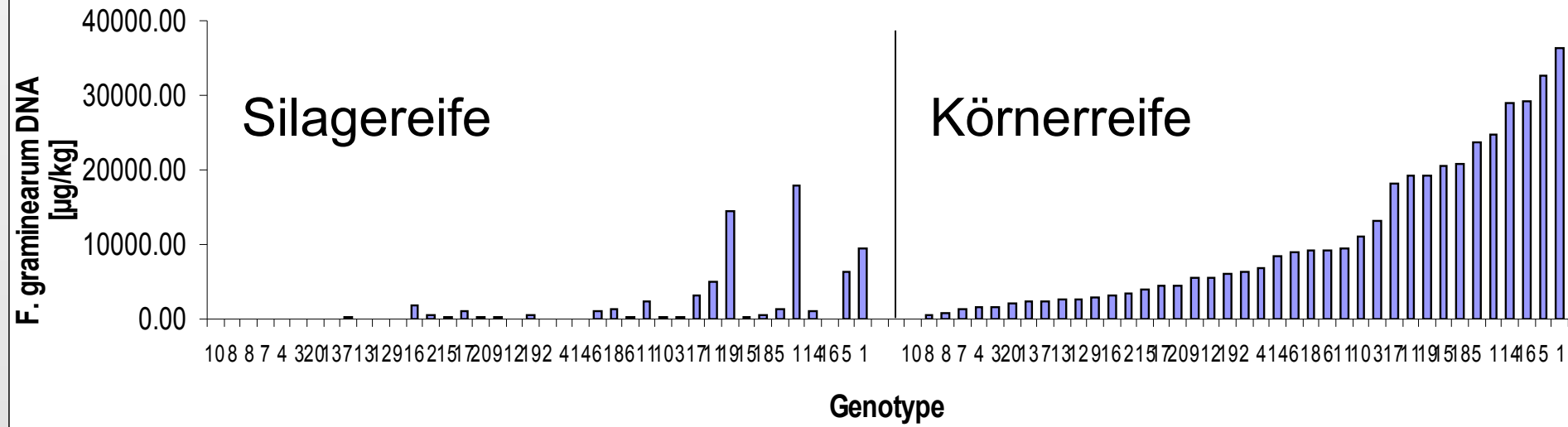
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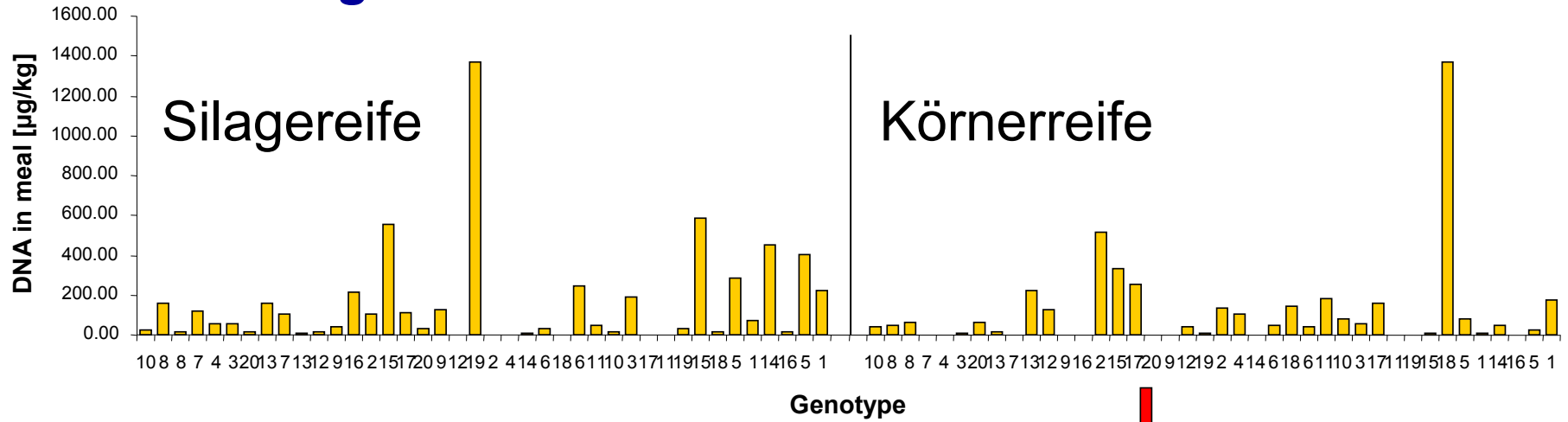


# Verteilung von *Fusarium* und Mykotoxinen in Maispflanzen

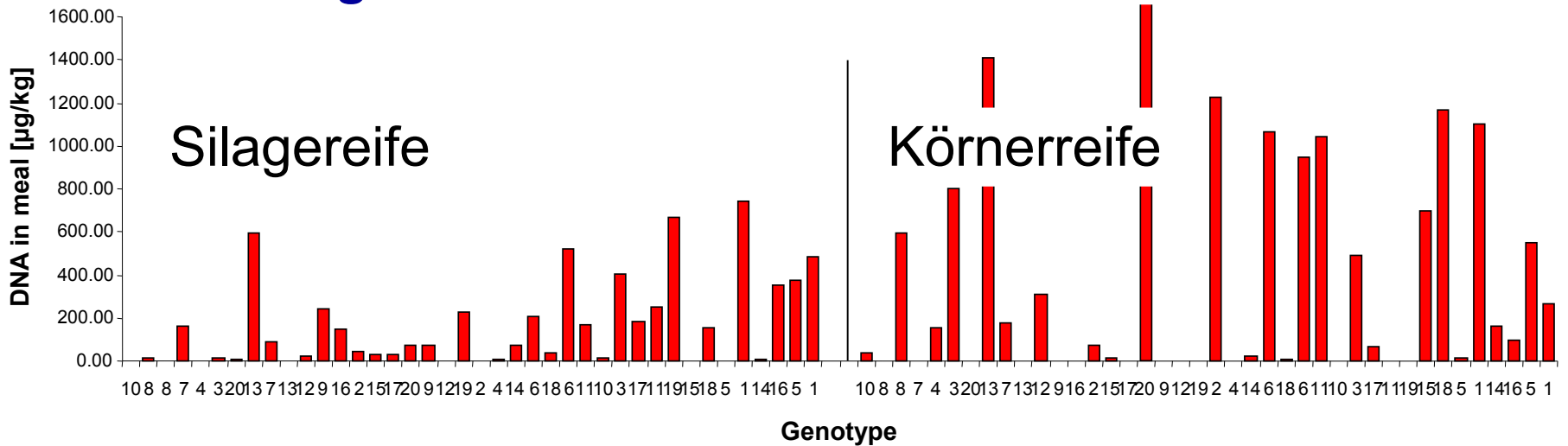
## *F. graminearum* in den Körnern



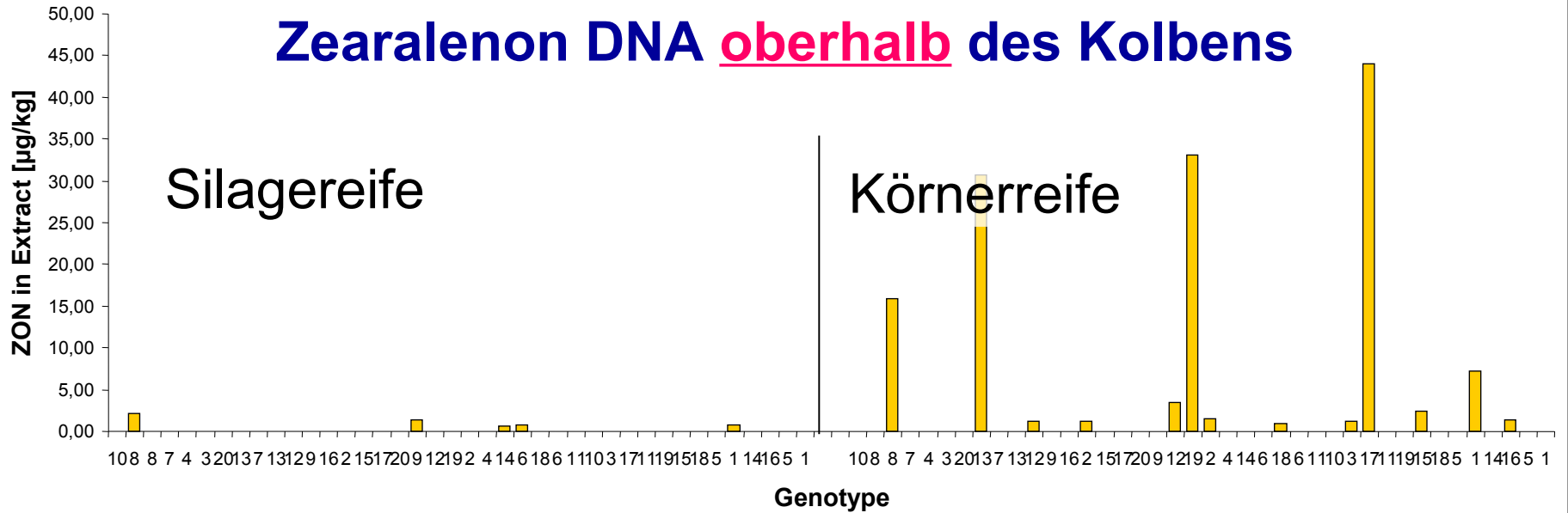
## *F. graminearum* DNA oberhalb des Kolbens



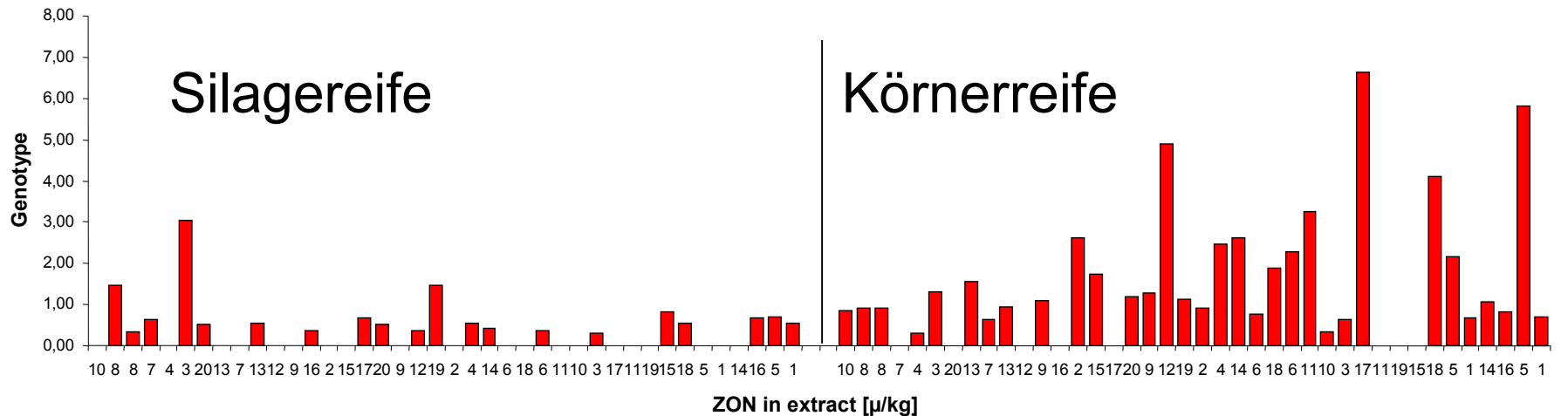
## *F. graminearum* DNA unterhalb des Kolbens



## Zearalenon DNA oberhalb des Kolbens



## Zearalenon DNA unterhalb des Kolbens



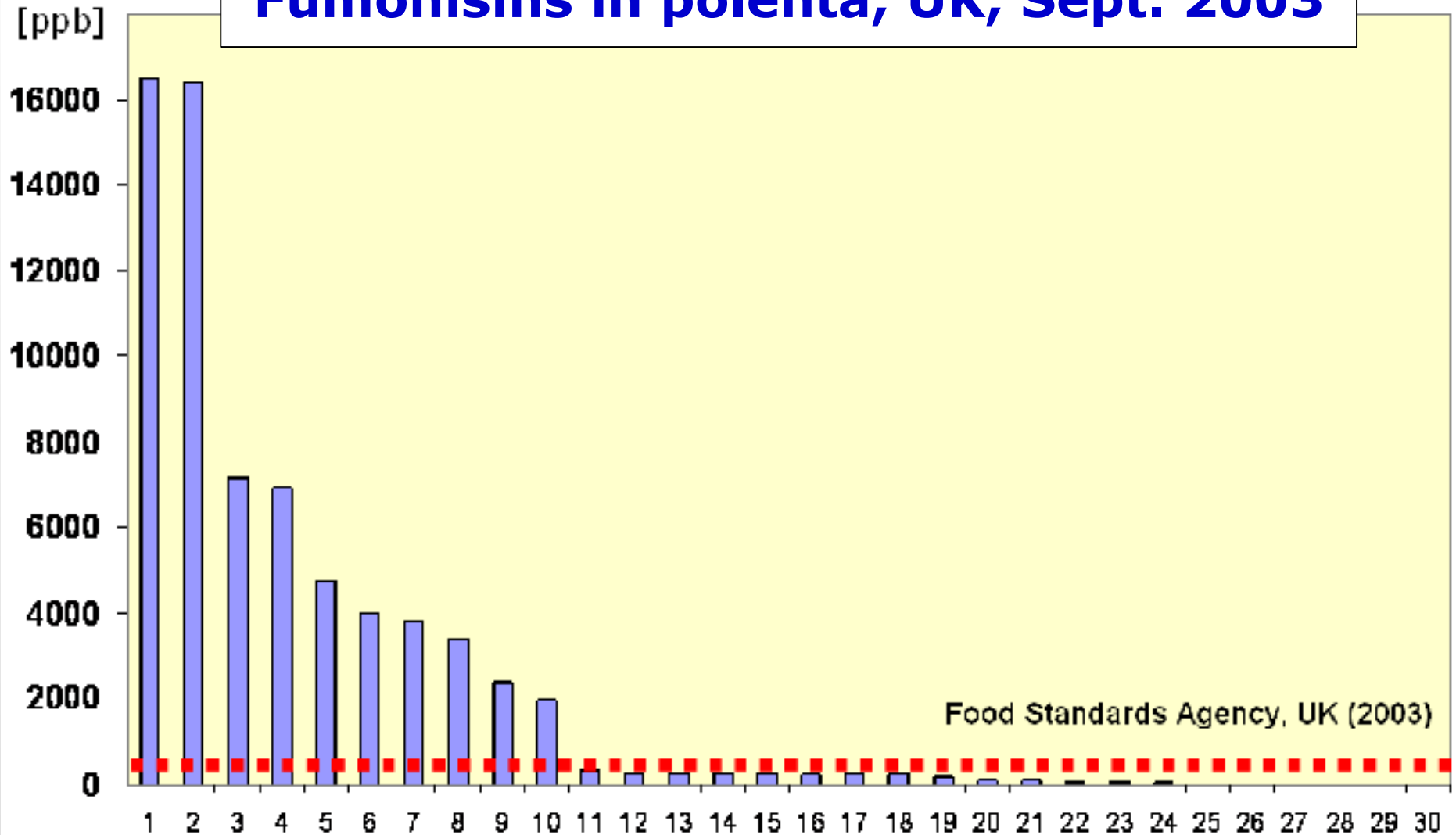


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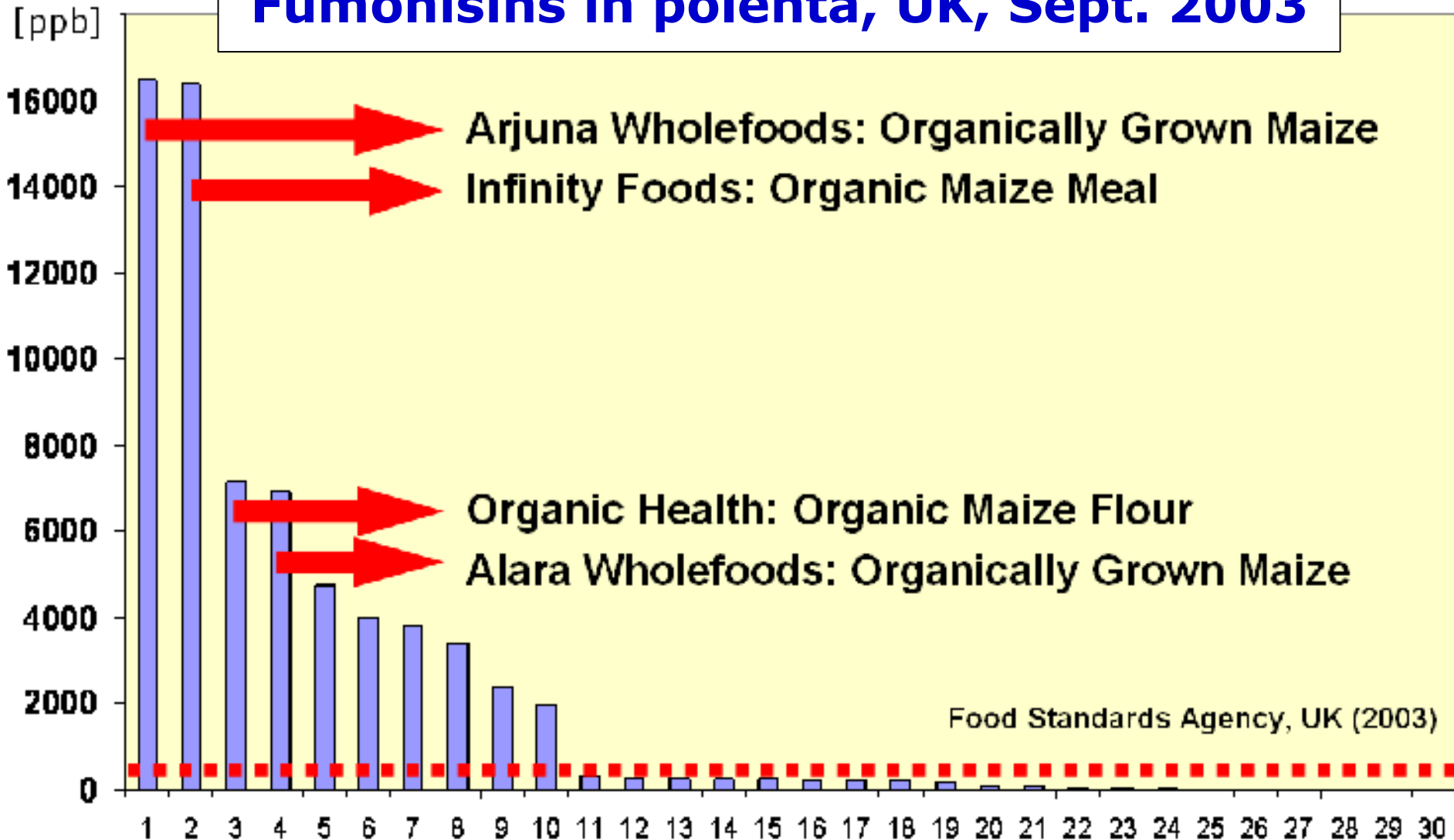


## Fumonisin in polenta, UK, Sept. 2003





## Fumonisin in polenta, UK, Sept. 2003





Bio-Lebensmittel schmecken besser  
und sind gesünder. 

Greenpeace, 8/2001



# Factors affecting mycotoxin content

## Organic

- Ploughing
- Non-host precrop
- No Bt cultivars
- (No fungicides allowed)
- (Low plant density)

## Conventional

- Low/no tillage
- Maize/wheat precrop
- Bt cultivars allowed
- (Fungicides used)
- (High plant density)

Fusarium/mycotoxins: ■ less, ■ more.



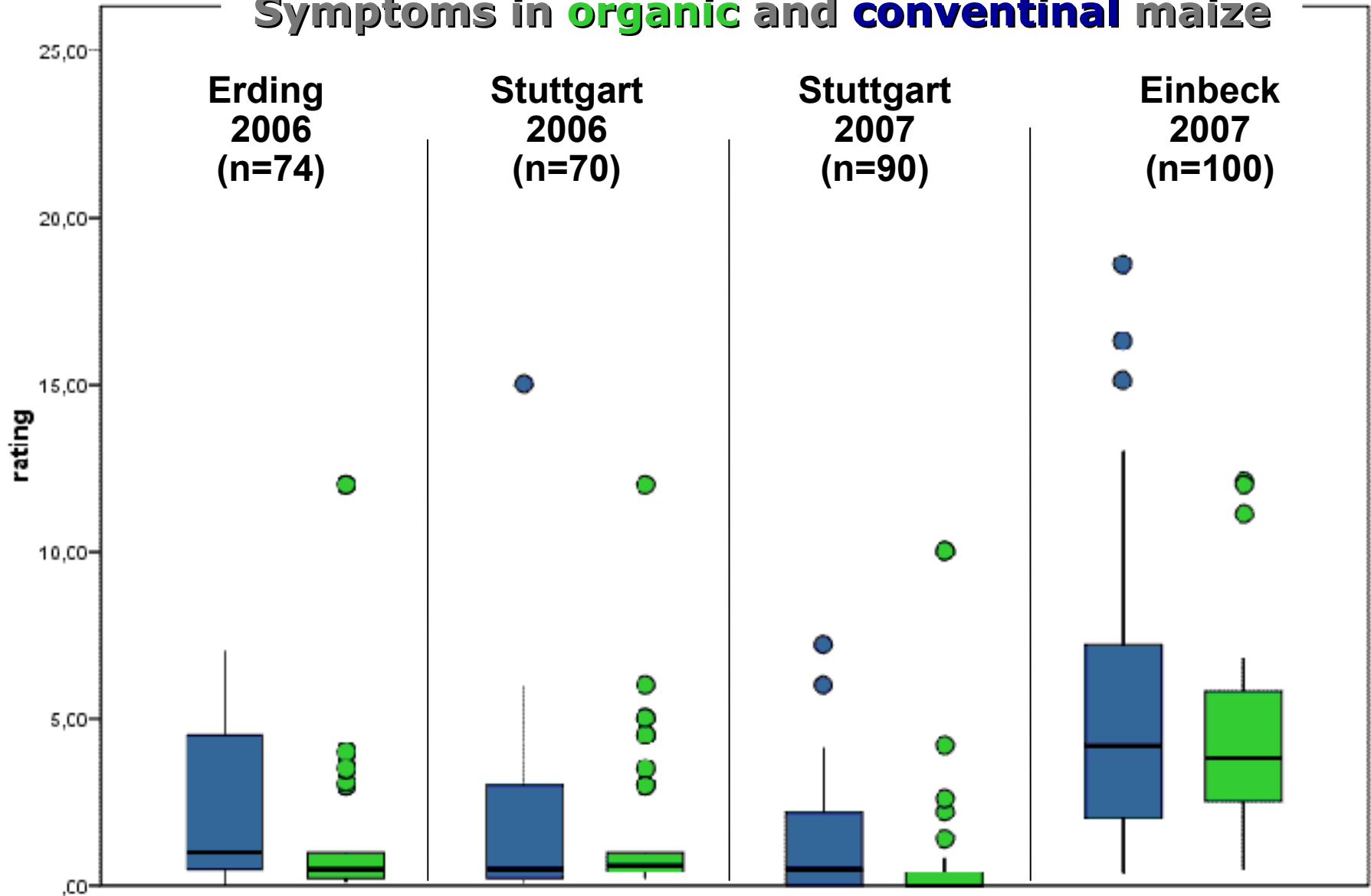
## Field trial

KWS Saat AG,  
Uni Hohenheim

- 18 maize genotypes in 2 replicas
- 3 locations, 3 years
- qPCR for *F. graminearum* and *F. verticillioides*
- DON, ZEA, FB1



## Symptoms in **organic** and **conventional** maize





## Vergleich der Mittelwerte

Nur signifikante Unterschiede sind angegeben.

Trial	DON	FB1	ZEA	Fg DNA	Fv DNA	Rating
Erding 05	<b>CONV</b>	ns	<b>CONV</b>	<b>CONV</b>	<b>ORG</b>	---
Erding 06	<b>ORG</b>	ns	ns	<b>ORG</b>	ns	ns
Stuttg. 06	<b>ORG</b>	ns	<b>ORG</b>	ns	<b>CONV</b>	ns
Stuttg. 07	---	---	---	---	---	ns
Trial	DON	FB1	ZEA	Fg DNA	Fv DNA	Rating



## Extreme values

> 10 times larger than the next highest value

- 1x zearalenone - ORGANIC
- 4x fumonisin B1 - ORGANIC



## Fumonisin in maize in BW 2000

- 11 samples > 1000 µg FB1/kg - ORGANIC
- Max. value 12.560 µg/kg - ORGANIC

Food investigation office Sigmaringen:  
41 certified organic maize samples  
133 conventional maize samples

[ILBW 16.04.0202]



# **Warum sind einzelne Öko-Mais-Proben so stark mit Fumonisinien belastet?**



# Acknowledgment

## Zusammenarbeit

KWS Saat AG: Dr. Bettina Kessel, Dr. Walter Schmidt

Universität Hohenheim: Prof. Dr. H. Geiger,  
Prof. Dr. T. Miedaner, Prof. Dr. A. Melchinger,  
Dr. H. Burger, V. Briggs

## Uni Göttingen

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