



Instituto Nacional de
Investigação Agrária e
Veterinária, I.P.



*Novas estratégias de integração sustentáveis que garantam
a qualidade e segurança na fileira do milho nacional*



Agroscope, Zurique - Suíça

***Relato da participação
3º workshop do MycoKey***

***Carla Brites
6 Setembro 2019***

MycoKey European project



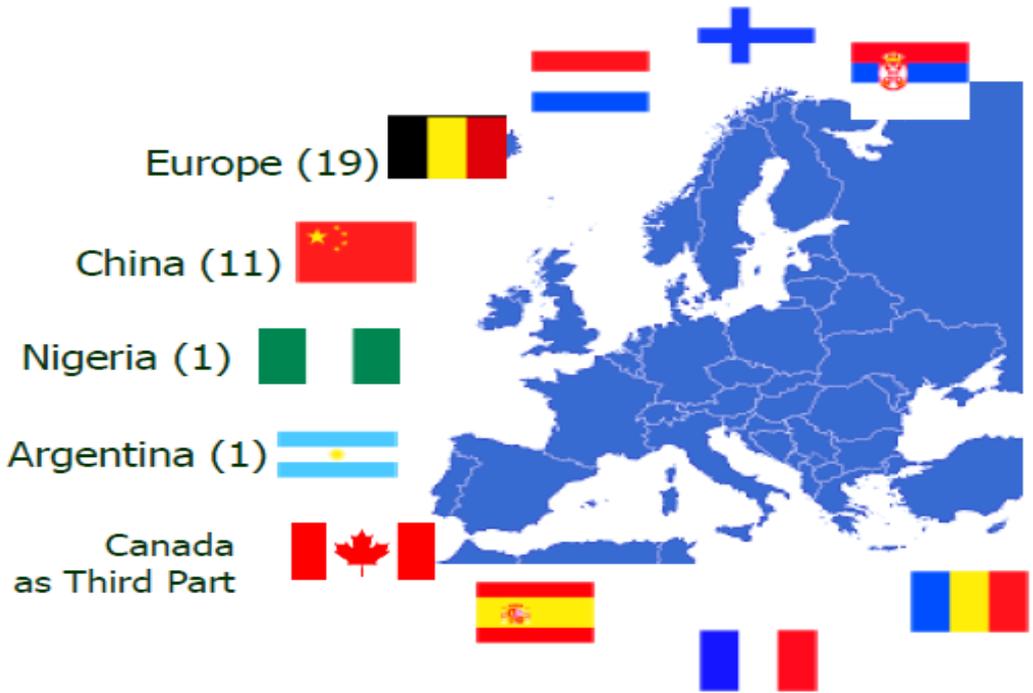
Mycotoxin management along various food and feed chains

GA 678781 H2020, orçamento 6,4M €

Abril 2016-Março 2020



Partners



23 Scientific Partners
5 Industrial Partners
1 Producers Association
3 Small Medium Enterprises

Tipo de micotoxina	Espécies de <i>Fusarium</i>	Região Europeia
Desoxinivalenol (DON)	<i>F. culmorum</i> ; <i>F. graminearum</i>	Norte
Zearalenona (ZEA)	<i>F. culmorum</i> ; <i>F. graminearum</i>	Norte
Fumonisinias	<i>F. verticillioides</i> ; <i>F. proliferatum</i>	Centro e Sul

Ocorrência de fumonisinas

- ❑ **Local:** climas continentais quentes
- ❑ **Alimentos:** milho (principal) podendo ocorrer no arroz e sorgo
- ❑ **Fator com maior impacto:** tecidos danificados por infestação



F. verticillioides



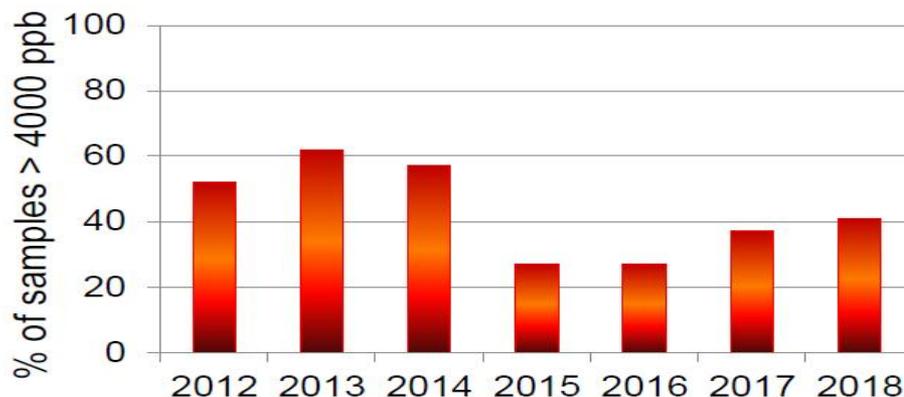
Espiga com grãos pulverulentos de cor rosa



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Occurrence of fumonisins ($\mu\text{g kg}^{-1}$) in Northern Italy (2012-2018)

About 40% of maize in Northern Italy had levels of fumonisin contaminations $> 4,000 \mu\text{g kg}^{-1}$ in 2018



Locatelli, Giornata del mais, Bergamo 2019.

Alessandra Lanubile presentation 'Breeding for resistance to *Fusarium* infection in maize'

Campo

- Detecção e monitorização dos fungos (*F. verticillioides*; *F. proliferatum*)
- Aplicar antifúngicos específicos (biofumigação)
- Melhorar o microbioma do solo (rotações; intercropping)
- Antecipação da colheita

Pós-Colheita

- Evitar pré-armazenagem grão húmido
- Gestão eficiente da secagem

Armazenagem

- Melhorar a limpeza do grão
- Circulação do grão
- Controle temperatura e humidade



GOOD AGRICULTURAL PRACTICES

- Well-timed planting dates and appropriate crop rotation
- Adequate management of irrigation and insect damage (European corn borer)
- Moisture content of grains not lower than 22-24% at harvest
- Drying grains with a maximum level of 15% moisture before storage
- Selection of resistant genotypes and hybrids



Mycotoxin Reduction in Grain Chains, Leslie & Logrieco, 2014; CODEX, 2018.

Alessandra Lanubile presentation 'Breeding for resistance to *Fusarium* infection in maize'

- As soluções mais eficazes foram obtidas com *Brassicaceae*
- Glucosinolatos são convertidos em isotiocianato (ITC) por ação da enzima mirosinase (depende da temperatura e pH)
- O ITC é volátil e tem ação fungicida

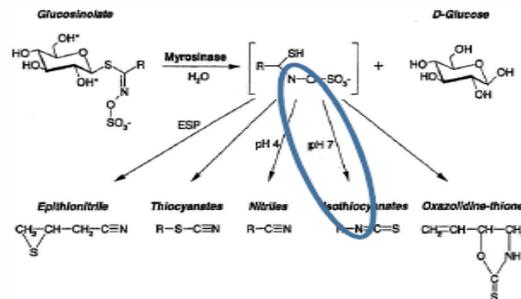




Crop Rotation: cover crops and bio-fumigations

○ Bio-fumigation: best know system is with Brassicaceae

- Glucosinolates are converted to isothiocyanate after cells are mechanically damaged
- ITC = volatile
- Myrosinase activity is t° and pH depended!



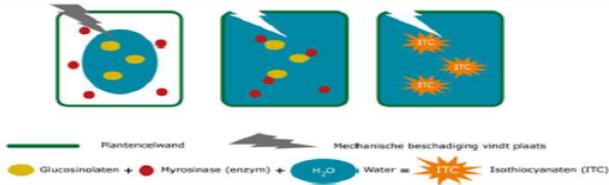
Glucosinolate + H₂O $\xrightarrow{\text{Myrosinase}}$ [R-SH-N-C-SO₂]⁻ + D-Glucose

[R-SH-N-C-SO₂]⁻ $\xrightarrow{\text{ESP}}$ Epithionitrile (pH 4) or Thiocyanates (pH 7)

[R-SH-N-C-SO₂]⁻ $\xrightarrow{\text{pH 4}}$ Nitriles (R-CEN)

[R-SH-N-C-SO₂]⁻ $\xrightarrow{\text{pH 7}}$ Isothiocyanates (R-N=C=S)

[R-SH-N-C-SO₂]⁻ $\xrightarrow{\text{pH 7}}$ Oxazo(dio)-thione



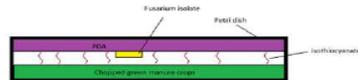



- A solução de mostarda castanha (*Brassica juncea*) foi a mais eficaz para a redução do crescimento micelar de *F. graminearum*

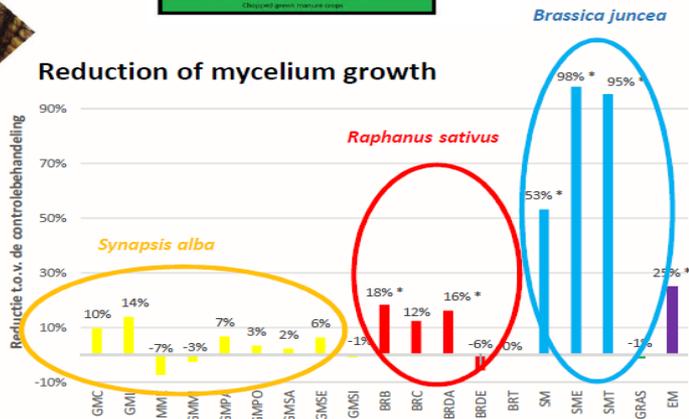


Crop Rotation: cover crops and bio-fumigations

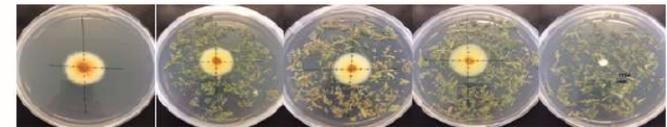
- Inverted petri dish method: volatiles



Reduction of mycelium growth

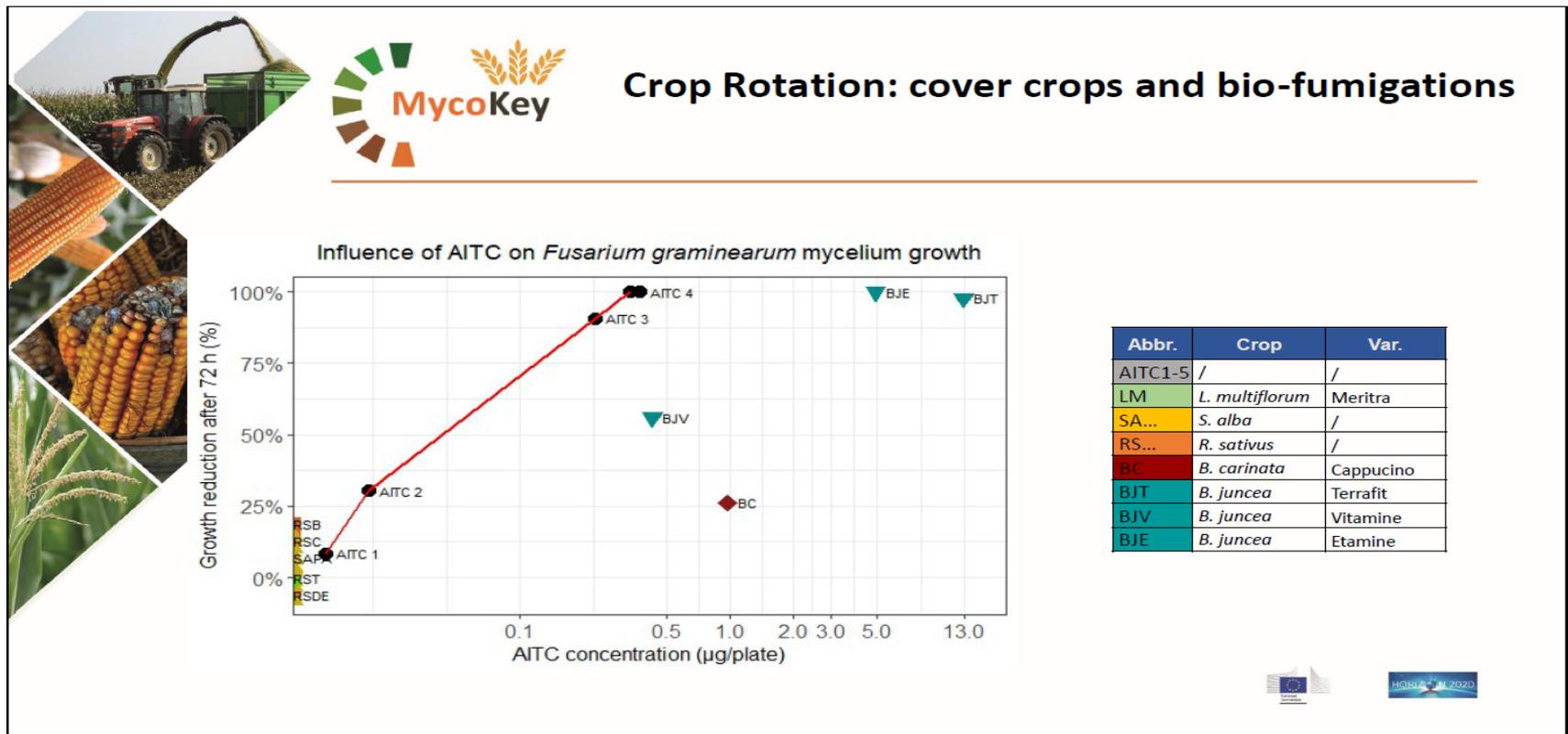


F. graminearum



C R. sativus S. alba B. carinata B. Juncea

- As variedades *Terrafit* e *Etamine* de mostarda castanha (*Brassica juncea*) foram as que revelaram maiores concentrações de ITC e as mais eficazes para a redução do crescimento micelar de *F. graminearum*



- Aplicações de soluções com 4% de farinhas de mostarda nos solos

B. Biofumigation & botanicals

Apply fresh **mulch layers** in autumn, “cut-&-carry” biofumigation



- White mustard
- Indian mustard
- Berseem clover

Spray **botanicals** (4% w/v) in autumn or spring



- Mustard 1
 - Mustard 2
 - Chinese galls
- seed flour from white mustard

🇨🇭 A. Maize-intercropping

pros

- Land- & resource-use efficiency
- Biodiversity
- Reduced nutrient leaching & soil erosion
- Weed suppression
- Interspecific facilitation
 - ❖ Control pests by attracting beneficials
 - ❖ Control soil- & residue-borne pathogens?

cons

- Interspecific competition → yield loss?
- Available machinery & equipment

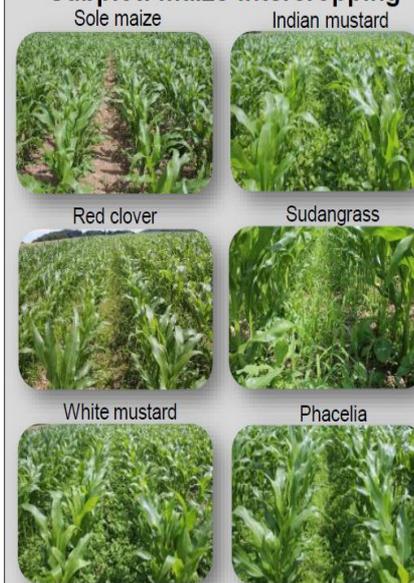


Brooker et al. 2014, New Phytologist
Yang et al. 2018, Agronomy

Prevention of Fusarium head blight in wheat with intercrops, biofumigation and botanicals
Dimitrios Drakopoulos

🇨🇭 A. Maize-intercropping

Subplot: maize-intercropping



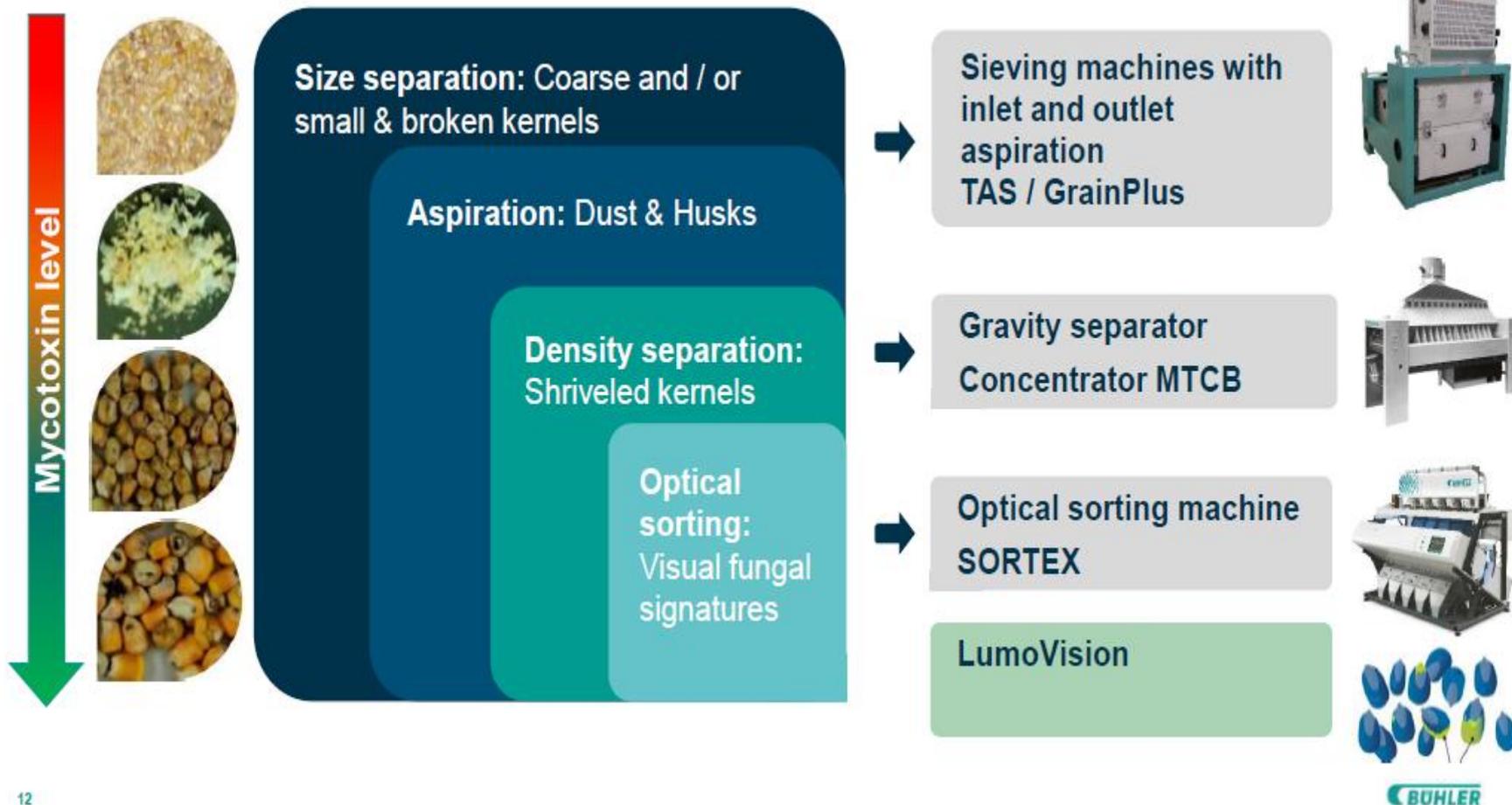
Whole plot: tillage



Prevention of Fusarium head blight in wheat with intercrops, biofumigation and botanicals
Dimitrios Drakopoulos

Melhorar a limpeza do grão

- Combinar diferentes tecnologias de limpeza para remover frações contaminadas

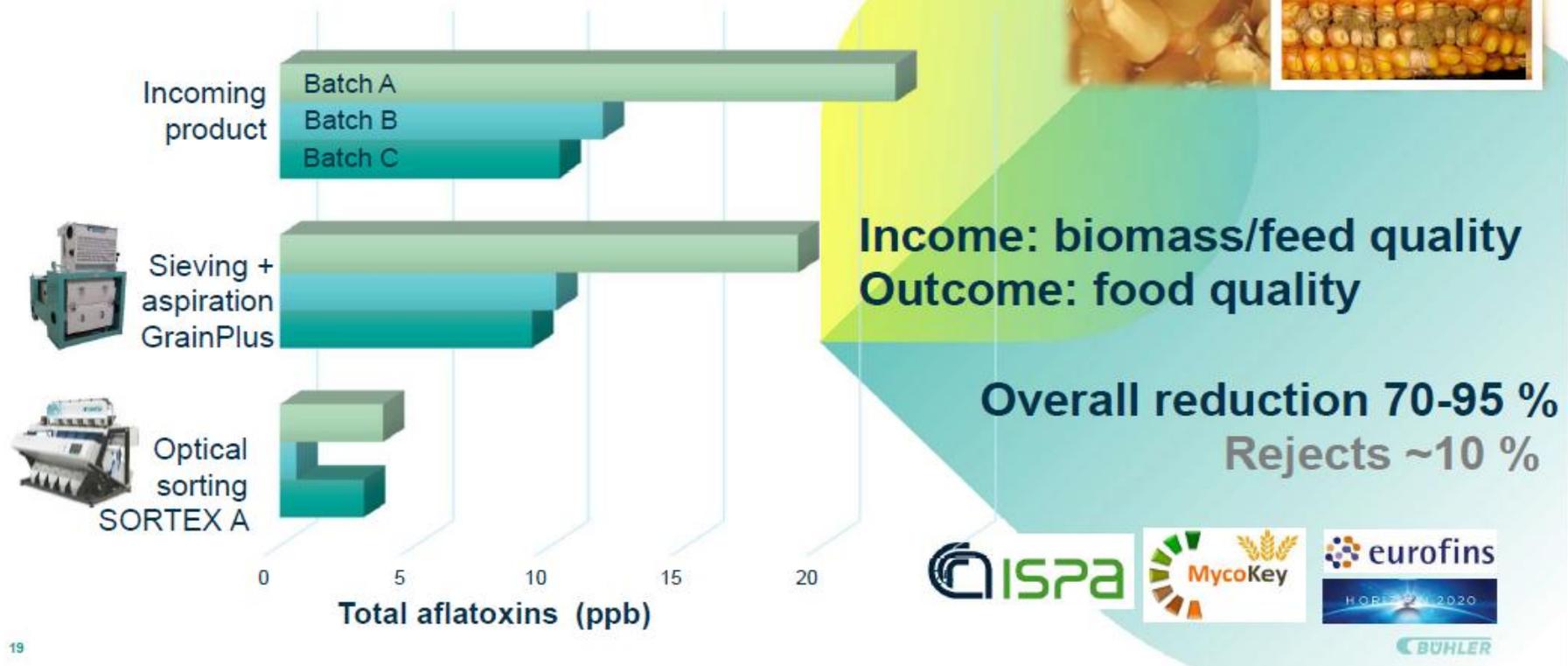


Melhorar a limpeza do grão

- A separação ótica acoplada a outras tecnologias de separação é eficaz na redução dos níveis de aflatoxinas

Maize: Aflatoxin reduction, Germany

Upgrade to food quality.



Separação ótica de grãos contaminados



Maize: Optical sorting example with SORTEX.

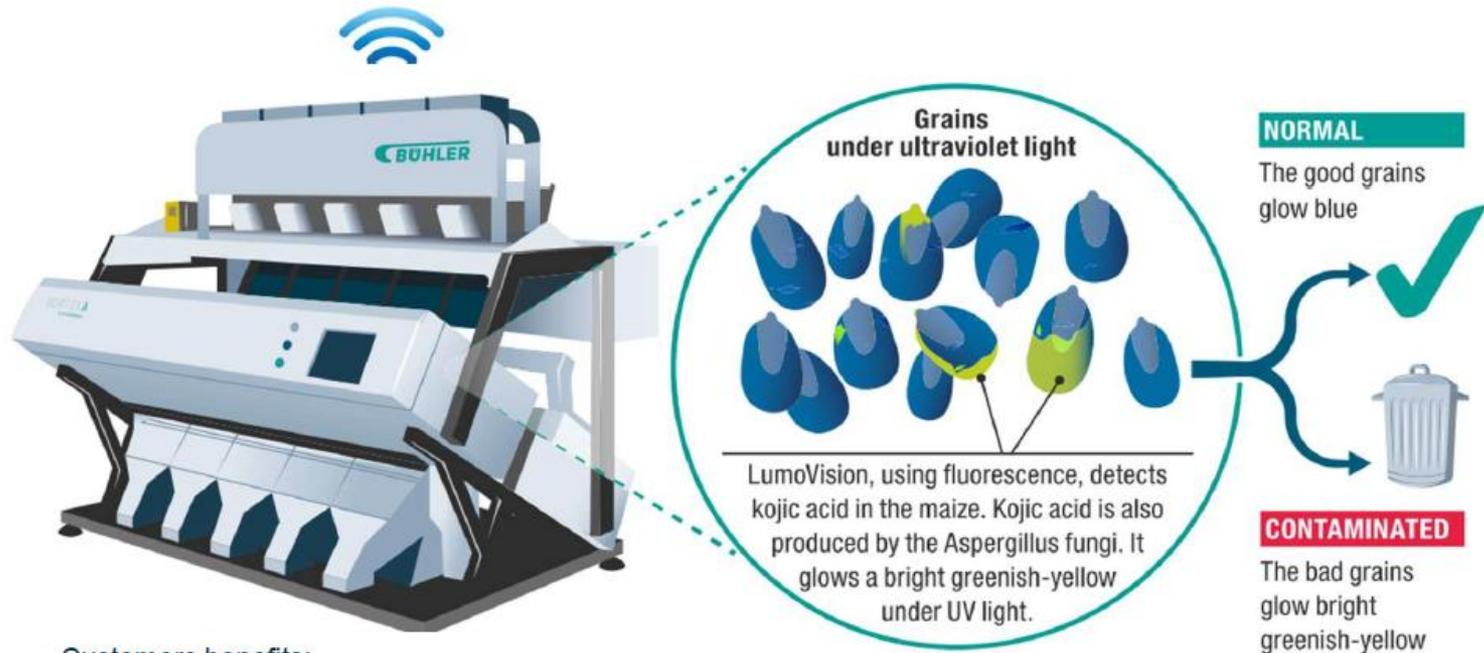


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- Os grãos com aflotoxinas têm ácido kójico que emite fluorescência ao passar por radiação ultravioleta

Lumovision.

Detection and removal of aflatoxin contaminated maize kernels.

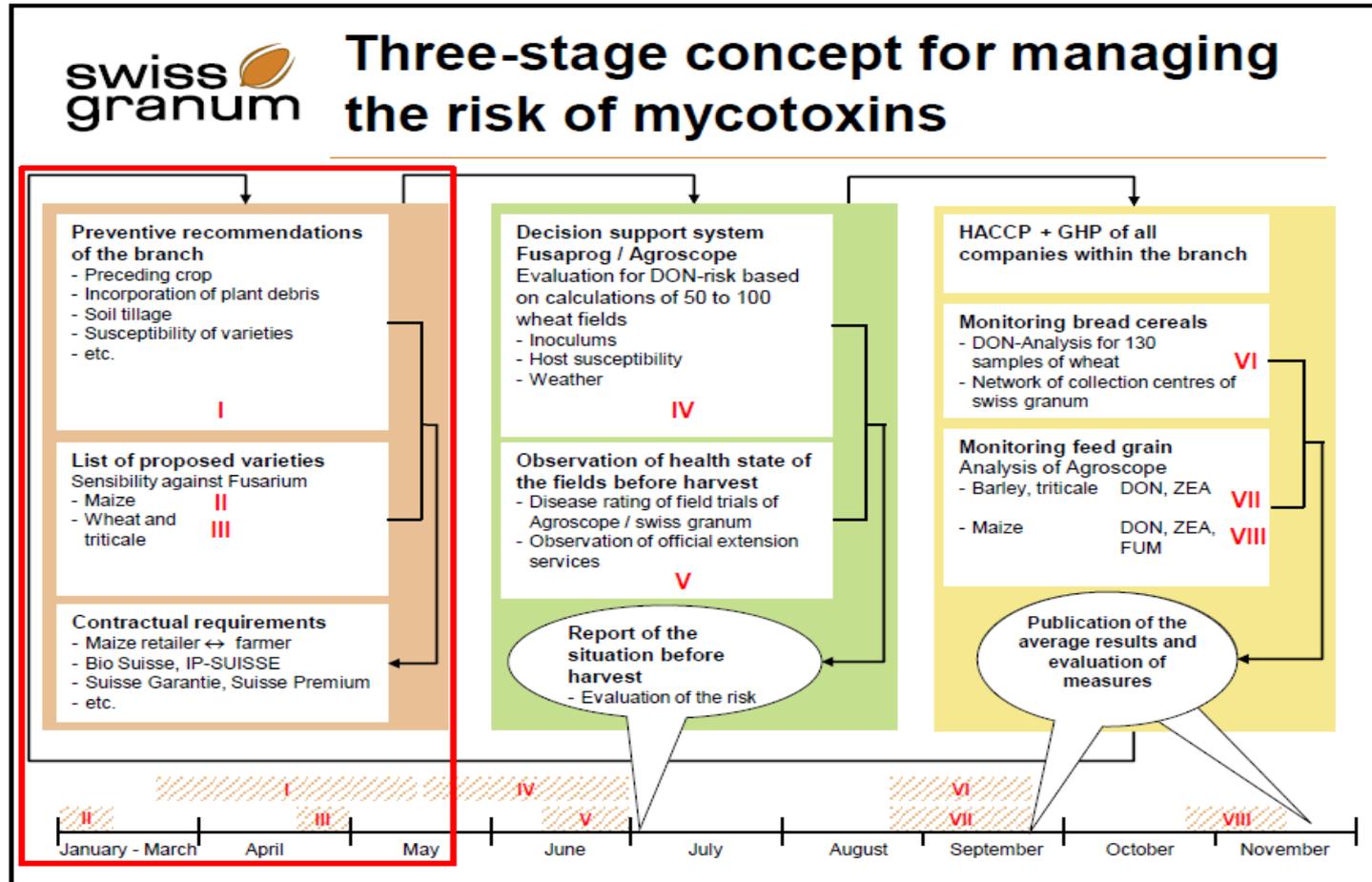


Customers benefits:

- Income: biomass quality
- Outcome: feed/food quality

BUHLER

Exemplo da gestão do risco de ocorrência de micotoxinas

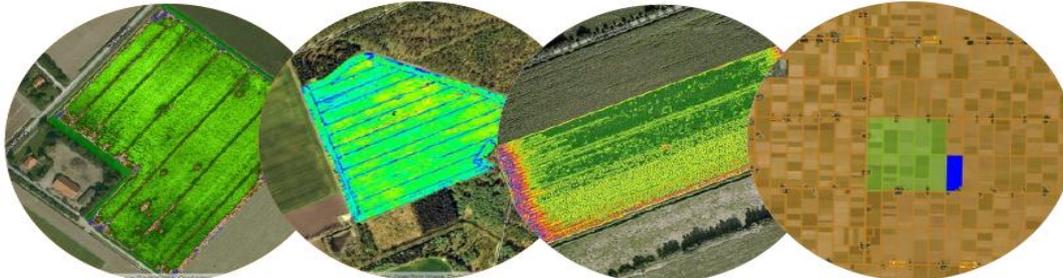


Stephan Scheuner presentation 'Prevention Strategies – a cereal stakeholders' perspective'

- Acesso através do registo no portal Akkerweb

MycoKey app: an ICT solution to facilitate mitigation of mycotoxin risks

Theo van der Lee
Third MycoKey technological workshop, Zurich, 19th June 2019



 WAGENINGEN
UNIVERSITY & RESEARCH

 100 years
1918-2018

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