Predicting the occurrence of mycotoxins in wheat, maize and nuts according to the holistic approach

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Outline

- Background
- Holistic approach
- Predictive model
- Progress and future plans

Corn (by Doug Wilson)

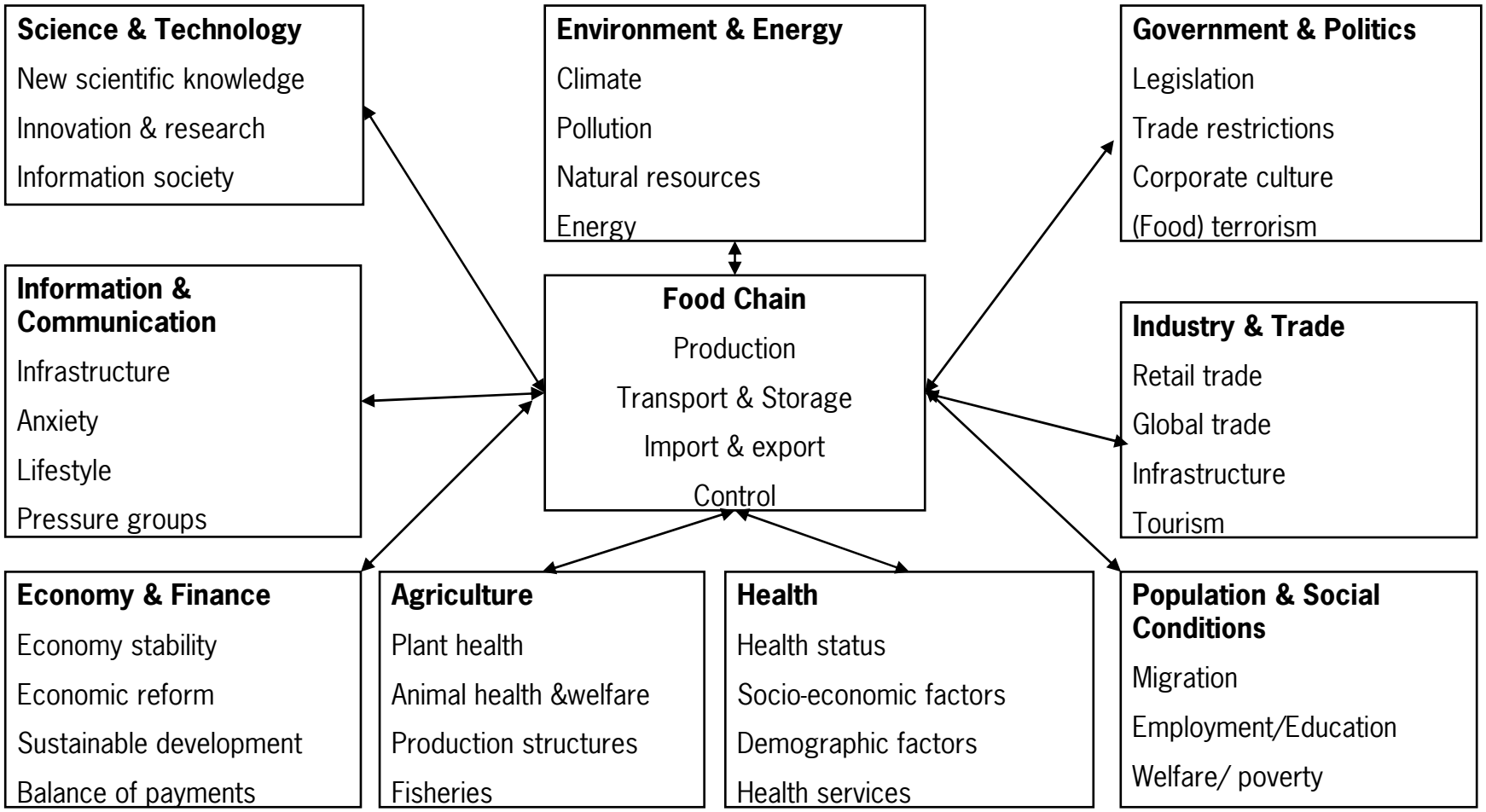
Background

- Holistic approach
  - PERIAPT project
  - EMRISK project
  - RIVM project for VWA
  - Many other projects

Nuts (www.nuthealth.org)

- SAFE FOODS
  - WP2 Early detection of emerging risks
  - Task 2.10 Early detection of mycotoxin risk
  - Task 2.10.1 Recognise mycotoxin risk signals

Holistic approach (1)



Source: EMRISK Final report, 2006

Holistic approach (2)

Sectors with different distances from food supply chain

- Primary sectors:
  - Science & technology
  - Environment & energy
  - Health
  - Agriculture
  - Economy & finance
  - Industry & trade
- Secondary sectors:
  - Government & politics
  - Population & social conditions
  - Information & communication

Background: Wheat harvest on the Palouse (ARS)

Holistic approach (3)

- Selecting indicators
  - Identify indicators
  - Define criteria for selection
  - Prioritise
- Develop decision making instrument

Nature	Features	Alert value	UF*	Examples
Qualitative	Yes No	Red Green	5 1	Bad Good
Semi-quantitative	Too low or too high Low or high Normal	Red Yellow Green	5 3 1	<25 or > 300 % 25-50 % or 150-300 % 50-150 %
Quantitative	Out of wide range Within wide range Within normal range	Red Yellow Green	5 3 1	> x ± 6 s.d. = x ± 6 s.d. = x ± 3 s.d.

- Collecting information

Predictive model (1) – Aim and use

- Objective:
  - predict the presence of re-emerging mycotoxins on wheat, maize and nuts
- Use:
  - adjust sampling strategies
  - adjust purchasing strategies
- Stakeholders:
  - risk assessors/risk managers
  - food/feed industry

Predictive model (2) – Background

- Several regional models are available
  - e.g. DONCAST

    used to predict DON in wheat in Canada

- For certain crops, legislation enforces controls
  - e.g. Pistachio nuts from Iran

Predictive model (3) – Two examples

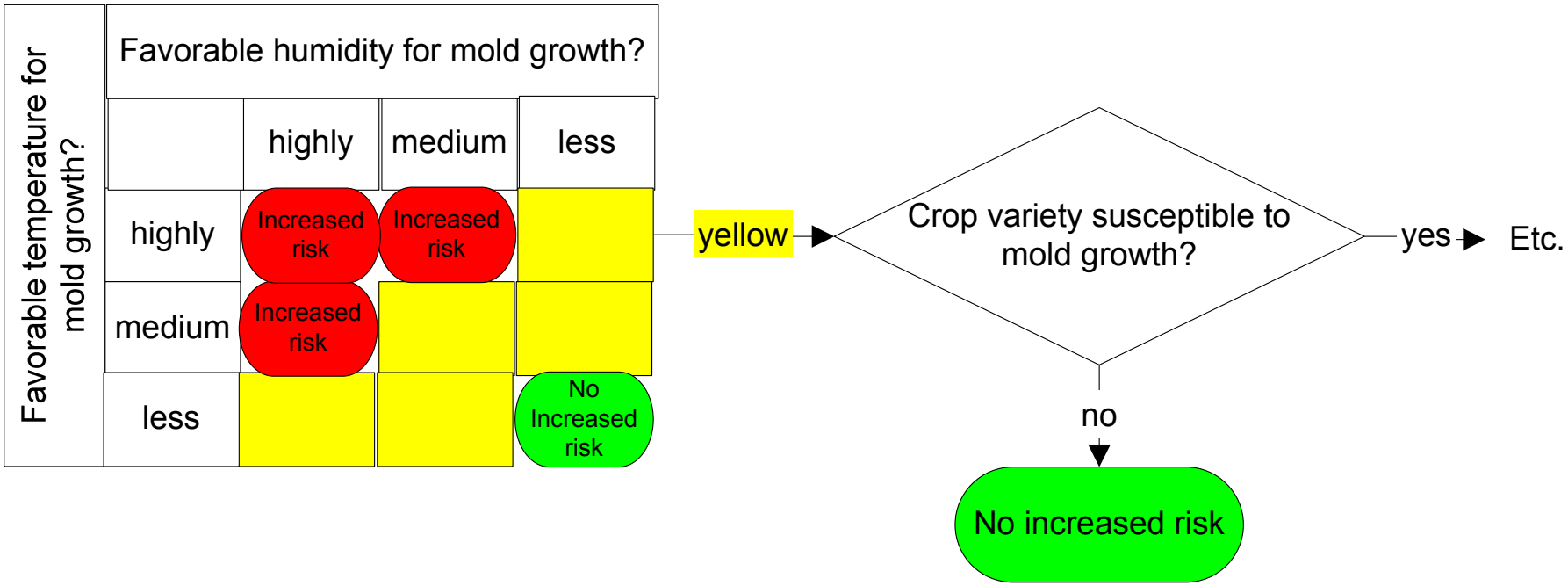
Fictive traffic light model with fictive scores

Indicator	Possible outcomes indicator		Results	Weighing factor	Score
Humidity	Red [1] Yellow Green	> 85 % 75 - 85 % < 75 %	1	2	2
Temperature	Red Yellow Green	26 -28 ºC 20-25 or 28-30 ºC <20 or > 30 ºC	1	2	2
Crop choice	Red Yellow Green	susceptible variety non-resistant variety resistant variety	0	1	0
Crop rotation	Red Green	Wrong crop rotation Right crop rotation	2	1	2
Total score	Red Yellow Green	> 5 3-5 0-2			6

[1] Possible outcomes for each different indicator: red = 2; yellow = 1; green = 0.

Predictive model (4) – Two examples

Fictive decision tree



Predictive model (5) – Approach

The project includes the following activities:

1. Identification of relevant mycotoxins
2. Identification of relevant indicators
3. Review and selection of indicators
4. Define risk categories within each indicator
5. Identification of data sources
6. Developing a predictive model
7. Testing the model - performance assessment

1. Identification of relevant mycotoxins

- Based on: RASFF and literature review

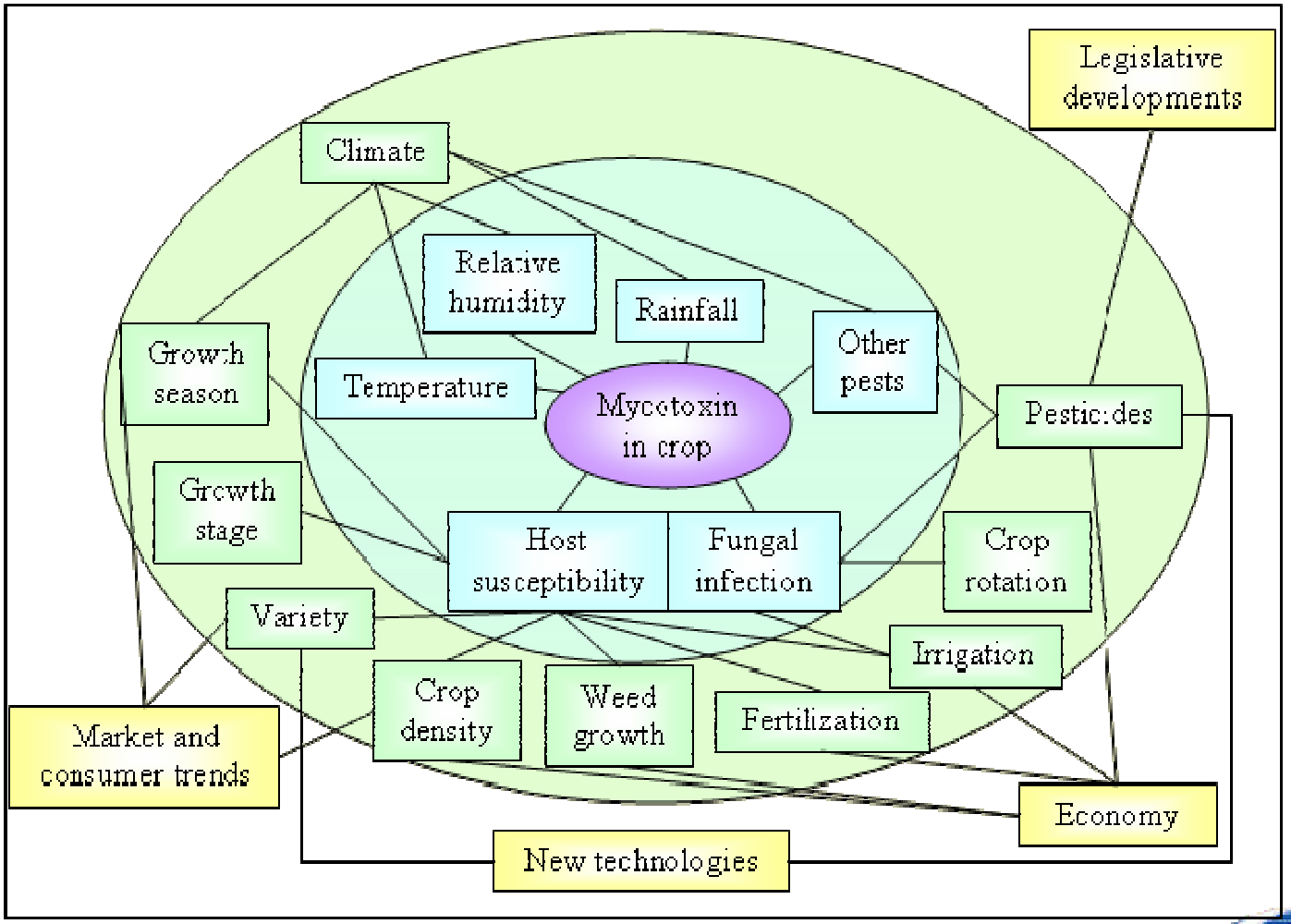
Commodity	Mycotoxin
Wheat	Deoxynivaenol (DON) Zearalenone (ZEA) Nivalenol (NIV) Ochratoxin A (OTA)
Maize	Fumonisin B1(FB1), FB2 and FB3 Ochratoxin A (OTA) Deoxynivaenol (DON) Zearalenone (ZEA) Nivalenol (NIV) Aflatoxin B1 (AFB1), AFB2, AFG1 and AFG2)
Nuts	Aflatoxin B1 (AFB1), AFG1, AFB2 and AFG2 Ochratoxin A (OTA)

2. Identification of relevant indicators (1)

- Based on:
  - Predictive models reviewed by UNICATT
  - Preliminary inventory of RIVM project for VWA (Dutch Food Safety Authority)
  - Publications on monitoring, management and prevention strategies
  - Literature review

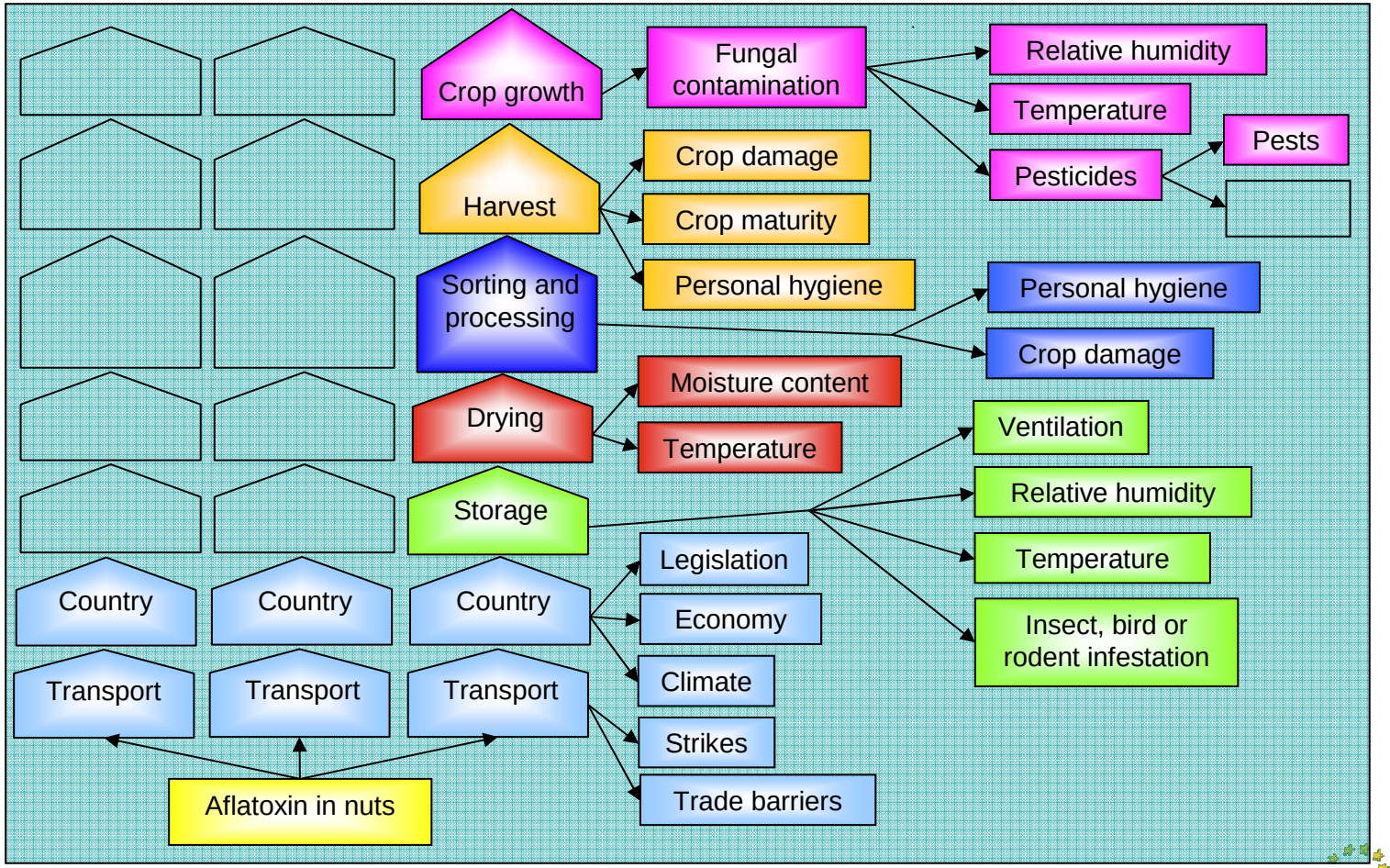
2. Identification of relevant indicators (2)

- Pre-harvest



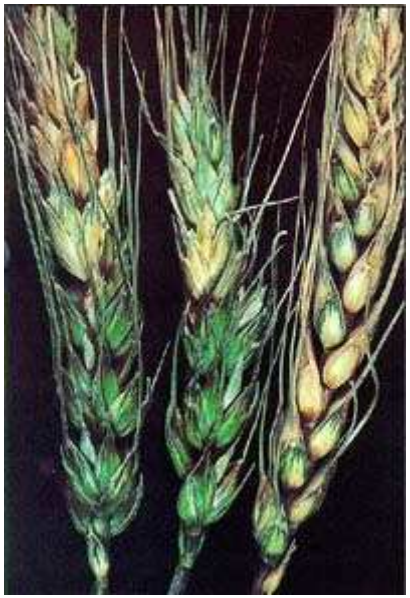
2. Identification of relevant indicators (3)

- Post-harvest



2. Identification of relevant indicators (4)

- Specify schemes for wheat, maize and nuts?



Wheat infected with fusarium head blight (www.ncsu.edu/news)

Corn infected with *A. flavus* (www.aspergillus flavus.org)

Walnut infected with *A.flavus* (msa.ars.usda.gov)

3. Review and selection of indicators (1)

- Based on: experts opinions
  - Interviews (May-June 2007)
  - Workshop (20 September 2007)
    - Focus on *Fusarium* toxins in wheat
  - In cooperation with MYCONET

Pistachio (Michailides, 2004)

3. Review and selection of indicators (2)

- Expert opinions
  - Identification of important indicators
  - Ranking of important indicators
  - Selection of most relevant indicators
  - Holistic approach: experts from different influential sectors were interviewed (e.g. agriculture, food chain, economy and social circumstances)

3. Review and selection of indicators (3)

Top 10 indicators based on interviews

Humidity/drought	Environment & Energy
Temperature	
Tillage policy	Agriculture
Crop rotation	
Crop choice	
Storage conditions and quality	Food Chain
Transport conditions and quality	
Global trade →	Industry & Trade
Limits for mycotoxins →	Government & Politics
Changes in eating patterns →	Social circumstances & Health

3. Review and selection of indicators (4)

Top 7 indicators based on workshop

Humidity (relative humidity)	Environment & Energy
Temperature	
Tillage policy	Agriculture
Crop rotation	
Crop choice	
Drying	
Storage and transport conditions →	Food Chain

4. Define risk categories within each indicator

- Clear definition of indicators (workshop)
- Determine cut-of values (future plans)

Indicator	Possible outcomes indicator		Results	Weighing factor	Score
Humidity	Red [1] Yellow Green	> 85 % 75 - 85 % < 75 %	1	2	2
Temperature	Red Yellow Green	26 -28 °C 20-25 or 28-30 °C <20 or > 30 °C	1	2	2
Crop choice	Red Yellow Green	susceptible variety non-resistant variety resistant variety	0	1	0

5. Identification of data sources

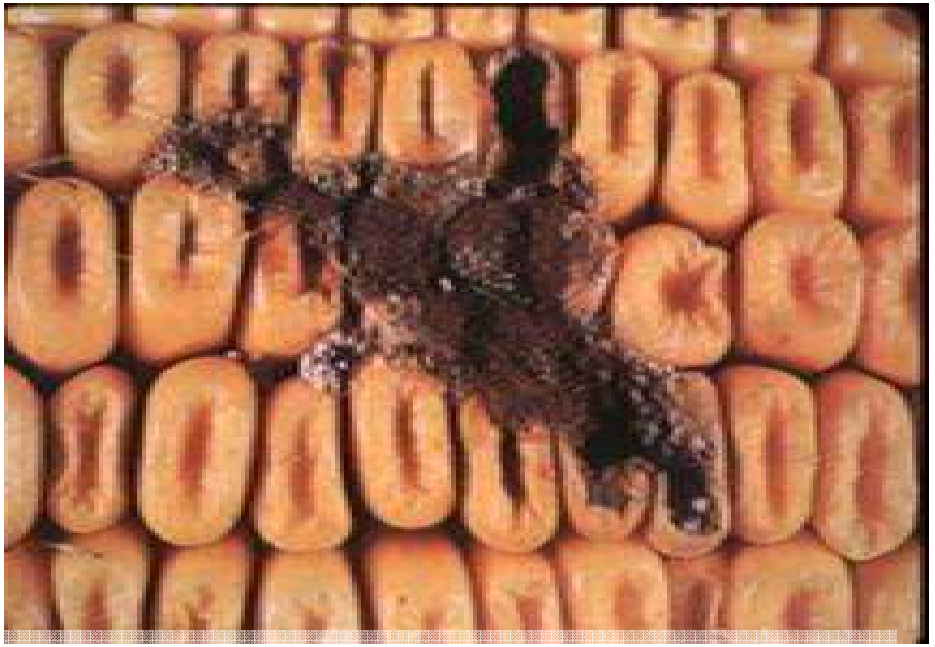
- Data sources of the preliminary inventory
- Data sources identified throughout the project
- Data from industry (future plans)
  - Confidentially?

6. Developing a predictive model

- Start simple => add extra indicators
- Interrelationships between indicators
- More input from industry needed
- Different models for different users, crops and moulds

7. Testing the model - performance assessment

- Use case studies from the past
- Investigate which indicators fell into which category



Corn infested by *A.flavus* (www.ansci.cornell.edu)


Thanks!
Any questions?