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Agroscope

PNR69 Healthy&Safe: Health promoting compounds and their impact on on resistance of *Fusarium* in wheat

Charlotte Martin, Torsten Schirdewahn, Romina Morisoli, Mario Bertossa, Thomas Bucheli, Felix Wettstein, Julien Dougoud, Jérémy Vincenti, Carine Oberson, Susanne Vogelgsang and **Fabio Mascher**

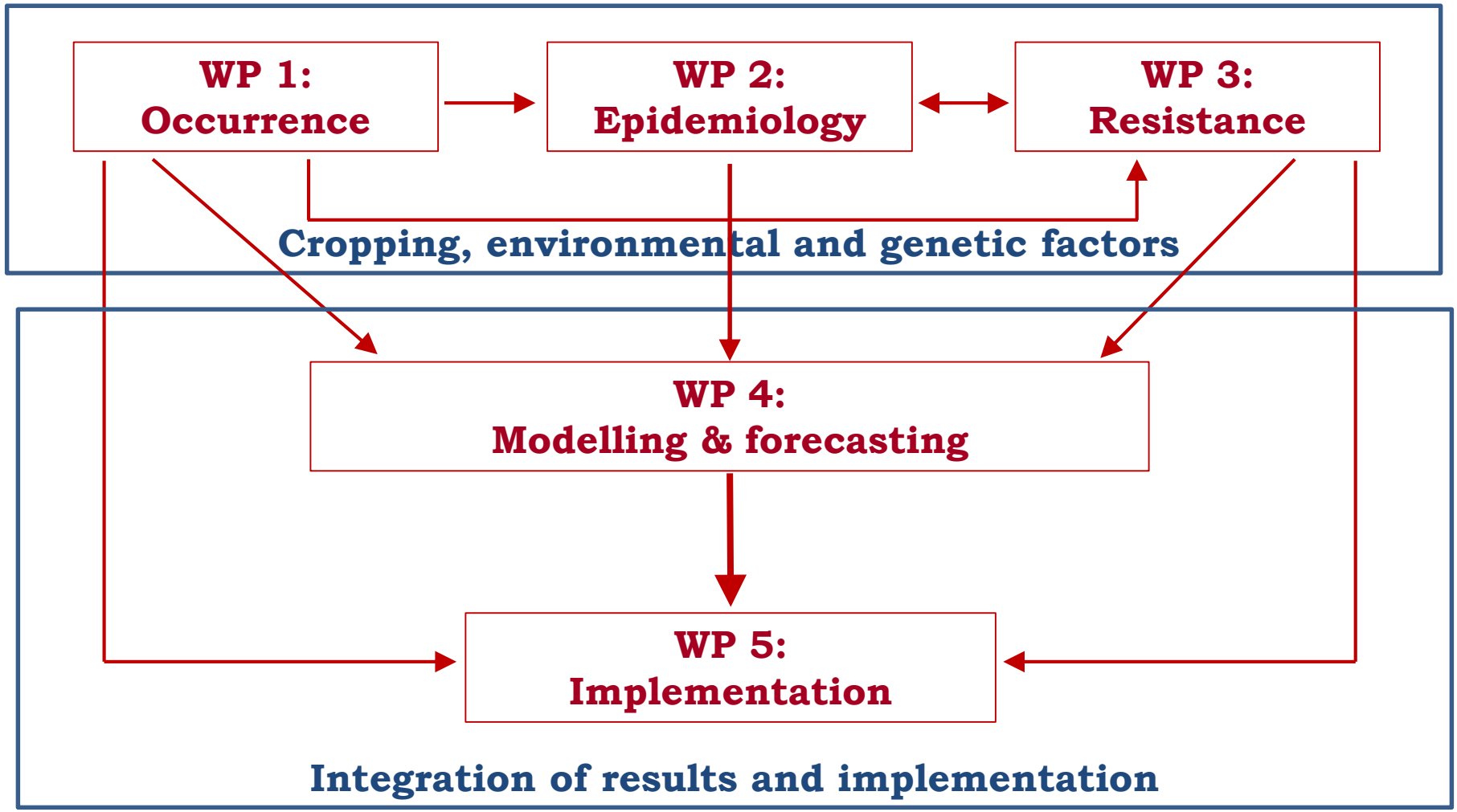
Alimentation saine et production alimentaire durable
Programme national de recherche PNR 69

Basic idea & hypothesis

- **Food versus feed**
  Cultivation of barley and oats as **food** in Switzerland
- **Better health**
  More health promoting compounds (**HPCs**) in cereal varieties (wheat, barley, oats), e.g. anthocyanins, arabinoxylans, carotenoids, β-glucans
- **Greater safety**
  HPCs could reduce growth of health threatening toxigenic fungi, e.g. *Fusarium* species

→ **Healthy & Safe**

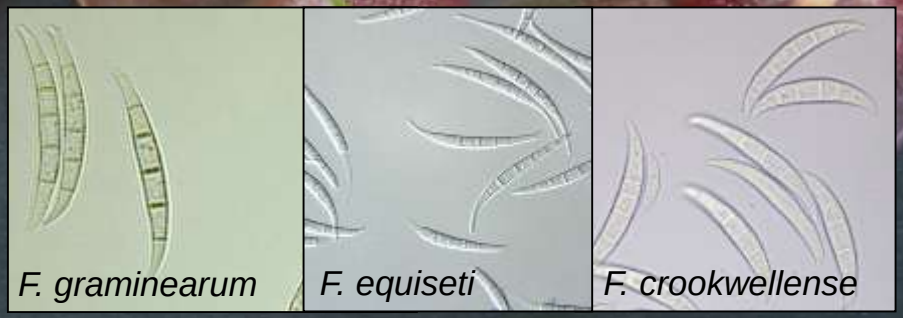
Healthy & Safe project
Work packages



Occurrence - Epidemiology - Resistance - Forecasting

WP 1

- **Growers' samples** (cropping factors)
- **Agroscope long-term and variety trials** (cropping & environmental factors)



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Occurrence - **Epidemiology** - Resistance - Forecasting

- **Climate chambers**
  Variety, temperature & leaf wetness duration
- **Field conditions**
  Weather & inoculum

Occurrence - Epidemiology - **Resistance** - Forecasting

- **Resistance experiments**
  HPC enhanced genotypes
- **Toronit x 211.12014 mapping population**
  Role of carotenoids
- **Wheat isolines**
  Anthocyanin spectrum
- **HPCs on *in vitro* growth and toxin production**

Occurrence - Epidemiology - Resistance - **Forecasting**

FusaProg for wheat, oats, barley and their mycotoxins

Informationssystem zur Risikobeurteilung von Fusarienbefall und DON-Belastung im Getreide

Anmeldung / Parzellenerfassung

CH-Karte mit regionalem Infektionsrisiko

Wetterbedingtes Infektionsrisiko (14 Tage)

Parzellenspezifisches DON-Belastungsrisko

Sortenliste

français

Berechungsparameter Schweiz

Kontakt: Tomke.Musa@art.admin.ch
Idee und Konzept: Hans-Rudolf Forrer ART

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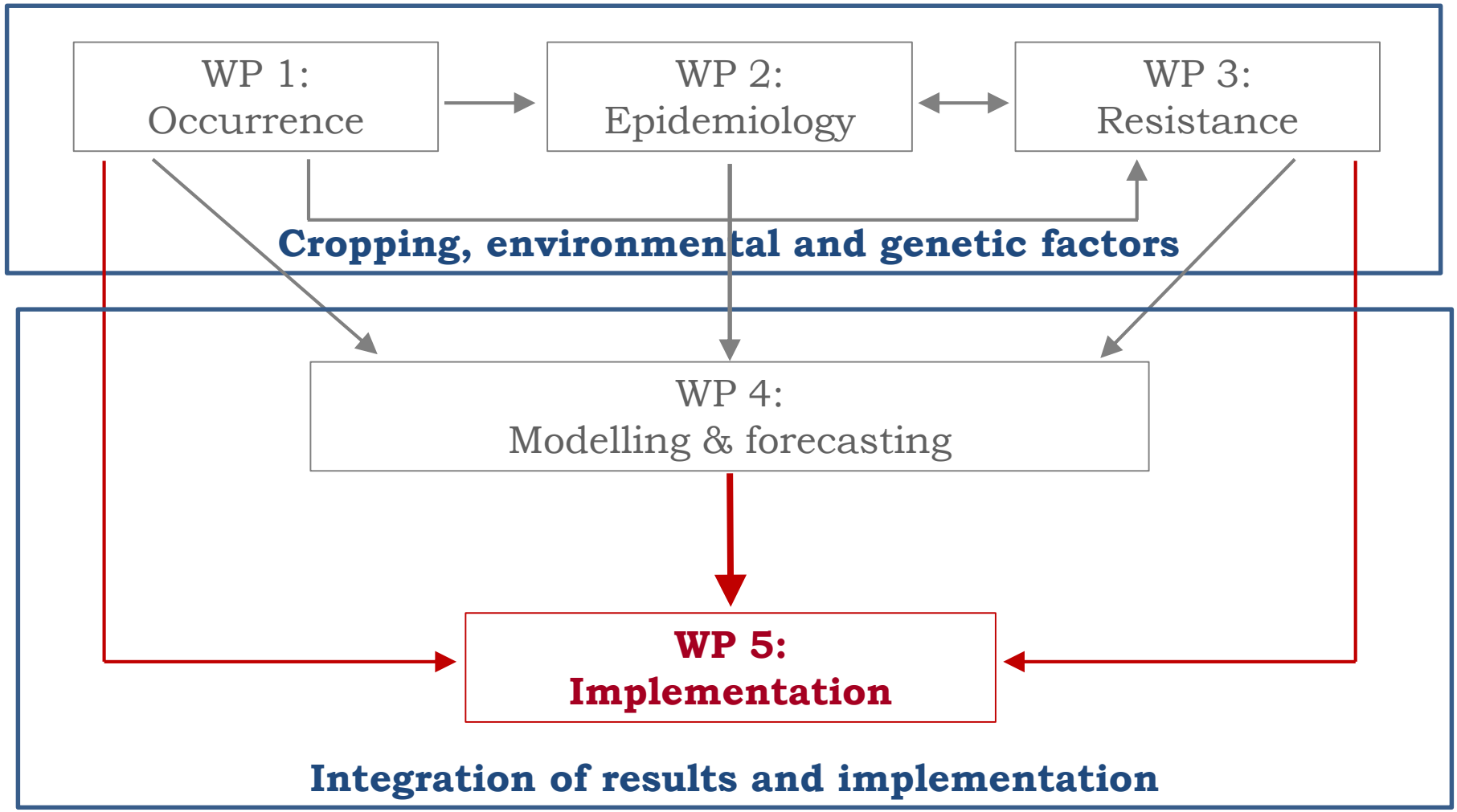
powered by WIDAS

Healthy & Safe project
Work packages



WP 5 Implementation partners

swissmill
Die Schweizer Getreidemühle.

Landi
GROS-DE-VAUD
La Coopérative Agricole et Meunière d'Echallens

swiss granum

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Zurich University of Applied Sciences

Konferenz der kantonalen Pflanzenschutzdienste (KPSD)
Conférence des services phytosanitaires cantonaux (CSP)
Conferenza degli servizi fitosanitari cantonali (CSF)

InfoCodex
Semantic Technologies

zh aw

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Objectives of the resistence part

- Study the impact of lutein on the resistance against FHB in spring wheat varitey Toronit.
- Study the impact of antocyanins in the resistance against FHB in winter wheat varieties.

Resistance against FHB in wheat

- FHB causes yield losses and reduces the quality of the harvest by accumulation of mycotoxins
- The resistance against this disease is an important breeding goal in wheat (and other cereals). In particular, it allows a sustainable cropping scheme.
- The resistance rellies on a large diversity of resistance mechanisms and genes (polygenic, quantitative resistance).

(Fotos: T. Schiderwahn)

Resistance against FHB in wheat

Different types of physiological resistance

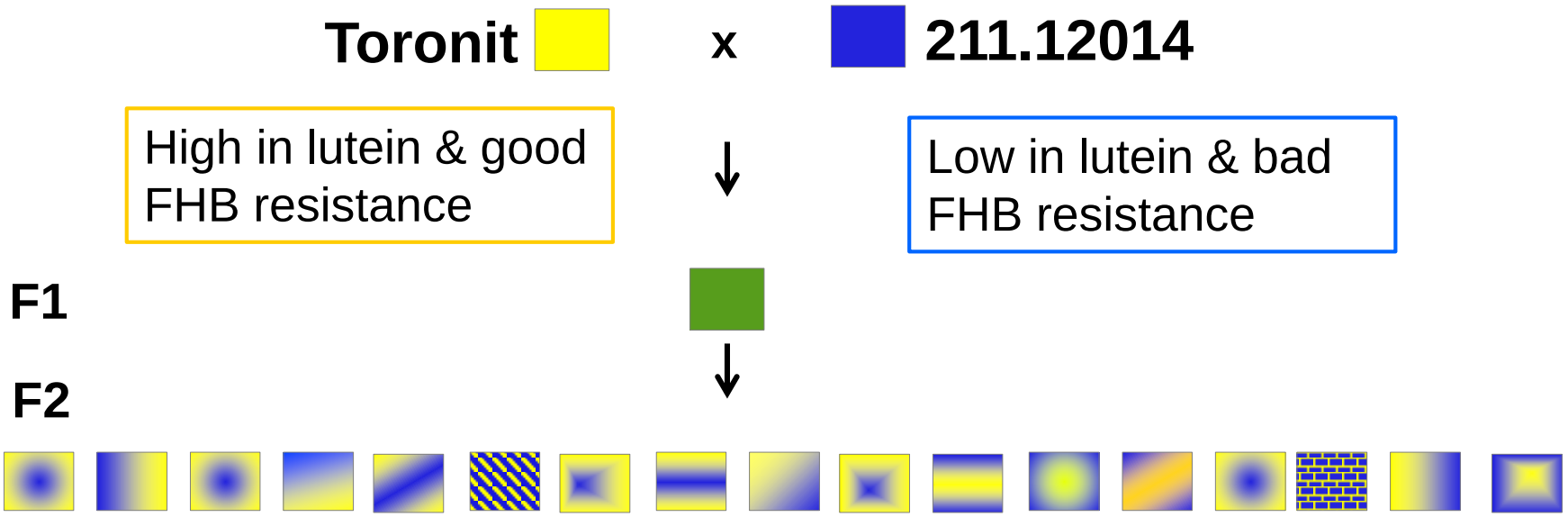
Type I : Resistance against the primary infecton

Type II : Limitation of spreading in the ear

(Foto: C.Martin)

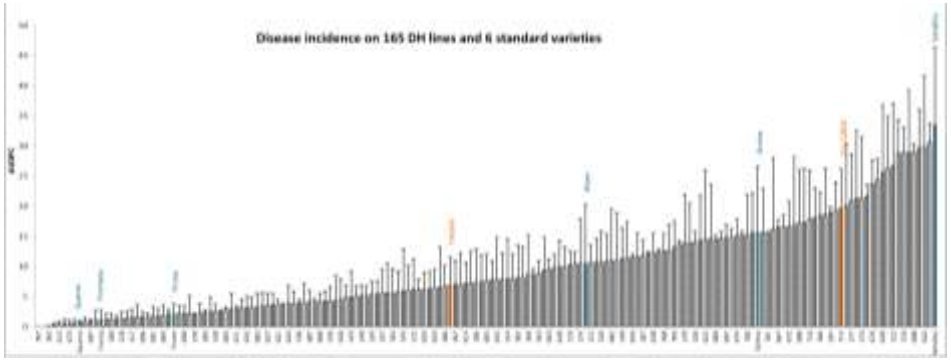
Type III : Kernel resistance.

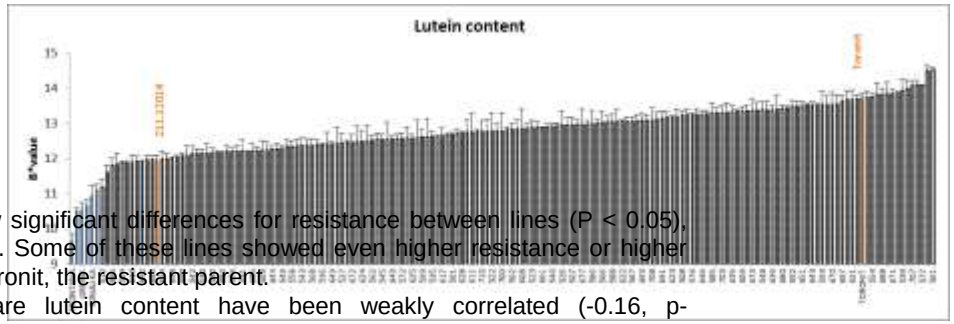
Resistance: mapping population



- **176 DH lines represent the genotypic diversity in the F2**
- **Segregation of genes:**
  Separate carotenoid content from FHB resistance
- **Phenotyping of the resistance of each DH line and available data on carotenoid contents of each line:**
  Correlation between the role of carotenoids in FHB resistance of cv. Toronit

Resistance: mapping population





- The first results show significant differences for resistance between lines ($P < 0.05$), and for lutein content. Some of these lines showed even higher resistance or higher lutein content than Toronit, the resistant parent.
- Disease incidence are lutein content have been weakly correlated (-0.16, p-value<0.05).
- As lutein is contained in grains, and so not present at infection at flowering stage, this first result may suggest a genetic link between FHB resistant components and lutein content.

Resistance tests

Criteria for notation
→ Disease incidence
→ Disease severity
→ Kernel analyses: TKW, FDK, mykotoxins.

Experimental approach

- 14 wheat varieties
- Artificial infections with *Fusarium graminearum*
- Trial sites: Vouvry, Changins, Reckenholz Cadenazzo
- 3 replicates w/o at each sites.
- Notation for diseaswe incidence and disease severity.
- Grain analyses: TKW, FDK, mycotoxins.

Versuchsfeld in Vouvry

1. Disease incidence

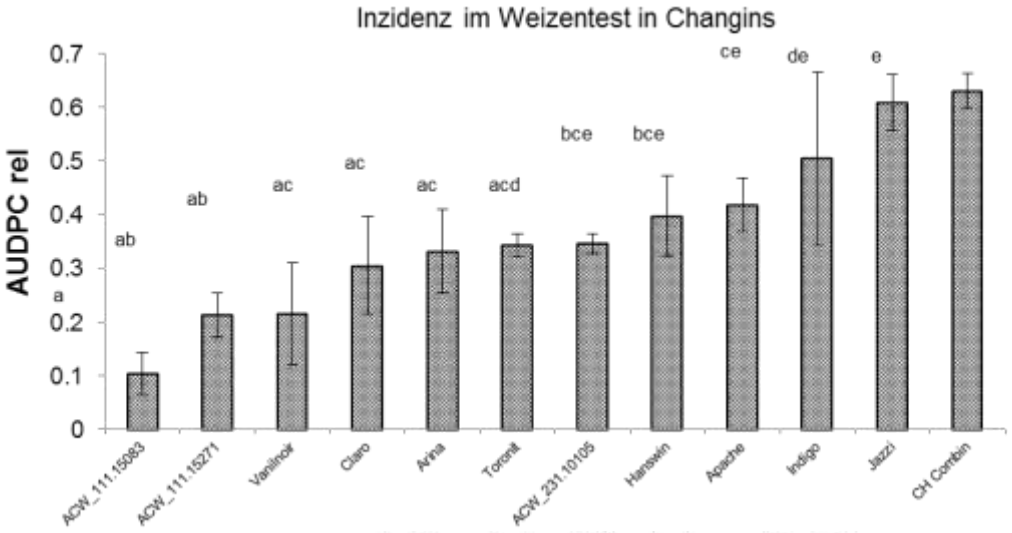
Incidence: Estimation of the risque that a plant will be infected.

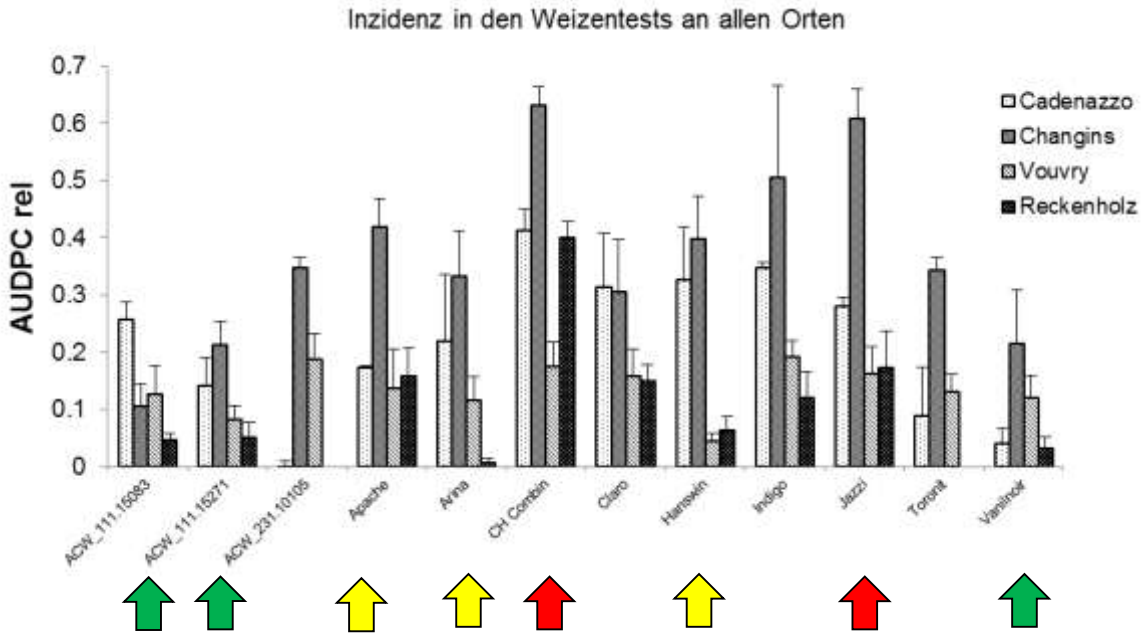
→ Counting of newly infected spikes
→ 3 notations

Resistenztest in Cadenazzo (Foto: F. Mascher)

Source : C.Martin

1. Disease incidence





Important differences

→in Changins: Combin, Jazzi, Indigo : Highest disease incidence.

→The risk is very high.

Influence of the environment

→ Highest inciudence in Changins

→ GxE Interactions with varety Hanswin

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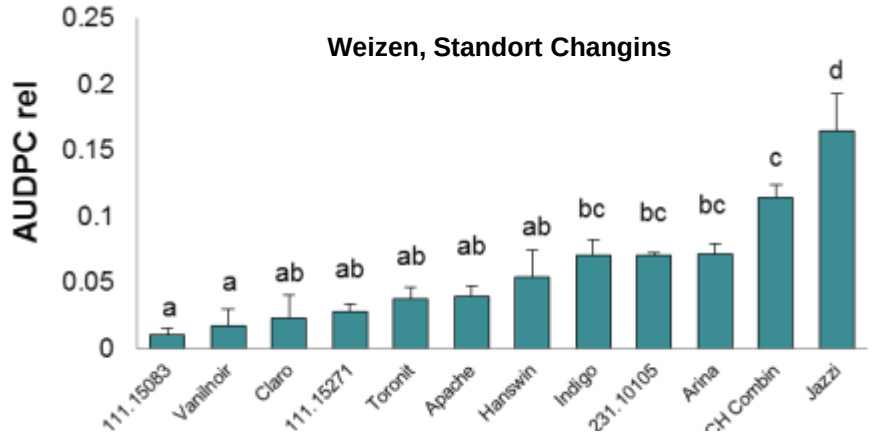
2. Disease severity

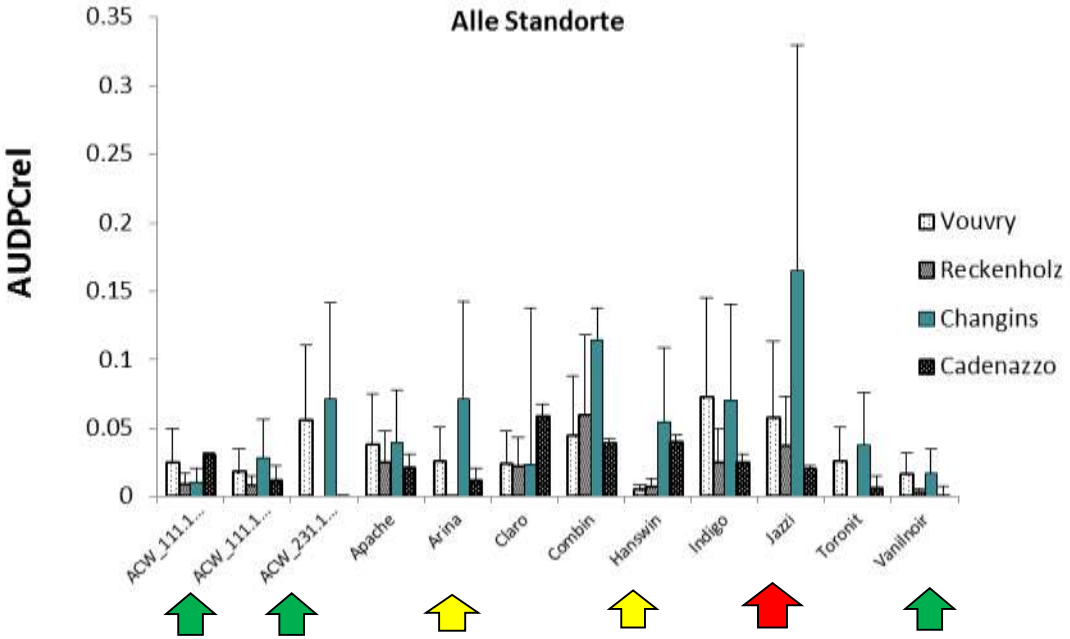
Disease severity = Strength of the infection.

Foto: APS.net

(Foto: T. Schiderwahn)

2. Disease severity





- → Important differences
- → G x E interactions
- → Combin and Jazzi show the highest susceptibility..
- → Varietes showing lower incidenceschow also lower severity, usulally.

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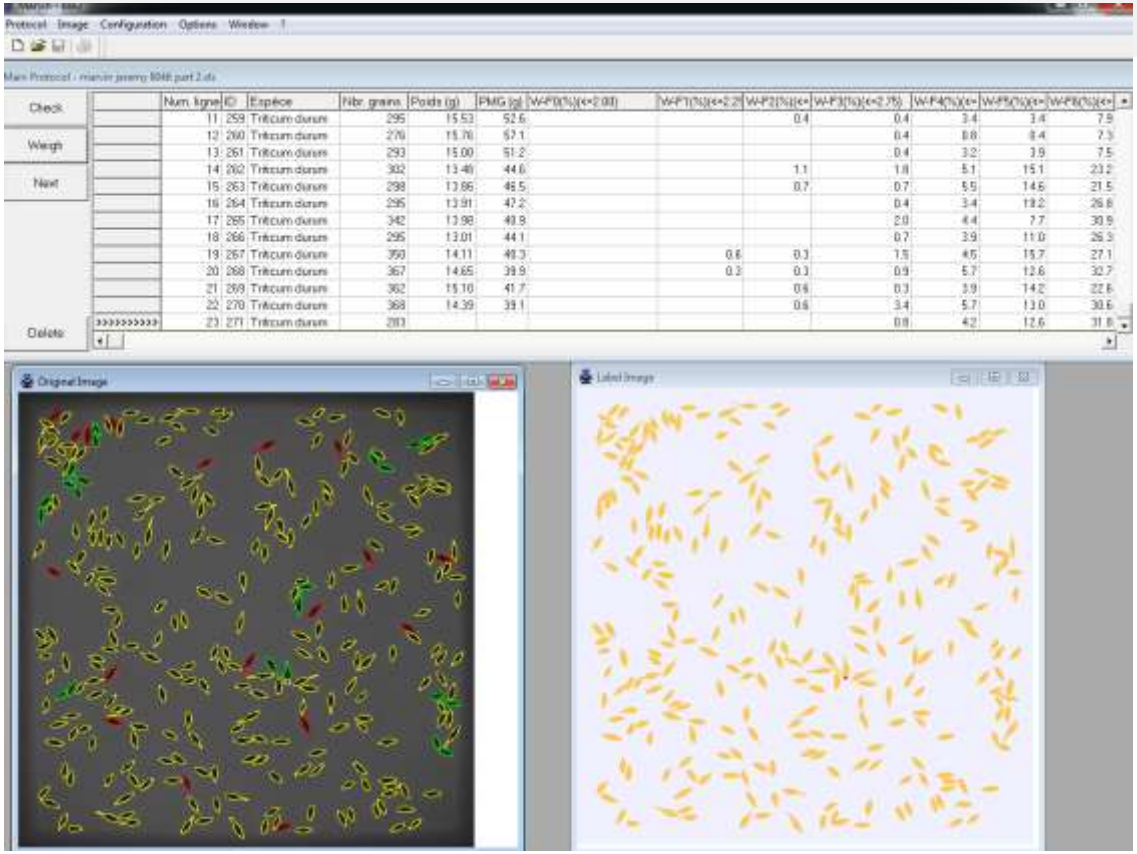
3. Kernel analyses

TKW: Thousand kernel weight → Impact on yield.

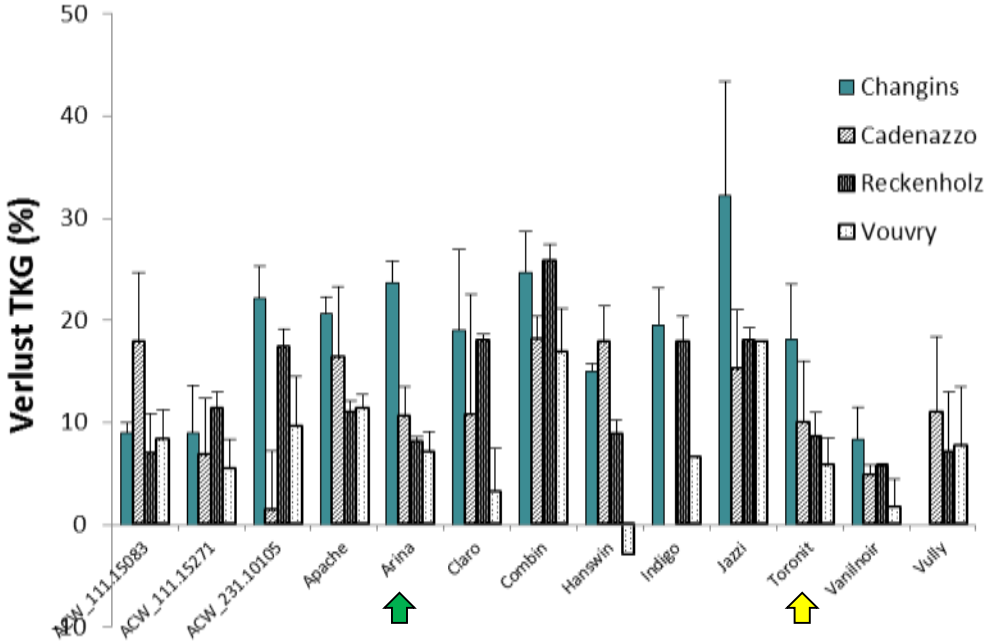
FDK: % of affected kernlels → Impact on quality

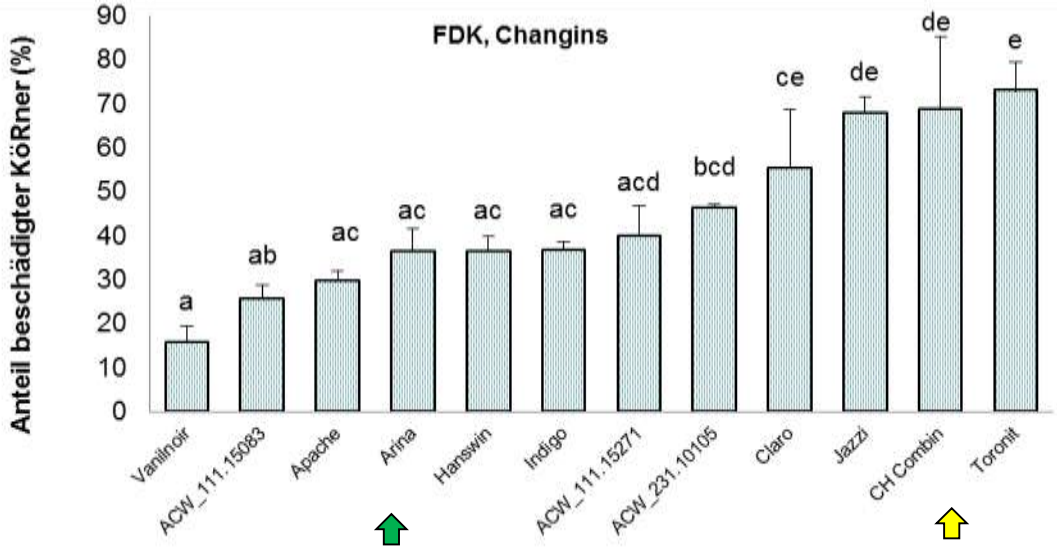
Analyses of mycotoxins (not yet finished)



Digital seed Analyser MARVIN. GTA Sensorik

4. First results





- Important TKW reductions

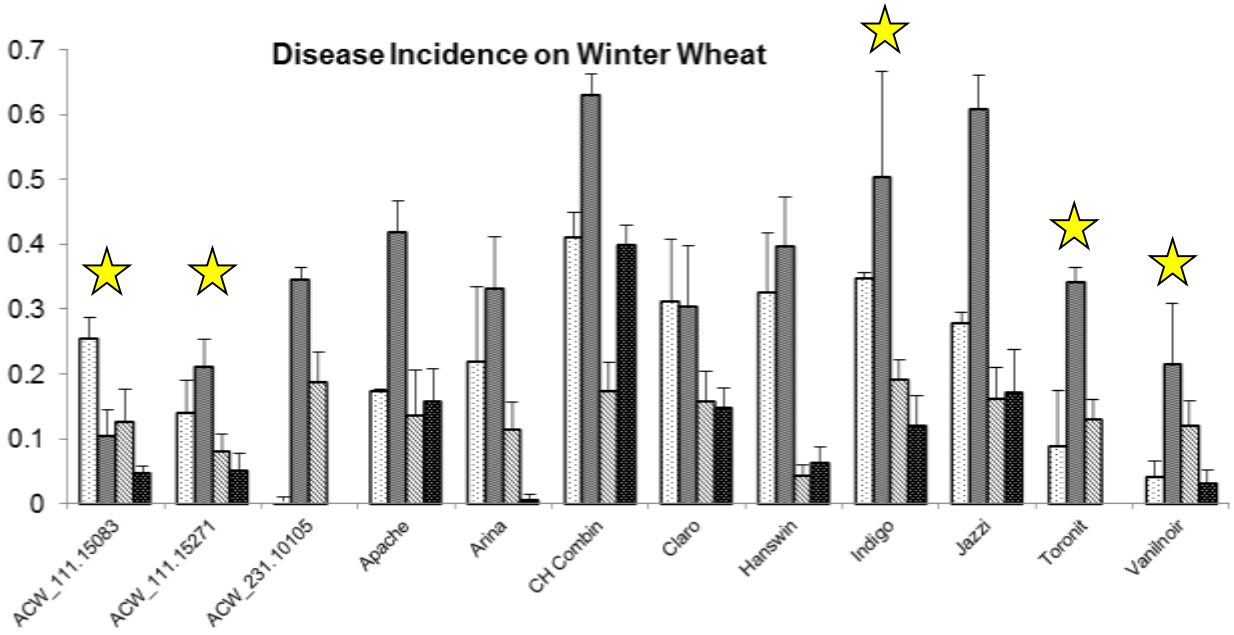
Mechanisms

→ Toronit : low reduction of TKW. But many damaged grains, jedoch viele beschädigte Körner → Infection does not hinder filling of grains.

→ Arina: Important loss of TKW but only little proportion of damaged grains.-> Infectoin impedes grain filling..

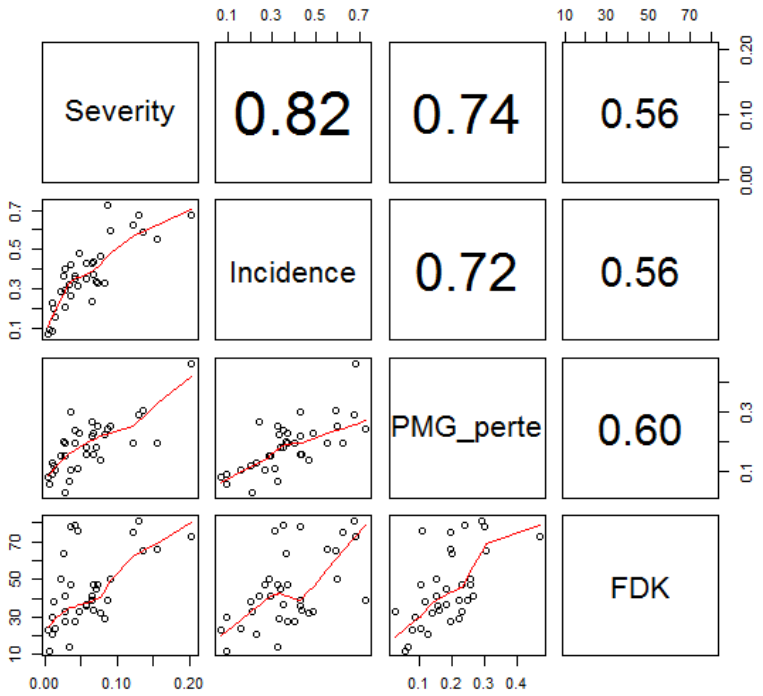
Impact of health promoting compounds on resisance

Content of anthocyanins or luteins as a resistance factor?



Colored varieties

Conclusions



- Little but significant impact of lutein on resisance: enhancing!
- By evaluation of different resistance types, there is abetter appreciation of the resistance.
- Resistance types are independent but somehow connected.
- This is of utmost importance for breeding of resistant varieties.
- GxE Interations, impact of the environment must be taken in consideration.
- The confirmation of the impact of lutein and anthocyanins provides new breeding criteria..

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