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Federal Department of Economic Affairs,
Education and Research EAER

Agroscope

Fusarium species and mycotoxins in oats: effect of cropping factors and health promoting compounds

T. Schirdewahn, C. Martin, F. Mascher, T.D. Bucheli,
M. Bertossa, R. Morisoli, T. Musa, S. Vogelgsang

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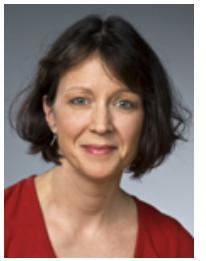

July 15, 2014

Healthy Nutrition and Sustainable Food Production
National Research Programme NRP 69

Outline

- Aims and challenge
- Project description
- Preliminary results
- Conclusions and upcoming work

Aims & challenge

- **Promotion of cereal production for food**

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  Swiss barley and oats for food, less for feed

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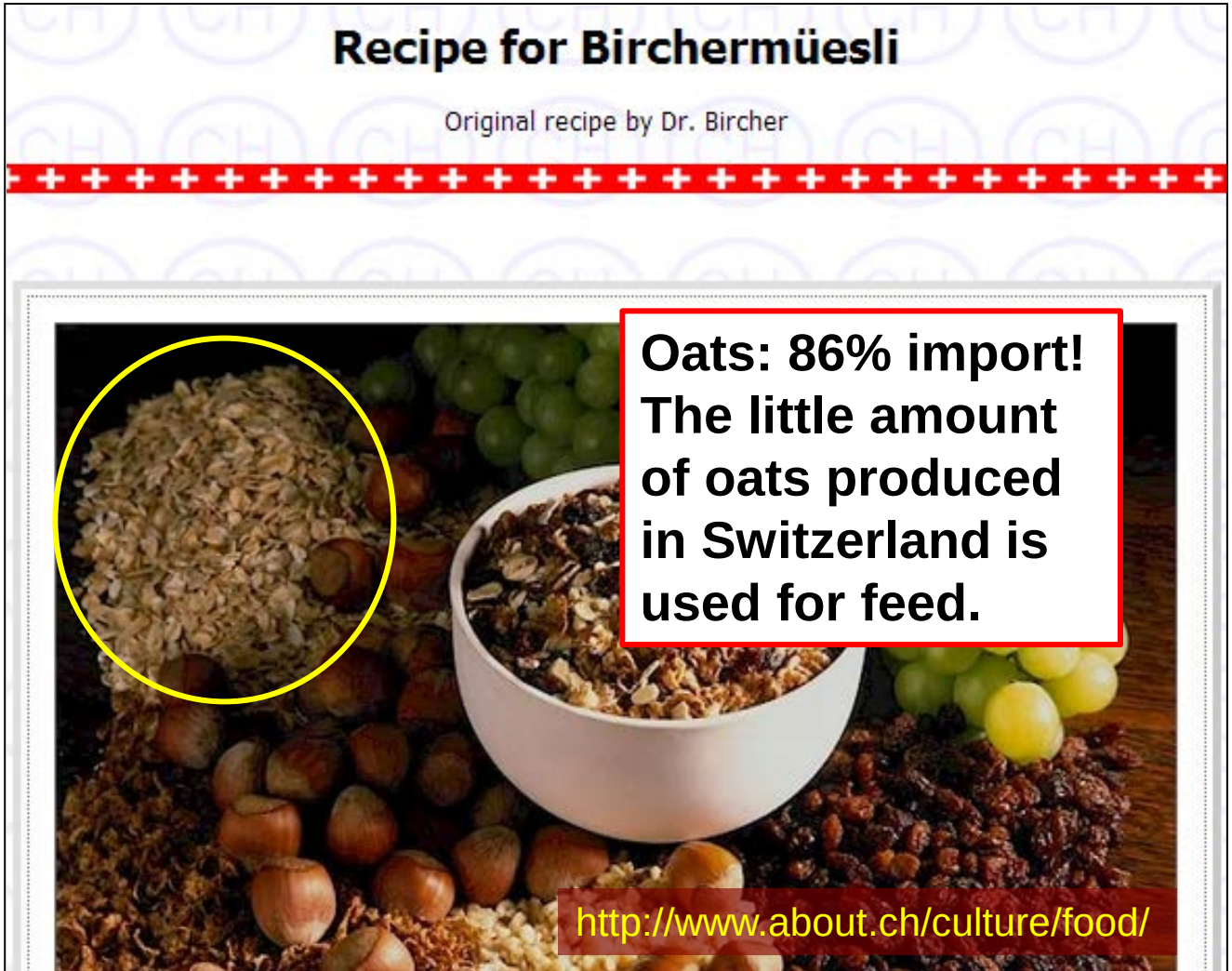


Aims & challenge

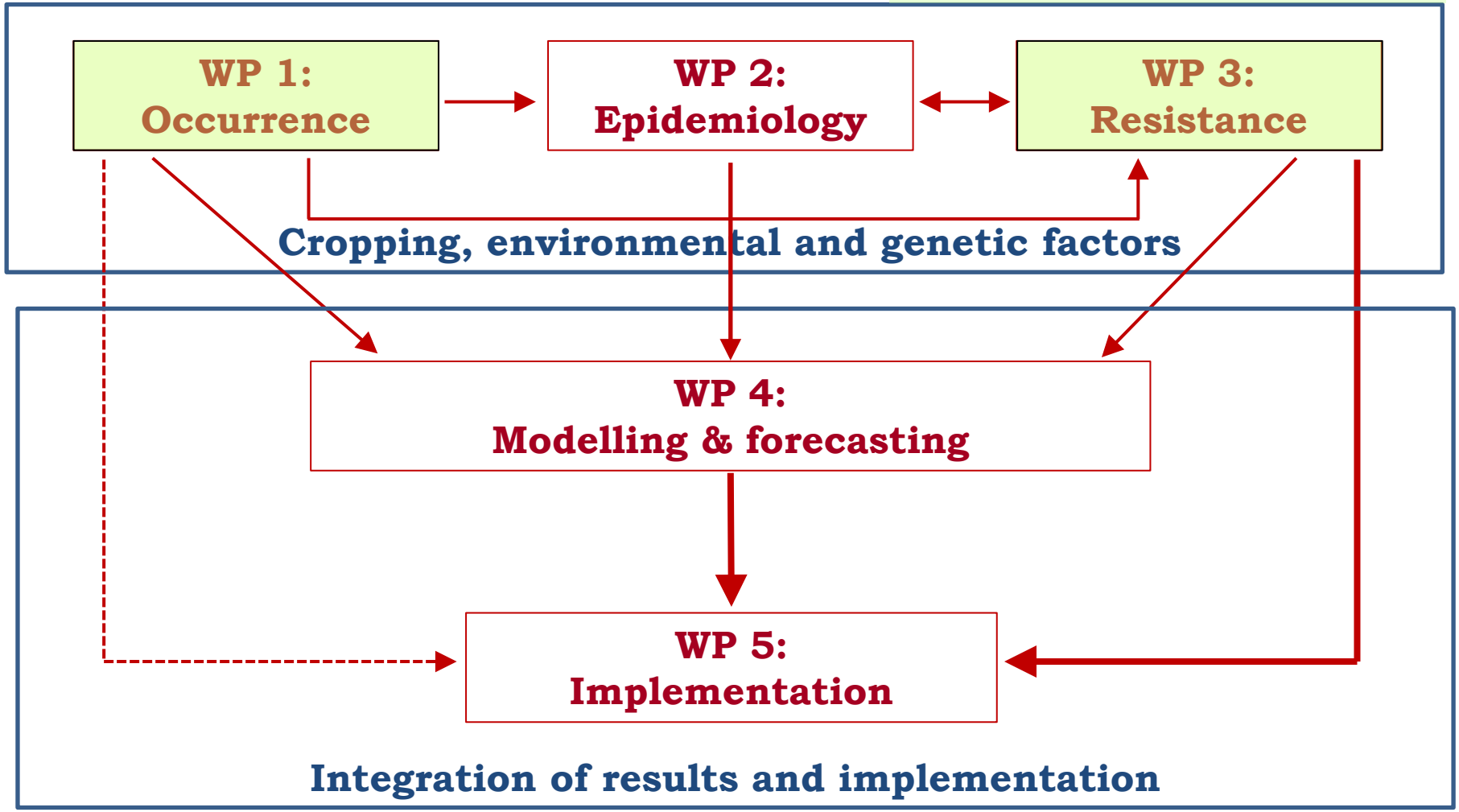
- **Promotion of cereal production for food**
  Swiss barley and oats for food, less for feed
- **Improved health**
  Elevated content of health promoting compounds (**HPCs**) in certain cereal varieties, e.g. phenolic acids, anthocyanins, arabinoxylans, carotenoids, β-glucans
- **Fusaria and mycotoxins**
  → severe yield losses
  → threat to human health

- **Improved safety**
  HPCs could reduce growth of toxigenic *Fusarium* species

→ **Healthy & Safe** (start: December 2013)

Healthy & Safe project
Work packages

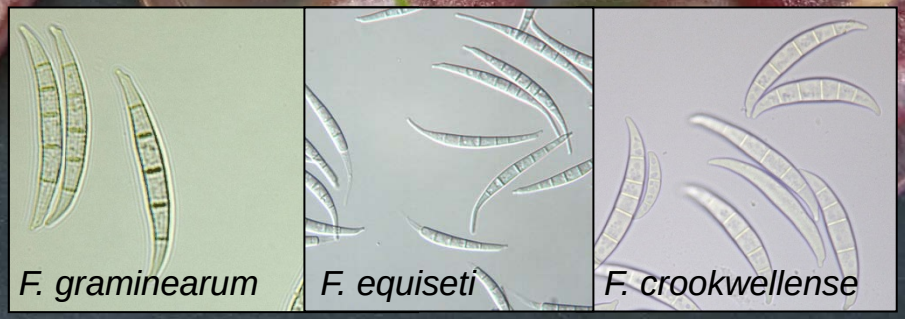
As of now: preliminary results available



Occurrence - Epidemiology - Resistance - Forecasting

WP 1

- **Monitoring of growers' samples** throughout Switzerland (cropping factors)
- **Agroscope variety trials** in S, W & E Switzerland (cropping & environmental factors)



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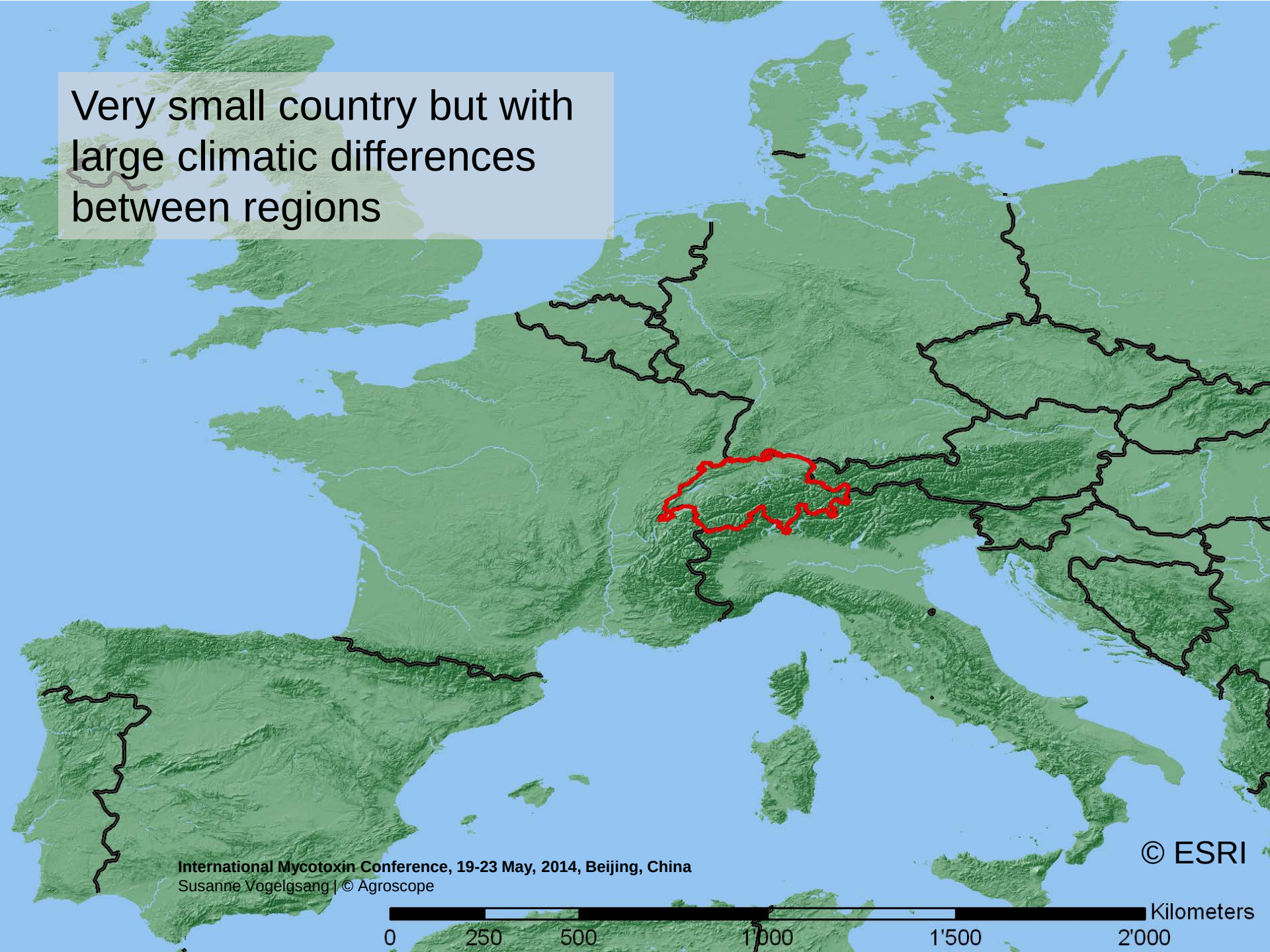
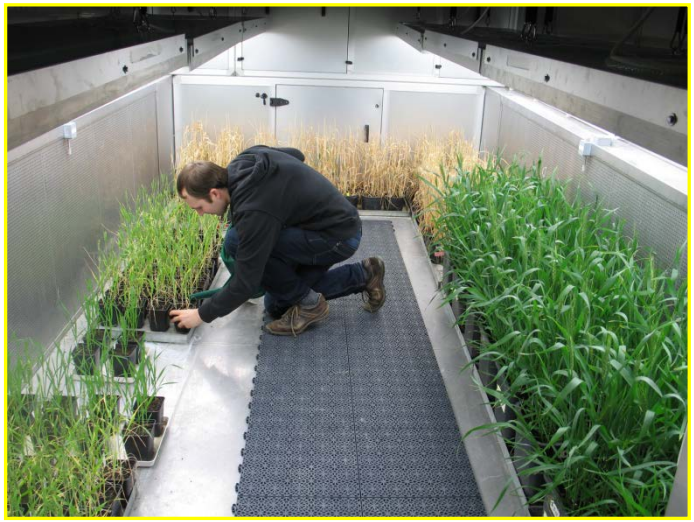


International Mycotoxin Conference, 19-23 May, 2014, Beijing, China

Susanne Vogelgsang | © Agroscope

WP 2



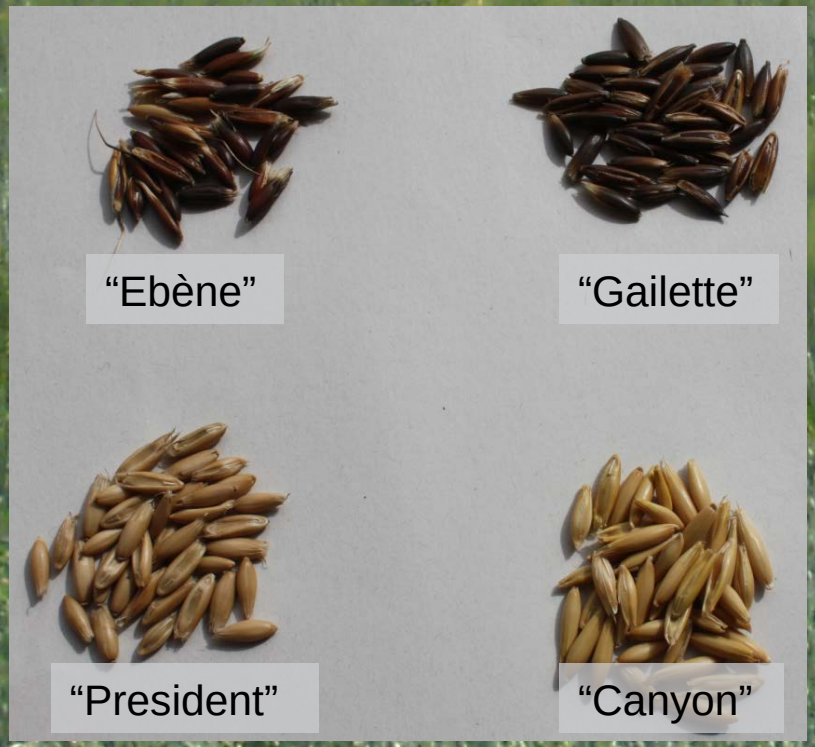
- **Climate chamber**
  Variety, temperature
  & leaf wetness duration

Occurrence - **Epidemiology** - Resistance - Forecasting

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

Occurrence - Epidemiology - **Resistance** - Forecasting

WP 3



- **Resistance experiments at three sites in Switzerland**
  - HPC enhanced genotypes
  - Artificial infections

Sites of resistance experiments

Sites of resistance experiments

Zurich-
Reckenholz

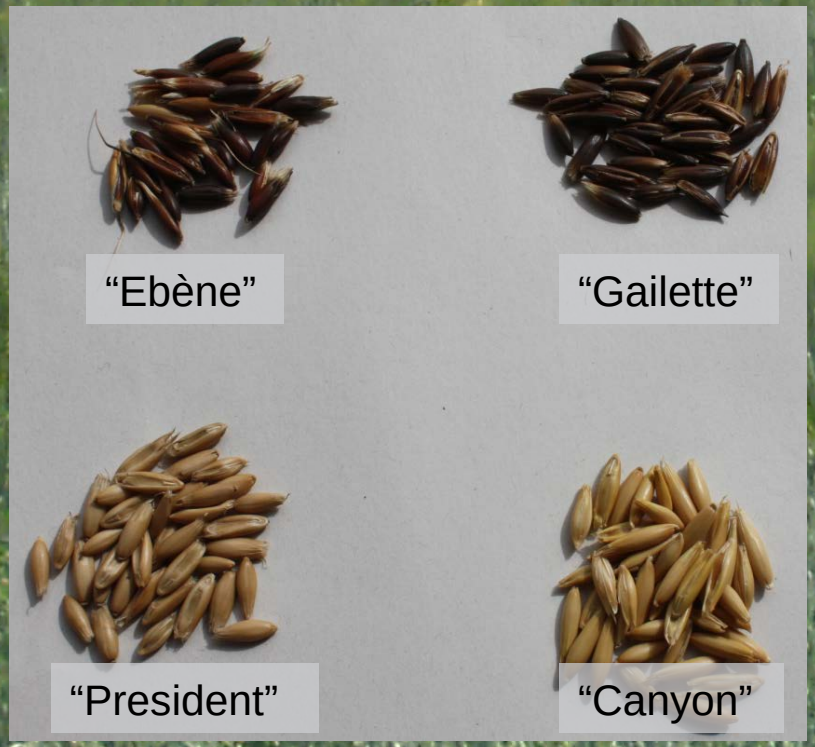
Liebefeld

Changins

Cadenazzo

Occurrence - Epidemiology - **Resistance** - Forecasting

WP 3



- **Resistance experiments at three sites in Switzerland**
  - HPC enhanced genotypes
  - Artificial infections
- **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

Kantonale Pflanzenschutzdienste | MeteoSchweiz | Programminformationen

Information system for risk assessment of FHB and DON contamination in wheat

WP 4

- 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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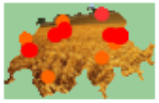
FusaProg for wheat, oats, barley and their mycotoxins

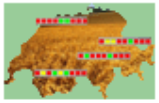
Information system for risk assessment of FHB and DON contamination in wheat

WP 4

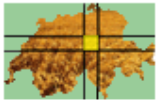
Anmeldung / Parzellenerfassung



CH-Karte mit regionalem Infektionsrisiko



Wetterbedingtes Infektionsrisiko (14 Tage)



Parzellenspezifisches DON-Belastungsrisko

Sortenliste

français

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FusaProg for wheat, oats, barley and their mycotoxins

Information system for risk assessment of FHB and DON contamination in wheat

WP 4

WebApp for FusaProg: as of now available for wheat only

FusaProg

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Kontakt: Tomke.Musa@art.admin.ch
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WP 5 Implementation partners

Industry & marketing

IP-SUISSE

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

swiss granum

swissmill
Die Schweizer Getreidemühle.

InfoCodex
Semantic Technologies

Extension

agridea
DEVELOPING AGRICULTURE AND RURAL AREAS

ARVALIS
Institut du végétal

strickhof

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

Research

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

sge Schweizerische Gesellschaft für Ernährung
ssn Société Suisse de Nutrition
ssn Società Svizzera di Nutrizione

Zurich University of Applied Sciences
zh aw

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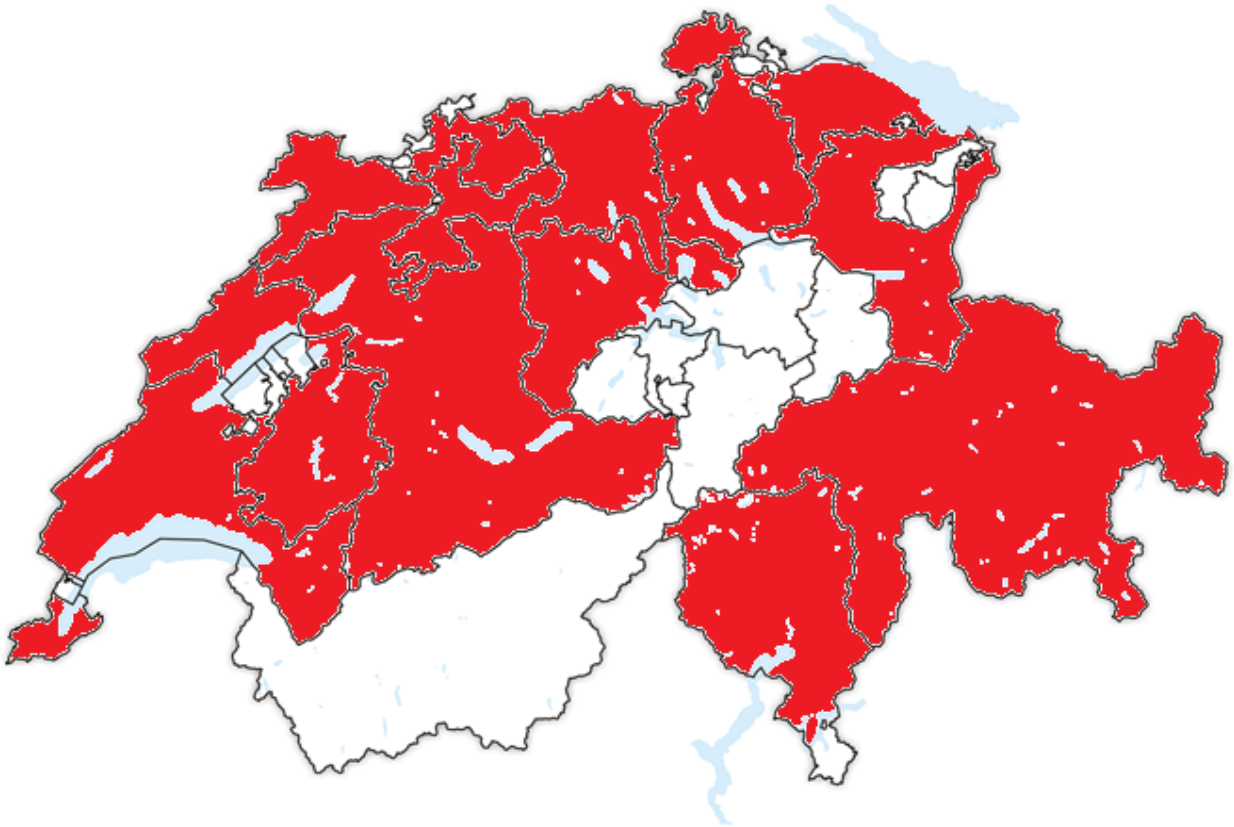
1. Workshop with partners, January 2014

1. Workshop with partners, January 2014

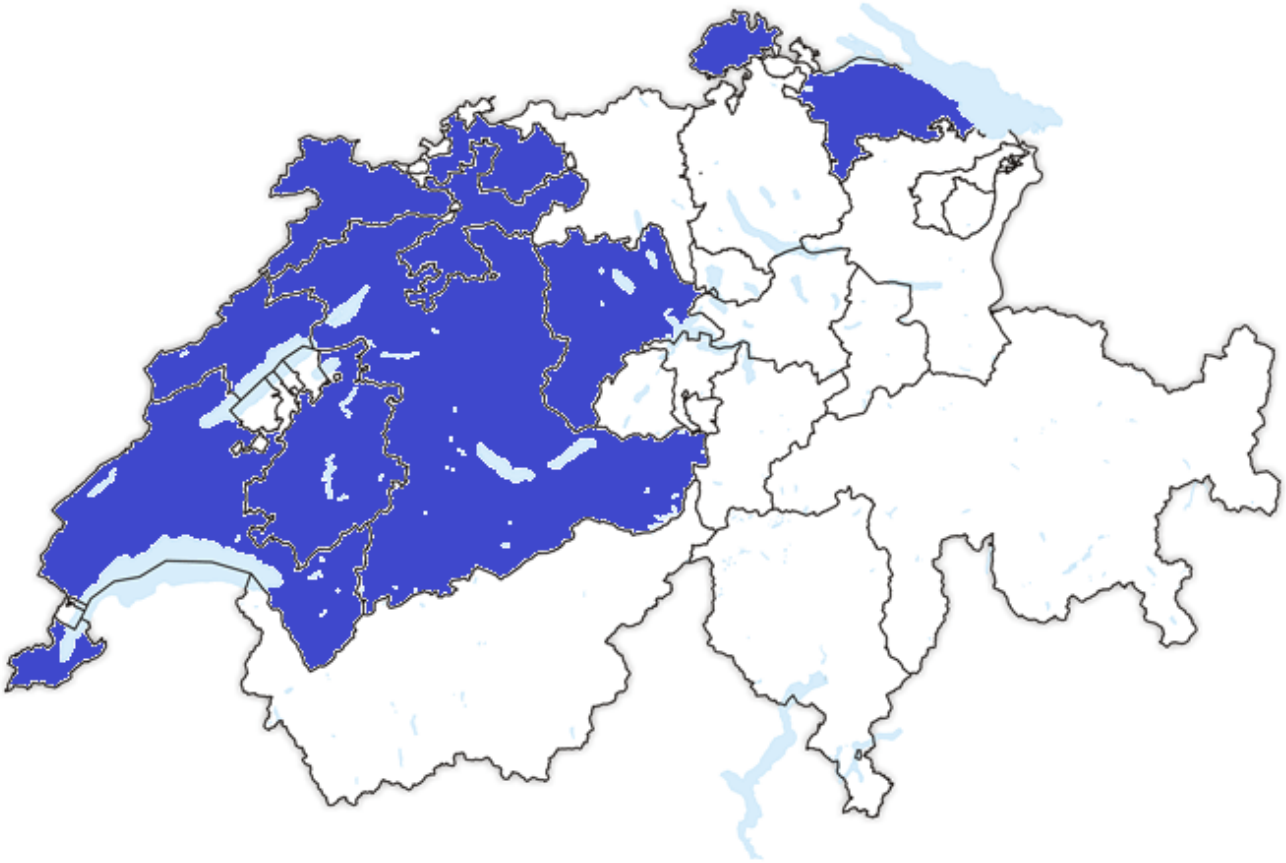
WP 1: Occurrence - monitoring 2013

- 280 barley samples from 17 cantons



WP 1: Occurrence - monitoring 2013

- 280 barley samples from 17 cantons
- **93 oat samples from 11 cantons**



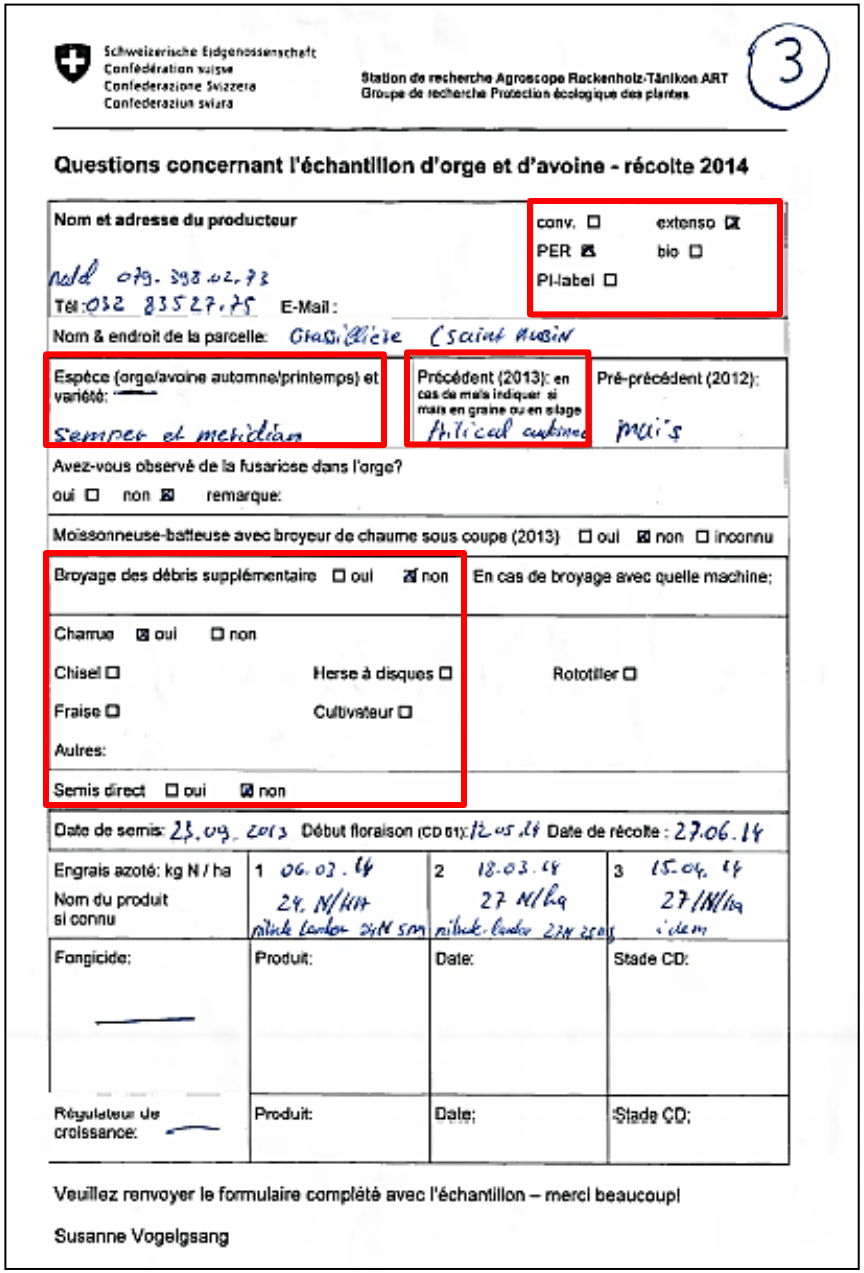
WP 1: Questionnaire on cropping factors

variety

tillage / residue management

production system

previous crop



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Station de recherche Agroscope Reckenholz-Tänikon ART
Groupe de recherche Protection écologique des plantes

3

Questions concernant l'échantillon d'orge et d'avoine - récolte 2014

Nom et adresse du producteur

reld 079. 398.02.78
Tél: 032 83527.75 E-Mail:

conv. ☐ extenso ☒
PER ☒ bio ☐
PI-label ☐

Nom & endroit de la parcelle: Grasslière (Saint Aubin

Espèce (orge/avoine automne/printemps) et variété: semper et meridian

Précédent (2013): en cas de maïs indiquer si maïs en graine ou en silage: hybrid cultivar

Pré-précédent (2012): maïs

Avez-vous observé de la fusariose dans l'orge?
oui ☐ non ☒ remarque:

Moissonneuse-batteuse avec broyeur de chaume sous coupe (2013) ☐ oui ☒ non ☐ inconnu

Broyage des débris supplémentaire ☐ oui ☒ non — En cas de broyage avec quelle machine:

Charrue ☒ oui ☐ non
Chisel ☐ Herse à disques ☐ Rototiller ☐
Fraise ☐ Cultivateur ☐
Autres:

Semis direct ☐ oui ☒ non

Date de semis: 23.09.2013 Début floraison (CD 61): 12.05.14 Date de récolte: 27.06.14

Engrais azoté: kg N / ha Nom du produit si connu	1 06.03.14 24 N/ha nitrat Lonza 24N 5M	2 18.03.14 27 N/ha nitrat Lonza 27N 5M	3 15.04.14 27 N/ha idem
Fongicide:	Produit:	Date:	Stade CD:
Régulateur de croissance:	Produit:	Date:	Stade CD:

Veuillez renvoyer le formulaire complété avec l'échantillon – merci beaucoup!

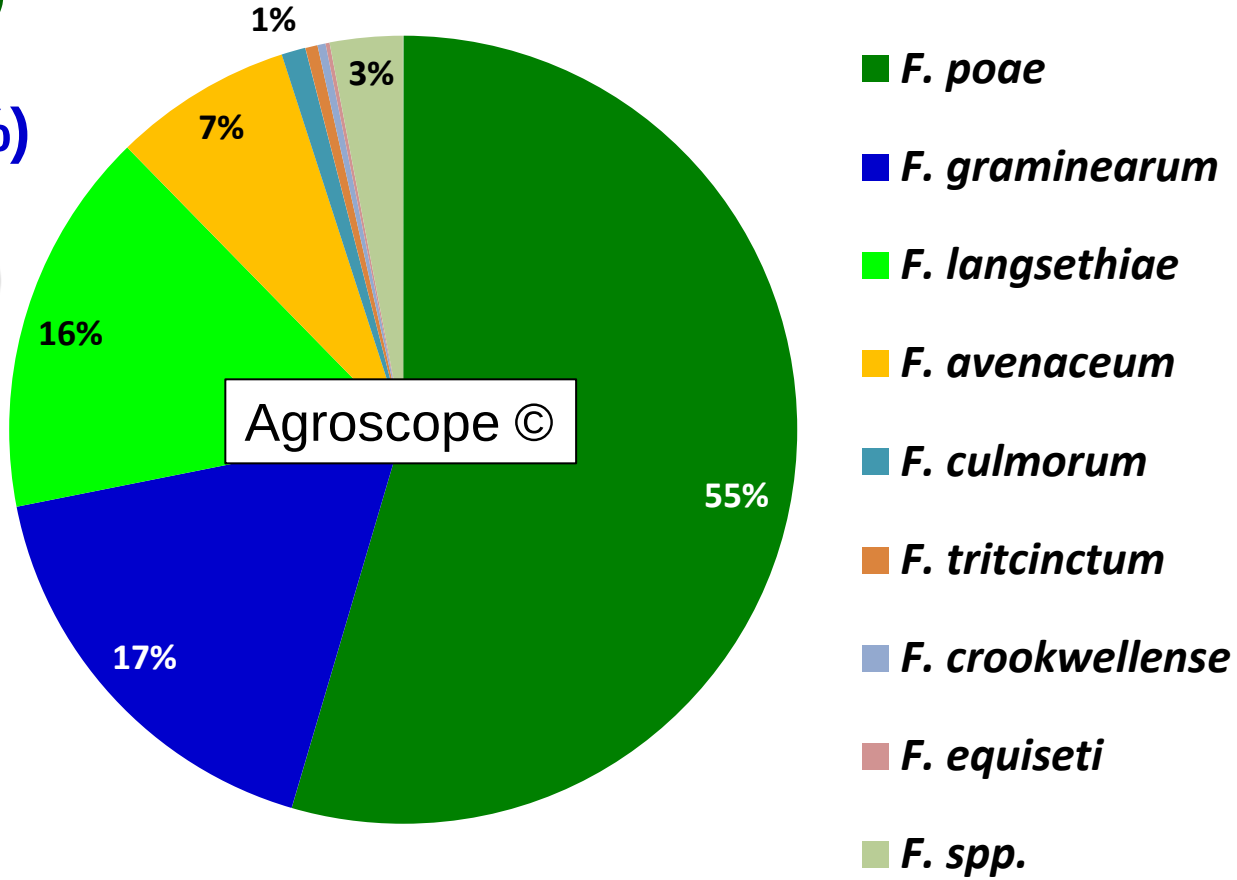
Susanne Vogelgsang

Results oat monitoring 2013 (n =93) *Fusarium* species distribution

FP: ∅ 4% (0-18%)

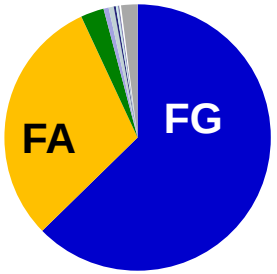
FG: ∅ 1 % (0-22%)

FL: ∅ 1% (0-11%)



Results oat monitoring 2013 *Fusarium* species distribution

Barley (n=280)



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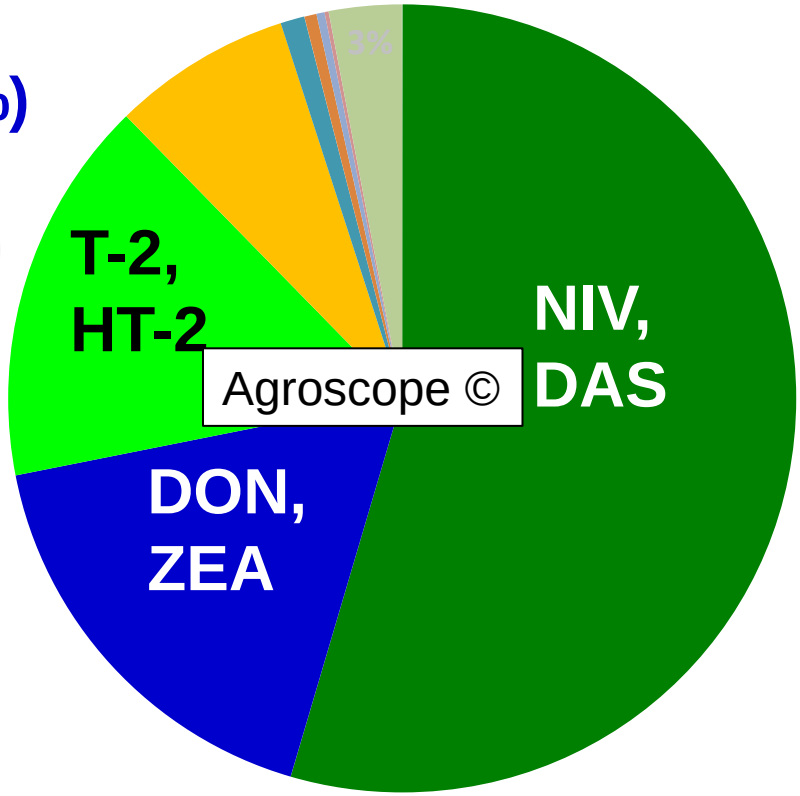
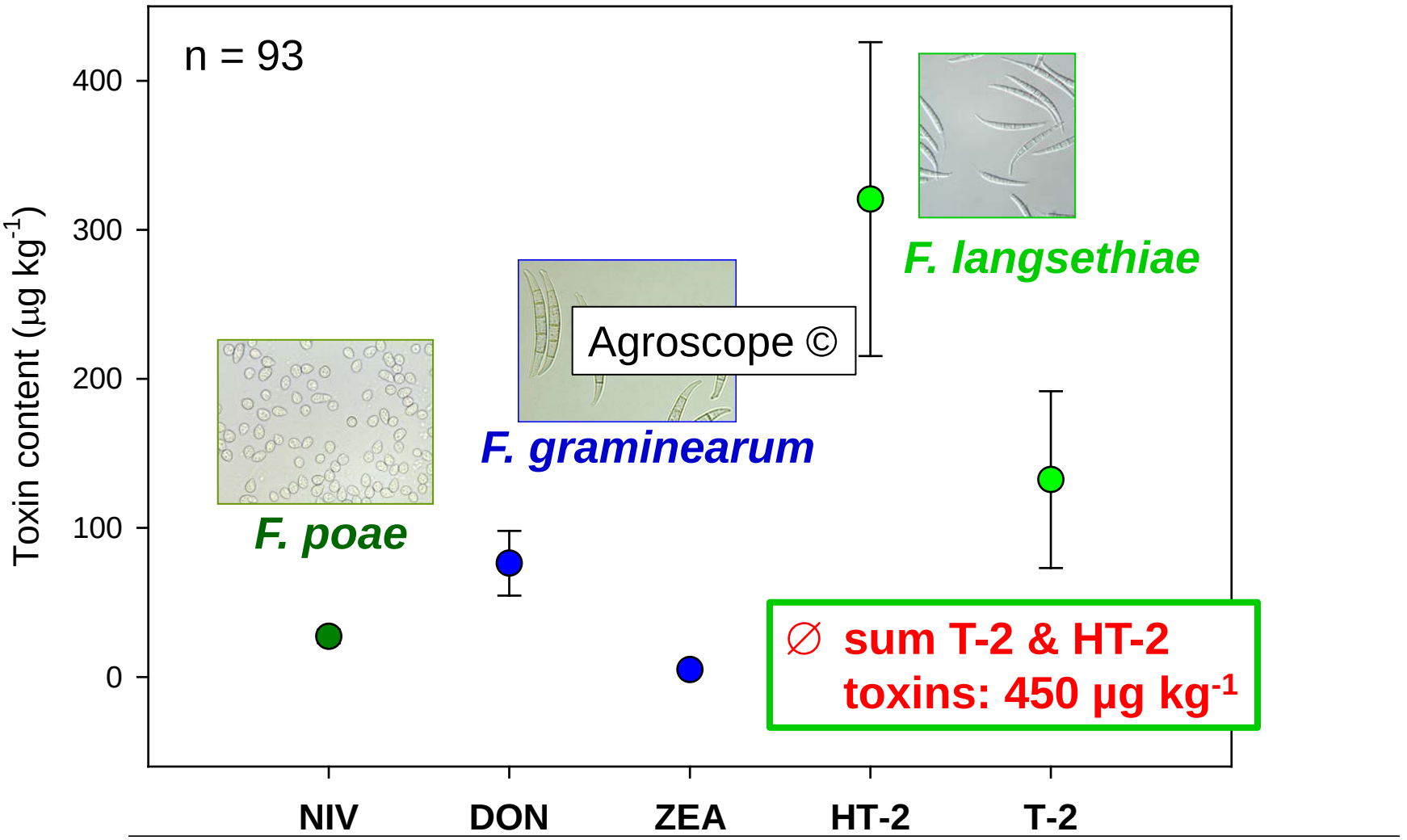
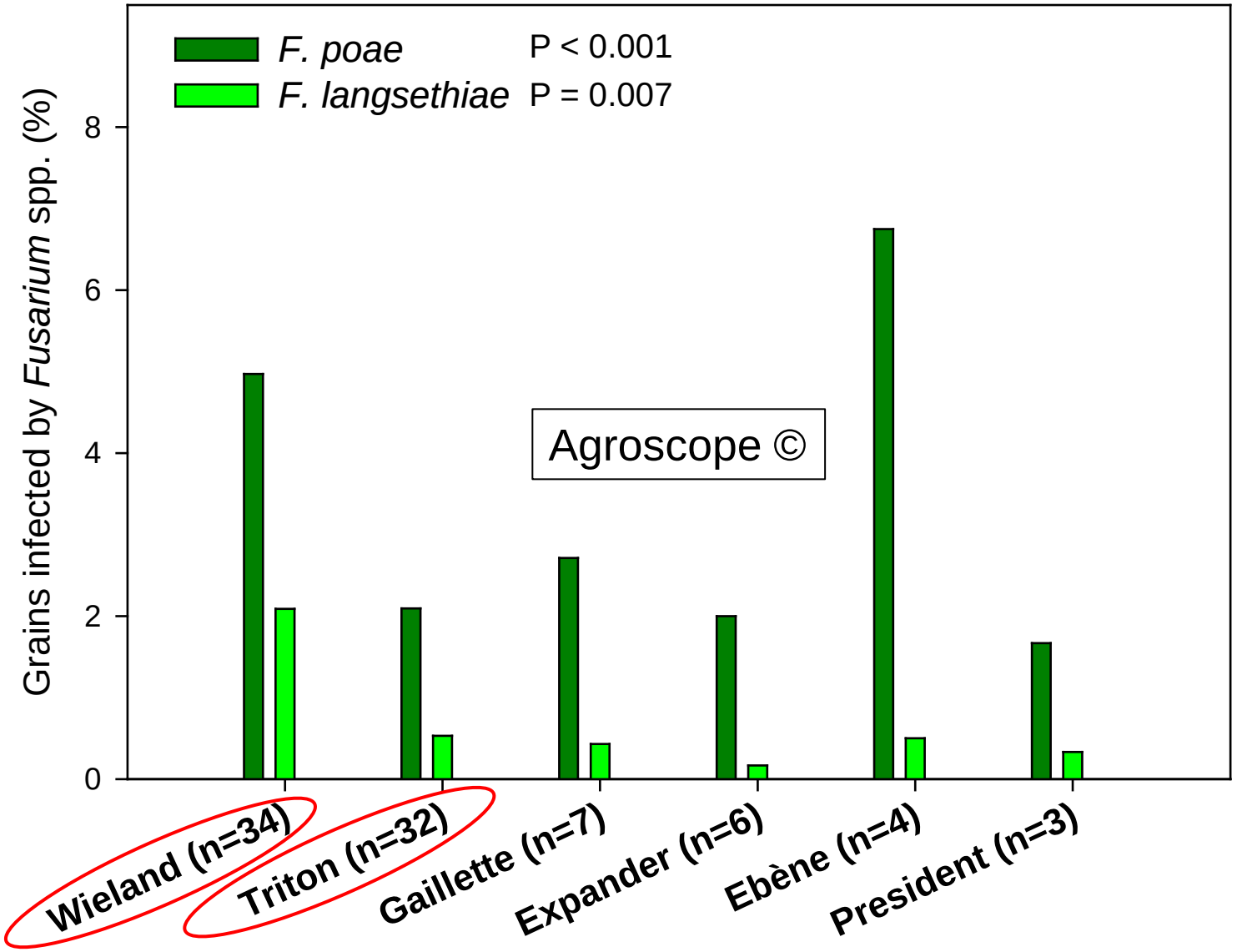


- *F. poae*
- *F. graminearum*
- *F. langsethiae*
- *F. avenaceum*
- *F. culmorum*
- *F. tritcinctum*
- *F. crookwellense*
- *F. equiseti*
- *F. spp.*

Oat monitoring: average toxin contents



Effect of oat varieties on incidence of *Fusarium* species



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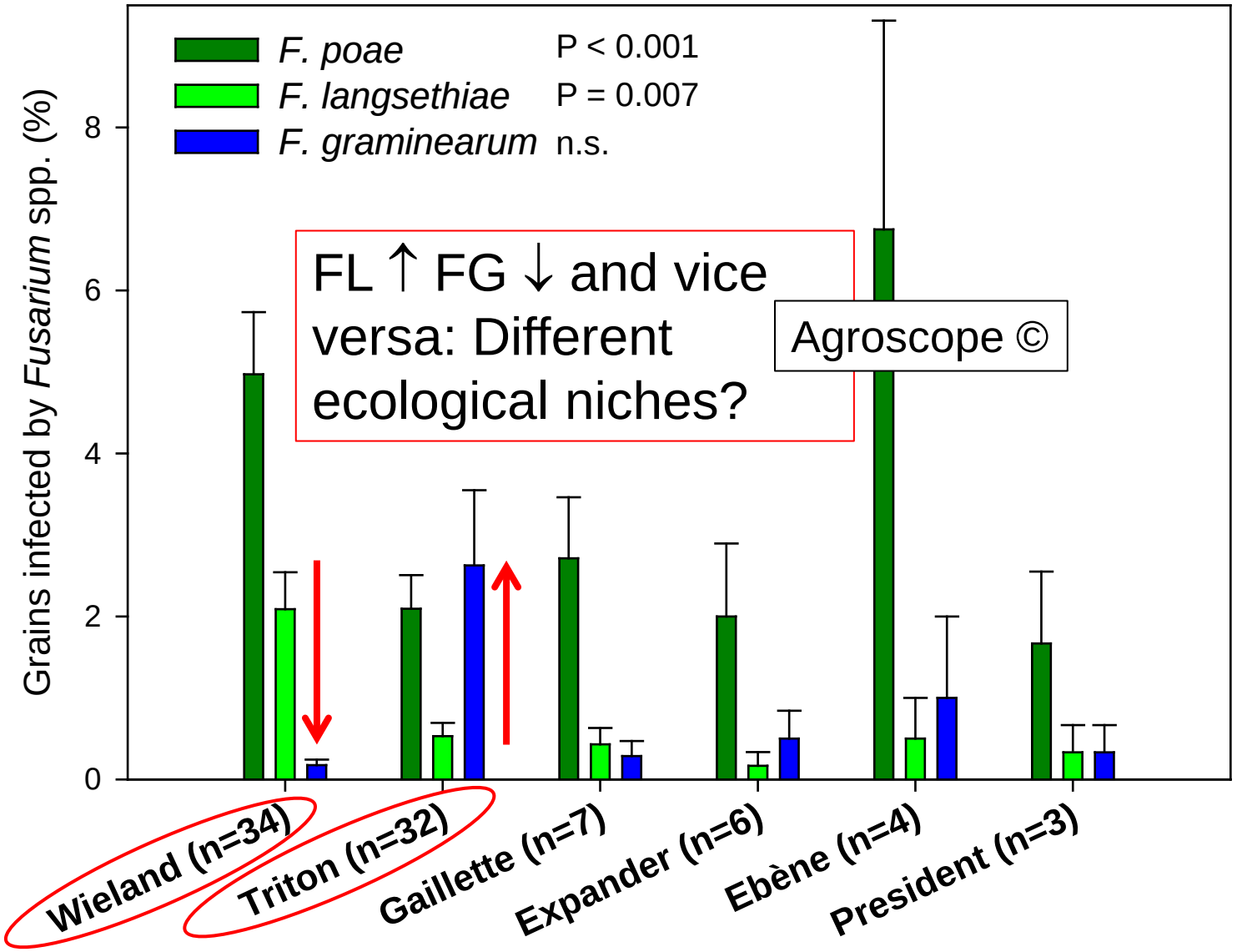
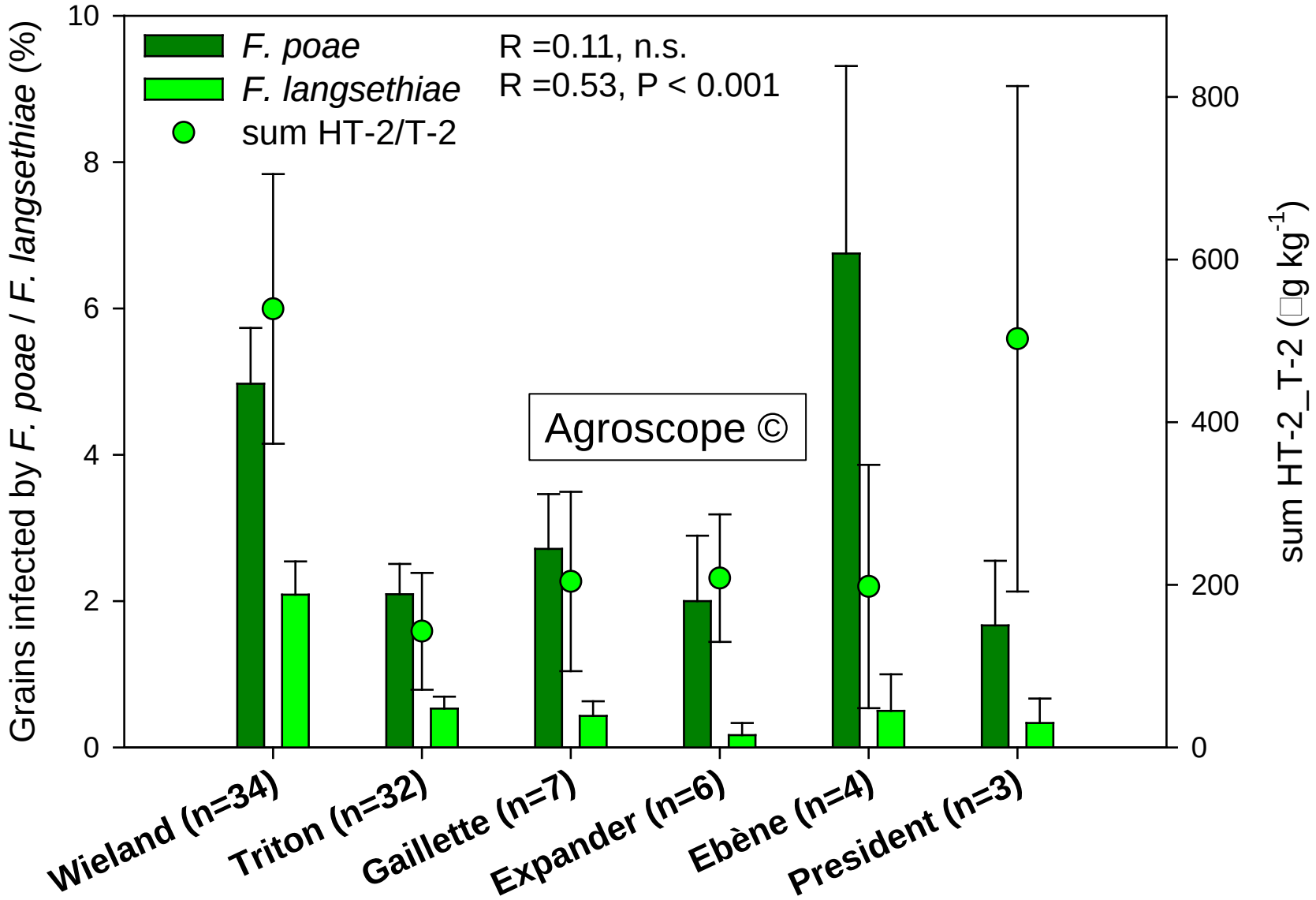
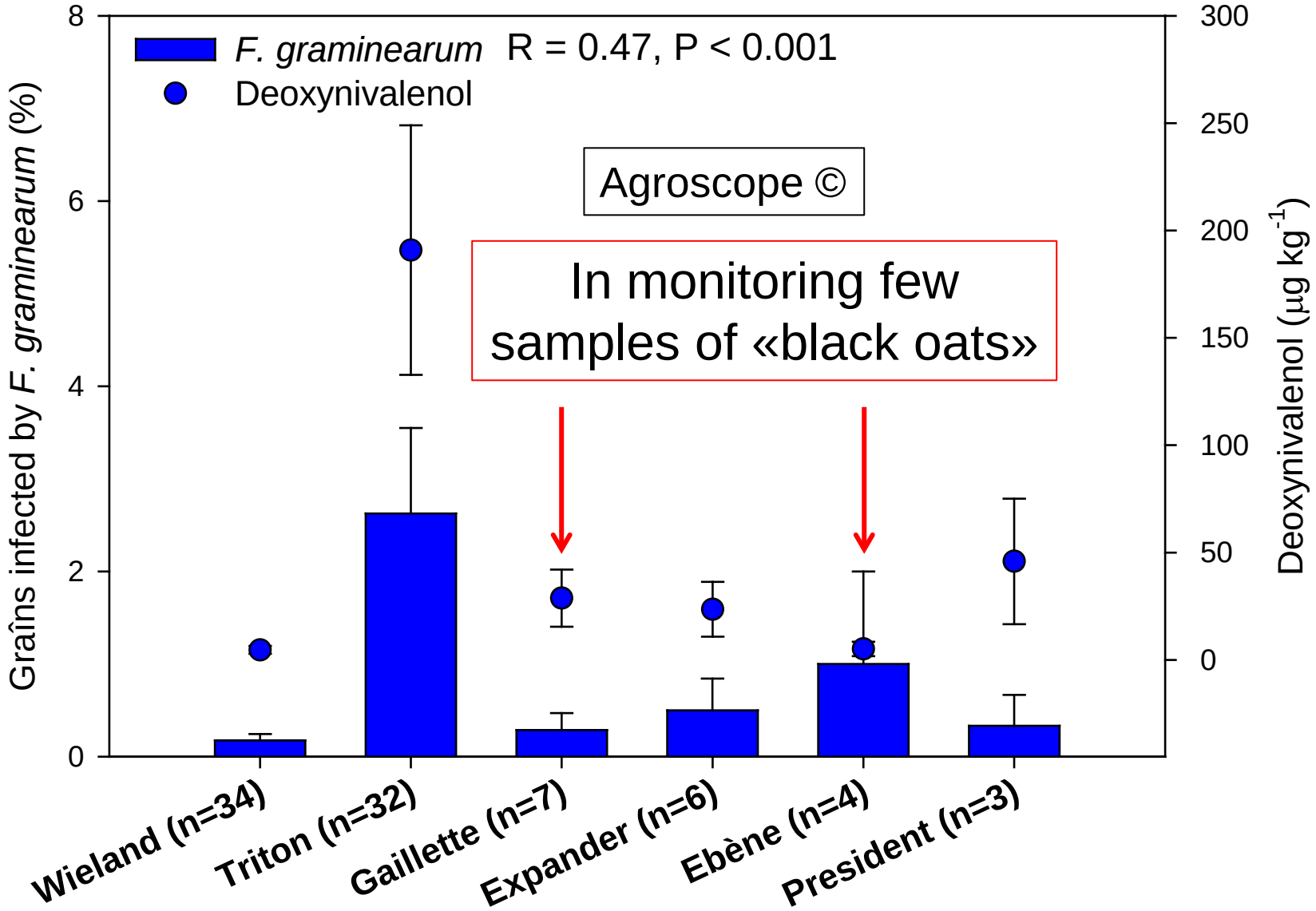


Effect of oat varieties on HT-2/T-2 toxin content & correlation



Effect of oat varieties on FG, DON content and correlation



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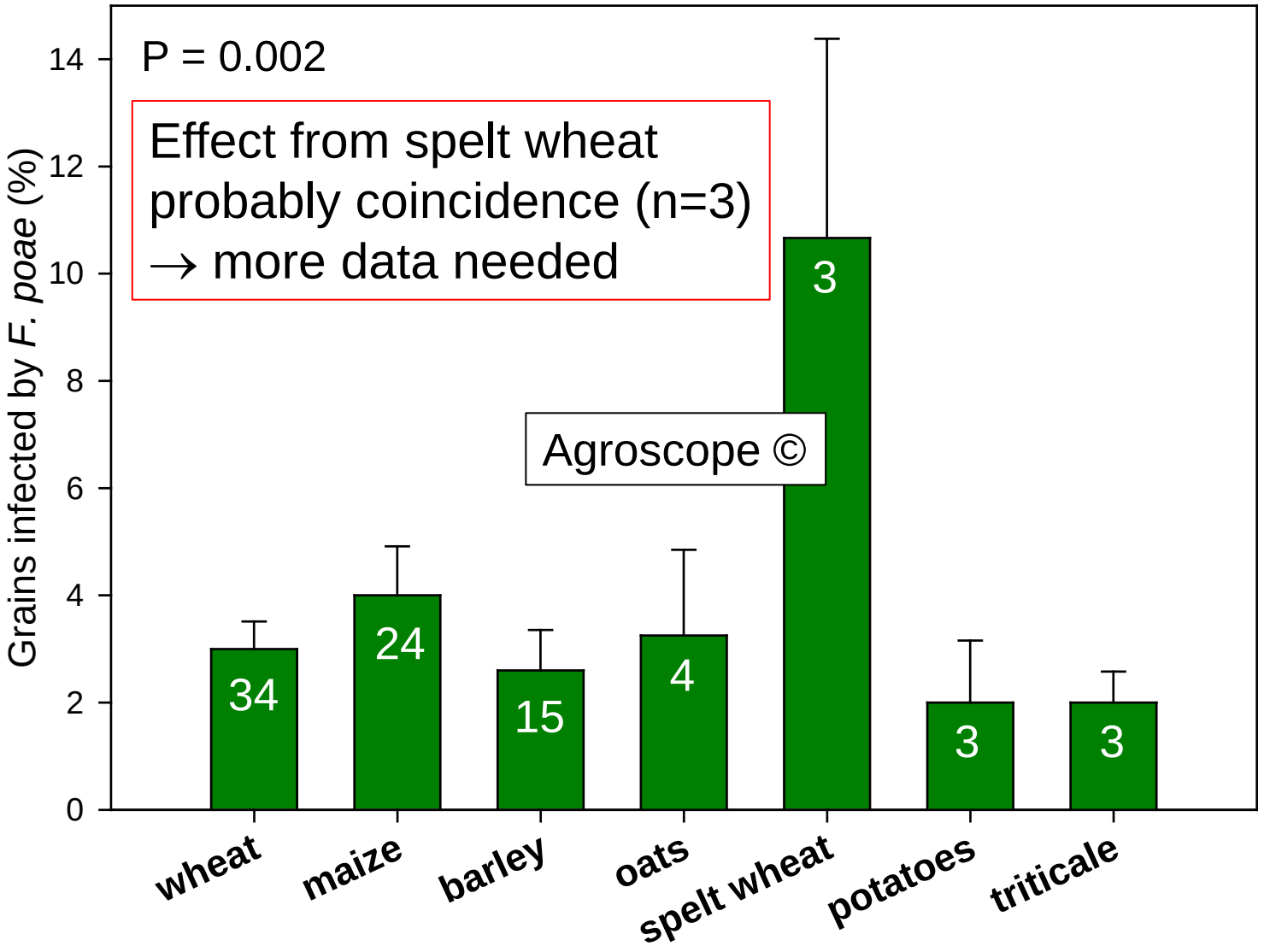
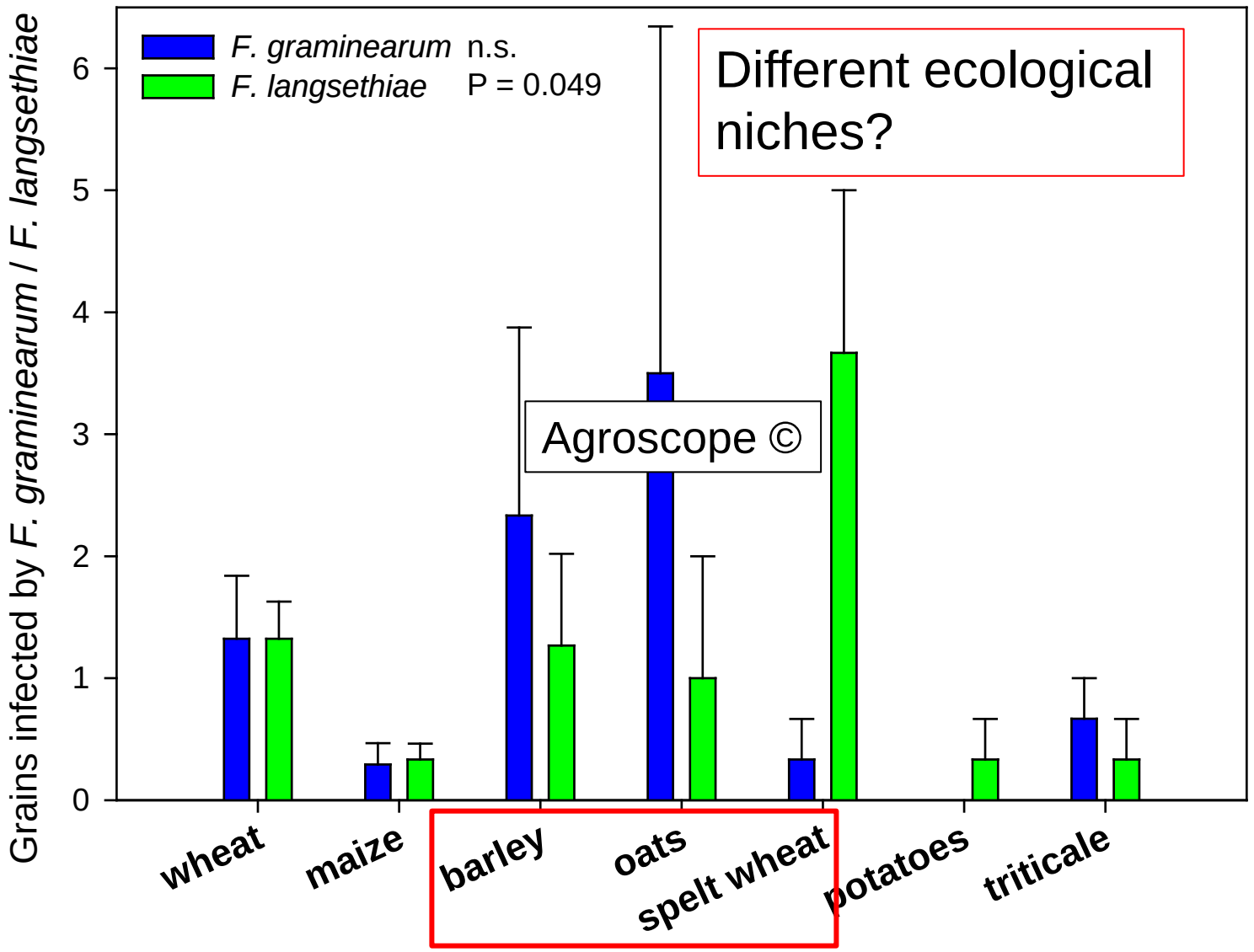
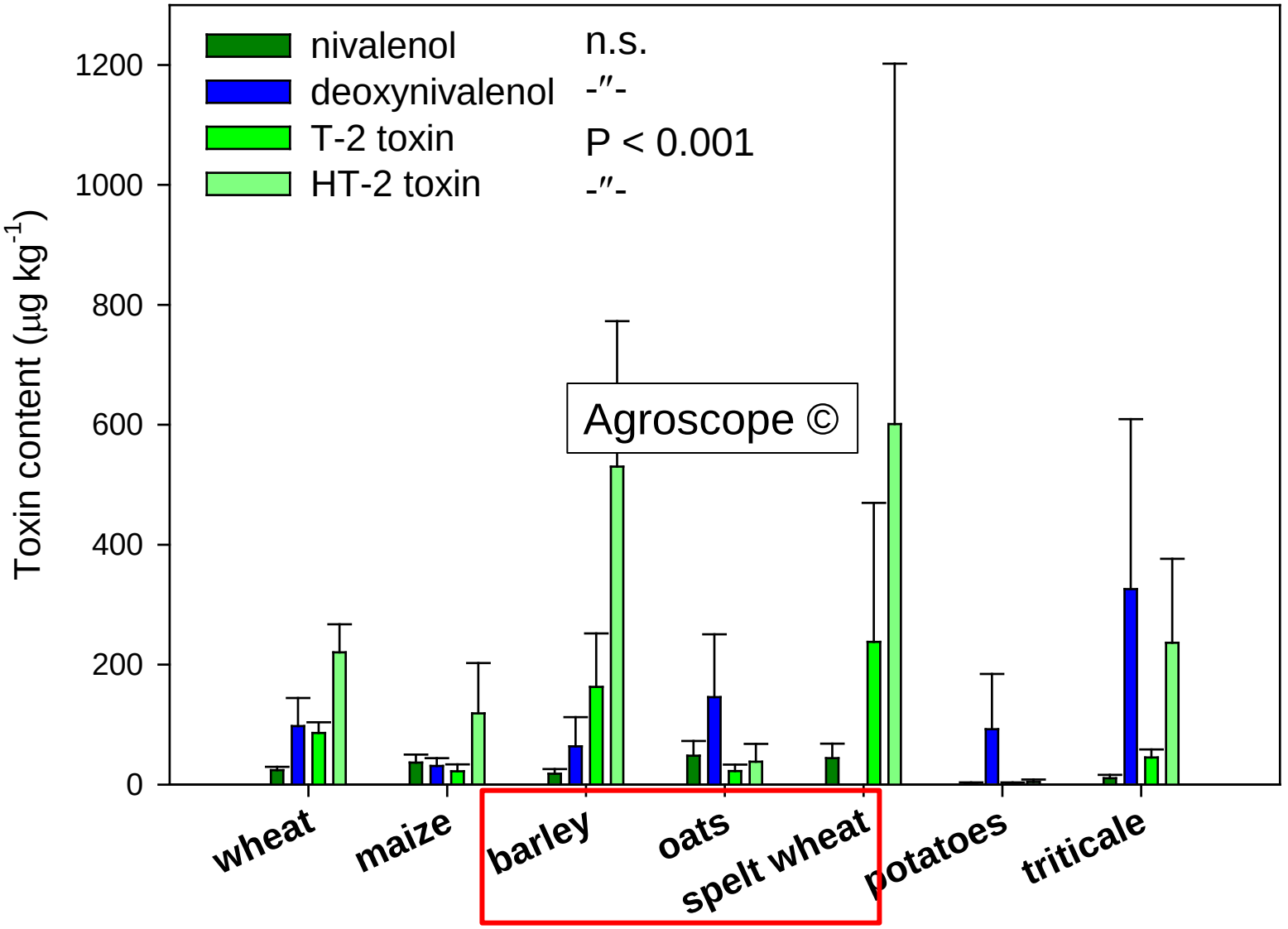
Effect of previous crops on *F. poae* incidence in oats

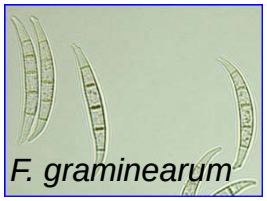


Effect of previous crops on incidence of *F. graminearum* / *F. langsethiae*

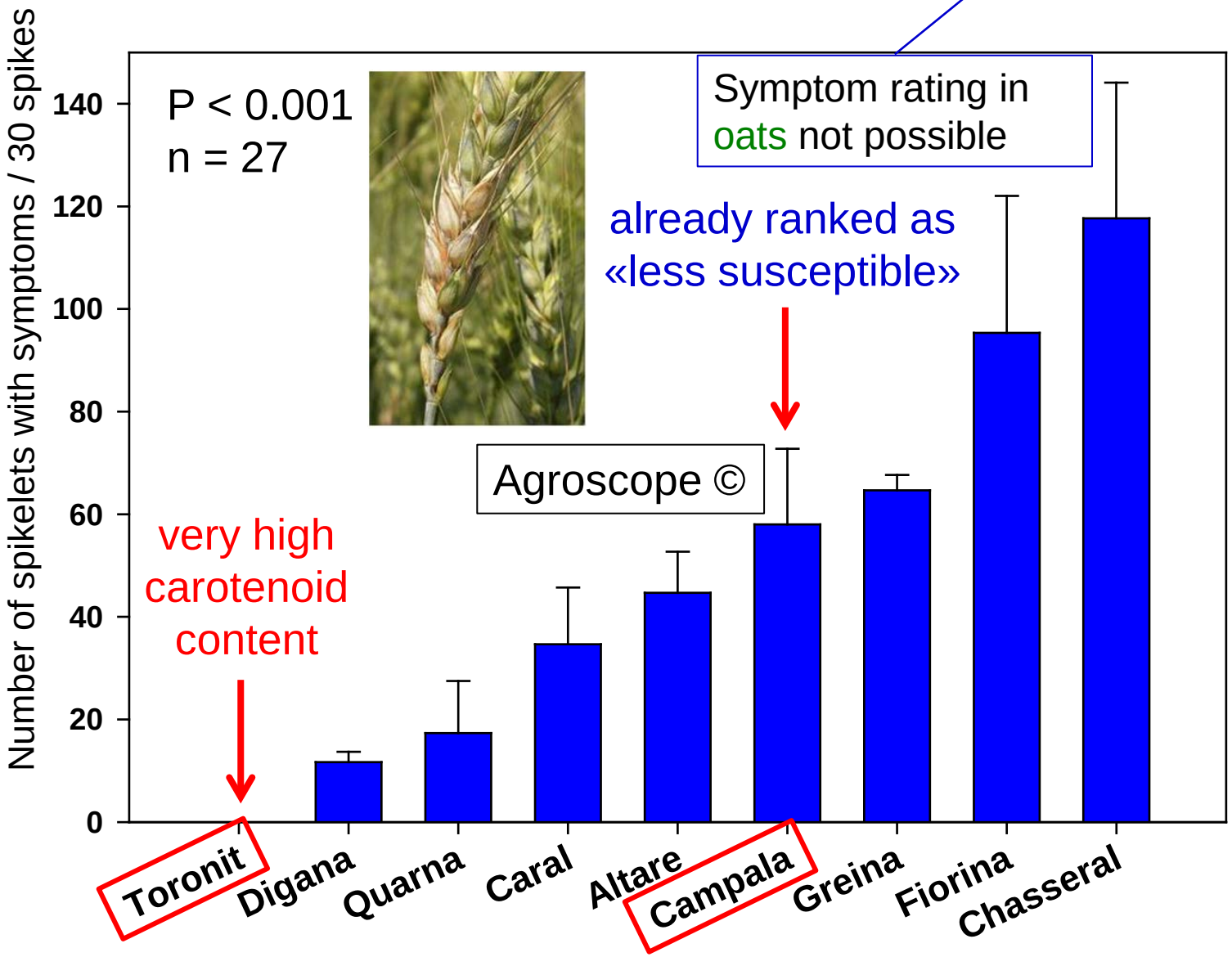


Effect of previous crops on toxins





Resistance experiments with artificial infections - symptoms in wheat varieties



Conclusions

- **Growers‘ oat samples were contaminated** **T-2 & HT-2** content somewhat scary
- **Pronounced effect between varieties**
  - different for individual *Fusarium* species
  - true variety effect, or weather or HPC related?
- **Effect of cropping factors not clear yet**
  Dataset for oats - in contrast to wheat and barley - still very small; more samples and in-depth analyses needed

Ongoing experiments and outlook

- **Oat and barley monitoring 2014 running**
- **Resistance experiments at 3 sites (oat, barley, wheat)**
  Harvest has started, followed by seed health test (incidence), qPCR, toxin content
- **Epidemiology: climate chamber experiments running, field in 2015**
  Effect of temperature, leaf wetness duration on infection, contamination and spore deposition

Health threatening mycotoxins

Value added, healthy & safe cereals

Economic & social benefits:

- reduced toxin risks and less fungicide use
- increased attractiveness of Swiss food products

Thank you

Support in the lab & field:

- Andreas Kägi
- Paride Missio
- Irene Bänziger
- Eveline Jenny
- Phillip Streckeisen
- Felix Wettstein
- Field workers group

Oat & barley samples:

- Cantonal plant protection officers
- Participating growers

Inspiration for research in plant pathology

Hans-Rudolf Forrer

Funding:

Swiss National Science Foundation

Healthy Nutrition and Sustainable Food Production
National Research Programme NRP 69

For your attention


RG Ecology of Noxious &
Beneficial Organisms