

## WP 8.1. sub-activity:

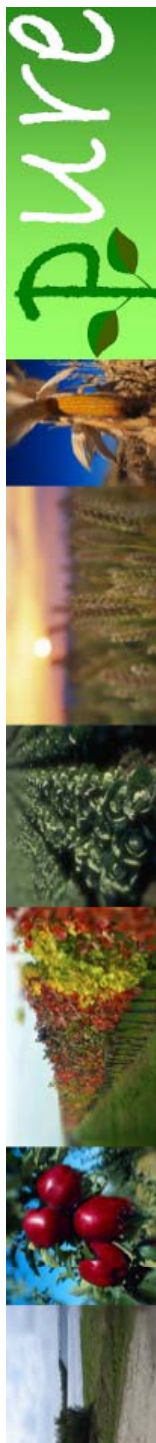
### Spread and distribution of aggressive strains of yellow rust in Europe

- Department of Agroecology, Aarhus University, Denmark
- Julius Kühn-Institut, Kleinmachnow, Germany
- INRA, BIOGER-CPP, Thiverval-Grignon, France



IPM Innovation – Poznan, Poland  
January 14-16, 2015

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# Outline

- Current yellow rust situation in Europe
- Invasion of non-European races
- Conclusions

# Yellow rust epidemiology in Europe is changing



Foto: Lise Nistrup Jørgensen





# Yellow rust epidemiology in Europe is changing

Triticale, Denmark, 11th March, 2014







# Yellow rust epidemiology in Europe is changing

Wheat: The Netherlands, 1st April 2014



Photo: Wopke van der Werf



# Yellow rust epidemiology in Europe is changing

2014 season with severe yellow rust epidemics in many parts of Europe, - including areas in central-, southern and eastern Europe where yellow rust is usually scarce or absent

- Warm autumn 2013 with perfect conditions for yellow rust infection and spread (warm days/dew night)
- Mild ("green") winter in many areas
- Several generation (disease cycles) during autumn-winter – building up high inoculum levels

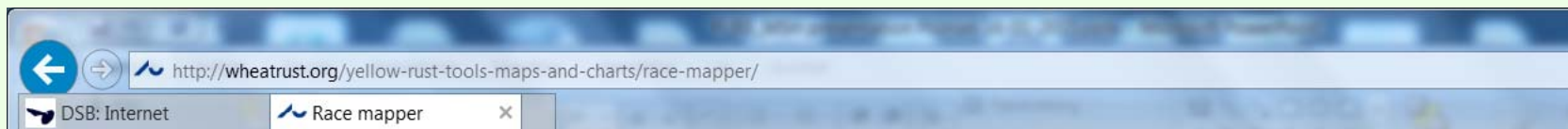


# Wheat rust quarantine Facility at GRRC, Denmark





# Rust epidemiology is changing



## YELLOW RUST RACES AND VIRULENCES

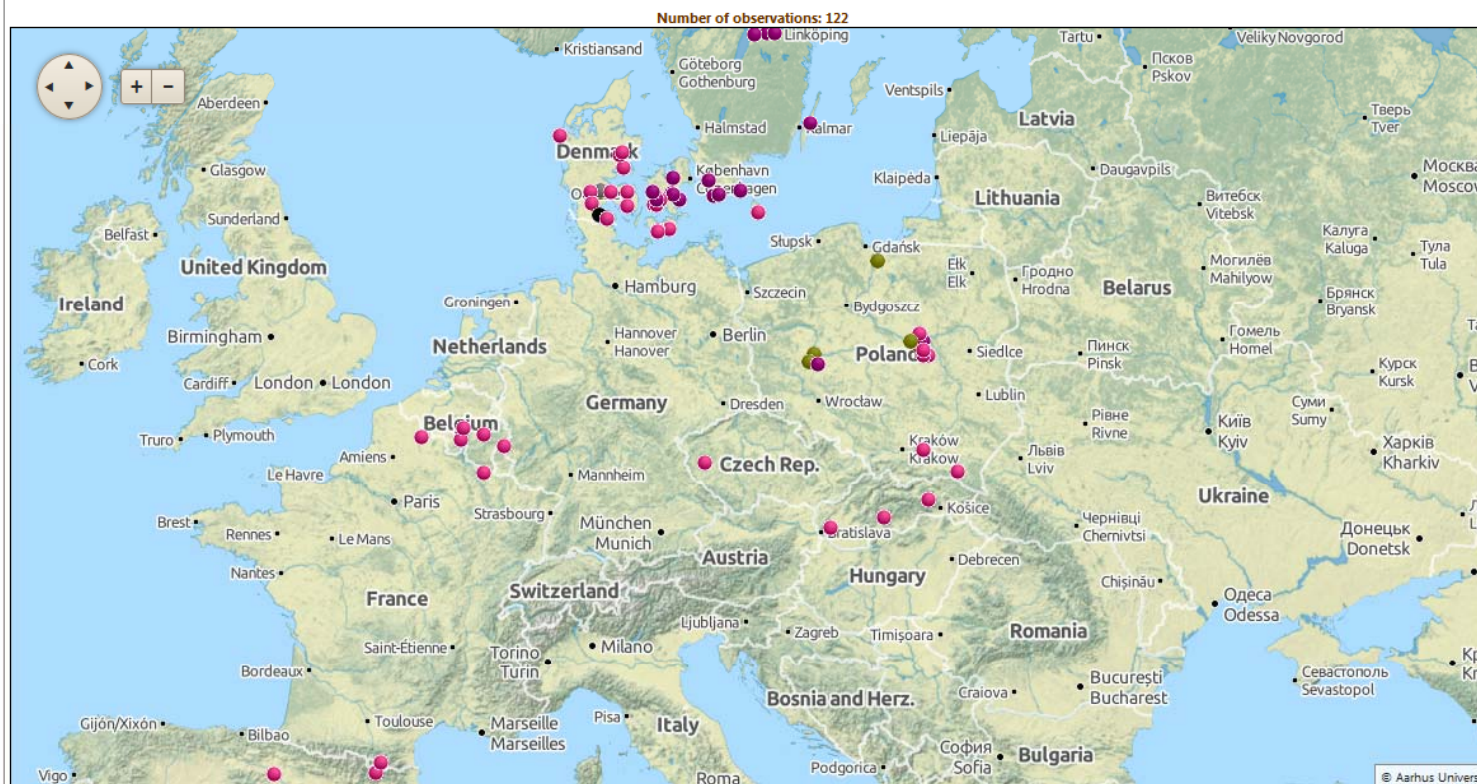
☒ Race map
 ☐ Virulence map
 ☐ Race frequency map
 ☐ Virulence frequency map
 ☐ Race frequency chart
 ☐ Virulence frequency chart

Year: ☒ 2014 ☐ 2013 ☐ 2012 ☐ 2011 ☐ 2010 ☐ 2009 ☐ 2008 ☐ 2007 ☐ 2006 ☐ 2005 ☐ 2004 ☐ 2003 ☐ 2002 ☐ 2001 ☐ 2000 ☐ 1999 ☐ 1998 ☐ 1997 ☐ 1995 ☐ 1994 ☐ 1993

Continent: ☒ Europe

Country: ☒ All ☒ Belgium ☒ Czech Republic ☒ Denmark ☒ Poland ☒ Slovakia ☒ Spain ☒ Sweden

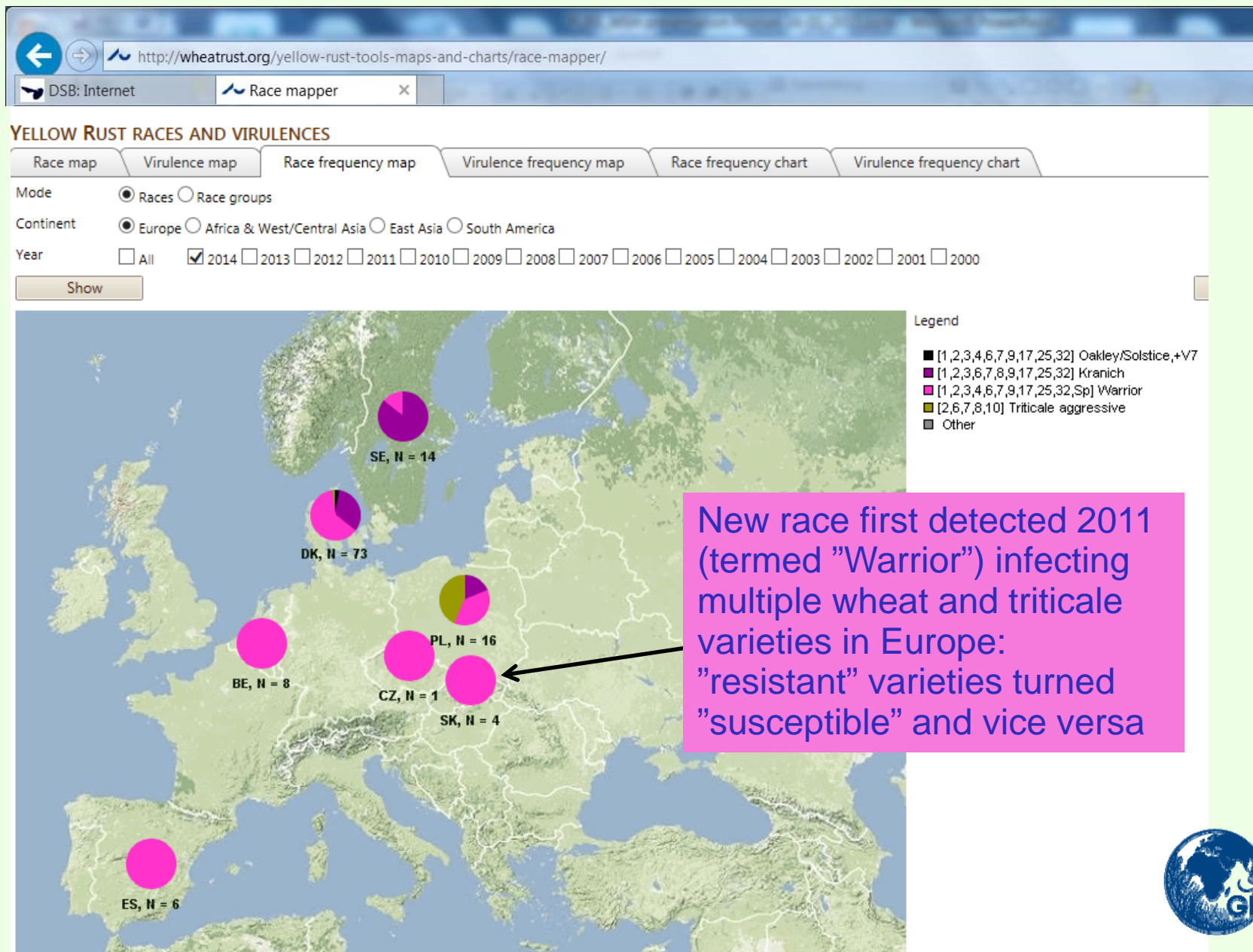
Races: ☒ All ☒ [1,2,3,4,6,7,9,17,25,32] Oakley/Solstice, +V7 ☒ [1,2,3,6,7,8,9,17,25,32] Kranich ☒ [1,2,3,4,6,7,9,17,25,32,Sp] Warrior ☒ [2,6,7,8,10] Triticale aggressive ☒ Other



Data provided by: Institut National de la Recherche Agronomique (France), Julius Kühn-Institut, Federal Research Centre for Cultivated Plants (Germany and Austria), National Institute of Agricultural Botany (United Kingdom) and Aarhus University (Denmark and Sweden).



# Rust epidemiology is changing



# Rust epidemiology is changing

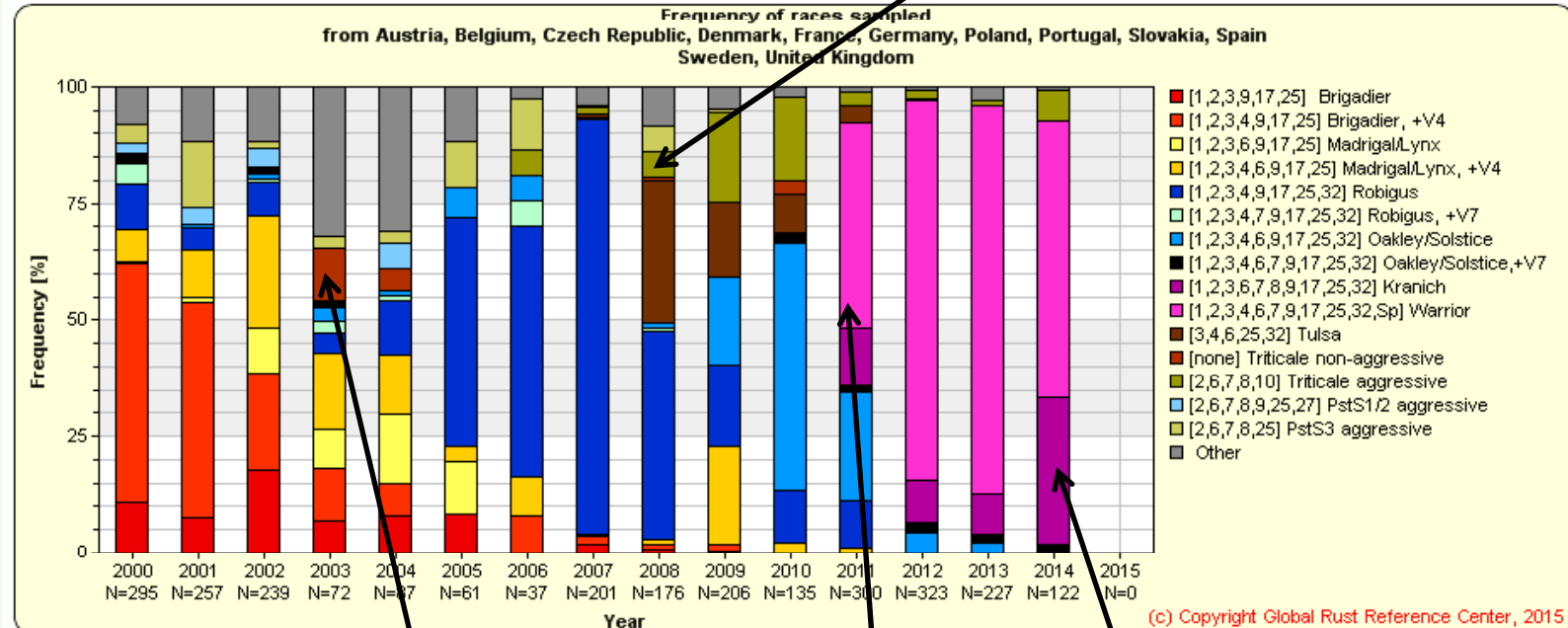
## RACES - CHANGES ACROSS YEARS

Mode ☒ Races ☐ Race groups

Continent ☒ Europe ☐ Africa & West/Central Asia ☐ East Asia ☐ South America

Country ☒ All ☒ Austria ☒ Belgium ☒ Czech Republic ☒ Denmark ☒ France ☒ Germany ☒ Poland ☒ Portugal ☒ Slovakia ☒ Spain ☒ Sweden ☒ United Kingdom

Show See race pattern Help



Data provided by: Institut National de la Recherche Agronomique (France), Julius Kühn-Institut, Federal Research Centre for Cultivated Plants (Germany and Austria), National Institute of Agricultural Botany (United Kingdom) and Aarhus University (Denmark and Sweden).

Non-aggressive race  
infecting triticale and barley

Warrior  
race

Kranich  
race





# Population genetic analyses:

## Methodology

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3. INRA UR 1290 BIOGER-CPP, BP01, 78850 Thiverval-Grignon, France
4. National Institute of Agricultural Botany, Cambridge, CB3 0LE United Kingdom
5. Institute of Biotechnology & Genetic Engineering, the University of Agriculture, Peshawar, Pakistan

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# Population genetic analyses:

## Methodology

### Isolate characterization

#### *Part A isolates*

- Race phenotyped in national labs: France, Germany, UK
- GRRC: Denmark, Sweden, Spain, Portugal, Uzbekistan, Tajikistan
- SSR genotyped at GRRC/Uppsala, using 16 of 20 SSR markers from Ali et al., 2014

#### *Part B isolates*

- Genotyping results from Ali et al. 2014 (INRA-Grignon, France) aligned with results for Part A isolates

### One common dataset developed





# Population genetic analyses:

## Hypotheses about origin of new races:

1. Mutations within existing races in Europe
2. Recombinants emerging from existing races in Europe
3. Exotic migrants from outside Europe



# Summary

**Question 1 & 2:** Mutants/recombinants within the existing European Pst pop.

No. Warrior, Kranich and Triticale-aggressive races are not European type yellow rust – many alleles exotic to EU population

**Question 3:**

Exotic migrants from outside Europe? Yes.

- Warrior and Kranich emerging from recombining population (high capacity to produce sexual spore forms). Clearly related but still divergent from the predominant Asian and post 2010 Central Asian population (the exact race/SSR genotype not represented in previous studies)
- Triticale-aggressive race: Clearly related to Mediterranean/Central Asian population

Results suggest aerial dispersal:

- Spread across large areas already in first year of detection
- At least five MLGs within W & K races detected in first years of detection



# Summary (continued)

## Significant implications for IPM in wheat

- Previously resistant varieties → susceptible
- Previously susceptible varieties → less susceptible
- Several of the races appeared “aggressive”,
  - more severe epidemics to be expected
  - influence on winter survival?
  - Warrior race virulent on both wheat and triticale: Role of small Triticale area as “spore factory” for huge wheat area should be evaluated
- Coordinated surveillance efforts on a European/global scale required (“next step” not predictable)

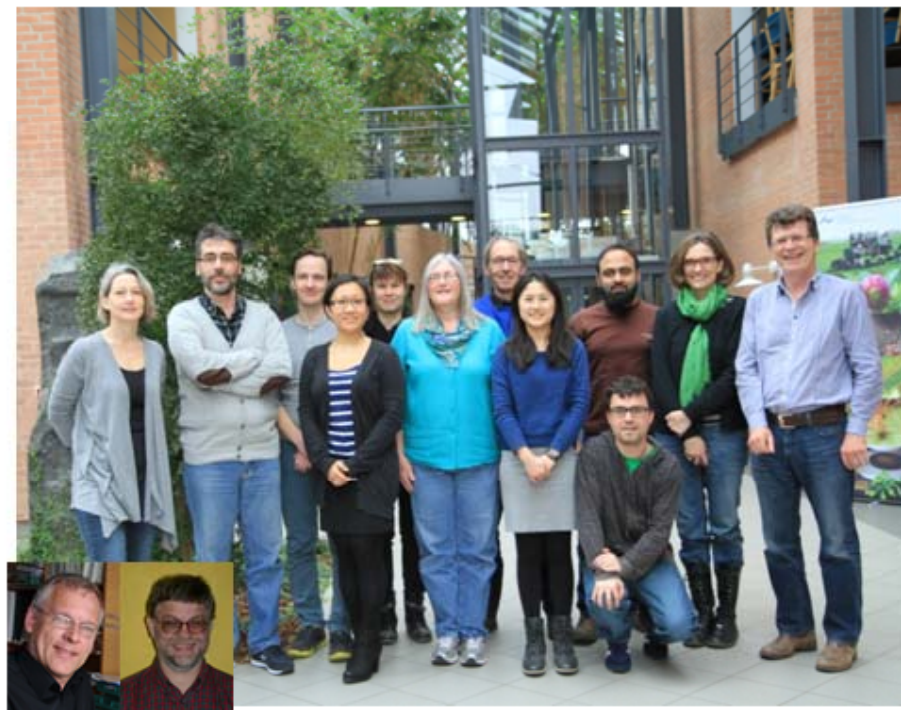


# Acknowledgements

## *International collaborators*

- Kumarse Nazari, ICARDA
- Amor Yahyaoui, ICARDA
- Ravi Singh, CIMMYT
- Dave Hodson, CIMMYT
- Claude Pope, INRA (F)
- Jonathan Yuen, Uppsala University (S)
- Cristobal Uauy, JIC (UK)
- Rosemary Bayles, NIAB (UK)
- Kerstin Flath, JKI (D)
- James Brown, JIC(UK)
- > 40 people who submitted wheat rust samples from Asia, Africa and South America

GRRC-team March 2014





# 14th International Cereal Rusts and Powdery Mildews Conference 2015

- *First announcement April 2014*
- *Registration opens November 2014*

<http://emcrf.au.dk/icrPMC2015/welcome-to-the-conference/>



**EMCRF**

The European and Mediterranean Cereal Rusts Foundation



GLOBAL RUST  
REFERENCE CENTER



Helsingør (30 km N Copenhagen)  
Denmark, July 5-8, 2015