RUSTWATCH – A European early warning system for wheat rust diseases

Research and Innovation action Grant Agreement 773311

Coordinated by

Prof. Mogens Støvring Hovmøller, Aarhus University, Denmark

UKCPVS stakeholders meeting, March 12, 2021
presentation via Zoom

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HORIZON 2020

RustWatch – early warning for wheat rust diseases

Management and networks

Management support team

- Emilia Alegria: Admin & budgets
- Annemarie F Justesen: Science
- Jens G Hansen: Communication & data management

24 partners, 5 M €, 4 years:

Yellow/stripe, brown/leaf, and black/stem rust

- 12 universities/research institutes
- 5 agricultural advisory services
- 7 SMEs/industries

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Key features of RustWatch

- Stakeholder driven early-warning system
- Value chain from plant breeding to end-user farmer
- Main rust research and resistance breeding capacity in Europe

- Shared lab/experimental facilities: pathogen & host genotyping/ phenotyping, field trial sites, data management and information systems

- Linking pathogen features and dynamics with plant breeding and extension activities

- Early-warning validation and feed-back from case study regions

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Key features of RustWatch

Pathogen characterisation and impact

I. Rust sampling beyond countries with national rust diagnostic labs

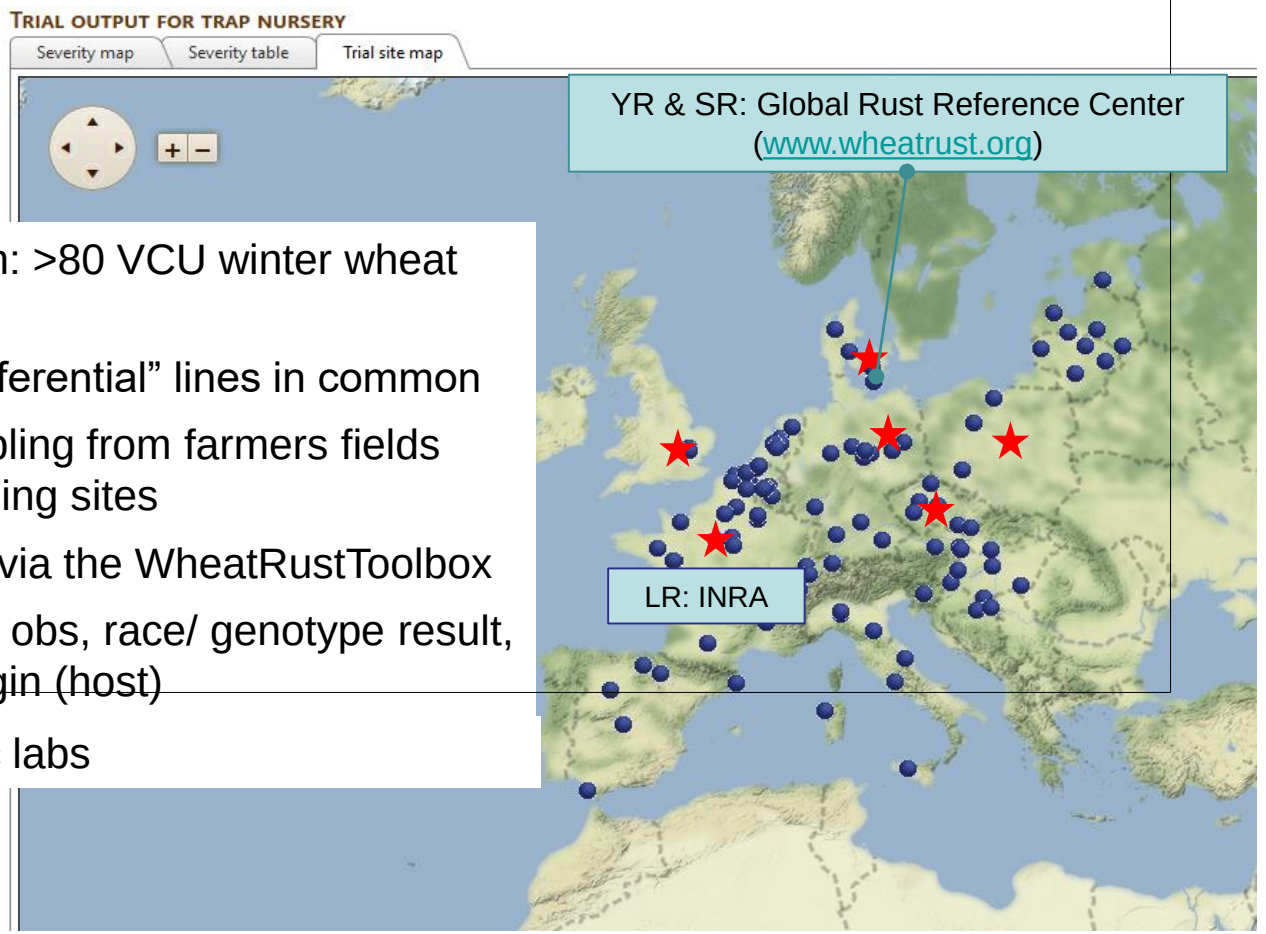
II. Alignment of lab methodologies, procedures and interpretation of results

III. Impact assessment of new rust races

Key features of RustWatch

I. Rust sampling across wider areas:

- Representation of pathogen diversity & ”unusual” disease observations



- 2020/21 season: >80 VCU winter wheat trial sites
- 7 wheat YR ”differential” lines in common
- Additional sampling from farmers fields and plant breeding sites
- Data managed via the WheatRustToolbox
- Linking disease obs, race/ genotype result, and sample origin (host)

★ Rust diagnostic labs

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Key features of RustWatch

II. Alignment of lab methodology, procedures and interpretation of result

Aim:

- Rapid dia
  national/r
- Secure liv
  ”new” rus
  (*research*

Procedure:

- Each nat
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  stem rust
- Labs exc
  alignmen

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g)

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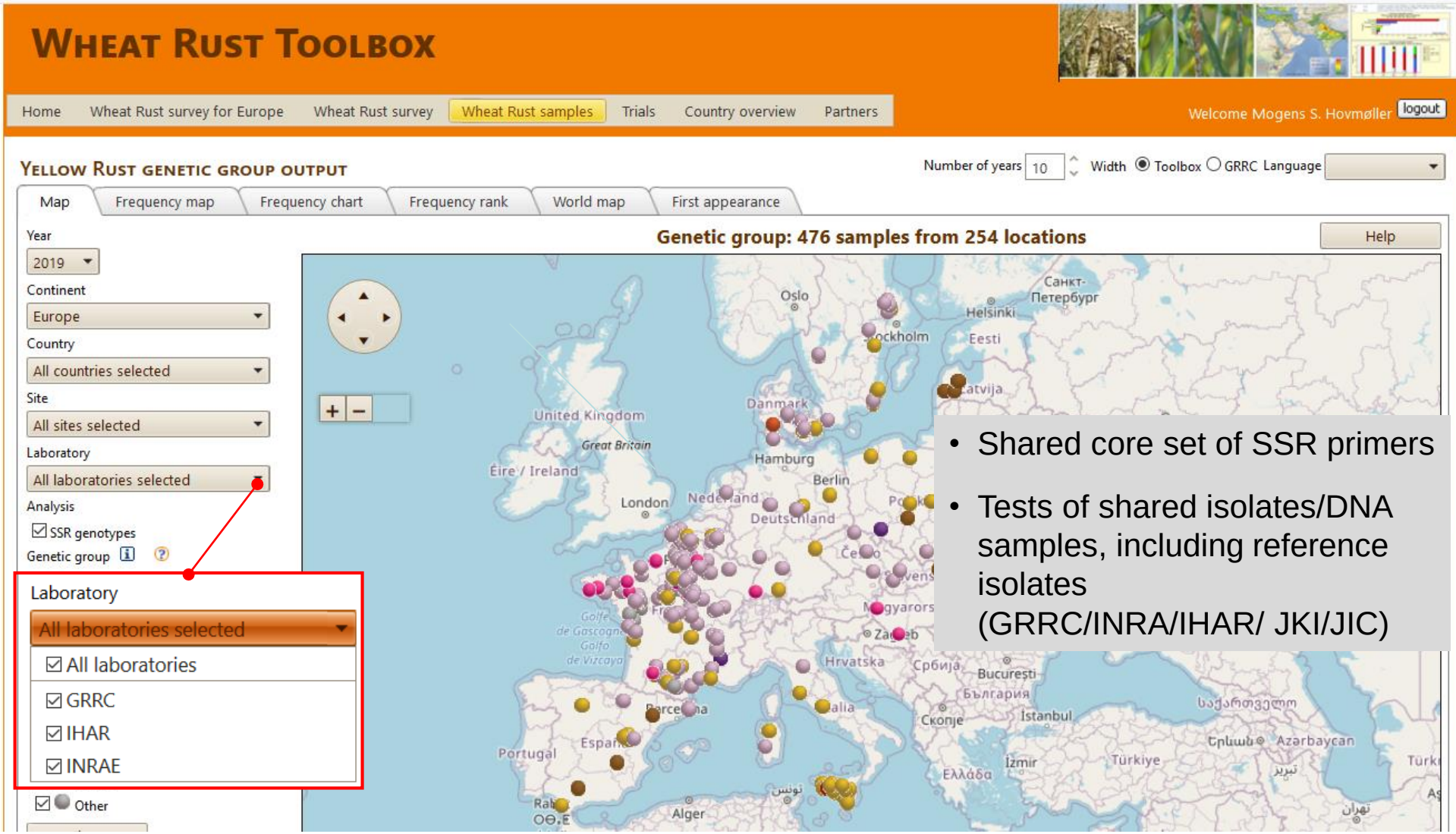
II. Alignment of methodologies, procedures and interpretation of results



- Shared core set of SSR primers
- Tests of shared isolates/DNA samples, including reference isolates (GRRC/INRA/IHAR/ JKI/JIC)

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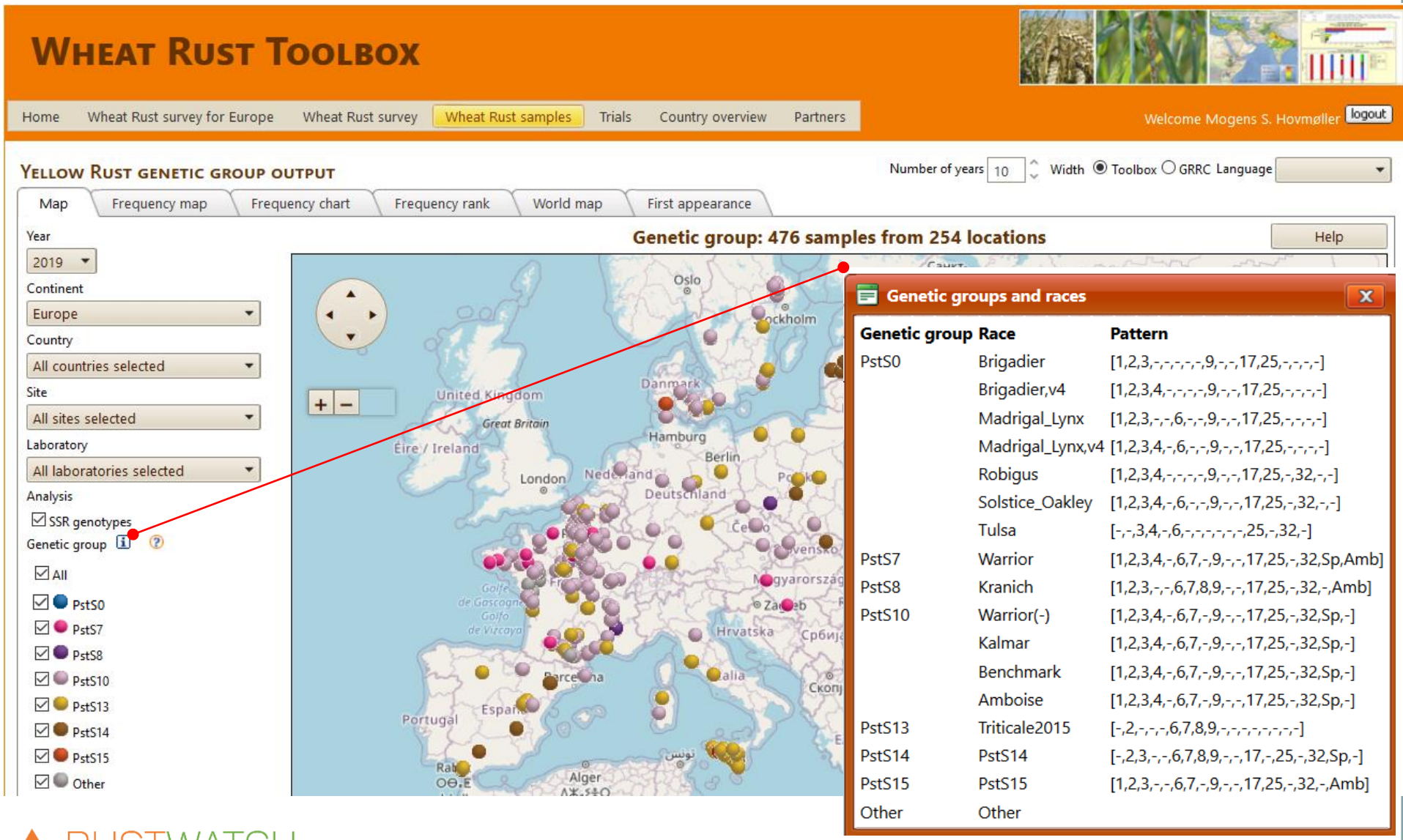
II. Alignment of methodologies, procedures and interpretation of results:



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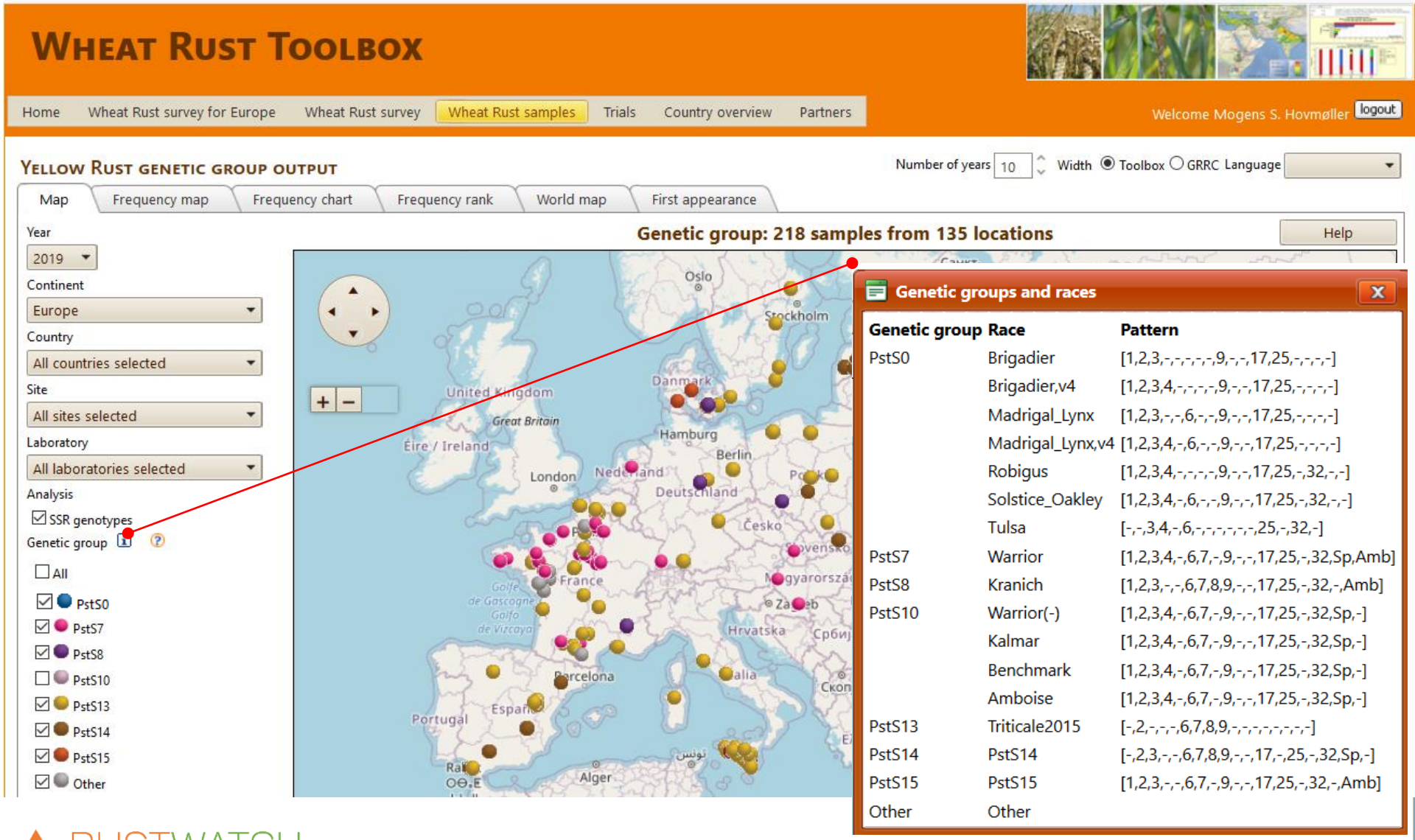
II. Alignment of methodologies, procedures and interpretation of results



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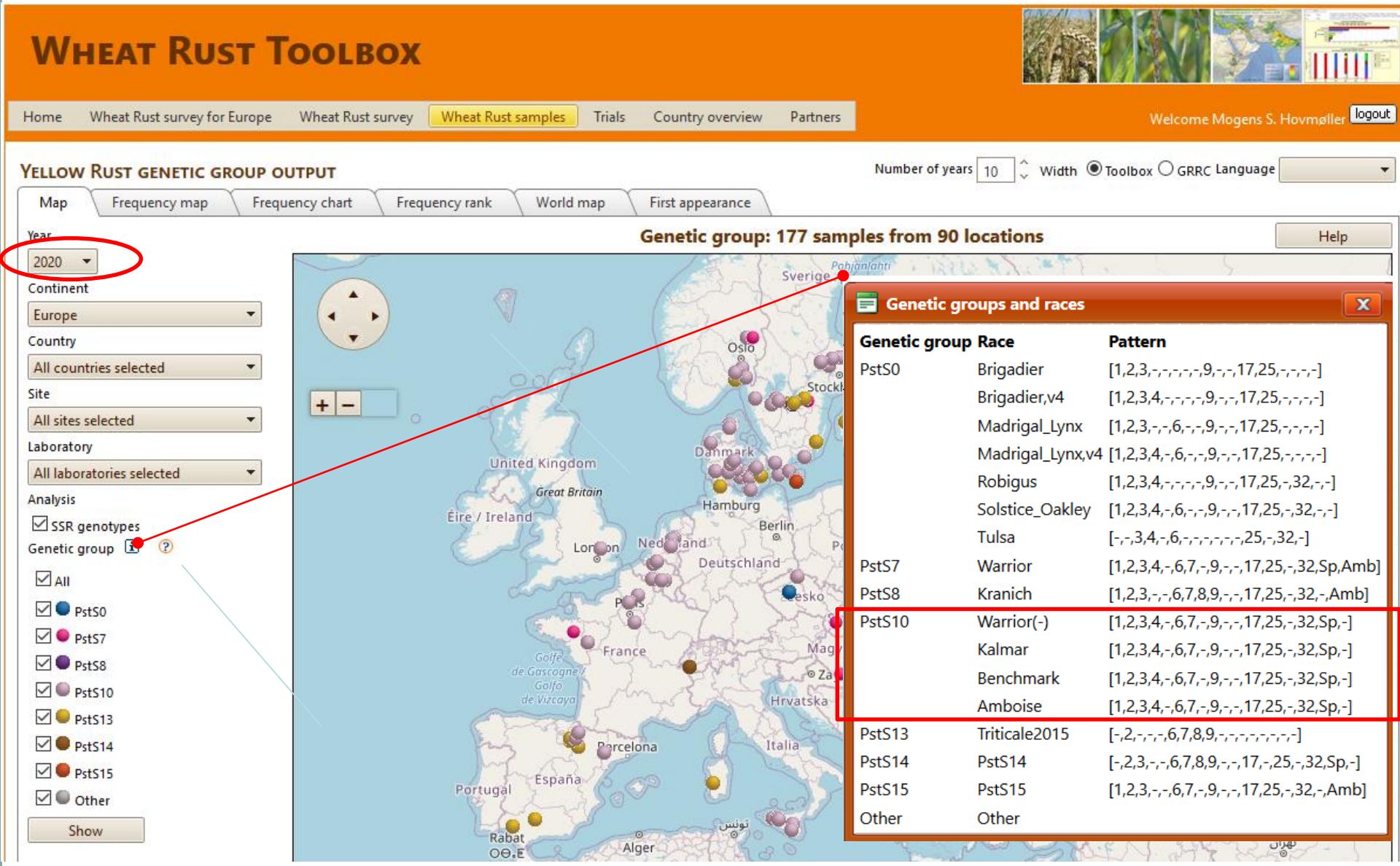

New races in PstS10: 8 isolates from UK, FR, SE, NL og DK, 4 varieties

Genetic groups and races

Genetic group	Race	Pattern
PstS7	Warrior	[1,2,3,4,-,6,7,-,9,-,-,17,25,-,32,Sp,Amb]
PstS8	Kranich	[1,2,3,-,-,6,7,8,9,-,-,17,25,-,32,-,Amb]
PstS10	Warrior(-)	[1,2,3,4,-,6,7,-,9,-,-,17,25,-,32,Sp,-]
	Kalmar	[1,2,3,4,-,6,7,-,9,-,-,17,25,-,32,Sp,-]
	Benchmark	[1,2,3,4,-,6,7,-,9,-,-,17,25,-,32,Sp,-]
	New2020	[1,2,3,4,-,6,7,-,9,-,-,17,25,-,32,Sp,-]
PstS13	Triticale2015	[-,2,-,-,-,6,7,8,9,-,-,-,-,-,-,-,-]
PstS14	PstS14	[-,2,3,-,-,6,7,8,9,-,-,17,-,25,-,32,Sp,-]
PstS15	PstS15	[1,2,3,-,-,6,7,-,9,-,-,17,25,-,32,-,Amb]
Other	Other	

Seedling test in green house 2020

Summary of results of race testing using extended panel of wheat host cultivars, Aarhus University, September 2020

				Cultivars			
Sample origin	Host	Genotype	Race	Benchmar	KWS Zya	Kalmar	Nemo
Denmark, 2014	Ragtac	PstS10	Warrior(-)	A	A	A	A
Denmark, 2017	Kalmar	PstS10	Kalmar	A	A	V	V
Nederlands, 2020	Nemo	PstS10	Kalmar	A	A	V	V
Denmark, 2020	Benchmark	PstS10	Benchmark	V	V	A	A
Sweden, 2020	Norin	PstS10	Benchmark	V	V	A	A
Belgium, 2020	Amboise	PstS10	Amboise	V	V	V	V
UK, 2020	Reflection	PstS10	Amboise	V	V	V	V
France, 2020	Nemo	PstS10	Amboise	V	V	V	V

* Amboise: combining virulence corresponding to R-specificities in Benchmark and Kalmar

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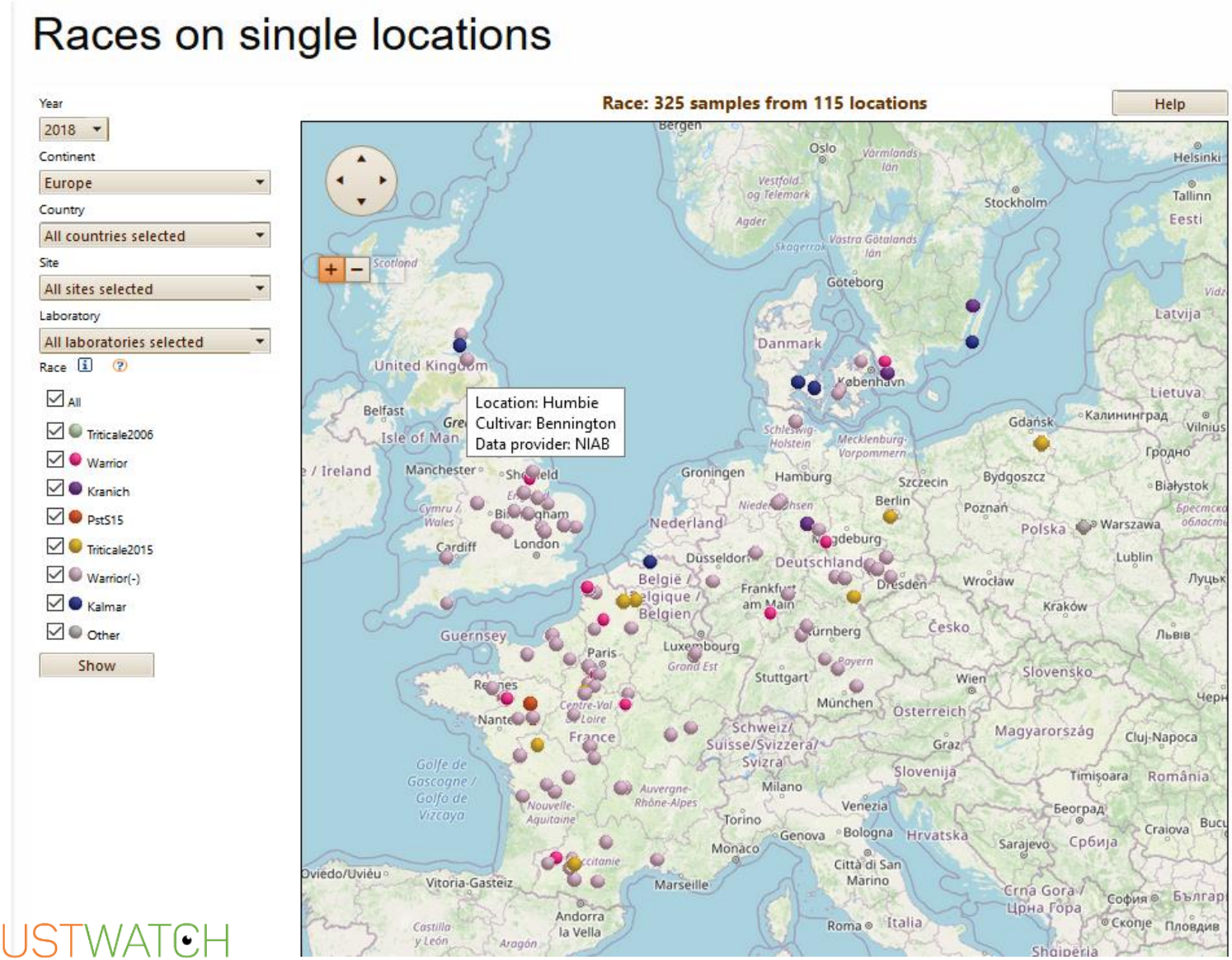
II. Alignment of methodologies, procedures and interpretation of results



II. Alignment of methodologies, procedures and interpretation of results

Race Frequency Map

Continent

Europe

Laboratory

All laboratories selected

Year

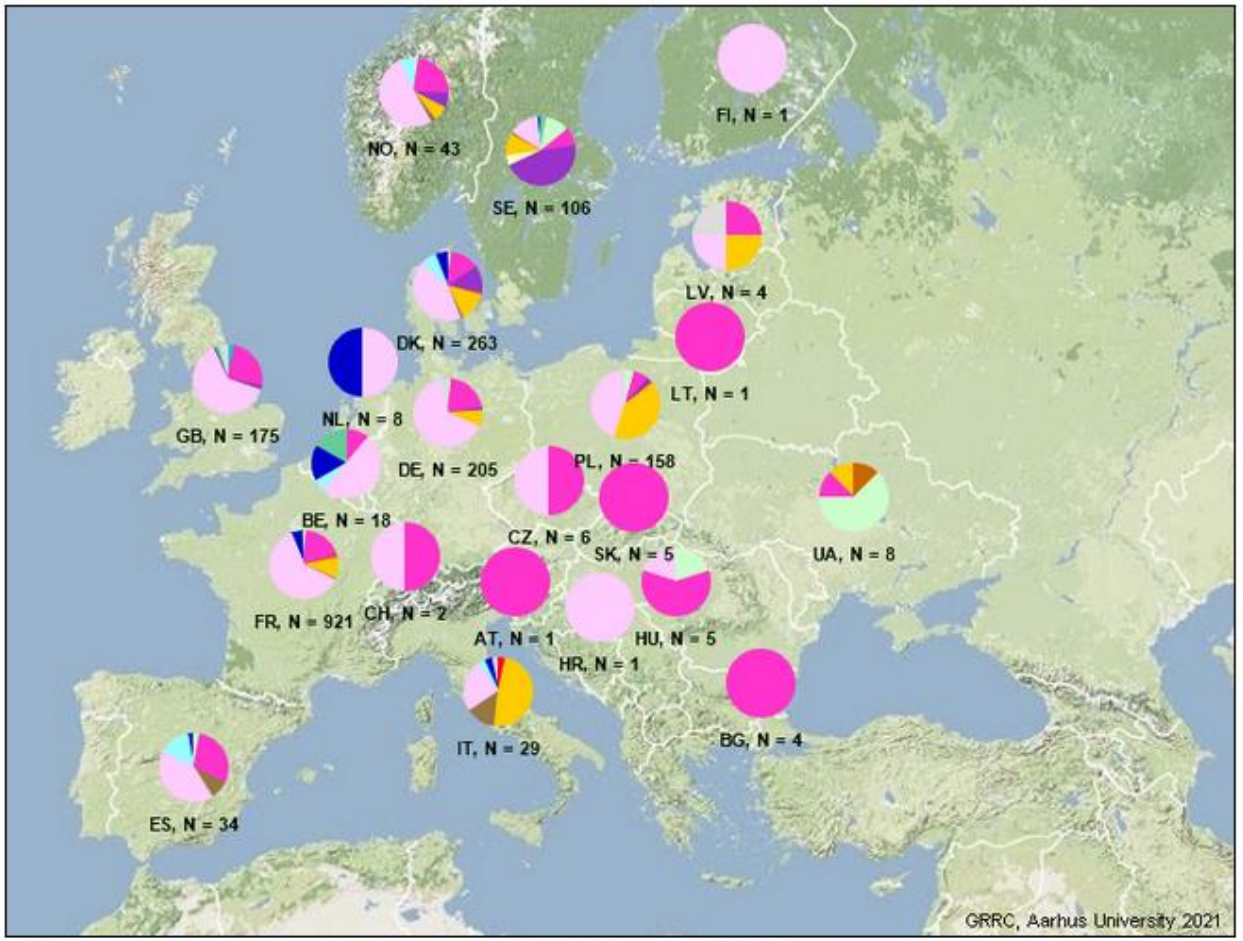
- All
- 2020
- 2019
- 2018
- 2017
- 2016
- 2015
- 2014
- 2013
- 2012

Race

- Solstice_Oakley
- Tulsa
- PstS2
- PstS2,v27
- Triticale2006
- Warrior
- Kranich
- PstS15
- Hereford
- Triticale2015
- PstS14
- Warrior(-)
- Benchmark
- Kalmar
- Amboise
- Other

Show

Help



Data provider : *GRRC, Denmark. IHAR, Poland. INRAE, France. JKI, Germany. NIAB, United Kingdom.*

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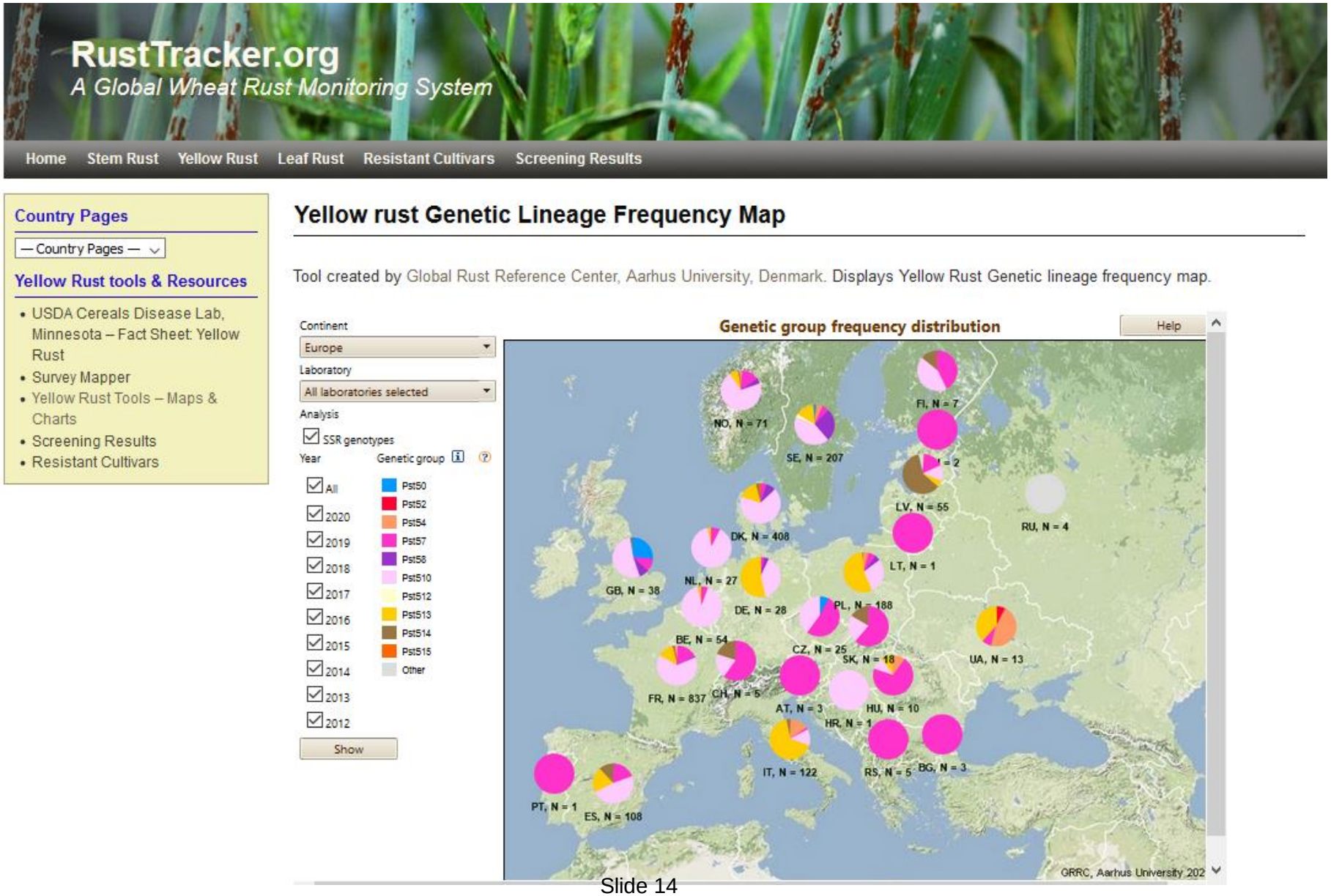
II. Alignment of methodologies, procedures and interpretation of results



Key features of RustWatch

II. Alignment of lab methodology, procedures and interpretation of result

Conclusions

- Collaboration with VCU facilitated better and diversified sampling coverage in Europe
- Simple and robust genotyping platform using shared core set of primers
- Several genetic groups consisted of a single race only, others had multiple races
- Alignment essential for direct comparison of results
  - Tests of shared of isolates/DNA samples, including reference isolates
  - Identical/duplicate seed sources of core set of differentials
  - Regular physical/web workshops to discuss results and new findings

III. Impact assessment of new rust races

Field nurseries of > 200 advanced breeding lines and cultivars at 8 locations in 3 years

Seedling and APR tests in green house (subset of lines)

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III. Impact assessment of new rust races

RustWatch ›

- Home
- About the project
- Dissemination activities incl. publications
- Case Study Regions
- Wheat Rust Early Warning
- IPM Trials
- Field nurseries
- Link to maps and charts on rust races and genotypes
- Contact
- Intranet for project Partners

Field nurseries

About the Field Nurseries

Approximately 250 winter wheat varieties and breeding lines were tested for susceptibility to novel emerging races of yellow rust (YR), leaf rust (LR) and stem rust (SR) under field conditions in both 2019 and 2020. The nurseries were conducted in DK (AU), UK (NIAB), DE (JKI), IT (AS.A.R), FR (ARVALIS) and at three locations of the breeders' network in DE (BREUN), SW (LANTMÄNNEN) and UK (RAGT). The methodology used for this is described in the milestone report M3.13 'Sharing protocols between partners for evaluating adult plant resistance of varieties and breeding lines to rust diseases under field conditions'.

The results of the 2019 and 2020 field nurseries are published in two separate reports. The 2020 data were analysed using the Field Nursery Data Management System (FNDMS), a collaborative effort between WP3 and WP4. This system, stores the data, do quality control, analyses and visualises the data.

Below you will find output visualisation tools from the Field Nursery Data Management System and finally links to reports and the user guide and documentation report about proper use of the tools.

Summary results as severity scores across cultivars by disease, year, locations and seed provider

Cultivar map with severity scores by disease, year, seed provider and cultivar

Disease pressure by environment

Reports and user guide to tools

Contact

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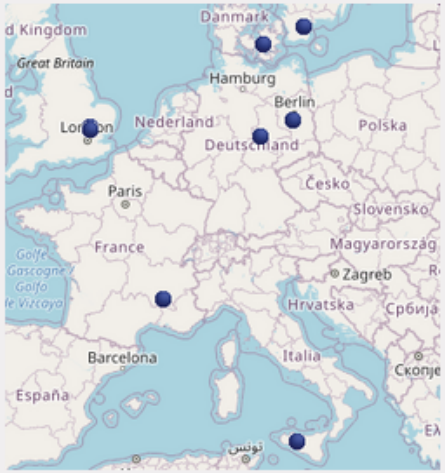
https://agro.au.dk/forskning/projekter/rustwatch/field-nurseries/

About the Field Nurseries



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Cultivar map with severity scores by disease, year, seed provider and cultivar

Disease pressure by environment

Reports and user guide to tools

- Field Nursery Data Management System, User guide and documentation
- Deliverable report D3.6 covering the analysis of results from 2020

Contact

The RustWatch consortium

1		AARHUS UNIVERSITET (AU)
2		NATIONAL INSTITUTE OF AGRICULTURAL BOTANY (NIAB)
3		INSTITUT NATIONAL DE LA RECHERCHE AGRONOMIQUE (Inra)
4		JULIUS KUHN-INSTITUT BUNDESFORSCHUNGSINSTITUT FUR KULTURPFLANZEN (JKI)
5		JOHN INNES CENTRE (JIC)
6		UNIVERSITAETSKLINIKUM HAMBURG-EPPENDORF (UKE)
7		The University of Agriculture, Peshawar (AUP)
8		Saatzucht Josef Breun GmbH & Co. KG (BREUN)
9		SOCIETE RAGT 2N SAS (R2N)
10		LANTMANNEN EKONOMISK FORENING (LM)
11		Associazione Agricola Randazzo (AS.A.R)
12		Nordic Seed A/S (NS)
13		GROUPE D'ETUDE ET DE CONTROLE DES VARIETES ET DES SEMENCES (GEVES)
14		Tystofte Foundation (TF)
15		ARVALIS INSTITUT DU VEGETAL (ARVALIS)
16		INSTITUTO NAVARRO DE TECNOLOGIAS E INFRAESTRUCTURAS AGROALIMENTARIAS SA (INTIA)
17		HIR Malmöhus AB (HIR)
18		EIDGENOESSISCHES DEPARTEMENT FUER WIRTSCHAFT, BILDUNG UND FORSCHUNG (WBF)
19		INSTYTUT HODOWLI I AKLIMATYZACJI ROSLIN - PANSTWOWY INSTYTUT BADAWCZY (IHAR)
20		Latvia University of Life Sciences and Technologies(LLU)
21		NARODNE POL'NOHOSPODARSKE A POTRAVINARSKE CENTRUM (NPPC)
22		BAYER AKTIENGESELLSCHAFT (BAYER)
23		LANDBRUG & FODEVARER F.M.B.A. (SEGES)
24		VYZKUMNY USTAV ROSTLINNE VYROBY VVI (VURV)

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Table 8. People submitting samples of rust infected leaves/stems of cereals 2018-2019.

Country	Collectors 2018-2019
Afghanistan	E Mohmand, A Bari Stanikzai, Z Ahmazada
	A Noori, A Raqib Lodin; G Ghanizada, Latif Rasekh
Argentina	Agustin Bilbao
	Agustin Pulido
	Alejandro Porfiri
	Ana Rodriguez
	Ana Storm
	Andrea Rosso
	Buck Semillas
	Carina Cáceres
	Carlos Grosso
	Clau
	Cris
	Die
	Enri
	Fab
	Fra
	Gus
	Igna
	Julian Garcia, Oro Verde
	Liliana Wehrhahne, Adelina Larsen
	Manuela Gordo
	Marcos Mitelsky
	Margarita Silion
	Mauro Montarini
	Norma Formento
	Victoria Gonzales, Daniel Ploper
Austria	Michael Oberforster
	Thomas Massinger
Belgium	F. De Brouwer; J. Pannecoucque
	G. Jacquemin & R. Meza
Bhutan	Dave Hodson, Sangay Tshewang
Chile	C. Jobet and R. Galdames
	Carola Vera; Ricardo Madariaga
	Erik Von Baer
Czech Republic	Alena Hanzalova
	Pavel Kraus
Denmark	Ghita Cordsen Nielsen
	Jeppe R. Andersen
	Lise Nistrup Jørgensen
	Susanne Sindberg
	Thomas Olsen
Egypt	Atef Shahin, Wasief Youssief
	Atef Shahin, Hend, Mohmed, Reda
Eritrea	Asmelash Wolday
Ethiopia	Ashenafi
	Bekele Abeyo; Ayele Badebo
	Dave Hodson
	Zerihun Tadesse
France	Clément Debiton
	Emmanuel Heumez
	Gorichon
	J.P. Maigniel
	Jérome Auzanneau
	Laurent Pageaud
	Marc Leconte
	Mathieu Grare
	Pascal Giraudeau
	S. Barrais; Vallerie Cadot

Country	Collectors 2018-2019
Germany	Anja Giebel
	Anne-Kristin Schmitt
	Catherine Cuendet, Getreidezuchtung Peter Kunz
	Cornelia Miersch, SMUL
	E. Kazman
	Friederike Schiermann
	Henning Hartwig, PZO
	Josef Holzapfel
	Kerstin Flath
	Matthias Haas
	Paul Gruner
	Sommerfeldt, Hoffmann
	Thomas Grafe
	Thomas Zschaeckel
	Uta Liesenberg
	Uwe Preiss

Country	Collectors 2018-2019
Iran	Farzad Afshari
	Mahboobeh Yazdani
	Mansour Karimiashni, Mohammad Razavi
	Mohsen Yassaie
Italy	Angela Iori, Fabrizio Quaranta, Andreina Belocchi, Mauro Fornara
	Anna Maria Mastrangelo
	Antonia Salerno
	Biagio Randazzo
	Daniela Marone
	Emilia Romagna
	to
	caferri
Kenya	Ruth Wanyera
Latvia	Līga Feodorova-Fedotova
Morocco	Ezzahiri Brahim
Netherlands	Lubbert van den brink
Norway	Andrea Ficke
	Chloe Grieu
	Morten Lillemo
Pakistan	Sajid Ali
Poland	Ewelina Piwowarczyk
	Pawel Czembor
Rwanda	Dave Hodson, Innocent Haberurema
Slovakia	Svetlana Sikova
	Alena Hanzlova
Spain	Carlos Cantero
	Dolors Villegas
	Enrique Can
	Ibai Elorza
	Jesús Goñi
	Joan Serra
	Luis Urquijo
	Manuel Calvo
	Neus Puig; Nieves Apa
Sweden	Alexia von Ehrenheim
	Alf Djurberg
	Anders Arvidsson
	Anders Lindgren
	Anna Berlin
	Anna Gerdtsson
	Anna-Karin Krijger
	Charlotte Norén
	Elisabeth Bölenius
	Elisabeth Lövstad
	Erling Christensson
	Eva Mellqvist
	Frans Johnson
	Gunilla Berg
	Gunnel Andersson, Linda af Geijerstam
	Johanna Holmblad
	Jonas Törngren
	Julia Dahlqvist, Anna von Heideken
	Karin Andersson
	Kristian Barck
	Kristian Jochnick
	Lars Johansson
	Lina Norrlund
	Louise Aldén
	Lovisa Eriksson
	Lukas Hallberg
	Robert Dinwiddie
Tanzania	Rose Mongi, Dave Hodson, Ari Uyole
	Salome Munissi, Nafet, Charles, Ramdhani
Tunisia	Marcel Thierry
	Amor Yahyaoui
Turkey	Alex Morgounov
Uganda	Bosco Chemayek
	Owere, Wasukira, Wobibi, Woniala
Ukraine	Vitaliy Paljasniy
Uzbekistan	Zafar Ziyaev

Thanks to collaborators from all parts of the world

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GRRC team 2019

AARHUS UNIVERSITY

GRRC

The Danish Council for Strategic Research

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