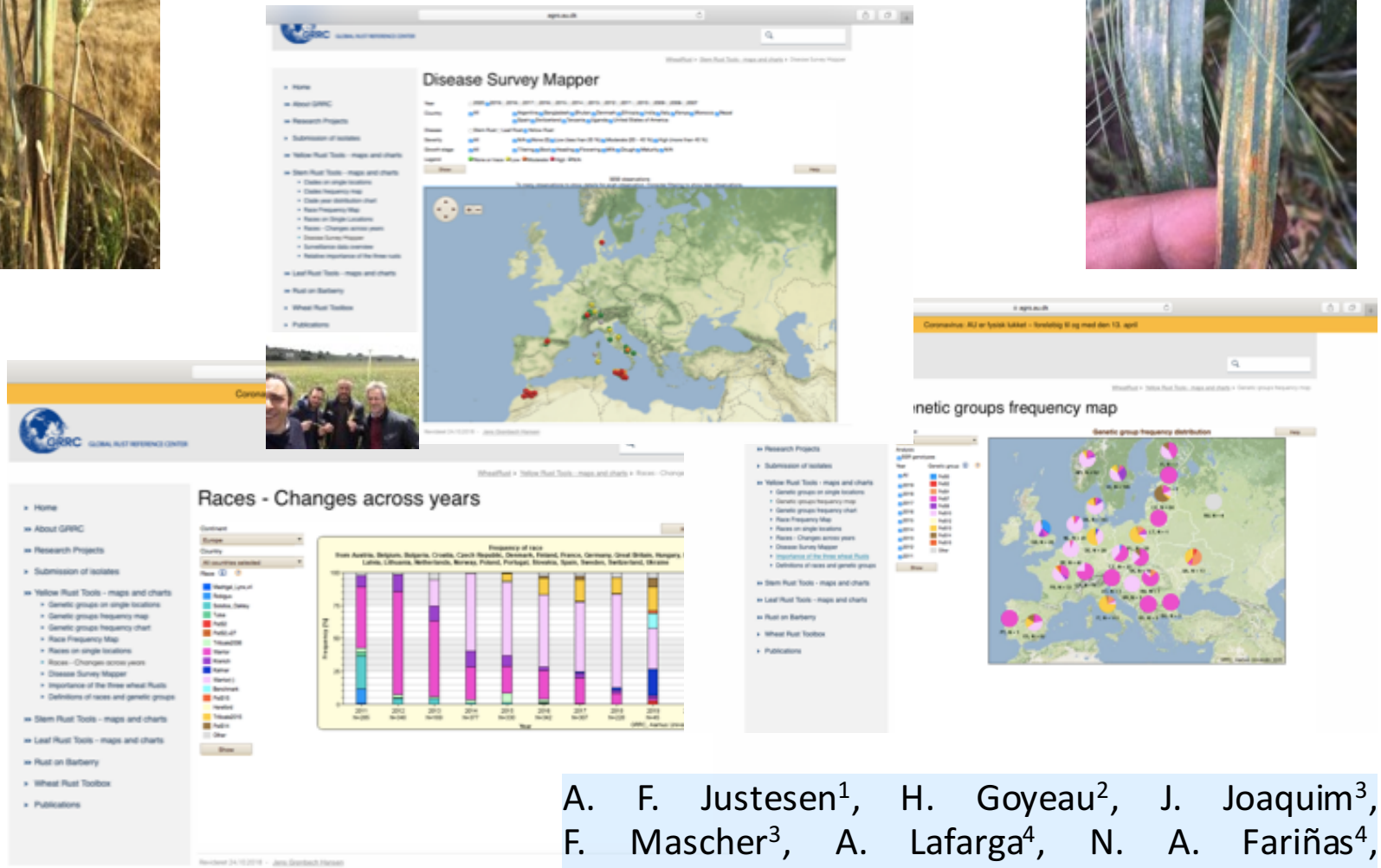
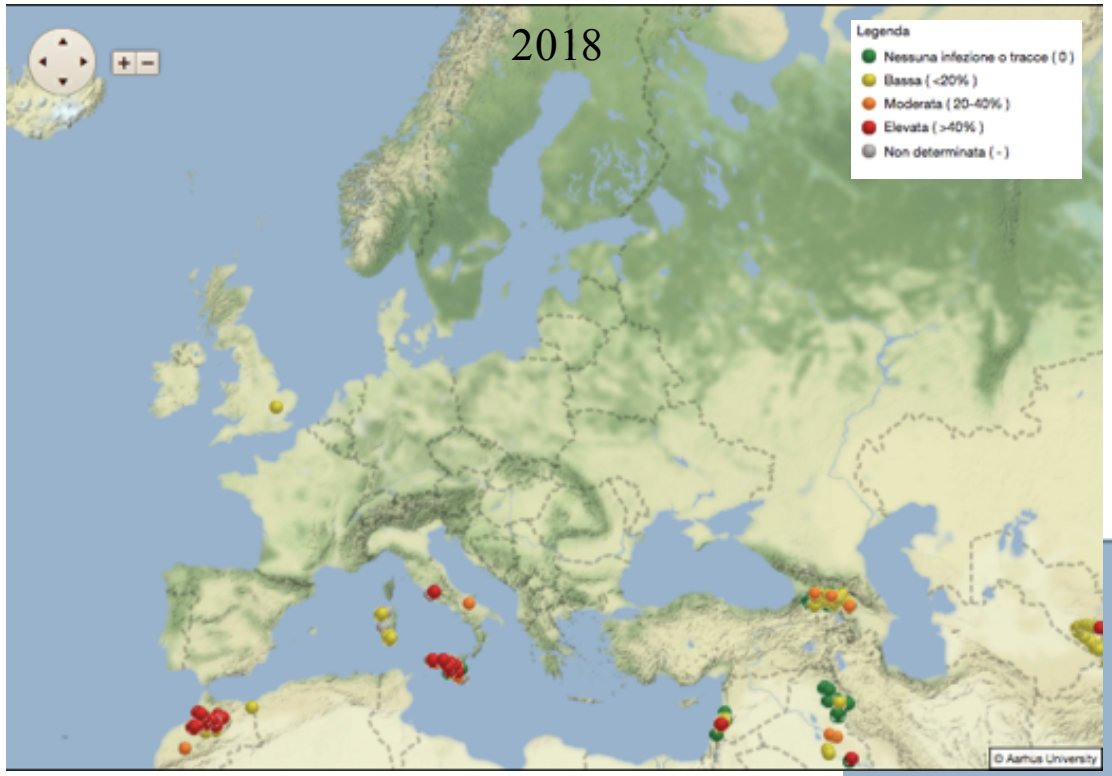
Ruggini in Europa:
Stato dell'arte e monitoraggio

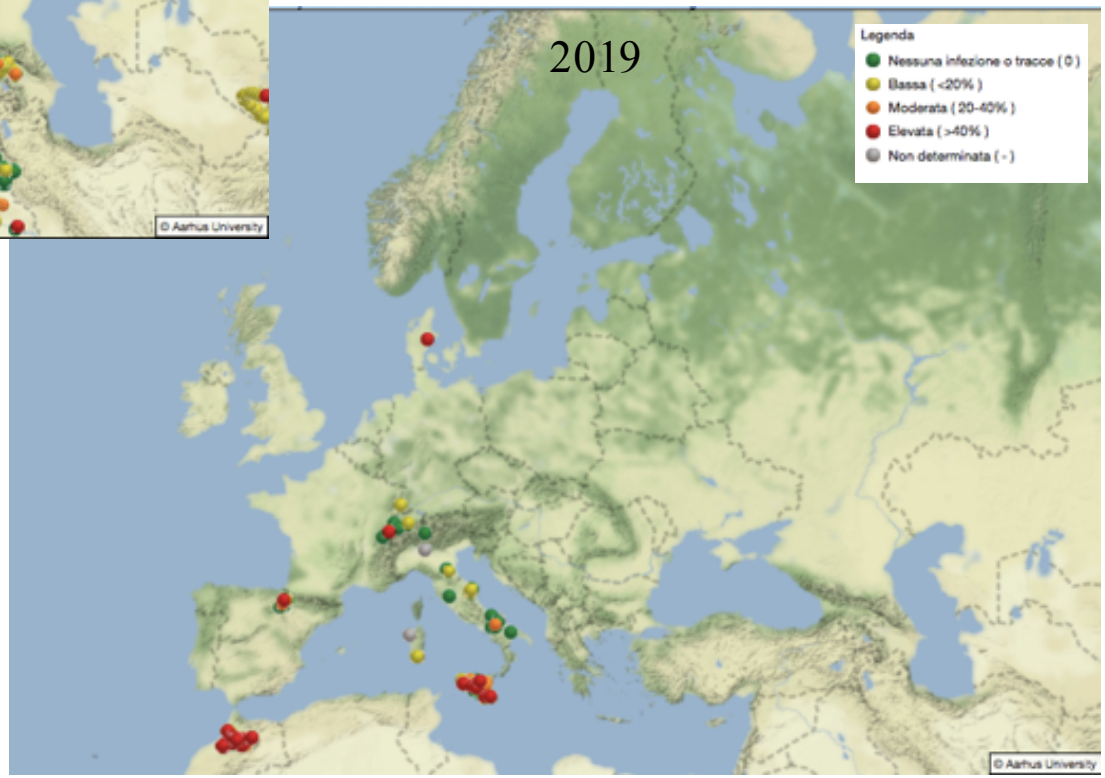


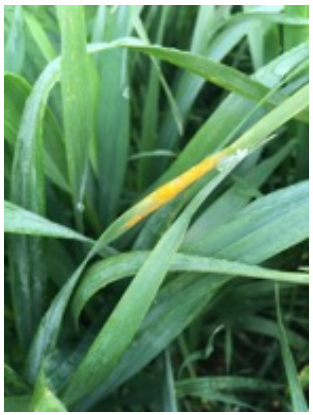
A. F. Justesen[1], H. Goyeau[2], J. Joaquim[3], F. Mascher[3], A. Lafarga[4], N. A. Fariñas[4], J. G. Hansen[2], M.S. Hømvoller[2], and B. Randazzo[5]
[1]Univertity of Aarhus, [2]INRA, [3]Agroscope, [4]INTIA, [5]AS.A.R.

RUSTWATCH
WHEAT RUST EARLY WARNING

Monitoraggio in pieno campo di ruggine gialla

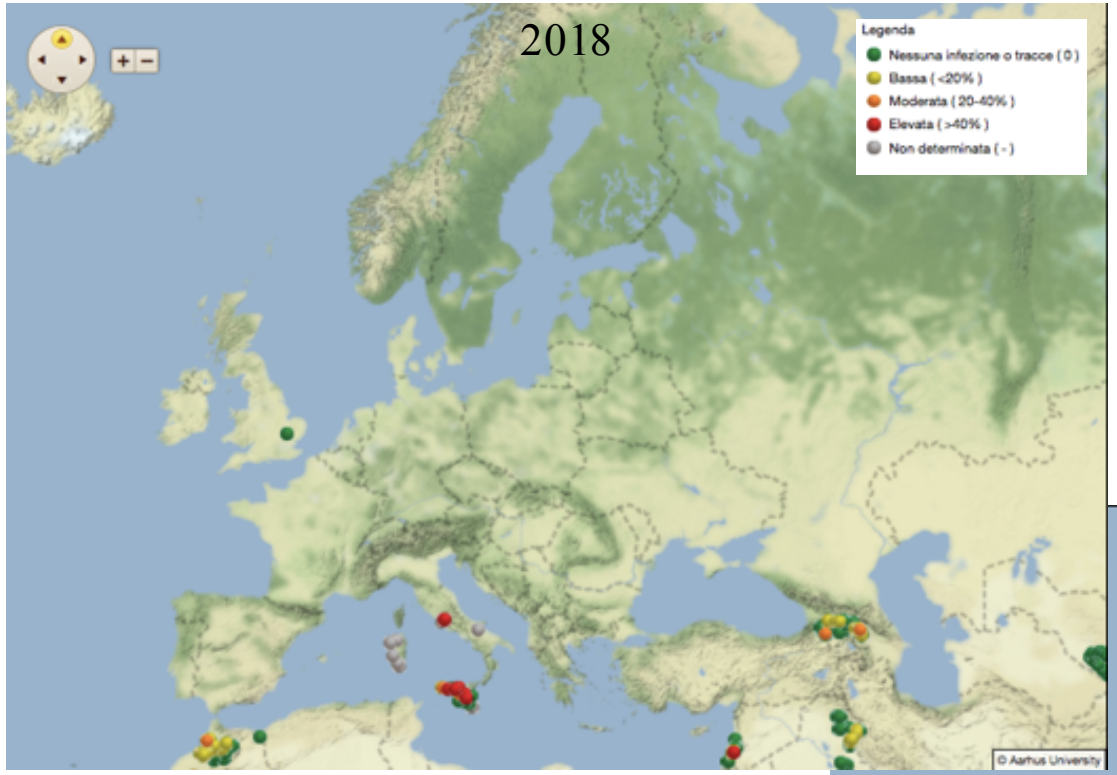


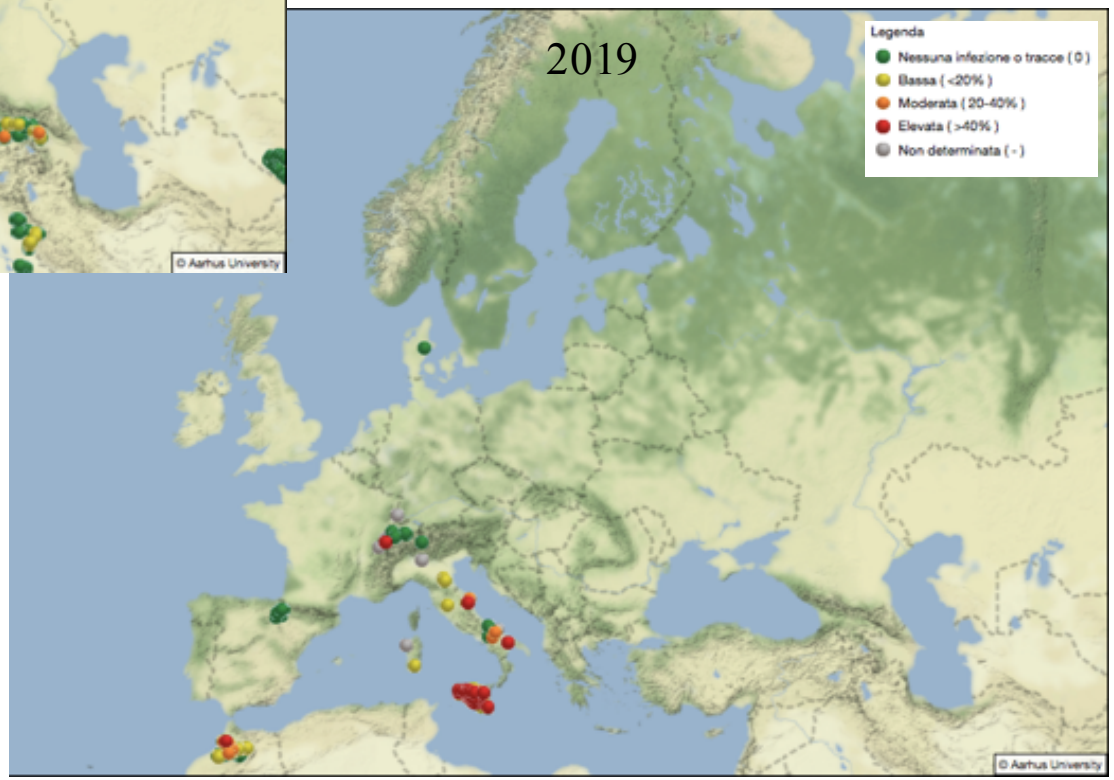




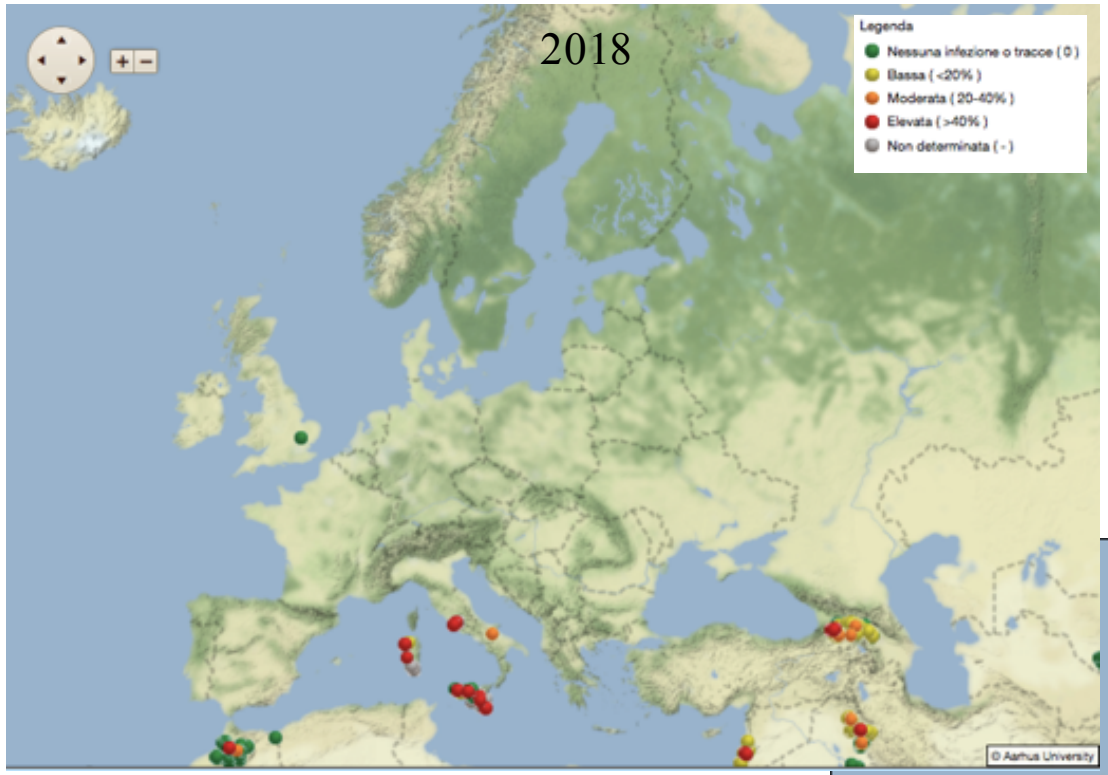
RUSTWATCH
WHEAT RUST EARLY WARNING

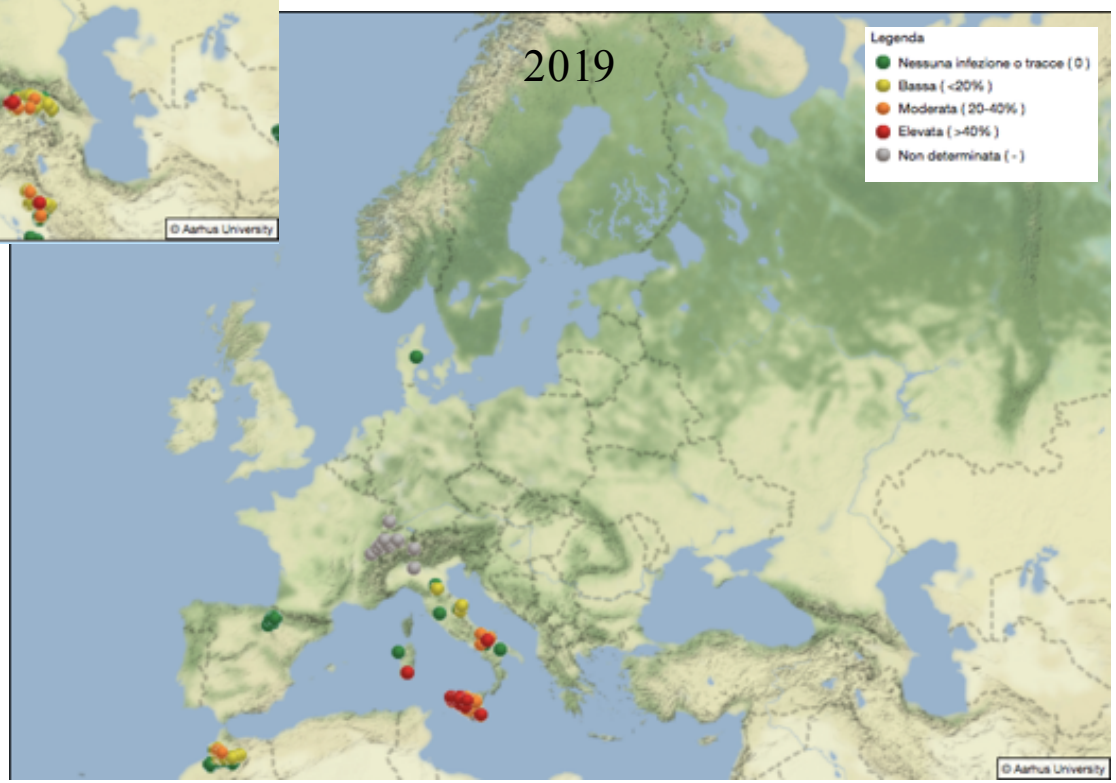
Monitoraggio in pieno campo di ruggine bruna





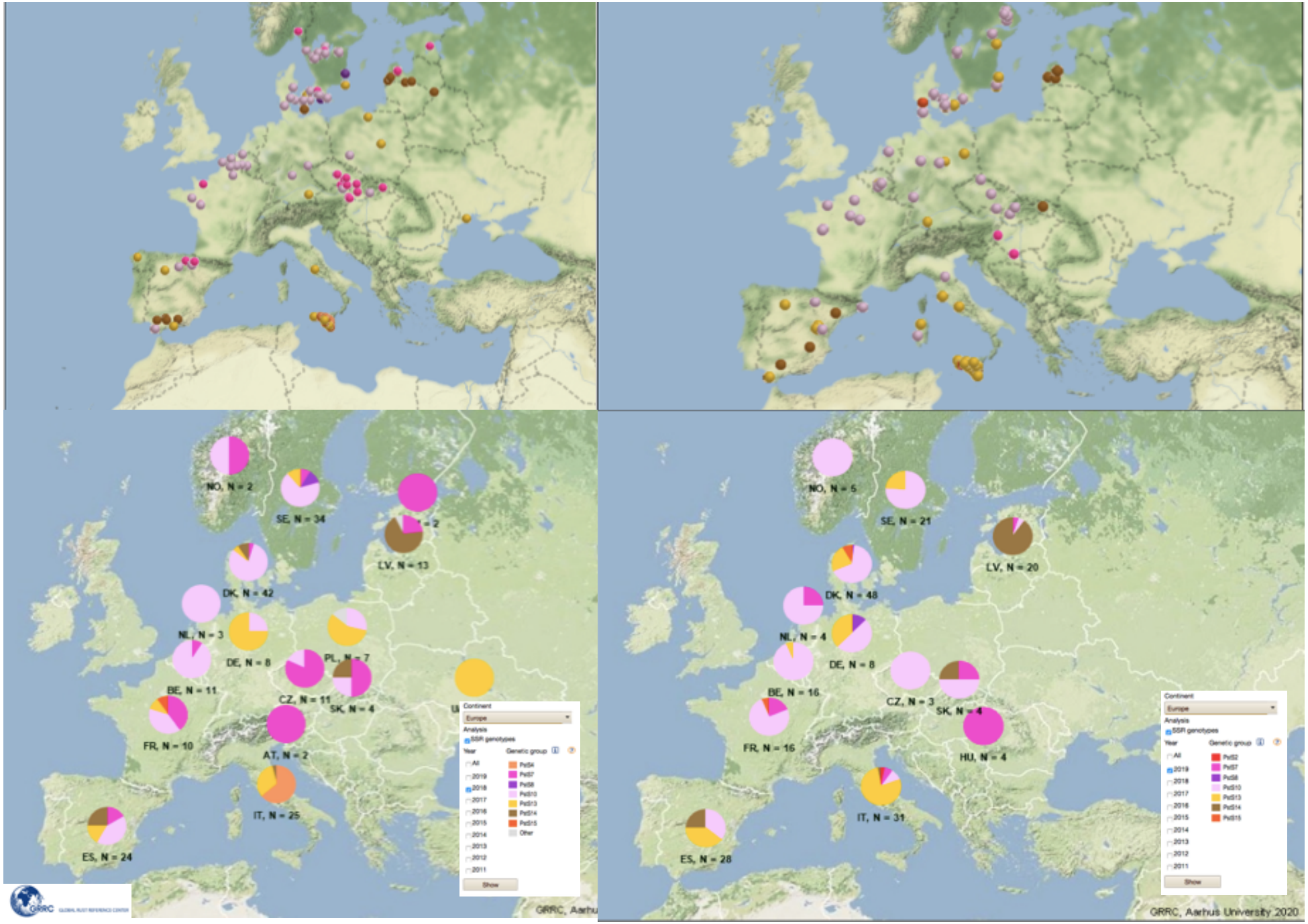
Monitoraggio in pieno campo di ruggine nera





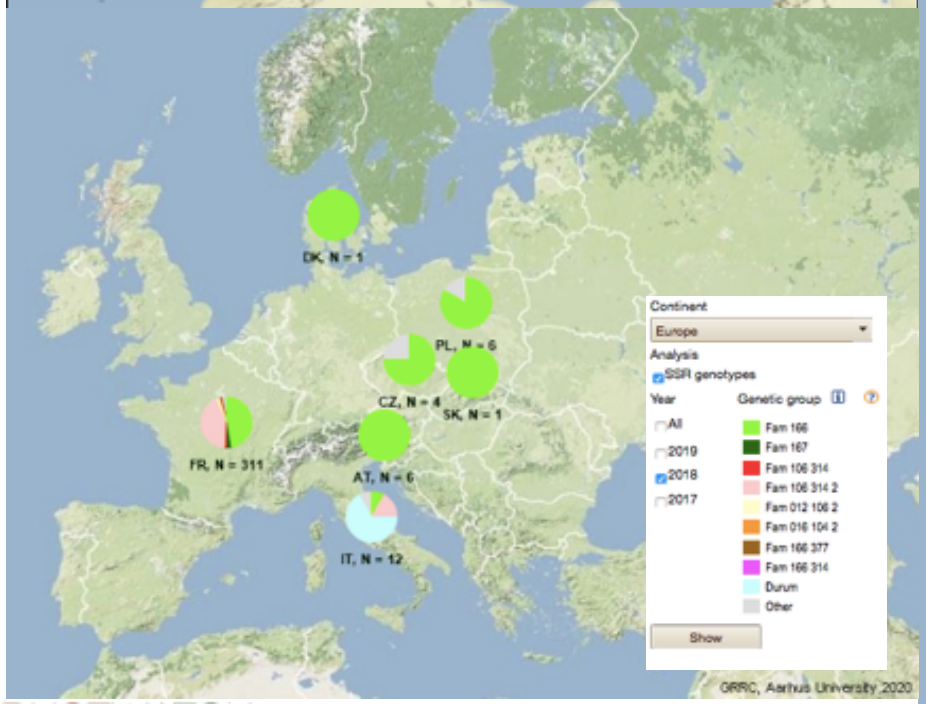
RUSTWATCH
WHEAT RUST EARLY WARNING

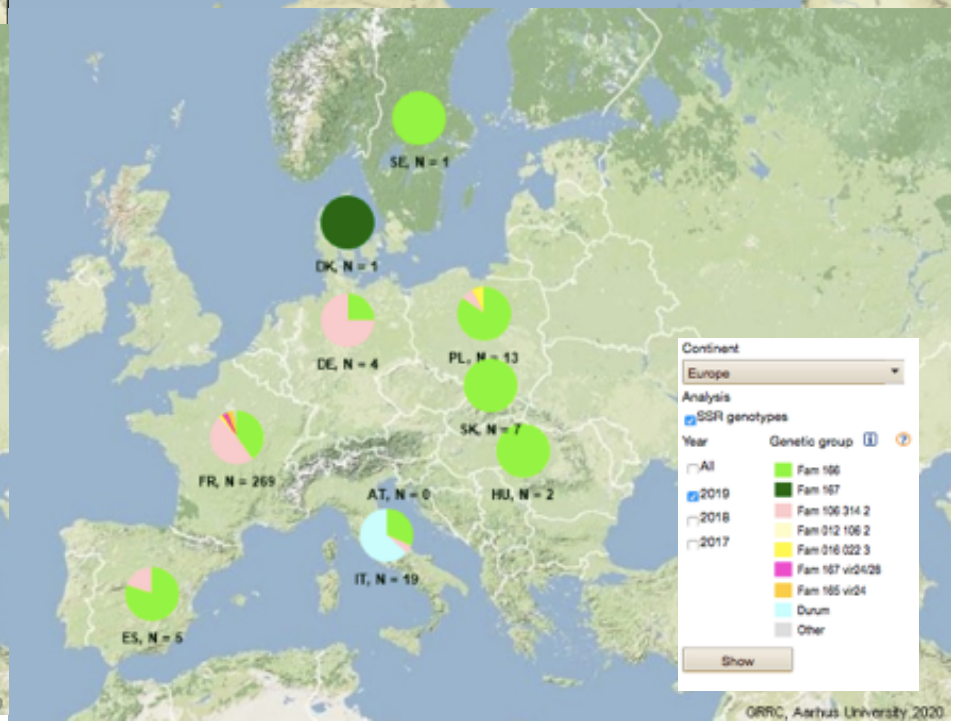
Mappe e Mappe di frequenza dei gruppi genetici di ruggine gialla



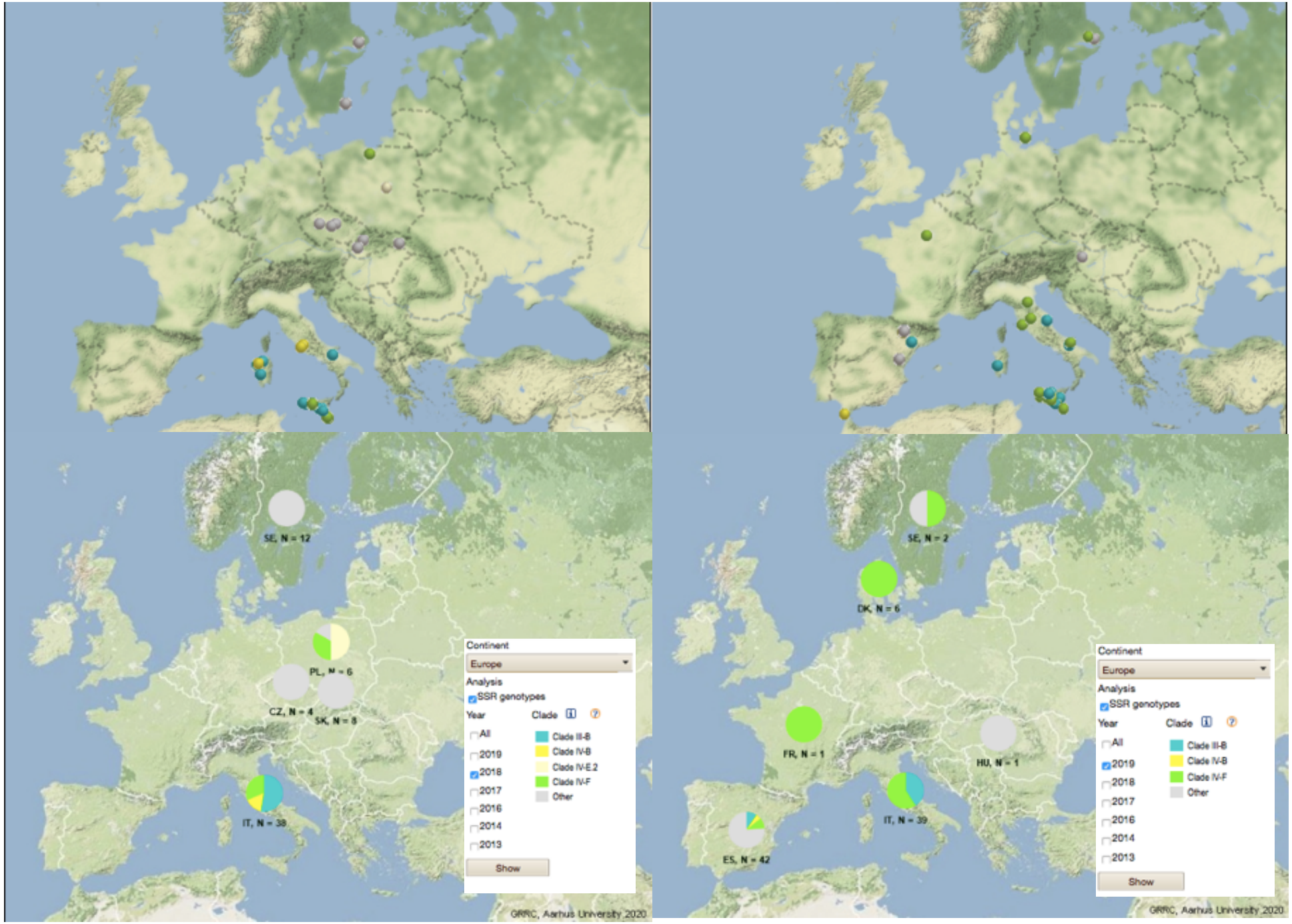
RUSTWATCH
WHEAT RUST EARLY WARNING

Mappe e Mappe di frequenza dei gruppi genetici di ruggine bruna



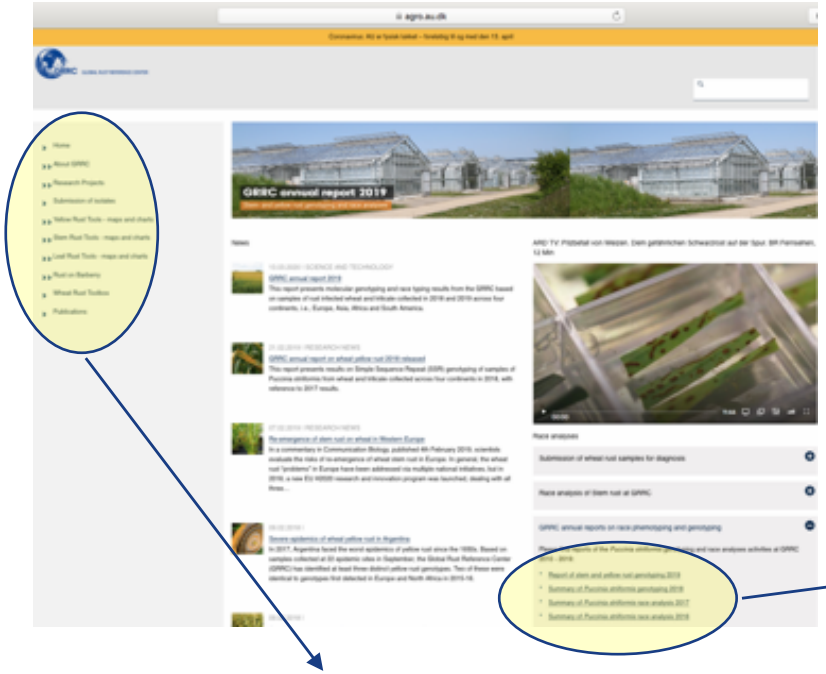


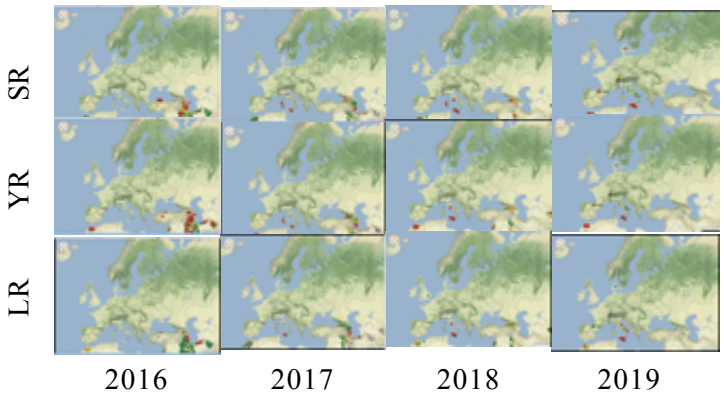
Mappe e Mappe di frequenza dei gruppi genetici di ruggine nera



RUSTWATCH
WHEAT RUST EARLY WARNING

www. wheatrust.org





GRRC GLOBAL RUST REFERENCE CENTER

RUSTWATCH
WHEAT RUST EARLY WARNING

Table 7. Correspondence between genetic groups and prevalent races of *P. striiformis* sampled from epidemic sites since 2000, Global Rust Reference Center, January 2020.

Common names of prevalent races and genetic groups in yellow rust - GRRC, January 2020			
Genetic group	**Race**	**Virulence phenotype***	**Prevalence in geographical region**
PstS0	Brigadier	1,2,3,-,-,-,-,9,-,-,17,-,25,-,-,-,AvS,-	Europe
	Brigadier,v4	1,2,3,4,-,-,-,-,9,-,-,17,-,25,-,-,-,AvS,-	Europe
	Madrigal_Lynx	1,2,3,-,-,6,-,-,9,-,-,17,-,25,-,-,-,AvS,-	Europe
	Madrigal_Lynx,v4	1,2,3,4,-,6,-,-,9,-,-,17,-,25,-,-,-,AvS,-	Europe
	Robigus	1,2,3,4,-,-,-,-,9,-,-,17,-,25,-,32,-,AvS,-	Europe
	Solstice_Oakley	1,2,3,4,-,6,-,-,9,-,-,17,-,25,-,32,-,AvS,-	Europe
	Tulsa	-,-,3,4,-,6,-,-,-,-,-,-,25,-,32,-,AvS,-	Europe
PstS1	PstS1	-,2,-,-,-,6,7,8,9,-,-,-,-,25,-,-,-,AvS,-	North America, Australia
	PstS1,v1	1,2,-,-,-,6,7,8,9,-,-,-,-,25,-,-,-,AvS,-	East Africa
	PstS1,v1,v27	1,2,-,-,-,6,7,8,9,-,-,-,-,25,27,-,-,AvS,-	East Africa
PstS2	PstS2	-,2,-,-,-,6,7,8,9,-,-,-,-,25,-,-,-,AvS,-	East Africa, West Asia, South Asia
	PstS2,v1	1,2,-,-,-,6,7,8,9,-,-,-,-,25,-,-,-,AvS,-	East Africa
	PstS2,v3	-,2,3,-,-,6,7,8,9,-,-,-,-,25,-,-,-,AvS,-	East Africa
	PstS2,v27	-,2,-,-,-,6,7,8,9,-,-,-,-,25,27,-,-,AvS,-	East Africa, West Asia, North Africa
	Pst2,v1,v27	1,2,-,-,-,6,7,8,9,-,-,-,-,25,27,-,-,AvS,-	East Africa, West Asia
	PstS2,v3,v27	-,2,3,-,-,6,7,8,9,-,-,-,-,25,27,-,-,AvS,-	East Africa
	PstS2,v10,v24	-,2,-,-,-,6,7,8,9,10,-,-,24,25,-,-,-,AvS,-	East Africa, West Asia
	PstS2,v10,v24,v27	-,2,-,-,-,6,7,8,9,10,-,-,24,25,27,-,-,AvS,-	West Asia
	PstS2,v3,v10,v24,v27	-,2,3,-,-,6,7,8,9,10,-,-,24,25,27,-,-,AvS,-	East Africa
PstS3	PstS3	-,(2),-,-,-,6,7,8,-,-,-,-,-,-,-,-,-,AvS,-	Europe, North Africa, West Asia
	PstS3,v25	-,(2),-,-,-,6,7,8,-,-,-,-,-,25,-,-,-,AvS,-	Europe, East Africa
PstS4	Triticale2006	-,2,-,-,-,6,7,8,-,10,-,-,24,-,-,-,-,-,-	Europe
PstS5	PstS5	1,2,3,4,-,6,-,-,9,-,-,-,-,25,-,32,-,AvS,Amb	Central Asia
	PstS5,v17	1,2,3,4,-,6,-,-,9,-,-,17,-,25,-,32,-,AvS,Amb	Central Asia, South Asia
PstS6	PstS6	1,2,-,-,-,6,7,-,9,-,-,17,-,-,27,-,-,AvS,-	East Africa, Central Asia, South Asia
PstS7	Warrior	1,2,3,4,-,6,7,-,9,-,-,17,-,25,-,32,Sp,AvS,Amb	Europe
PstS8	Kranich	1,2,3,-,-,6,7,8,9,-,-,17,-,25,-,32,-,AvS,Amb	Europe
PstS9	PstS9	1,2,3,4,-,6,-,-,9,-,-,-,-,25,27,32,-,AvS,Amb	Central Asia, South Asia
	PstS9,v17	1,2,3,4,-,6,-,-,9,-,-,17,-,25,27,32,-,AvS,Amb	Central Asia
PstS10	Warrior(-)	1,2,3,4,-,6,7,-,9,-,-,17,-,25,-,32,Sp,AvS,-	Europe, North Africa
	Kalmar	1,2,3,4,-,6,7,-,9,-,-,17,-,25,-,32,Sp,AvS,-	Europe
	Benchmark	1,2,3,4,-,6,7,-,9,-,-,17,-,25,-,32,Sp,AvS,-	Europe
PstS11	PstS11	-,2,-,(4),-,6,7,8,-,-,-,17,-,-,27,32,-,AvS,-	Central and West Asia, East Africa
PstS12	Hereford	-,2,3,-,-,6,7,8,-,-,-,17,-,25,-,32,-,AvS,-	Europe
PstS13	Triticale2015	-,2,-,-,-,6,7,8,9,-,-,-,-,-,-,-,-,AvS,-	Europe, South America, West Asia
PstS14	PstS14	-,2,3,-,-,6,7,8,9,-,-,17,-,25,-,32,(Sp),AvS,-	Europe, North Africa
PstS15	PstS15	1,2,3,-,-,6,7,-,9,-,-,17,-,25,-,32,-,AvS,Amb	Europe

* Figures and symbols designate virulence and avirulence (-) corresponding to yellow rust resistance genes: Yr1, Yr2, Yr3, Yr4, Yr5, Yr6, Yr7, Yr8, Yr9, Yr10, Yr15, Yr17, Yr24, Yr25, Yr27, Yr32, and the resistance specificity of Spalding Prolific (Sp), Avocet S (AvS) and Ambition (Amb), respectively. Kalmar and Benchmark are new races in PstS10, which can only be distinguished by these varieties.

SSR_name	Race_name	Number of observations
Clade I (Ug99)	TTKSK	4
	TTKST	11
	TTKTK	6
	TTKTT	39
	-	69
Clade I Total		128
Clade III-B	TTRTF	31
	-	24
Clade III-B Total		55
Clade IV-B	TKTTF	9
	TTTTF	13
	-	6
Clade IV-B Total		28
Clade IV-E.2	TKKTF	2
	-	9
Clade IV-E.2 Total		11
Clade IV-F	TKKTF	32
	-	37
Clade IV-F Total		69
Other	LKMNC	2
	RFCNC	8
	RFCPC	1
	Other	6
	-	39
Other Total		**57**
Grand Total		**348**

- not tested

Table 4. Relationship between genetic groups and prevalent races detected within these in 2018-2019 (cf. Table 2)

GRRC GLOBAL RUST REFERENCE CENTER

Table 5. Correspondence between race name and virulence on common stem rust differential lines.

	Virulence corresponding to NA differentials 1-20 (main R-gene indicated)																			
Race_name	*Sr5*	*Sr21*	*Sr9e*	*Sr7b*	*Sr11*	*Sr6*	*Sr8a*	*Sr9g*	*Sr36*	*Sr9b*	*Sr30*	*Sr17*	*Sr9a*	*Sr9d*	*Sr10*	*SrTmp*	*Sr24*	*Sr31*	*Sr38*	*SrMcN*
LKMNC	*5*	-	-	-	-	*6*	*8a*	*9g*	*36*	-	-	*17*	*9a*	-	*10*	-	-	-	-	*McN*
RFCNC	*5*	*21*	-	*7b*	-	-	*8a*	*9g*	-	-	-	*17*	*9a*	-	*10*	-	-	-	-	*McN*
RFCPC	*5*	*21*	-	*7b*	-	-	*8a*	*9g*	-	-	-	*17*	*9a*	-	*10*	*Tmp*	-	-	-	*McN*
TKKTF	*5*	*21*	*9e*	*7b*	-	*6*	*8a*	*9g*	-	*9b*	*30*	*17*	*9a*	*9d*	*10*	*Tmp*	-	-	*38*	*McN*
TKTTF	*5*	*21*	*9e*	*7b*	-	*6*	*8a*	*9g*	*36*	*9b*	*30*	*17*	*9a*	*9d*	*10*	*Tmp*	-	-	*38*	*McN*
TTKSK	*5*	*21*	*9e*	*7b*	*11*	*6*	*8a*	*9g*	-	*9b*	*30*	*17*	*9a*	*9d*	*10*	-	-	*31*	*38*	*McN*
TTKST	*5*	*21*	*9e*	*7b*	*11*	*6*	*8a*	*9g*	-	*9b*	*30*	*17*	*9a*	*9d*	*10*	-	*24*	*31*	*38*	*McN*
TTKTK	*5*	*21*	*9e*	*7b*	*11*	*6*	*8a*	*9g*	-	*9b*	*30*	*17*	*9a*	*9d*	*10*	*Tmp*	-	*31*	*38*	*McN*
TTKTT	*5*	*21*	*9e*	*7b*	*11*	*6*	*8a*	*9g*	-	*9b*	*30*	*17*	*9a*	*9d*	*10*	*Tmp*	*24*	*31*	*38*	*McN*
TTRTF	*5*	*21*	*9e*	*7b*	*11*	*6*	*8a*	*9g*	*36*	*9b*	-	*17*	*9a*	*9d*	*10*	*Tmp*	-	-	*38*	*McN*
TTTTF	*5*	*21*	*9e*	*7b*	*11*	*6*	*8a*	*9g*	*36*	*9b*	*30*	*17*	*9a*	*9d*	*10*	*Tmp*	-	-	*38*	*McN*

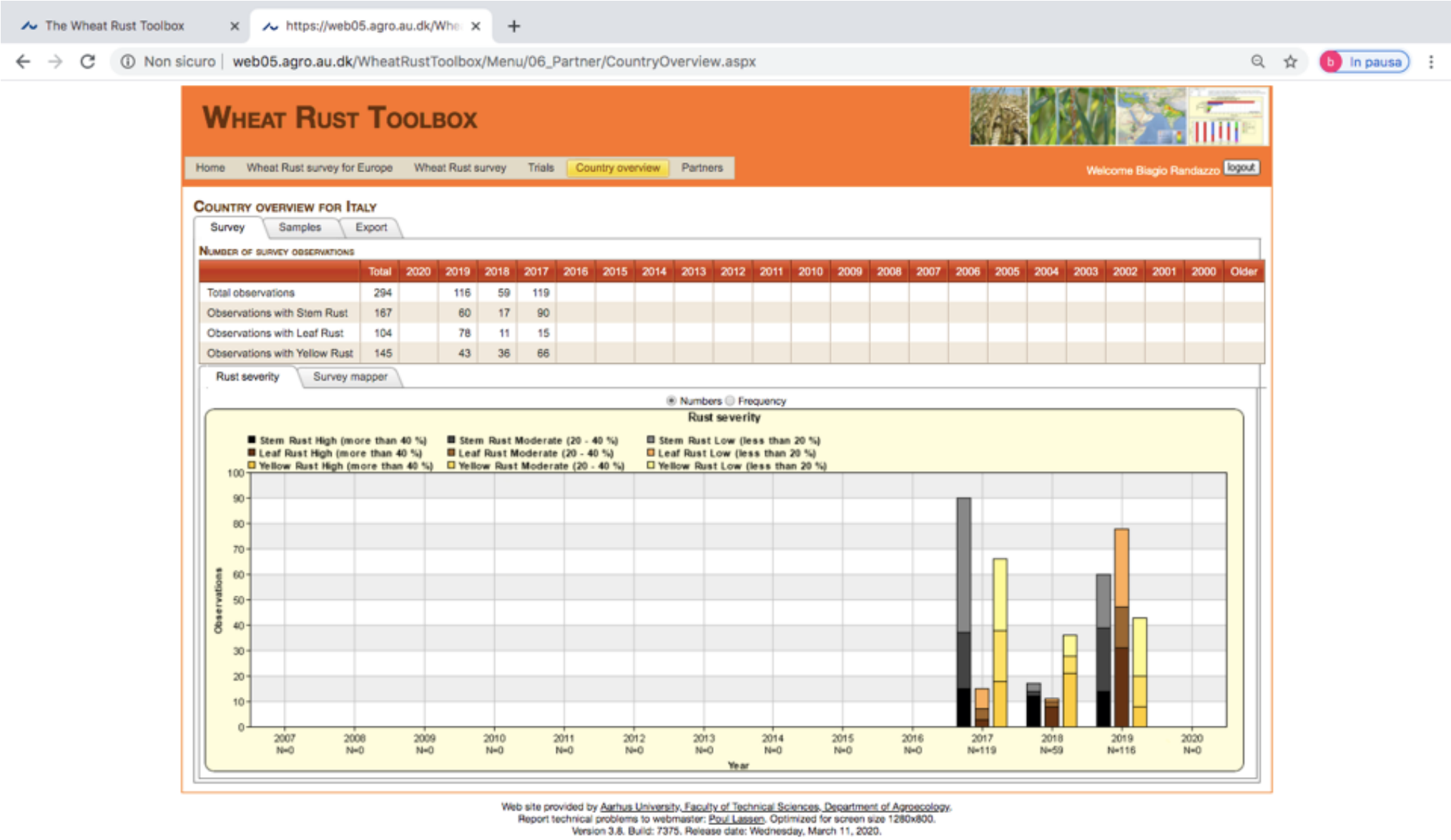
Table 8. People submitting samples of rust infected leaves/stems of cereals 2018-2019.

Country	Collectors 2018-2019
Afghanistan	Z 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
	Claudio Bosco
	Cristina Palacios
	Diego Alvarez
	Enrique Alberione
	Fabricio Mock
	Franco Petrelli
	Gustavo Duarte
	Ignacio Erreguerena
	Julián Garcia, Oro Verde
	Liliana Wehrhahne, Adelina Larsen
	Manuela Gordo
	Marcos Mitelsky
	Margarita Sillon
	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

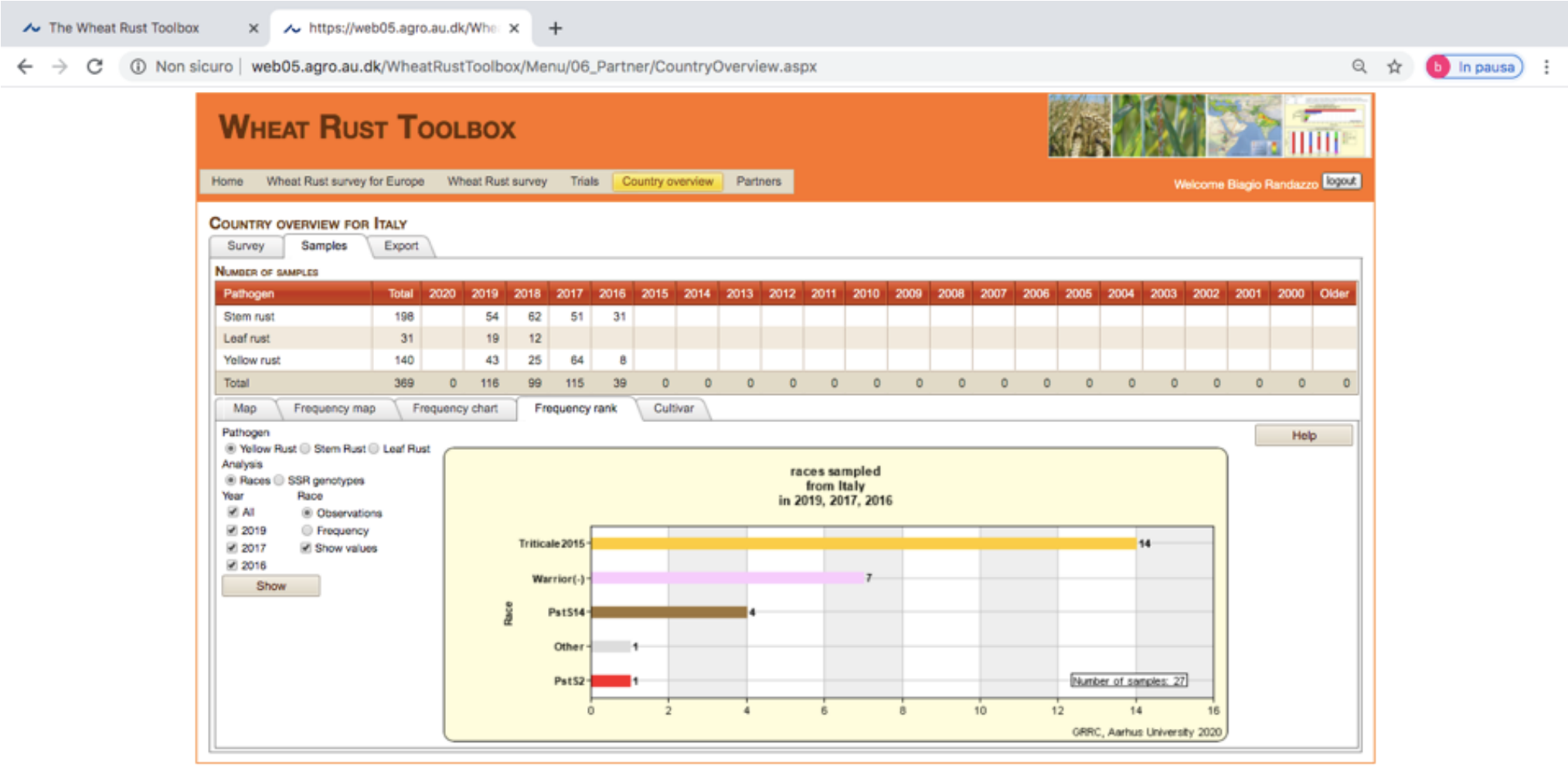
Country	Collectors 2018-2019
Iran	Farzad Afshari
	Mahboobeh Yazdani
	Mansour KarimJashni, Mohammad Razavi
	Mohsen Yassaie
Italy	Angela Ioni, Fabrizio Quaranta, Andreina Belocchi, Mauro Fornara
	Anna Maria Mastrangelo
	Antonia Salerno
	Biagio Randazzo
	Daniela Marone
	Emilia Romagna
	Francesca Nocente
	Giovanni Laidò, Rossano Contato
	Giuseppina Goddi
	Luca Fiorilla
	Lucio Salafia
	Oriana Porfiri
	Stefania Stefanelli, Marco Maccaferri
	Virgilio Balmas
Kenya	Ruth Wanyera
Latvia	Liga 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 Habarurema
Slovakia	Svetlana Sikova
	Alena Hanzlova
Spain	Carlos Cantero
	Dolors Villegas
	Enrique Can
	Ibal 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 Meliqvist
	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

GRRC GLOBAL RUST REFERENCE CENTER

Italia: monitoraggio in pieno campo (2017-2019)

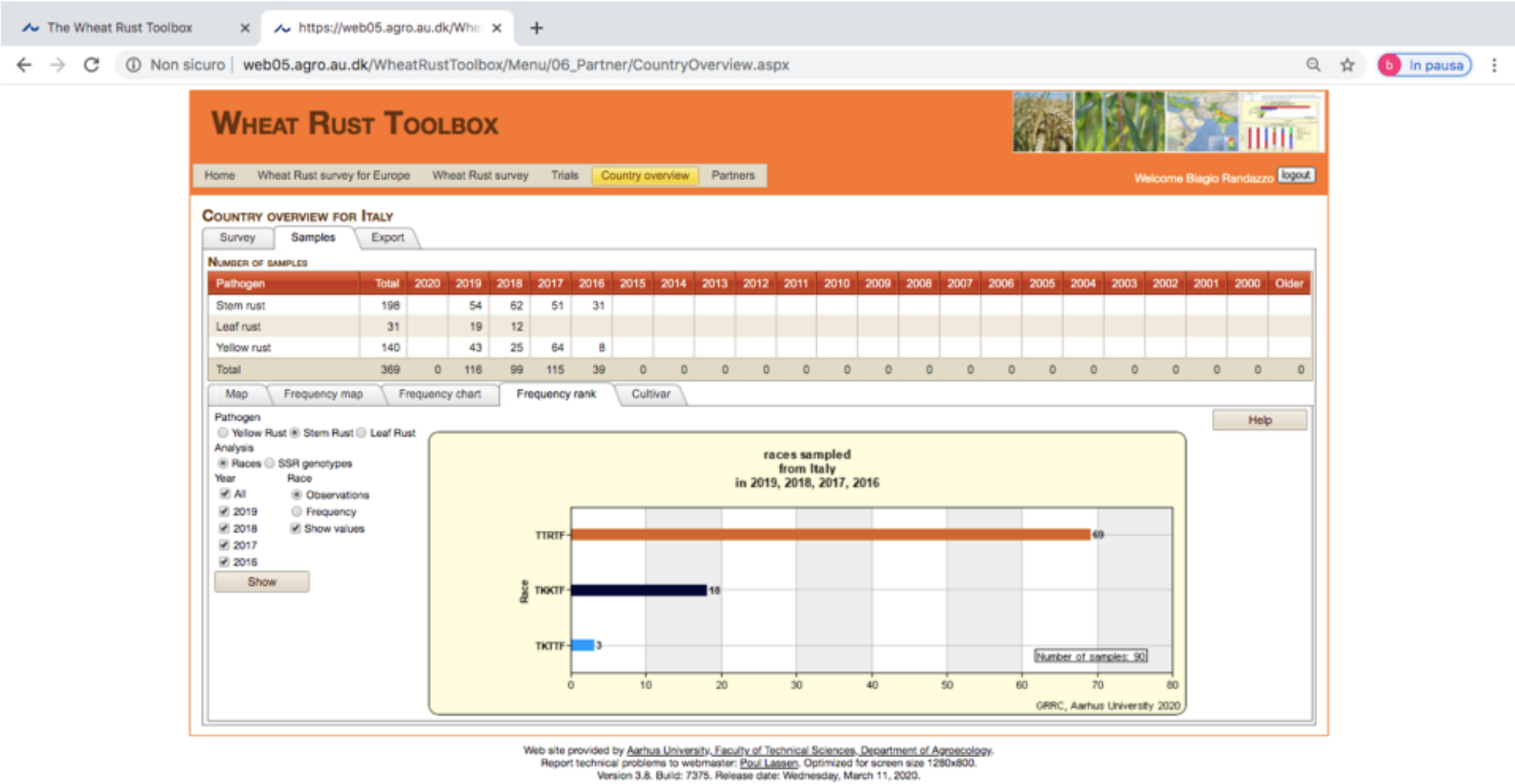
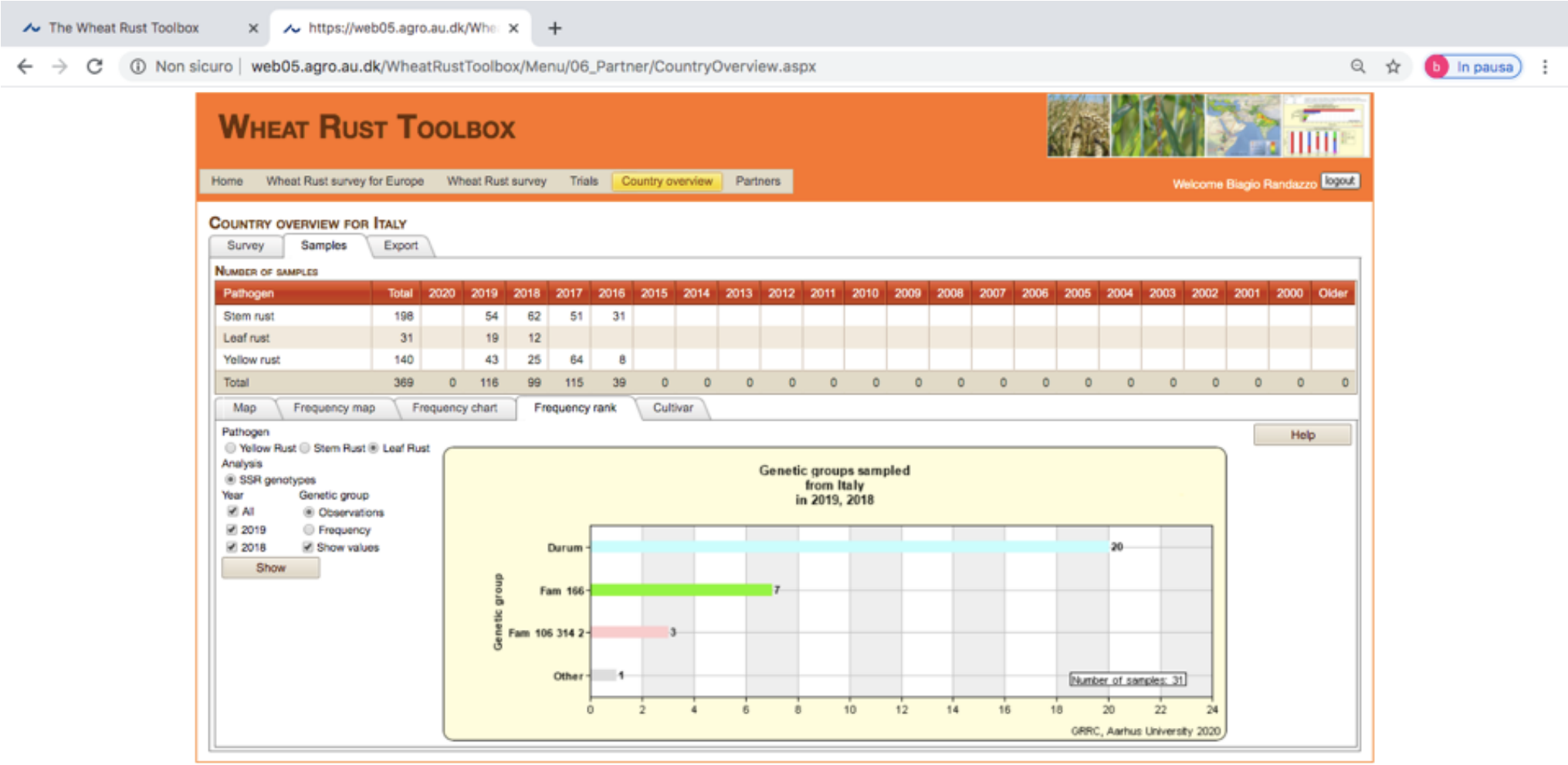


Italia: monitoraggio in peno campo - razze di ruggine gialla campionate (2016-2019)



Pathogen	Total	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	Older
Stem rust	198		54	62	51	31																	
Leaf rust	31		19	12																			
Yellow rust	140		43	25	64	8																	
Total	369	0	116	99	115	39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Italia: monitoraggio in peno campo - razze di ruggine nera campionate (2016-2019)



Italia: monitoraggio in peno campo – gruppi genetici di ruggine bruna campionate (2016-2019)