Hvedegulrust: Virulens og resistens i svenske sorter 2011-2012

Växtskydds- och växtodlingskonferensen i Linköping, Konsert & Kongress, 29 nov. 2012

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Outline

- Current Yellow rust epidemic situation in Europe and in DK/S recent years
- Corresponding virulence (race) distribution
- Swedish wheat varieties: YR susceptibility to recent races in inoculated field trials
- International networks and collaboration
- New wheat rust research initiatives

European countries with widespread YR epidemics in 2012/ high yield responses to fungicide control

Yellow rust epidemic, Sweden 2011

Yellow rust epidemic situation in Sweden and Denmark 2009-12: **Triticale**

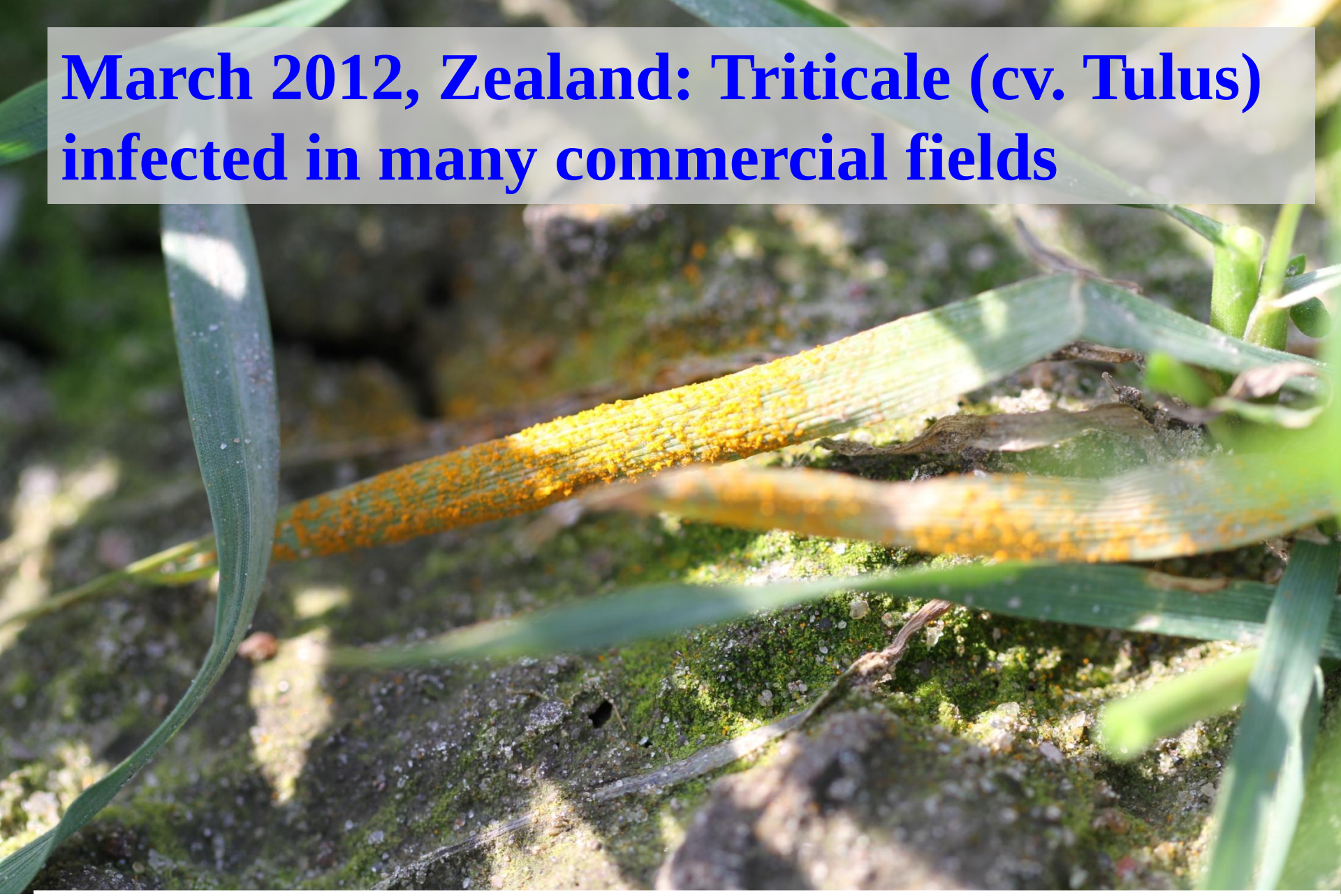
- **2009-10**
  - Sweden & Denmark: Severe epidemics and losses of 50-100% typical for organic growers in DK
  - New aggressive race was recovered from most triticale epidemic sites – many triticale varieties remained resistant, no winter wheat varieties affected by this race, but several spring wheats susceptible
- **2011**
  - Susceptible varieties generally replaced by resistant varieties (e.g., Tulus), few epidemics in 'old' varieites
- **2012**
  - March-April: High incidence of YR in Tulus and other triticale varieties, many sites in Denmark
  - May-July: Epidemics did not evolve in most varieties

Yellow rust epidemic situation in Sweden and Denmark 2009-12: **Winter wheat**

- **2009-10**
  - Sweden: Epidemics in 'Tulsa' and other susceptible varieties
  - Denmark: Low disease incidence, - in 2010 no yellow rust recorded in farmers fields
- **2011**
  - Sweden: Widespread and severe epidemics, e.g., in Tulsa, Audi, Kranich and others
  - Denmark: Epidemics in few varieites, e.g., Ambition
  - November-December: high disease incidence in many varieties
- **2012**
  - Sweden: Widespread and severe epidemics in many varieties
  - Denmark: Widespread and severe epidemics in several varieties, but widely grown varieties: Mariboss, Hereford, Jensen and others, remained resistant at adult plant stage

November 2011 Skåne/Sjælland

March 2012, Zealand: Triticale (cv. Tulus) infected in many commercial fields



Telia production on infected wheat – June 2012

Number of Pst samples, Sweden 2011-2012

	2011		2012	
Location	**Failure**	**recovery**	**Failure**	**recovery**
Borrby		1		
Asmundtorp		1		
Borgholm, Öland	1			
Borrby	4	12		
Fjälkinge				2
Furelund	4	8		
Gavle				1
Gärdstösa, Øland				1
Hossmo, Kalmar			1	2
Kalmar	3			1
Klagstorp	4	5		
Korskrog			1	
Kuddby			1	
Kulltorp, Kalmar				1
Laholm/Halland			1	1
Linköbing	1		3	2
Lundelm			3	
Mjölby		1	1	
Munga			1	
Norrköping		3		1
Ônnestad			4	2
Östra Stenby			1	
Renstad				1
Simrishamn		1		
Simrithamn, Alnarp		1		
Skegrie	8	1		
Skurup		2		
Skänninge		1	2	4
Skörne			1	
sollebrun			1	
Södertäjle			1	
tidköbing			2	
Tierp			1	
Tomelilla		2		
Tommarp	2			
Trelleborg	1	2		
Trelleborg	1			
Vasterås			3	
Vemmenhög	2	2		
Visby, Gotland	1			
Vittskåvle				1
Väderstad				2
Ängelholm	4	4		
Ödeshög				1
örsjö/Skurup			1	
Östra Ryd				2
Östra Stenby				1
Åstorp		1		
(Tom)			7	6
Total	**36**	**48**	**37**	**32**
	36	**48**	**37**	**32**

P. striiformis pathotypes detected in Denmark and Sweden 2011-2012; number of isolates

Country	Pathotype code	Common name	2010-11 season		2011-12 season			Total
			autumn	summer	autumn	spring	summer	
Denmark	-,(2),-,-,-,6,7,8,-,10,-,-,*,-,-,-,*,-,*,-,-,-	Triticale aggressive		9			2	11
	-,-,3,4,-,6,-,-,-,-,-,-,-,25,-,32,Sd,Su,-,An,Avs,-	Tulsa		1				1
	1,2,3,-,-,6,-,-,9,-,-,17,-,25,-,-,Sd,-,-,An,AvS,-	Lynx					1	1
	1,2,3,4,-,6,-,-,9,-,-,17,-,25,-,-,Sd,Su,-,An,AvS,-	Lynx variant					1	1
	1,2,3,4,-,6,-,-,9,-,-,17,-,25,-,32,Sd,Su,-,An,AvS,-	Oakley		7			4	11
	1,2,3,-,-,6,-,-,9,-,-,17,-,25,-,32,Sd,-,-,An,AvS,-	Oakley variant		2				2
	1,2,3,4,-,6,7,-,9,-,-,17,-,25,-,32,Sd,Su,Sp,An,AvS,-	?					1	1
	1,2,3,4,-,6,7,-,9,-,-,17,-,25,-,32,Sd,Su,Sp,An,AvS,Amb	Ambition/Warrior		5			2	7
	1,2,3,-,-,6,7,8,9,-,-,17,-,25,-,32,Sd,-,-,An,AvS,Amb	Kranich		5	3	9	19	36
Denmark Total				**29**	**3**	**9**	**30**	**71**
Sweden	-,(2),-,-,-,6,7,8,-,10,-,-,*,-,-,-,*,-,*,-,-,-	Triticale aggressive					4	4
	-,-,3,4,-,6,-,-,-,-,-,-,-,25,-,32,Sd,Su,-,An,Avs,-	Tulsa		2	2			4
	1,-,3,4,-,6,-,-,-,-,-,-,-,25,-,32,Sd,Su,-,An,AvS,-	Tulsa variant		1				1
	1,2,3,-,-,6,7,8,9,-,-,17,-,25,-,32,Sd,-,-,An,AvS,Amb	Kranich		18	10		4	32
	1,2,3,4,-,6,7,-,9,-,-,17,-,25,-,32,Sd,Su,Sp,An,AvS,Amb	Ambition/Warrior		1			1	2
Sweden Total				**22**	**12**		**9**	**43**
Grand total				**51**	**15**	**9**	**39**	**114**

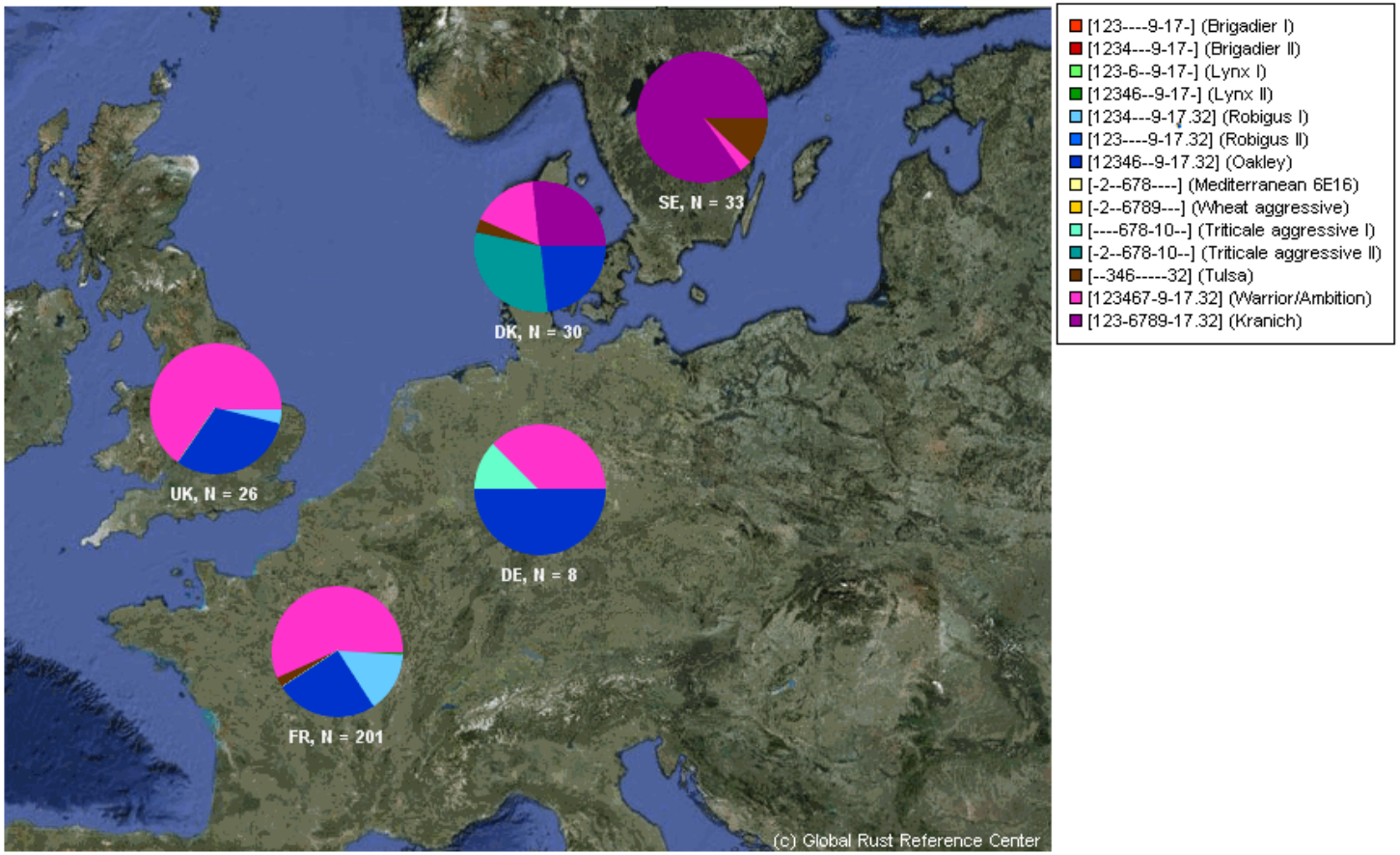
PATHOTYPE BY YEAR MAP

Year

Show

All 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011

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)

Pathotype code	Common name of race	Host variety	2010-11 season autumn	2010-11 season summer	2011-12 season autumn	2011-12 season summer	Total
-,(2),-,-,-,6,7,8,-,10,-,-,*,-,-,-,*,-,*,-,-,-	Triticale aggressive	Cando				2	2
		Dinaro				2	2
-,-,3,4,-,6,-,-,-,-,-,-,-,25,-,32,Sd,Su,-,An,Avs,-	Tulsa	Brons			1		1
		Jensen			1		1
		Kopral	1				1
		Olivin	1				1
1,-,3,4,-,6,-,-,-,-,-,-,-,25,-,32,Sd,Su,-,An,AvS,-	Tulsa variant	Akteur	1				1
1,2,3,-,-,6,7,8,9,-,-,17,-,25,-,32,Sd,-,-,An,AvS,Amb	Kranich	Akteur	2				2
		Audi	5			1	6
		Boomer			2		2
		Cardos	2				2
		Cubus			1		1
		Cumulus			1		1
		Ellvis			2		2
		Hereford			1		1
		Holeby	1				1
		Kr 99 224				1	1
		Kranich	6		2	1	9
		Loyal			1		1
		Oakley	2				2
		Stava				1	1
1,2,3,4,-,6,7,-,9,-,-,17,-,25,-,32,Sd,Su,Sp,An,AvS,Amb	Ambition/Warrior	Audi	1				1
		Sequence				1	1
Total			**22**		**12**	**9**	**43**

P. striiformis pathotypes detected in Sweden 2011-2012; number of isolates

Pathotype code	Common name of race	Location	2010-11 season autumn	2010-11 season summer	2011-12 season autumn	2011-12 season summer	Total
-,(2),-,-,-,6,7,8,-,10,-,-,*,-,-,-,*,-,*,-,-,-	Triticale aggressive	Hossmo, Kalmar				2	2
		Östra Ryd				2	2
-,-,3,4,-,6,-,-,-,-,-,-,-,25,-,32,Sd,Su,-,An,Avs,-	Tulsa	Skurup		1			1
		Skänninge		1			1
		Ängelholm			1		1
		Klagstorp			1		1
1,-,3,4,-,6,-,-,-,-,-,-,-,25,-,32,Sd,Su,-,An,AvS,-	Tulsa variant	Skurup		1			1
1,2,3,-,-,6,7,8,9,-,-,17,-,25,-,32,Sd,-,-,An,AvS,Amb	Kranich	Borrby		9	3		12
		Asmundtorp		1			1
		Furelund			2		2
		Norrköping		3		1	4
		Klagstorp			1		1
		Skegrie			1		1
		Simrishamn		2			2
		Skänninge				1	1
		Tomelilla		2			2
		Trelleborg		1			1
		Trial station Lönnstorp				1	1
		Vemmenhög			2		2
		Ängelholm			1		1
		Ödeshög				1	1
1,2,3,4,-,6,7,-,9,-,-,17,-,25,-,32,Sd,Su,Sp,An,AvS,Amb	Ambition/Warrior	Kulltorp, Kalmar				1	1
		Åstorp		1			1
Grand total				**22**	**12**	**9**	**43**

Inoculated field trials

Middel af % severity		Ambition race			Lynx race			Kranich race		
Variety	Crop	30-05-12	12-06-12	28-06-12	30-05-12	12-06-12	28-06-12	30-05-12	12-06-12	28-06-12
Ambition	W wheat DK	20,0	50,0	50,0	0,2	(4,5)	(15)	15,0	41,7	45,8
Hereford	W wheat DK	0,0	0,1	0,2	0,0	0,0	0,0	0,5	1,3	2,3
JB Asano	W wheat DK	33,3	30,8	41,7	0,0	2,0	13,3	29,2	29,2	50,0
Jensen	W wheat DK	0,2	0,3	0,3	0,0	0,0	0,0	0,2	0,5	1,0
Mariboss	W wheat DK	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Audi	W wheat Se	20,0	45,8	41,7	0,5	(4,5)	(22,5)	20,0	45,8	58,3
Beate (SW 57008)	W wheat Se	0,1	1,7	2,3	0,0	0,0	0,3	1,7	12,5	9,3
Boomer	W wheat Se	0,0	0,0	0,3	0,0	0,0	0,2	0,1	2,8	4,0
Br 8037b26	W wheat Se	1,4	3,7	2,7	0,0	0,0	0,0	4,3	7,5	7,5
Brons (SW 56884)	W wheat Se	0,0	0,2	0,0	0,0	0,0	0,0	0,7	0,4	0,0
Cumulus	W wheat Se	26,7	45,8	66,7	0,2	3,0	(29,2)	25,0	50,0	66,7
Ellvis	W wheat Se	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2
Frontal	W wheat Se	0,1	4,3	3,7	0,0	2,3	0,5	1,5	17,5	10,0
HADM Norin	W wheat Se	0,5	2,3	3,0	0,2	0,5	3,7	5,8	11,7	25,0
HADM Opal	W wheat Se	0,0	0,0	0,3	0,0	0,0	0,3	0,0	0,0	0,0
Hymack	W wheat Se	0,2	13,3	10,0	0,7	10,0	7,0	12,7	33,3	29,2
Inspiration	W wheat Se	6,0	6,7	4,3	2,0	2,2	4,3	7,0	15,0	18,3
Kerubino	W wheat Se	20,0	29,2	33,3	0,2	1,5	(17,5)	29,2	41,7	50,0
Kranich	W wheat Se	3,0	6,7	3,7	0,0	0,1	4,3	10,8	15,0	20,0
Loyal	W wheat Se	0,8	6,7	4,3	0,0	0,1	4,0	3,7	14,2	12,5
Nimbus	W wheat Se	1,7	25,0	20,0	0,0	0,7	4,0	2,3	20,0	20,0
Olivin	W wheat Se	0,5	0,3	0,3	3,7	2,2	0,7	2,3	3,0	11,0
Opus	W wheat Se	1,0	3,0	1,0	0,3	2,0	0,5	1,4	4,3	7,7
Praktik (RAGT 10	W wheat Se	0,1	0,7	0,7	0,7	0,8	0,2	1,7	3,7	2,3
Razzano	W wheat Se	0,7	15,0	15,0	2,3	14,2	6,7	5,8	25,0	22,5
Stigg	W wheat Se	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
SW 75107	W wheat Se	0,4	0,3	0,0	0,0	0,0	0,2	0,7	1,7	0,7
SW 75127	W wheat Se	0,2	4,3	2,3	0,0	0,1	1,7	2,3	10,8	11,7
SW Harnesk	W wheat Se	0,1	0,4	0,0	0,0	0,2	0,0	0,3	1,0	1,0
Average		4,7	10,2	10,6	0,4	1,4	1,8	6,4	14,1	16,8

Middel af % severity		Ambition race			Lynx race			Kranich race		
Variety	Crop	30-05-12	12-06-12	28-06-12	30-05-12	12-06-12	28-06-12	30-05-12	12-06-12	28-06-12
BR 1351b2	Triticale	4,3	7,5	20,0	0,0	2,0	3,5	1,7	1,7	6,7
Br 1390a27	Triticale	0,3	2,3	10,0	0,0	0,0	0,7	0,0	0,0	1,0
Empero	Triticale	0,4	3,0	5,0	0,0	0,0	0,3	0,1	0,3	0,3
Gringo	Triticale	1,3	10,0	20,0	0,0	0,5	1,0	0,2	0,5	3,7
MAH 5809	Triticale	1,5	5,2	15,0	0,0	0,2	2,8	0,1	0,7	1,7
Ragtac	Triticale	0,4	3,7	29,2	0,0	0,1	2,3	0,4	1,7	13,3
SW Valentino	Triticale	1,5	3,0	10,0	0,0	0,4	5,0	0,8	1,7	12,5
Tulus	Triticale	0,8	3,7	20,0	0,0	0,0	0,5	0,0	0,0	0,5
Average		1,3	4,8	16,1	0,0	0,4	2,0	0,4	0,8	4,9

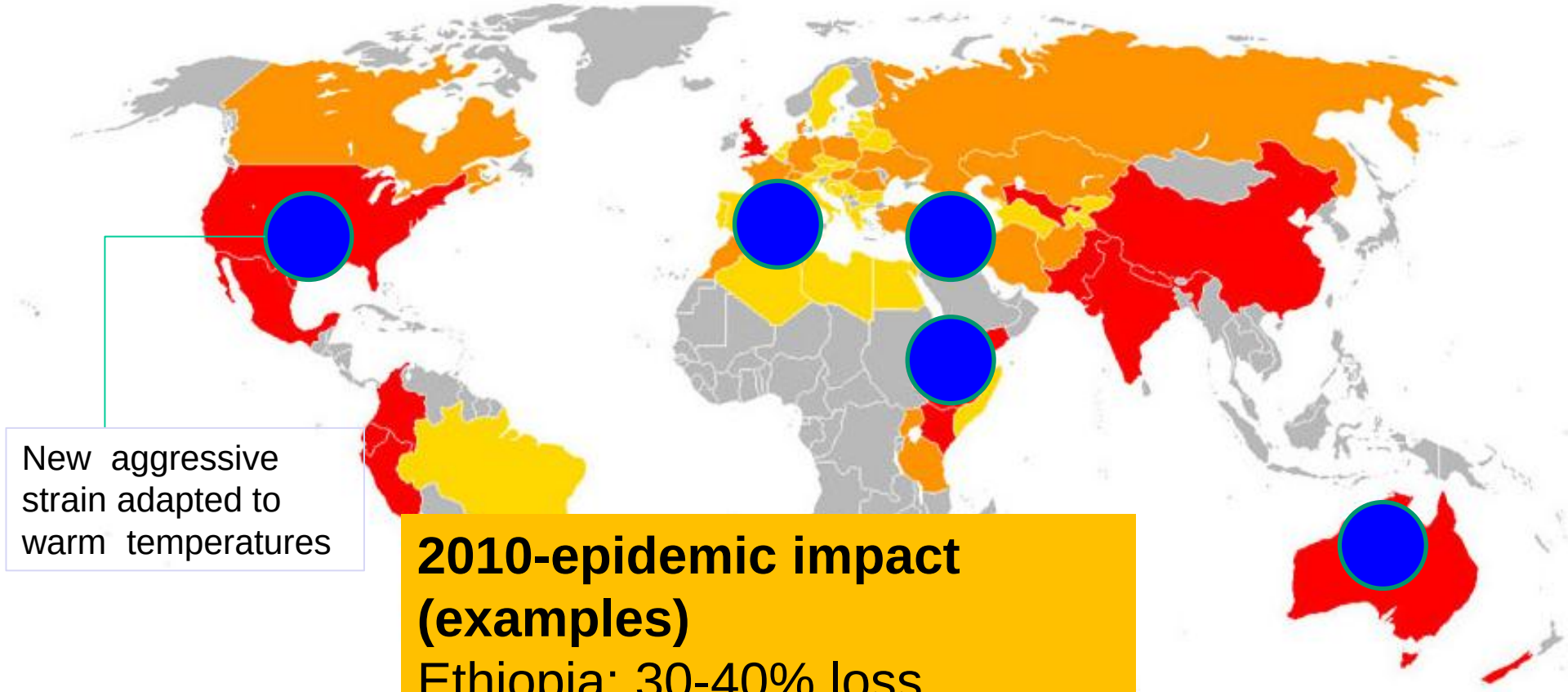
March 2012, Zealand: Triticale (cv. Tulus) was infected in many commercial fields

Samples were collected from multiple locations in Denmark

- Only isolates of the Kranich-race were recovered
- April: new infections in affected crops were widespread but limited sporulation
- May-June: Epidemics never developed in Tulus-triticale

Triticale (cv. Tulus), inoculated by isolates of the Kranich-race, Flakkebjerg, June 12, 2012

Impact of wheat yellow rust globally



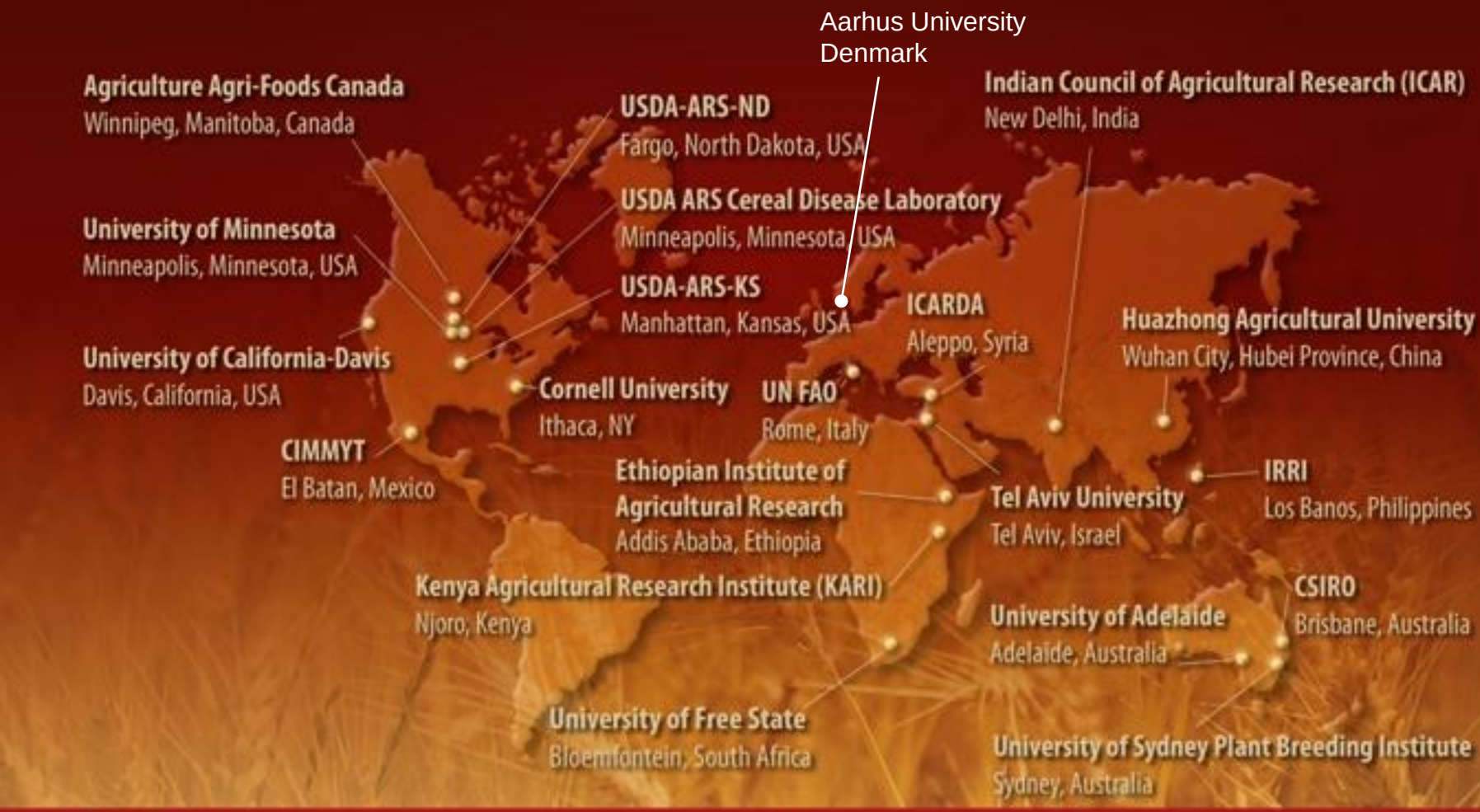
New aggressive strain adapted to warm temperatures

2010-epidemic impact (examples)
Ethiopia: 30-40% loss
Tajikistan: 40-50% loss

(Wellings, 2011: Euphytica

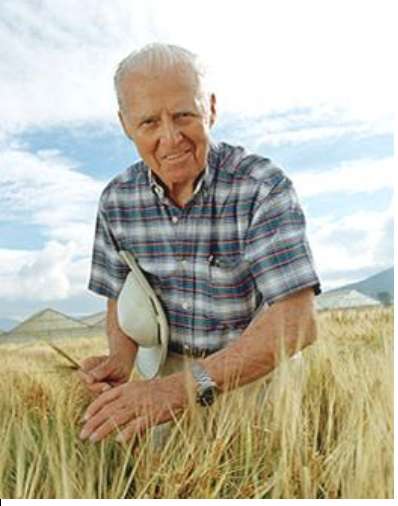
Code	Incidence	Severity
	Rare	negligible losses
	Localised, 2 in 5 years over 25% growing areas	1-5% crop losses
	Widespread 2 or 3 years in 5 over whole production region	5-10% crop losses

The Borlaug Global Rust Initiative Network & Global Rust Reference Center



Tine Thach
Aarhus University October 11, 2012

BGRI
Borlaug Global Rust Initiative



BGRI
Borlaug Global Rust Initiative

Projects

Multinational efforts required

1. Intensify wheat rust surveillance (early warning)
2. Research in the evolution of rust fungi
3. Intensify plant breeding
4. Capacity building and training of scientists from developing countries
5. Rapid dissemination of results via web-based tools

Rapid communication via Net-based solutions: Wheat Rust Toolbox

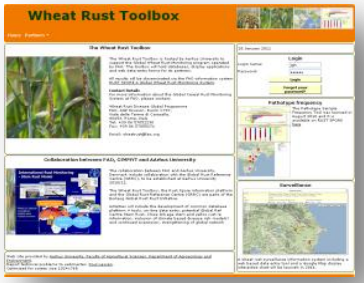
Jens Grønbech Hansen (2012):

EuroWheat

GRRC

RustTracker

Wheat rust toolbox

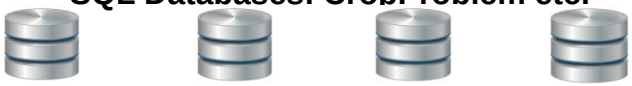


Models and applications layer [.NET]

XML, CSV

Exchange and integration with external platforms

SQL Databases: CropProblem etc.



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Large international grant for research in wheat rust

A sum of 40 m USD has found its way to research to fight wheat stem (black) rust, a serious fungal disease threatening wheat productivity. The grant was awarded by the Bill & Melinda Gates Foundation in the USA and the UK Department for (DFID). A share of the funds will go to scientists from the Department of Integrated Pest Management at Aarhus University to expand activities at the Global Rust Reference Centre (GRRC), which is located at the department in Flakkebjerg near Copenhagen, Denmark.

Read more

COLLABORATION WITH ICARDA AND CIMMYT

The centre was established in 2008 as a global hub for investigating wheat rust upon the request of the international institutions International Maize and Wheat Improvement Center (CIMMYT), based in Mexico, and International Center for Agricultural Research in the Dry Areas (ICARDA), which is based in Syria. With the new grant the activities at the reference centre will expand markedly.

An International wheat stripe rust symposium was organised by

RUSTFIGHT - MEETING THE NEW CHALLENGES FROM INFECTIOUS RUST FUNGI ON CROP PLANTS

The Danish Research Council for Strategic Research is contributing 19.8m DKK to a new research project to be led by Aarhus University. The results from the project will bring more knowledge to the prevention and control of wheat rust.

The Danish Council for Strategic Research

The research will be a collaboration between The Global Rust Reference

The Borlaug Global Rust Initiative

Borlaug Global Rust Initiative

The Borlaug Global Rust Initiative (BGRI), founded by the late Dr. N.E. Borlaug, has the overarching objective of systematically reducing the world's vulnerability to stem, yellow, and leaf rusts of wheat and facilitatingg the evolution of a sustainable international system to contain the threat of wheat rusts and continue the enhancements in productivity required to withstand future global threats

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YELLOW RUST EUROPE

In Europe new multivirulent strains appeared in at least four NW-European countries in 2011: UK, France, Denmark, Sweden. Several wheat varieties became affected and the new strains seems to be very aggressive based on field observations. It is first time ever recorded in Europe that a single strain emerges at this geographical scale in high frequencies in the same growing season, suggesting large scale long-distance aerial spore dispersal autumn 2010/ spring 2011 from an unknown source

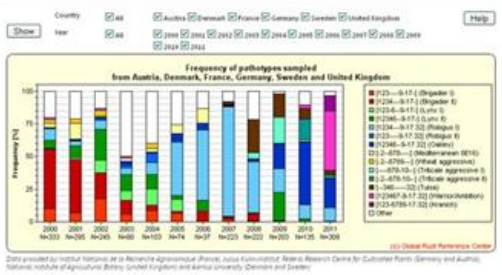
Four PCR-based markers uniquely identifying aggressive strains PstS1/ PstS2 and differentiating these from other known Pst strains are being developed at the Global Rust reference Centre. For isolates collected in Denmark and Sweden, preliminary results suggest that the new strain may be a recombinant involving aggressiveness.

Below is link to different tools that analyse and display information about the historical and current distribution and importance of yellow rust in Europe. Use the link below the Screen dumps or select from the menu to the left.

For further information about epidemiology and control of cereal diseases in Europe see EuroWheat

YELLOW RUST SWEDEN, 2011

PATHOTYPE BY COUNTRY



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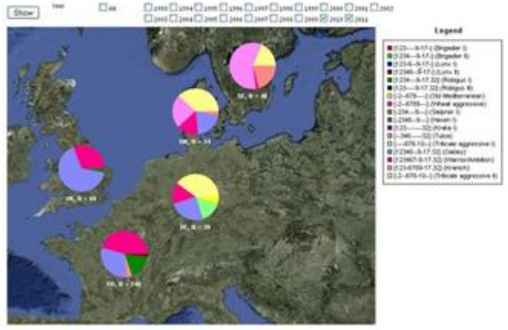

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STEMRUST

Stem rust on wheat caused by race Ug99 and its variants is currently spreading across Africa, Asia and the Middle East and is causing major concern due to the large numbers of people dependent on wheat for sustenance. The strain was named after the country where it was identified (Uganda) and the year of its discovery (1999). It spread to Kenya, then Ethiopia, Sudan and Yemen, and is becoming more virulent as it spreads.Scientists are working on breeding strains of wheat that are resistant to UG99. However, wheat is grown in a broad range of environments. This means that breeding programs would have extensive work remaining to get resistance into regionally adapted germplasms even after resistance is identified.

Below is link to different tools that analyse and display information about the historical and current distribution and importance of stem rust, leaf rust and yellow rust - mainly in Africa/Central and West Asia. Use the link below the Screen dumps or select from the menu to the left.

For further information see RustSpore and Globalrust.org

CLICK ON PHOTO TO ENLARGE

PATHOTYPE FREQUENCY GRAPH

Go to this tool

PATHOTYPE BY COUNTRY

Go to this tool

PATHOTYPE BY YEAR MAP

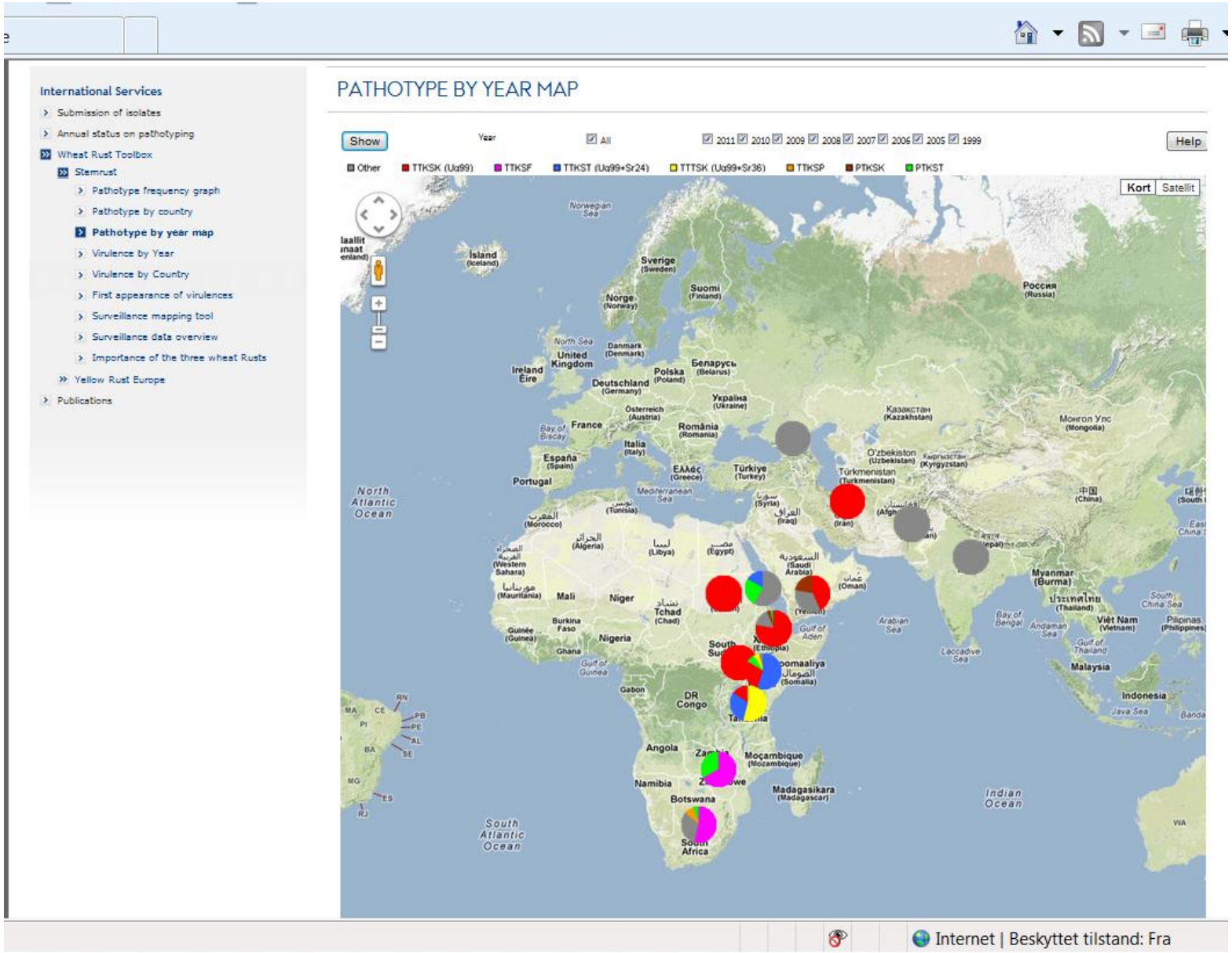
Go to this tool

VIRULENCE BY YEAR MAP

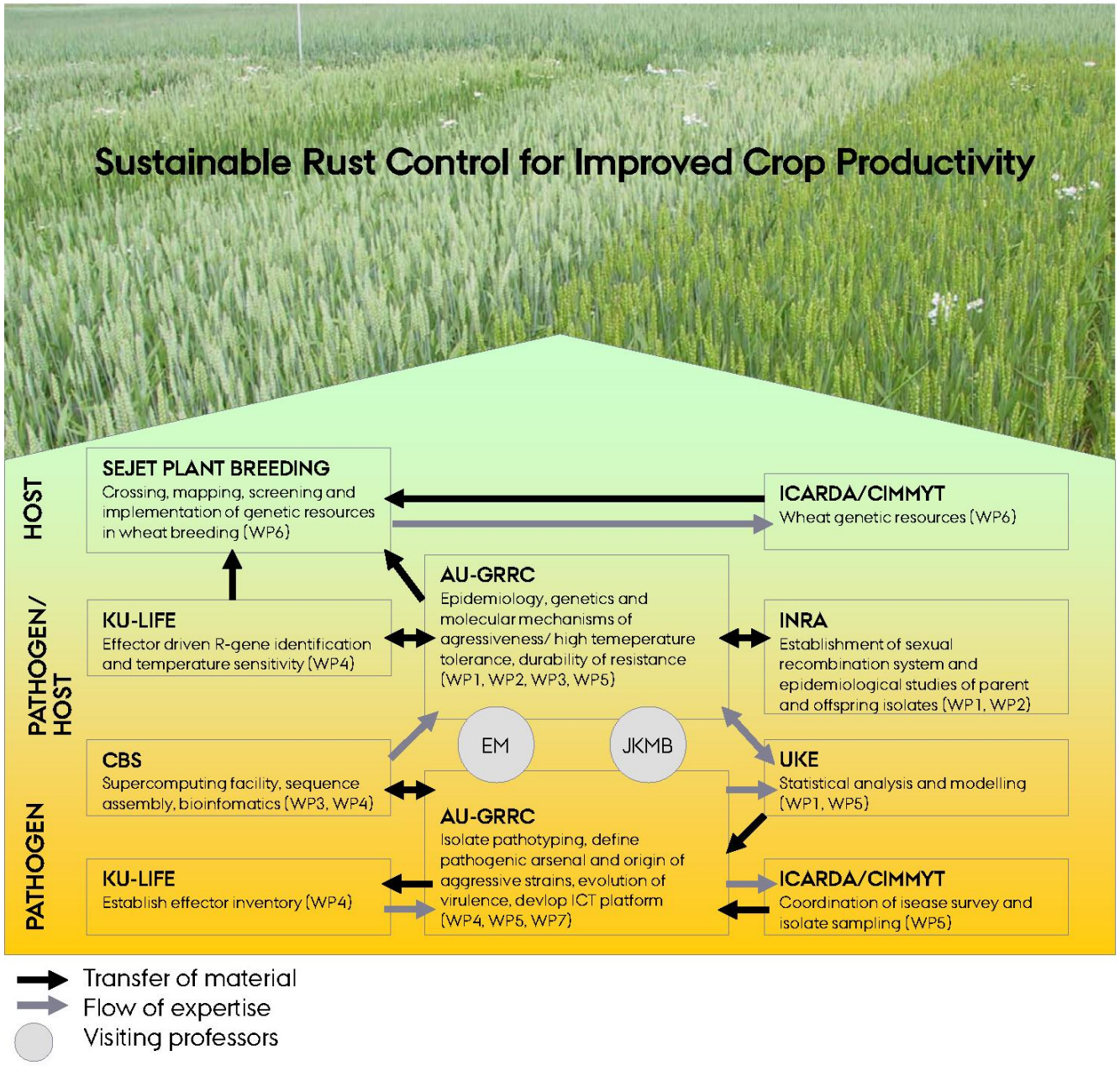
VIRULENCE BY COUNTRY

VIRULENCE FIRST APPEARANCE

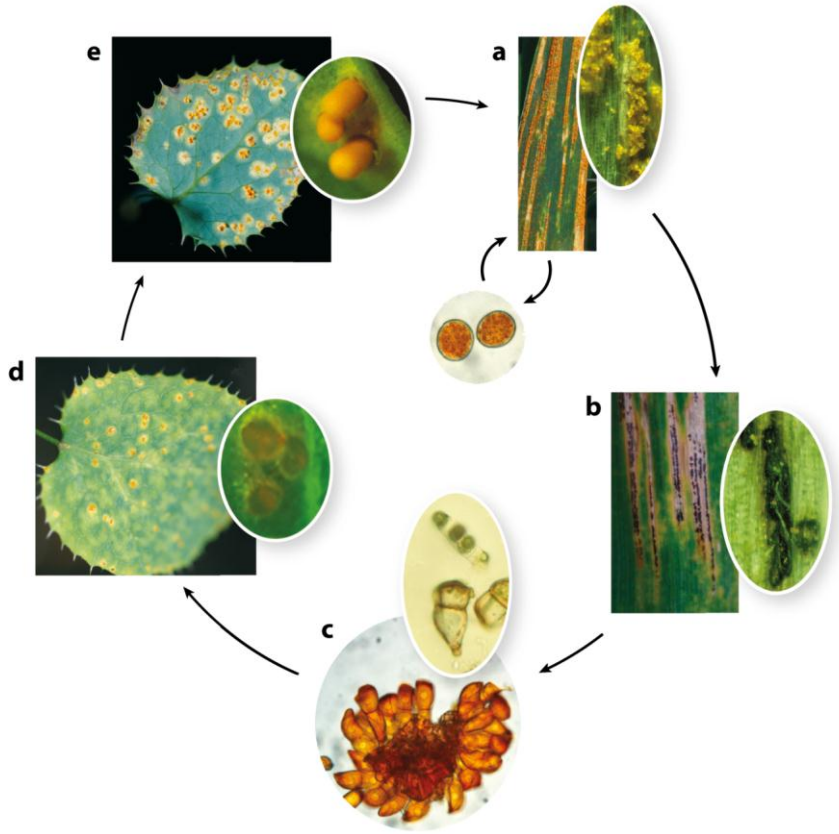
Internet | Beskyttet tilstand: Fra


International Services
Submission of isolates
Annual status on pathotyping
Wheat Rust Toolbox
Stemrust
Pathotype frequency graph
Pathotype by country
Pathotype by year map
Virulence by Year
Virulence by Country
First appearance of virulences
Surveillance mapping tool
Surveillance data overview
Importance of the three wheat Rusts
Yellow Rust Europe
Publications
PATHOTYPE BY YEAR MAP
Show
Year
All
2011 2010 2009 2008 2007 2006 2005 1999
Help
Other
TTKSK (Ug99)
TTKSF
TTKST (Ug99+Sr24)
TTTSK (Ug99+Sr36)
TTKSP
PTKSK
PTKST
Kort
Satellit
Internet | Beskyttet tilstand: Fra

RUSTFIGHT
DSF: 19,8 mill/ 2012-2016



Nyt samarbejde med SLU-Uppsala (Jonathan Yuen)

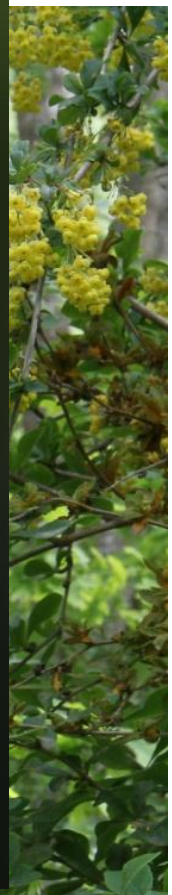


Hovmøller MS, et al. 2011.
Annu. Rev. Phytopathol. 49:197–217

Phd projekt (2011-14) med fokus på at undersøge, om Berberris vulgaris har betydning for YR epidemiologi i Sverige

Phd stud. Kerstin Gillen

Alternate host common in some areas in Europe



Samarbejdaftale med Jordbruksverket fornyet Juni 2012

Jordbruks verket

Avtal

INDGÅET
16 JULI 2012

Avtalets namn:	Fusariumarts- och fusariumtoxinanalyser i höstvete, havre och vårvetevårvete, havre, rågvete och korn. Fusariumanalyser samt virulenstudier på svenska gulrostisolat och smittoförsök med höstvetesorter. Analyser av Septoria tritici	**Referensnr:**	Dnr 25-2363/12
Upphandling:	Fusariumarts- och fusariumtoxinanalyser i höstvete, havre och vårvetevårvete, havre, rågvete och korn. Fusariumanalyser samt virulenstudier på svenska gulrostisolat och smittoförsök med höstvetesorter. Analyser av Septoria tritici	**Upph. ref.nr:**	Dnr 25-2363/12
Startdatum:	2012-06-15	**Slutdatum:**	2013-06-14
Typ av avtal:	Avtal	**Förlängning:**	1 st á 1 år

Parter:

Global Rust Reference Center (January 2012)		% of working hours 2012	
Professor	Mogens Støvring Hovmøller	100	
Seniorforsker	Annemarie F. Justesen	75	
Post doc	Stephanie Walter (indtil 2016)	100	
Post doc 2	NN (fra ultimo 2012)	100	
Post doc 3	MM (fra 2013/14)	100	
Phd stud.	Chris Sørensen (indtil 31.05.12)	100	
Phd stud.	Tine Thach (fra 01.02.2012)	100	
Phd stud.	PP (fra medio 2013)	100	
Laborant	Ellen Frederiksen	100	
Laborant	Sarah Adams	100	
Laborant	Anne-Pia Larsen	33	
Gartner	Steen Meier	50	
AC TAP	Ny fra 1.4.12 (12 mdr)	100	
Forsker	Jens Grønbech Hansen/Poul Lassen (Foulum)	9 months	

www.wheatrust.org