

## UKCPVS stakeholders meeting 2020

4 March 2020



**CEREALS & OILSEEDS** 

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#### Introduction

- UKCPVS originated in 1967 (over 50 years ago)
- Identifies changes in pathogen populations that may have an adverse effect on UK cereal production
- Communicates significant findings to the industry as soon as possible
- Jointly funded by AHDB and APHA (Defra)





#### Processes



#### Population change

#### Step 1

Identify population change Differential tests



#### Step 2

Identify risk associated with change Variety seedling and adult plant tests



## Identify change: Differential tests

Differential cultivar	Resistance gene
Chinese 166	Yr1
Kalyansona	Yr2
Vilmorin 23	Yr3+
Hybrid 46	Yr4
Heines Kolben	Yr2, Yr6
Avocet x Yr7	Yr7
Compair	Yr8
Kavkaz x 4 Fed	Yr9
Avocet xYr15	Yr15
Avocet x Yr17	Yr17
Carstens V	Yr32



### Identify change: Differential tests

		1	2	3a, 4a	3b,4b	Ŋ	9	~	7,22, 23	6,7	7,17	∞	8,19	6	10	15
Isolate code	Host	Chinese 166	Kalyansona	Vilmorin 23	Hybrid 46	Avocet Yr5	Avocet Yr6	AV x Yr 7 NIL	Lee	Cadenza	Apache	Av x Yr8 NIL	Compair	Avocet Yr9	Moro	AVS x yr15
16/009	Reflection	3.0	3.0	3.0	3.0	0.0	3.0	3.0	2.9	3.0	2.9	0.0	0.0	4.0	0.0	0.0
16/019	KWS Target	3.0	4.0	4.0	3.0	0.0	4.0	4.0	3.0	3.0	2.9	0.0	0.0	3.2	0.0	0.0
16/035	Reflection	4.0	4.0	4.0	3.0	0.0	3.2	3.0	3.0	3.2	3.0	0.0	0.0	3.0	0.0	0.0
16/048	Myriad	3.1	3.1	4.0	3.0	0.0	3.0	3.0	3.0	3.0	2.4	0.0	0.0	3.0	0.0	0.0
16/135	Cordiale	3.0	4.0	3.5	3.0	0.0	3.0	3.0	3.0	3.5	3.0	0.0	0.0	3.0	0.0	0.0
16/144	KWS Gator	3.0	4.0	4.0	3.0	0.0	3.0	3.5	3.5	3.0	2.2	0.0	0.0	3.0	0.0	0.0
16/184	Zulu	3.0	3.5	3.5	3.0	0.0	2.8	2.0	0.3	0.2	0.1	0.0	0.0	3.0	0.0	0.0

### Identify risk: Variety tests



recommended <b>lists</b>			
	LCOL	I ILINDI	

www.ahdb.org.uk/ukcpvs

Ø	UKCPVS	AHDB
-		

#### Seedling and adult plant resistance to yellow rust for winter wheat varieties

Seeding resistance is categorised using five different isolates, selected by the UK Cereal Pathogen Virulence Survey (UKCPVS), to best represent the diversity in the yellow rust population at the time of testing. A variety is classified as seediling susceptible if it is susceptible to any one of the isolates.

The adult plant resistance presented in the table is based upon the Recommended Lists (RL) yellow rust disease ratings for 2019/20, which were calculated in 2018.

As pathogen populations are diverse and can change rapidly, so can resistance status. As isolates chosen for testing are a subset of the population, actual field performance may vary. It is important that crops are monitored regularly and unexpected disease observations reported to UKCPV8.

AHDB Recommended List varieties	RL Rating 2018/19	2018/19 RL Adult plant recistance	2017 Seedling Stage Resistance	2018 Seedling Stage Recictance	
Costello	9	Resistant	Resistant	Resistant	
Crusoe	9	Resistant	Susceptible	Susceptible	
KWS Crispin	9	Resistant	Resistant	Resistant	
LG Motown	9	Resistant	Susceptible	Susceptible	
Dickens"	9	Resistant	Susceptible	Susceptible	
KWS Sickin	9	Resistant	Resistant	Resistant	
LG Sundance	9	Resistant	Susceptible	Susceptible	
RGT Illustrious	9	Resistant	Susceptible	Susceptible	
Revelation	9	Resistant	Susceptible	Susceptible	
Freiston	9	Resistant	Susceptible	Susceptible	
KWS Trinity	9	Resistant	Susceptible	Resistant	
Elcit	9	Resistant	Susceptible	Susceptible	
KWS Jackal	9	Resistant	Susceptible	Susceptible	
Elation	9	Resistant	Susceptible	Susceptible	
KWS Extase	9	Resistant		Susceptible	
LG Detroit	9	Resistant		Susceptible	
KWS Firefly	9	Resistant		Resistant	
LG Skyscraper	8	Resistant		Susceptible	
LG Spotlight	8	Resistant		Susceptible	
Savelo	8	Resistant	Susceptible	Susceptible	
Evolution	8	Resistant	Susceptible	Susceptible	
Graham	8	Resistant	Susceptible	Susceptible	
Hardwicke	8	Resistant	Susceptible	Susceptible	
KWS Barrel	8	Resistant	Susceptible	Susceptible	
KWS Basset	8	Resistant	Susceptible	Susceptible	
Moulton	8	Resistant	Susceptible	Susceptible	
Shabras	8	Resistant	Susceptible	Susceptible	
RGT Gravity	8	Resistant	Susceptible	Susceptible	
Dunston	7	Moderate resistance	Susceptible	Susceptible	
KWS Zvatt	7	Moderate resistance	Susceptible	Susceptible	
KWSTI	7	Moderate resistance	Susceptible	Suscentible	
KWS Silverstone"	7	Moderate resistance	Susceptible	Susceptible	
Souder		Moderate resistance	Susceptible	Susceptible	
KWS Kerrin	7	Moderate resistance	Susceptible	Susceptble	
KWS Santiago"	7	Moderate resistance	Susceptible	Susceptible	
Gleam	7	Moderate resistance	Susceptible	Susceptible	
Leeds	5	Moderate resistance	Susceptible	Susceptible	
Viscount	6	Moderate resistance	Susceptible	Susceptible	
Bennington	-	Moderate resistance	Susceptible	Suscenthie	
Grafton"	6	Moderate resistance	Susceptible	Susceptible	
Skyfall	i i	Moderate resistance	Susceptible	Susceptble	
7.00		Suscentible	Susceptible	Susceptible	
IB Diego		Susceptible	Susceptible	Susceptible	
Continie"	4	Susceptible	Susceptible	Susceptible	
Uvriad		Susceptible	Susceptible	Susceptible	
Reflection 1		Gusceptule	Cussettile	Gusceptule	
Kenecoon -	3	Susceptible	Susceptible	Susceptible	

#### Identify risk: Adult plant trials

Five representative races trialled on Recommended Lists (RL) varieties and candidates





# Wheat yellow rust

Amelia Hubbard





### Background

- Incursion of Warrior group in 2011
- Highly diverse population
- Some changes seen in varietal performance (e.g. KWS Zyatt), although not consistent across the country



#### Race naming system: Colours and numbers



#### Pathotype = virulence profile

Lists the virulence genes the isolate carries and any additional test cultivars infected at seedling stage. For example:

![](_page_12_Figure_2.jpeg)

This time last year...

#### Adult plant trials (2019)

Five representative races from the 2018 survey trialled on RL varieties and candidates in 2019 field trials

![](_page_14_Picture_2.jpeg)

### Adult plant trial isolates (2019)

Isolate	Host	Name	Pathotype
18/002	Reflection	Red 27	1,2,3,4,6,7,9,17,25,32,Re,Sp,Ro,So,Ca,Ap,Ev
18/003	Victo	Red 60	1,2,3,4,6,7,9,17,25,32,Re,Sp,Ro,So,Ev
18/009	Leeds	Purple 5	1,2,3,4,6,7,9,17,25,32,Sp,Ro,So,Ca,Ap
18/030	Revelation	Red 47	1,2,3,4,6,7,9,17,25,32,Sp,Ro,So,Wa,Ca
18/065	JB Diego	Red 43	1,2,3,4,6,7,9,17,25,32,Sp,Ro,So,Wa,Ca,Ap

### Adult plant trials (2019)

- RL variety with the highest disease level was Zulu, but the susceptible controls – Robigus, Solstice and Reflection – were much higher
- Many RL varieties showed very good resistance (the majority of the ones rated 7–9)
- Some RL varieties reacted to just one of the five isolates tested Elysium, KWS Basset, KWS Kinetic, LG Spotlight, KWS Kerrin and KWS Zyatt

#### Variety seedling tests (with 2018 Isolates)

Variety	Red 27	Red 60	Purple 5	Red 47	Red 43	Variety	Red 27	Red 60	Purple 5	Red 47	Red 43
Costello	0.0	0.0	0.0	0.0	0.0	KWS Jackal	2.2	1.9	0.8	0.1	0.0
Elation	3.0	2.2	3.0	3.0	2.8	KWS Siskin	0.0	0.0	0.0	0.0	0.0
Elicit	3.0	3.0	3.0	3.0	2.8	LG Detroit	3.0	2.1	0.5	0.1	0.3
Graham	3.0	2.9	3.0	3.0	3.0	LG Motown	2.4	2.9	3.0	2.3	2.3
KWS Barrel	2.5	2.4	2.9	3.0	2.7	LG Skyscraper	3.0	2.8	3.0	3.0	1.9
<b>KWS Basset</b>	3.0	3.0	3.0	4.0	3.0	LG Spotlight	4.0	3.0	3.0	3.0	3.9
KWS Crispin	0.0	0.0	0.0	0.0	0.0	LG Sundance	2.9	2.0	3.0	3.0	2.9
KWS Extase	3.0	0.0	0.0	0.4	0.0	RGT Gravity	3.0	0.1	2.9	2.4	0.0
KWS Firefly	0.2	0.1	0.0	0.0	0.0	<b>RGT Illustrious</b>	1.9	1.9	1.3	0.9	0.3

#### Variety seedling tests (with 2018 Isolates)

- All varieties susceptible at the seedling stage to at least one race, except Costello, KWS Crispin, KWS Firefly, KWS Jackal, KWS Parkin, KWS Siskin, RGT Illustrious, RGT Saki and Theodore
- KWS Firefly also showing with very good resistance at seedling stage

• Please get in touch, if yellow rust is seen on these varieties at any growth stage

Samples (2019)

## Samples received (2019)

- 243 samples
- 31 counties (+2 unknown)
- 56 varieties (+1 unknown)

![](_page_20_Figure_4.jpeg)

#### Samples received (2019)

KWS 

 Invicia
 KWS Kilburn

 KWS Willow
 Robigus

 SY118301
 Wullow

 Revelation
 Costello

 Bennington
 RGT LanternOlympus

 Revelation
 Costello

 Bennington
 RGT LanternOlympus

 CT
 Wasabi

 KWS
 KWS

Invicta B 3 Diego 🔒 Viscount Victo SY Insitor KWS Barrel Dunston Elysium フ Stigg KWS Lili Firefly Cordiale 🗲 raduate Saki Spotlight LG RW41648 Claire Kinetic Spyder Relay Shabras थ् Gravity Reflection Malunas 🛱 NS Santiago Skyfall KWS W358 LG Skyscraper llustrious KWS Basset LG Rhythm RGT Blossom **KWS Extase KWS Cochise KWS Siskin** Elicit

#### Samples received (2019)

![](_page_22_Figure_1.jpeg)

#### Wheat yellow rust virulence frequencies

![](_page_23_Figure_1.jpeg)

No Virulence detected for Yr5, Yr10 or Yr15

#### Wheat yellow rust virulence frequencies

![](_page_24_Figure_1.jpeg)

#### Common pathotypes detected in 2019

"Race" name	Pathotype	% Frequency
Red 24	1,2,3,4,6,7,9,17,25,32,Re,Sp,Ro,So,Wa,Ca,St,Ap,Ev	10
Red 5	1,2,3,4,6,7,9,17,25,32,Re,Sp,Ro,So,Ca,Ap	6
Red 8	1,2,3,4,6,7,9,17,25,32,Sp,Ro,So,Ca	6
Red 9	1,2,3,4,6,7,9,17,25,32,Sp,Ro,So	6
Red 36	1,2,3,4,6,7,9,17,25,32,Re,Sp,Ro,So,Wa,Ca,St,Kr,Ap	6
Red 39	1,2,3,4,6,7,9,17,25,32,Sp,Ro,So,Wa,Ca,St,Kr,Ap	6

#### New pathotypes detected in 2019

Race name	Pathotypes
	1,2,4,6,7,9,17,25,32,Re,Sp,Ro,So,Wa,Ca,St,Kr,Ap,Cr
	1,2,3,6,7,9,17,25,32,Re,Ro,So,Wa,Ca,St,Kr,Ap,Cr
	1,2,3,4,6,7,9,17,25,32,Re,Sp,Ro,So,Wa,Ap,Ev
Awaiting	1,2,3,4,6,7,9,17,25,32,Sp,Ro,So,Wa,St,Ap,Ev
	1,2,3,4,6,7,9,17,25,32,Sp,Ro,So,Wa
genotype	1,2,3,4,6,7,8,9,17,25,32,Re,Sp,Ro,So,Ca,St,Ap
data	1,2,4,6,7, <b>8</b> ,9,17,25,32,Sp,Ro,So,Wa,St, <b>Kr</b>
	1,2,3,4,6,7, <mark>8</mark> ,9,17,25,32,Sp,Ro,So,Ca
	2,3,4,6,7,8,17,25,32,Sp,Ro,So,Ca,St
	2,3,4,6,7, <b>8</b> ,17,25,32,Ro,So,Ca

10 new isolates Virulence for Yr8, Kranich and Crusoe

#### New pathotypes detected in 2019

Race name	Pathotypes
_	1,2,4,6,7,9,17,25,32,Re,Sp,Ro,So,Wa,Ca,St,Kr,Ap,Cr
	1,2,3,6,7,9,17,25,32,Re,Ro,So,Wa,Ca,St,Kr,Ap,Cr
	1,2,3,4,6,7,9,17,25,32,Re,Sp,Ro,So,Wa,Ap,Ev
Awaiting	1,2,3,4,6,7,9,17,25,32,Sp,Ro,So,Wa,St,Ap,Ev
	1,2,3,4,6,7,9,17,25,32,Sp,Ro,So,Wa
genotype	1,2,3,4,6,7,8,9,17,25,32,Re,Sp,Ro,So,Ca,St,Ap
data	1,2,4,6,7,8,9,17,25,32,Sp,Ro,So,Wa,St,Kr
	1,2,3,4,6,7,8,9,17,25,32,Sp,Ro,So,Ca
$\rightarrow$	2,3,4,6,7,8,17,25,32,Sp,Ro,So,Ca,St
$\rightarrow$	2,3,4,6,7,8,17,25,32,Ro,So,Ca

Host: KWS Firefly

Host: KWS Zyatt

#### Hereford race?

- Hereford race PstS12 designated by the GRRC
- Pathotype with avirulence for Yr1 and Yr9, virulence for Yr8
- 2,3,6,7,8,17,25,32,AvS
- Seen at low frequency in Sweden in 2015-17

Impact at adult plant stage?

## Distribution of new pathotypes

![](_page_29_Figure_1.jpeg)

### New pathotypes found in 2019

- 10 new pathotypes
- More isolates having a reaction on Yr8, Kranich and Crusoe
- Some isolates appear to be avirulent on Yr1 and Yr9 with virulence for Yr8
- No correlation between pathotype and location

![](_page_30_Picture_5.jpeg)

#### Genetic groups (2018)

![](_page_31_Picture_1.jpeg)

![](_page_31_Figure_2.jpeg)

No isolates were detected from pink or blue groups

#### Genetic groups: six-year summary

![](_page_32_Figure_1.jpeg)

#### Adult plant resistance

- Varietal resistance is one of the best ways to reduce yield loss associated with yellow rust
- Resistance can be all stage or operate only at the adult plant stage
- Mechanisms are poorly understood
- May be influenced by environment or may require enough plant tissue in order to be effective
- Will differ between varieties and across season
- Definitely active once flag leaf emerges

#### Race changes and ratings

• RL ratings calculated using data from three years, across the country

• New races can emerge sporadically and may not be uniformly distributed

 2016: Changes in varietal performance seen across the country: ratings based on one year of data only

 2019: Changes in varietal performance more sporadic: ratings based on three years of data. Expect new pathotypes to spread in 2020. This spread will be captured in the RL 2021/22 ratings

#### Wheat yellow rust disease resistance ratings

**2020/21 disease resistance ratings** 

![](_page_35_Picture_2.jpeg)
#### New RL ratings (table footnote)

- RL20/21 ratings have a box around the wheat yellow rust (and brown rust) ratings
- Higher than expected levels of disease in some trials
- No dramatic changes in average disease ratings
- Not yet clear if reported cases of high rust indicate initial emergence of new rust races or high disease pressure
- Highly dynamic nature of the rusts means all varieties should be closely monitored
- Local rust populations may differ from general UK population

#### RL untreated trials (2019)



Graham 8 KWS Zyatt 7

#### Changes in RL variety ratings

- Only three varieties have gone down by one point
- No varieties have increased in rating
- Newly Recommended varieties RGT Saki and Theodore have very high resistance ratings of 9

Variety	2019/20	2020/21
KWS Zyatt	8	7
Bennington*	6	5
Viscount*	7	6

\* No longer in trials



#### RL winter wheat candidates (harvest 2020)

Variety	Previous/ proposed name	Rating	Variety	Previous/ proposed name	Rating
LG Seeker	LGWU149	7	LG Tapestry	LGWU148	9
LG Prince	LGWU153	9	<b>KWS Plectrum</b>	KWSW358	7
LG Illuminate	LGWU144	9	RGT Quicksilver	RW41783	9
LG Astronomer	LGWU143	9	BAW55	Swallow	-
EW6364	Merit	-	KWS Cranium	KWSW360	9
LG Quasar	LGWU151	8	SY Clipper	SY117710	-
RGT Galactus	RW41785	8	BAW57	Banquo	-
			EW5475B	Astound	-

**RGT** Wolverine

RGT Silversurfer RW41789

RW41740

Wheat yellow rust

7

9

### What next?

#### Adult plant trials (2020)

Isolate	Host Variety	Pathotype
19/010	KWS Zyatt	2,3,4,6,7,8,17,25,32,Ro,So,Ca
19/165	KWS Zyatt	2,3,4,6,7,8,17,25,32,Sp,Ro,So,Ca,St
19/038	Shabras	1,2,4,6,7,8,9,17,25,32,Sp,Ro,So,Wa,S,Kr
19/119	KWS Firefly	1,2,3,4,6,7,9,17,25,32,Sp,Ro,So,Wa,St,Ap,Ev
19/215	KWS Extase	1,2,4,6,7,9,17,25,32,Re,Sp,Ro,So,Wa,Ca,St,Kr,Ap,Cr

#### Samples (2020)

- Have we seen any rust? Reports/samples?
- 20/001

Host: Graham

Location: Shropshire

Sampled: Autumn 2019

• Pathotype

1,2,3,4,6,7,9,17,25,32,Sp,Ro,So,Ap



#### Wheat yellow rust summary

• New isolates identified, although their impact is yet to be assessed

- 63% of current RL are highly rated (ratings of 8 or 9)
- Unusual foci/epidemics could be first indication of something new

• Keep us updated via email or phone



## Wheat brown rust

Sarah Wilderspin





#### Background

• Surveillance started later than other cereal diseases in 1973

- At the start of the survey there were limited options for resistant varieties to brown rust (e.g. Clement)
- In 2014, the *Puccinia triticina* population overcame the moderate resistance in Crusoe

Samples (2018)

#### Adult plant trials

Isolate	Host variety	Pathotype
18/001	KWS Siskin	2c,3a,3bg,3ka,10,13,14a,15,16,17,20,23,(26),37,Cr
18/011	Graham	3a,3bg,3ka,10,13,14a,15,17,20,23,(26),37,Cr
18/030	Buster	1,2c,(3a),3bg,3ka,10,13,14a,15,17,20,(24),(26),37,Cr
18/038	KWS Zyatt	1,(3a),3bg,3ka,10,13,14a,15,16,17,20,23,(26),37,Cr
18/041	KWS Santiago	1,3a,3bg,3ka,10,13,14a,15,16,17,20,23,(26),(28),37,Cr

#### Adult plant trial results



#### Variety seedling test results

Seedling tests inoculated with same five isolates as those inoculated in the field



Samples (2019)

#### Samples received (2019)

- 55 samples
- 9 counties
- 28 varieties



#### Timescale of samples received



#### Virulence frequencies: Five-year summary



28 isolates tested

#### Virulence frequencies: 2017-19



28 isolates tested

#### Pathotype frequency



28 isolates tested

Pathotype

#### New pathotypes



new pathotypes

existing pathotypes

#### KWS Firefly – RL rating

Winter wi	heat 2019/20																																	
Yield, agronomy	omy and disease resistance																																	
AHDB	AHDB Recommended List																																	
RECOMMENDED	Winter wheat 2020/21																																	
	Yield, agronomy and disease resistance																																	
End-use group	AHDB																																	1
Scope of recommend	RECOMMENDED	all.			striout	ctase	skin	iii	_	refly	E	1000				light	<b>cka</b>		u de	dance	umo	-	5	5	netic		dive	utin		_	je e			OS1 o
Fungicide-treated gra		(z sw	kyfal	2 UISOB	SGT III.	WSE	WS SI	6 Det	U SWO	WSFI	WS B	alcit WS Ba	3	o Skv	NGT Se	G Spo	ar sw	lation	, in the second	G Sun	G Mot	liscoun	a ve la	Y Insit	WS KO	mean	GT Gr	WS K	habra	at a second	WS O	unstor	ostelic	verag
United Kingdom (11.2	End-use group Scope of recommendation	UK I	nabim C	Group	1 UK	LIK I	abim G	roup 2	TIK X	× UK	nabim	I Group 3	K 11K	-	K UK	K UK	×	Sof	t Group	4 11K 1		N	UK	UK	UK X	UK	LIK	Hard	Group	4 11K 1	x F		UK	
East region (11.2 t/ha	cope of recommendation	UK.	C	UK	UN	UK	c	Lun	•	UN	c	•	•	. 0	NE	w		c	*		* *		*	NEW	NEW	UN	UN	Lavi	UK	UK (	• NE	N •	UK	
West region (11.3 t/h	Fungicide-treated grain yield (% treated control) United Kingdom (11.2 t/ha)	99	97	96	96	101	101	100	99	102	100	100 9	8 97	10	05 10	4 103	101	101	101	100	99 97	96	96	105	104	103	103	102	102	102 1	101 10	0 100	99	2.1
North region (11.2 t/h	East region (11.1 t/ha) West region (11.2 t/ha)	99 99	97 97	96 97	96 96	100	101	100	99 99	102 102	100 100	99 91 100 91	8 97 8 97	10	06 10	4 102 4 104	101	101	101 102	100 100	99 97 99 96	96 96	96 95	104	104 105	103	103 103	102 102	102 102	101 1 104 1	101 10 101 10	0 100 2 99	99 101	2.3
United Kingdom (11.2	North region (11.3 t/ha) Untreated grain yield (% treated control)	97	96	92	92	100	98	[93]	101	98	104	100 9	7 98	10	03 [10	1] 100	102	101	96	99	98 98	99	95	[105]	[102]	102	102	103	102	99 9	96 [[9	]] 99	98	3.1
Agronomic features	United Kingdom (11.2 t/ha) Agronomic features	83	78	71	82	95	83	77	71	84	72	81 7	1 69	8	3 86	5 80	76	77	79	85	83 67	75	77	82	79	84	79	79	81	88 (	83 9	) 82	81	4.9
Resistance to lodging	Resistance to lodging without PGR (1–9) Resistance to lodging with PGR (1–9)	7	8	7	7	7	6	8	7 8	8	7	7 7	6	7	777 878	7	7	7	7	6 7	6 7 6 8	7	7	6	7	7	7	7	7	7	7 7 7 8	7	7	0.6
Resistance to lodging	Height without PGR (cm) Ripening (days +/- Skyfall, -ve = earlier)	84 0	83 0	81 0	89 +1	90 0	84 0	85 +1	81 +2	82 +1	83 +1	85 8	5 89 1 0	9	1 87 0 +3	7 93 3 +1	86 +1	82 +1	91 +1	86 +2	83 85 0 +2	80 +1	85 +3	93 +1	83 0	86 0	87 +1	85 +1	86 0	87 8	86 80 +1 0	2 92 +1	82 +2	1.7 0.6
Height without PGR (	Resistance to sprouting (1-9) Disease resistance	[5]	5	6	6	[7]	5	[6]	7	161	6	[5] 6	5	(6	5] [5]	[7]	[5]	[6]	[5]	[4]	[5] 6	5	5	[5]	[6]	[5]	[4]	[5]	[4]	7	5 [7	[5]	6	0.8
Ripening (days +/- JE	Midew (1-9)	7	6	6	6	6	8	5		5		6 5	7	7	7 6	6	7	7	7	7	7 3	6	6	6	6	6	4	7	6	7	6 7	5	8	1.0
Resistance to sprout	Yellow rust (1–9) - see note below Brown rust (1–9) - see note below	6	8	3	6	7	5	5		6	5	9 8	5 7	6	59	7	5	6	7	6	9 7 7	8	8	4	6	6	6	7	5	8 6	5 7	6	5	1.1
Disease resistance Mildow (1_0)	Septoria nodorum (1–9) Septoria tritici (1–9)	[6] 6.4	[6] 5.8	[6] 6.2	(6) 6.0	8,1	[6] 6.6	5.3	6.9	- 7.0	(P)	[6] [6 5.5 5.	6] (6) 0 5.4	5.	 .0 6.1	- 8 5.1	[5] 4.9	[6] 4.3	(7) 6.6	[6] 7.9 !	[6] [6] 5.4 4.8	[6] 4.8	[7] 6.0	6.6	5.0	[6] 6.3	(6) 4.8	[6] 4.9	[6] 6.3	(6) ( 6.8 (	[6] - 5.9 8.	[6] 2 6.6	[6] 6.1	0.9
Yellow rust (1-9)	Eyespot (1–9) Fusarium ear blight (1–9)	7@ 6	6@ 7	5 6	6@ 6	6	5	[5] 7	4	5	5 6	4 5	i 4	[4	4] - 5 6	[5] 6	4	4 6	4 6	3 6	4 5 6 7	4	7@ 6	6	6	4 6	4 6	5 6	4 5	4 6	4 -	6@ 6	5 6	1.7 0.5
Brown rust (1–9)	Orange wheat blossom midge		R			-			•	R	R	RR	R R	F	R R	R	R	R		R	R R	R		R	R	R	R	R		-	R-			
Septoria nodorum (1-	m (1- Comparisons of varieties across regions are not valid.																																	
Septoria tritici (1-9)	9) Yellow and brown rust ratings																																	
Eyespot (1-9)	During 2019 higher than expected levels of yellow and brown rust were seen in some trials. Careful analysis of the 2019 data from RL trials did not reveal dramatic changes in average disease ratings. These are																																	
Fusarium ear blight (1	national average ratings and it is not yet clear if the reported cases of high yellow and brown rust disease levels in 2019 indicate the initial emergence of new rust races or exceptionally high disease pressure at some sites. Given the highly dynamic nature of the yellow and brown rust populations in the UK over recent years all varieties should be closely monitored for rusts, as local rust populations may differ from the general UK population and may be more or population submit the DL ratine support.																																	
Orange wheat blosso	ess violent on a variety train the RL rating suggests.	0 - V																																
	E&W = Recommended for the UK E&W = Recommended for the East and West regions	C = Yiel this tabl	le KWS :	Santiago	o was also listed	a yield		g = Belle esistance	gene to	eyespot	but this h	idezvous has not be	en	Ave	arage LSI	D (5%): V	arieties th	nce nat are mo	ore than o	ne														
	N = Necommended for the North region	* = Vari [] = Lim	iety no k ited data	onger in a	trials		i t	R = Believ lossom n verified in	red to be nidge (O Recomm	resistant WBM) bu	to orang t this has ist tests.	ge wheat s not been	1	con	fidence k	evel.	anny one	a ent at D	6 2078								W	he	at	br	ow	n r	usi	:

#### KWS Firefly – differential tests

 <30% of samples tested were virulent on KWS Firefly at seedling stage

• KWS Firefly appears to carry the same resistance as *Lr28* from our seedling tests



#### KWS Firefly – samples received

Isolate	Host Variety	Virulent KWS Firefly at Seedling Stage
19/005	KWS Firefly	Virulent
19/006	KWS Firefly	Virulent
19/007	KWS Firefly	Virulent
19/012	KWS Firefly	Virulent
19/025	KWS Firefly	Virulent
19/044	KWS Firefly	Virulent
19/054	KWS Firefly	Virulent
19/053	RGT Blossom	Virulent
19/003	KWS Firefly	Avirulent
19/032	KWS Firefly	Avirulent
19/037	KWS Firefly	Avirulent
19/052	KWS Firefly	Avirulent

#### KWS Firefly – pathotypes

Isolate	Pathotype
19/005	1,3a,3bg,3ka,10,13,14a,15,16,17,26,28,37,Cr
19/006	,2c,3a,3bg,3ka,10,13,14a,15,16,17,(26),(28),37,Cr
19/007	1,3a,3bg,3ka,10,13,14a,15,16,17,26,28,37,Cr
19/012	1,3a,3bg,3ka,10,13,14a,15,16,17,26,28,37,Cr
19/025	1,3ka,10,13,14a,15,16,17,26,28,37,Cr
19/044	1,3ka,10,13,14a,15,16,17,26,28,37,Cr
19/053	1,3a,3bg,3ka,10,13,14a,15,16,11,20,26,28,37,Cr
19/054	1,3ka,10,13,14a,15,16,17,26,28,37,Cr

#### KWS Firefly – pathotypes

Isolate	Pathotype
19/005	1,3a,3bg,3ka,10,13,14a,15,16,17,26,28,37,Cr
19/006	1,2c,3a,3bg,3ka,10,13,14a,15,16,17,(26),(28),37,Cr
19/007	1,3a,3bg,3ka,10,13,14a,15,16,17,26,28,37,Cr
19/012	1,3a,3bg,3ka,10,13,14a,15,16,17,26,28,37,Cr
19/025	1,3ka,10,13,14a,15,16,17,26,28,37,Cr
19/044	1,3ka,10,13,14a,15,16,17,26,28,37,Cr
19/053	1,3a,3bg,3ka,10,13,14a,15,16,17,20,26,28,37,Cr
19/054	1,3ka,10,13,14a,15,16,17,26,28,37,Cr

#### KWS Firefly – pathotype locations



#### KWS Firefly – Lr28 virulence frequencies



28 isolates tested

#### KWS Firefly – Lr28 virulence frequencies



28 isolates tested

# Why has KWS Firefly resistance to brown rust dropped?

#### Wheat brown rust disease resistance ratings

**2020/21 disease resistance ratings** 



#### Adult plant trials (2020)

Isolate	Host Variety	Pathotype
19/005	KWS Firefly	1,3a,3bg,3ka,10,13,14a,15,16,17,26,28,37,Cr
19/012	KWS Firefly	1,3a,3bg,3ka,10,13,14a,15,16,17,26,28,37,Cr
19/032	KWS Firefly	1,3a,3bg,3ka,10,13,14a,15,16,17,(24),(26),37,Cr
19/053	RGT Blossom	1,3a,3bg,3ka,10,13,14a,15,16,17,20,26,28,37,Cr
19/054	KWS Firefly	1,3ka,10,13,14a,15,16,17,26,28,37,Cr

#### Wheat brown rust summary

Moderate disease pressure throughout the season

• *Lr20* and *Lr28* saw some seedling virulence frequency changes with two new pathotypes identified for carrying virulence to *Lr28* 

 Otherwise there were no major changes in varietal performance from seedling virulence frequencies and adult plant trial results



## Barley yellow rust

Amelia Hubbard





#### Samples received (2019)

- 9 samples
- 4 counties
- 9 varieties



Barley yellow rust

#### Test results

- Four isolates tested
- Seedling test includes three resistance genes: BYR1, 2 and 3
- Two pathotypes identified
- >BYV1,2,3

≻BYV1

 Pathotypes similar to previous years. However, in some cases, only one of the differentials was infected. This shows there may be additional background resistances present in those differentials
#### Samples received (since 2011)



Barley yellow rust



# Wheat and barley powdery mildew

Amelia Hubbard





#### Changes to the mildew survey

• Only samples sent in are tested

• No longer sampling from our own field trials

 No longer sending out mobile trap nurseries to collect airborne spores in our home areas

>Some years, we may not have any samples to test

Powdery mildew

#### Update

• Mildew found, but not accompanied by reports of varietal problems

• Wheat mildew samples received, but none survived incubation

• Limited number of barley mildew samples received





# Barley powdery mildew

Amelia Hubbard





#### Background

- Found at low moderate levels
- Range of varietal resistance
- *mlo* still effective
- Population seems stable: varietal performance appears consistent
- Most recent notable change: Gradual erosion of Propino

## Samples received (2019)

- 5 samples
- 1 county
- 5 varieties

Low levels of mildew



Barley powdery mildew

#### Differential set

Differential	Resistance Gene	Differential	Resistance Gene
Golden Promise	0	Triumph	MIa7,MIAb
W.37/136	Mlh	Tyra	Mla1
W.41/145	Mlra	Roland	Mla9
Goldfoil	Mlg	Apex	mlo11
Zephyr	Mlg,Ml(CP)	Riviera	mloRiv
Midas	Mla6	Digger	Mla13
Lofa	MILa	Ricardo	MIa3
Hassan	Mla12	Vanessa	
H.1063	Mlk1	Optic	
Porter	Mla7	Propino	
Lotta	MIAb		



Barley powdery mildew









Barley powdery mildew

#### Seedling virulence tests

- Four single pustule isolates tested from one sample
- Virulence for *Mlh*, *Mlra*, *Mlg*, *Mla6*, *Mla7*, *Mla12* and Vanessa was found in 100% isolates
- No virulence was detected for *Mla3, Mla9, Mlo11, Mlo Riv,* and Propino
- Virulence for *Mla7* rose from 17% to 100%. Virulence for Mla13 also risen from 14% to 75%
- Virulence for *Mla1* has decreased from 69% to 25%

#### UKCPVS 2019 summary

- 2019 saw changes in the pathogen populations
- New/interesting isolates identified
- These will be investigated further and we await genotyping results for wheat yellow rust
- 63% of the winter wheat (RL2020/21) is highly resistant to yellow rust (rating of 8 or 9) compared to 11% for brown rust

Be vigilant: Send in samples when you see the diseaseKeep us updated on unusual sightings via email/phone

#### UKCPVS sampling instructions

Please complete this form and send with each sample for virulence analysis to FREEPOST UKCPVS			it would be useful for NIAB to be able to contact you after a sample has been received in case we have any further questions. All personal data supplied will be kept confidential to the UKCPVS project, and will be deleted after two years of the sample submissions. Full details of the NIAB privacy polic can be found on www.niab.com.			
Sample no FOR OFFICE USE ONLY	Variety	Dete	Location (include county & postcode if known) (AHDB trials operators - include trial ID)	Severity of attack * (% leaf area infection)	Crop 65	Notes (e.g. fungicide treatment)
f foci present,	give assessment for foci	and also plot (or field) as a v	whole.	Tel:		
Address:			Mobile:			
-				Email:		

It is not compulsory to include contact information. However,



# Rustwatch

#### Amelia Hubbard







#### Rustwatch: Overview

- EU project with 25 partners
- Led by Global Rust Reference Centre, Aarhus University, Denmark
- Develop an early warning system for the three rusts to improve resilience
- Four years (started May 2018)



#### Rustwatch: Objectives of interest

- Linking of rust surveys across Europe
- Integration of field pathogenomics
- Investigate the sexual cycle
- Aggressiveness studies
- Investigate pathogen transmission and spread
- Microphenotyping of rust resistance
- Investigate new rust races in the 'off season'
- Integrated pest management trials
- Trialling of UK wheat varieties in Pakistan



#### Investigate new races

• Investigate new races seen in other parts of Europe

Send UK wheat varieties/breeding lines to other countries

Investigate new races seen in UK in the winter

Sample collected summer 2020

Race identified autumn 2020

Test new race on adult plants in glasshouse spring 2021

Normally have to wait until Summer 2021



### Puccinia striiformis: Rapidly changing pathogen

- Population derived by sexual recombination
  - Pre-2011 changes were asexual and step wise
- Lots of diversity: anything is possible!
- Combining efforts of existing virulence surveys to get a better idea of population changes across Europe



#### Rustwatch: Varietal performance across Europe

- Panel of 230 elite European wheat and durum varieties
- Investigating effects of different races in different countries
- Trialled in UK (NIAB and RAGT), Denmark, Germany (JKI and Breun) and Italy
- Either inoculated with a single race or open to natural infection
- NIAB trial inoculated with Red 24 race behind 2016 epidemic



#### Rustwatch: Investigate the sexual cycle





Zheng et al 2013 Nat. Comm.

### Rustwatch: We need your help

- Samples as always
- Barberry locations: are they in a hedge near you?





Botanical Society of Britain and Ireland

# Barberry survey (2018-19)





## Barberry survey (2018-19)











## Rust on barberry









#### Have you seen this plant?





# Barberry survey (2018)

- What kind of rust was on the 2018 samples?
  - Looked like a stem rust
  - Probably ryegrass stem rust
  - Further work ongoing

 Continued monitoring: further sites needed

 Caution needed in handling the plants: barberry carpet moth is a protected species





## Further information

- Annual report: <u>ahdb.org.uk/ukcpvs</u>
- Global Rust Reference Centre: <u>wheatrust.org/yellow-rust-tools-maps-and-charts</u>
- Field pathogenomics: <u>yellowrust.com</u>
- Rustwatch <u>agro.au.dk/forskning/projekter/rustwatch</u>

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- Samplers



# Inspiring our farmers, growers and industry to succeed in a rapidly changing world