

UKCPVS Stakeholders Meeting 2019

Amelia Hubbard Sarah Wilderspin Sarah Holdgate



CEREALS & OILSEEDS

UKCPVS Results 2019

- Introduction: Sarah Holdgate
- Wheat and Barley Powdery Mildew: Sarah Holdgate
- Wheat Brown Rust: Sarah Wilderspin
- Wheat Yellow Rust: Amelia Hubbard











Introduction

• UKCPVS in operation for over 50 years.

 Aims to identify changes in pathogen populations that may have an adverse effect on cereal production in the UK and report them as soon as possible

• Funded jointly by APHA (Defra) and AHDB











Methods



Animal & Plant Health Agency



Identifying Changes in Populations

• Step 1: Identifying any population change



Differential Tests

• Step 2: Identifying risk associated with change

Variety Seedling and Adult Plant Tests









Identifying Population 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









Identifying Change: Differential Tests

		1	2	3a, 4a	3b,4b	IJ	9	7	7,22, 23	6,7	7,17	œ	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	Avoce Yr9	Moro	AVS x yr15
16/009	Reflection	3.0	3.0	3.0	3.0	0.0	3.0	2.0	2.9	3.0	20	0.0	0.0	4.0	0.0	0.0
16/013	Revelation	3.0	3.0	3.0	3.0	0.0	3.0	2.2	3.0	3.0	2.1	0.0	0.0	3.0	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
16/158	KWS Kerrin	3.0	3.1	3.0	3.0	0.0	2.8	3.0	1.7	0.0	0.0	0.0	0.0	3.0	0.0	0.0







Identifying Risk: Seedling Variety Tests



Brexit

Markets and prices

Knowledge library

Tools

Events

UK Cereal Pathogen Virulence Survey

Monitoring changes in pathogen virulence

Managed by NIAB, and funded by AHDB Cereals & Oilseeds and Defra, the UK Cereal Pathogen Virulence Survey (UKCPVS) receives infected cereal leaf samples from agronomists, trials officers and researchers.

From these samples, pathogen isolates are selected and tested to check their virulence against wheat and barley varieties. The testing can detect new races of cereal pathogens capable of causing disease on previously resistant cereal varieties.

UKCPVS needs you!

The success of LIKCRVS depends on infected careal leaf samples received from the field

RECOMMENDEDLISTS



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 yell rust population at the time of testing. A variety is classified as seedling susceptible if it is susceptible to any one of the isolates

resistance presented in the table is based upon the Recommended Lists (RL) velow 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 UKCPVS.

	AHDB Recommended List varieties	RL Rating 2018/19	2018/19 RL Adult plant recistance	2017 Seedling Stage Resistance	2018 Seedling Stage Recistance			
	Costello	9	Resistant	Resistant	Resistant			
	Crusoe	9	Resistant	Susceptible	Susceptible			
	KW8 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			
100000000000000000000000000000000000000	Freiston	9	Resistant	Susceptible	Susceptible			
1000000	KWS Trinity	9	Resistant	Susceptible	Resistant			
	Elcit	9	Resistant	Susceptible	Susceptible			
TAB MUN	KWS Jackal	9	Resistant	Susceptible	Susceptible			
ANS11100	Elation	9	Resistant	Susceptible	Susceptible			
110110111111111	KWS Extase	9	Resistant		Susceptible			
55999789599	LG Detroit	9	Resistant		Susceptible			
1999999999999	KWS Firefly	9	Resistant		Resistant			
9388897797697	LG Skyscraper	8	Resistant		Susceptible			
6969999996876	LG Spotlight	8	Resistant		Susceptible			
Surrout.	Savelio	8	Resistant	Susceptible	Susceptible			
1	Evolution	8	Resistant	Susceptible	Susceptible			
	Graham	8	Resistant	Susceptible	Susceptible			
the second s	Hardwicke	8	Resistant	Susceptible	Susceptible			
	KWS Barrel	8	Resistant	Susceptible	Susceptible			
	KWS Basset	8	Resistant	Susceptible	Susceptible			
	Moulton	8	Resistant	Susceptible	Susceptible			
Real Property in	Shabras	8	Resistant	Susceptible	Susceptible			
	RGT Gravity	8	Resistant	Susceptible	Susceptible			
	Dunston	7	Moderate resistance	Susceptible	Susceptible			
- 1 C	KWS Zyatt	7	Moderate resistance	Susceptible	Susceptible			
	KWS LI	7	Moderate resistance	Susceptible	Susceptible			
	KWS Silverstone"	7	Moderate resistance	Susceptible	Susceptible			
	Spyder	7	Moderate resistance	Susceptible	Susceptible			
viru	KWS Kerrin	7	Moderate resistance	Susceptible	Susceptible			
	KWS Santiago"	7	Moderate resistance	Susceptible	Susceptible			
and the second	Gleam	7	Moderate resistance	Susceptible	Susceptible			
	Leeds	6	Moderate resistance	Susceptible	Susceptible			
	Viscount	6	Moderate resistance	Susceptible	Susceptible			
	Bennington	6	Moderate resistance	Susceptible	Susceptible			
2001	Gratton*	6	Moderate resistance	Susceptible	Susceptible			
	Skyfall	6	Moderate resistance	Susceptible	Susceptible			
220	Zulu	5	Susceptible	Susceptible	Susceptible			
	JB Diego	5	Susceptible	Susceptible	Susceptible			
	Cordiale'	4	Susceptible	Susceptible	Susceptible			
	Myriad	4	Susceptible	Susceptible	Susceptible			
	Reflection*	3	Susceptible	Susceptible	Susceptible			
	* Not included in trial in 2018 ** Not included in trials before 2018							



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Identifying Risk: Adult Plant Trials

Five representative races trialled on RL varieties and candidates









Varieties Susceptible to Red 24 and Blue 7



2018 Season Update

- Another quiet year compared to 2017:
 - Low moderate yellow rust pressure
 - High but late brown rust
 - Occasional reports of mildew









Wheat Powdery Mildew







Wheat Powdery Mildew (*Blumeria graminis* f.sp. *tritici*) in the UK

- Monitored since the beginning of the survey
- Resistance to mildew based on Pm genes and other unnamed genes
- Historically issues with swift breakdown in resistance
- More stable situation now: likely to be combination of small effect resistance genes which are harder to overcome by the pathogen





2018 Wheat Powdery Mildew Samples Received

- 36 samples
- 9 counties
- 27 varieties









Current Differential Set

ating 50 Years of Research

Differential	Resistance Gene	Differential	Resistance Gene
Cerco	0	Broom	Pm3d
Galahad	Pm2	Sicco	Pm5, MiSi2
Chul	Pm3b	Wembley	MISo
Armada	Pm4b	Axona	MIAx
Flanders	Pm5	Amigo	Pm17
Brimstone	Pm6	Shamrock	MISh
Clement	Mld	Robigus	MIRo
Maris Dove	Pm8	Warrior	
Brock	Pm2, MITa2	Stigg	
Mercia	Pm5, MITa2	Crusoe	
Tonic	ΜΙΤο	-	







Results

lsolate number	Host Varie	ty	Date sampled/received		RL R 201	ating 6/17	I	_ocat	ion															
17/002	Apac	che	25/01/2017					Cambridgeshire																
17/005	Arma	ada	15/03/2017					Cam	bridg	eshire	•													
17/015	Belgr	ade	05/06/2017		ç)		C	hesh	ire														
17/010	LG Blet	chlev	21/04/2017					Her	eford	shire														
17/032	Cer											~	2			2								
17/033	Cer											Ta 2	ITa			ISi								
17/034	Cer					q	q					,MI	, M	_	p	, M	0	v	7	Ļ	0			
17/035	Cer	Isolate	Heatvariaty		m2	m3	m4	m5	9 <i>m</i> (pII	m8	m2	m5	11Tc	m3	m5	II Sc	(A)	m1	IISI	IIRc			
17/011	Cou	Number	HOSt variety		٩	٩	٩	٩	еЪ	2	٩	٩	٩	2	٩	٩	2	2	٩	k V	2			
17/031	Duns				ad		la	ers	ton	nt					۲		ley	_	•	Joc	sn	r		е
17/007	Elic			ပ္ပ	lah	n	nac	pde	sm	me	ve ve	ock	rcia	nic	noc	co Co	dme	one	nigo	ami	big	Irrio	60	osr
17/020	Freis			Cel	Ga	ch	Arr	Fla	Bri	Cle	do, do	Bro	Me	Toi	Brc	Sic	We	AX	Am	Sha	Ro	Wa	Sti	с С
17/029	Freis	17-02-02	Apache	4.0	4.0	0.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	0.0	0.0	4.0	0.0	1.0	0.0	0.0	0.0	4.0
17/008	Glea	17-02-03	Apache	3.5	3.5	0.0	3.3	3.5	3.3	3.5	3.3	3.8	3.0	3.5	3.3	0.0	0.0	3.0	0.0	1.8	0.0	0.0	0.0	3.0
17/018	Glea	17-04-01	RW41525	4.0	4.0	0.0	4.0	3.5	4.0	0.0	4.0	4.0	4.0	4.0	4.0	3.0	3.3	4.0	0.0	2.0	0.0	0.0	0.0	4.0
17/026	Grah	17-04-02	RW41525	4.0	4.0	3.0	4.0	4.0	4.0	0.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	1.0	0.0	0.0	0.0	4.0
17/013	JB Di	17-05-01	Armada	3.0	3.0	0.0	3.0	0.8	3.0	3.0	3.3	3.8	3.3	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.5	0.0	0.0	3.5
17/009	KWS C	17-05-02	Armada	3.0	4.0	3.0	4.0	2.0	4.0	4.0	4.0	4.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.0	0.0	0.0	4.0
17/027	KWS C	17-08-01	Gleam	3.8	4.0	3.8	4.0	3.5	3.8	4.0	0.0	4.0	4.0	2.0	2.0	0.0	0.0	0.0	0.5	0.0	4.0	0.0	0.0	0.0
17/001	KWS K	17-08-02	Gleam	4.0	3.8	4.0	4.0	3.5	4.0	4.0	0.0	3.5	3.8	3.0	1.5	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0
17/036	KWS K	17 00 01	KWS Crispin	33	3.5	2.0	3.8	3.0	33	0.0	3.0	1.5	3.0	3.0	3.0	3.5	33	3.5	0.0	0.0	3.Q	4.0	33	3.8
17/017	KWS Sa	17-09-01	KWS Crispin	2.5	2.5	2.0	2.5	2.0	2.5	0.0	2.5	1.5	2.5	2.0	2.0	2.0	2.0	4.0	0.0	0.0	2.0	2.2	2.0	2.0
17/028	KWS T	17-09-02		3.5	3.5	3.0	3.5	3.0 1 E	3.5	4.0	0.0	4.0	3.5	0.0	0.0	<u>0.0</u>	0.0	4.0	0.0	0.5	3.5	0.0	0.0	0.0
17/016	Lee	17-10-01	Dietchiey	4.0	4.0	1.0	4.0	1.5	4.0	4.0	0.0	4.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0
17/019	Revela	17-10-03	Bletchley	4.0	4.0	2.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	2.8	4.0	0.0	1.0	4.0	0.0	0.0	4.0
17/021	RGT G	17-11-01	Cougar	4.0	4.0	0.0	4.0	4.0	4.0	3.0	0.0	3.5	3.0	0.0	0.0	3.5	3.3	0.0	0.0	0.0	3.5	0.0	0.0	0.0
17/030	RGT G	17-11-02	Cougar	3.3	3.8	0.0	4.0	2.3	3.3	4.0	0.0	3.8	3.8	0.0	0.3	0.5	0.8	0.3	0.0	0.0	4.0	0.0	0.0	0.0
17/014	RGT Knig	17-14-01	Knightsbridge	4.0	4.0	1.8	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	1.0	1.0	4.0	1.5	1.0	4.0	0.0	0.0	4.0
17/004	RW41		RGT																					
17/025	KWSS	17-14-02	Knightsbridge	4.0	4.0	0.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	3.0	4.0	3.0	1.0	4.0	0.0	0.0	4.0

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Plant Health Agency **CEREALS & OILSEEDS**



Changes in Virulence Frequencies

- Generally stable
- Virulence found frequently for *Pm2*, *Pm4b*, *Pm5*, *Pm6*, *Pm8*, *MITa2*
- Virulence rarely found for *Pm3b*, MISi2, MISo, Pm17, MISh



■2014 ■2015 ■2016 ■2017 ■2018

8 Animal &

Agency





Common Pathotypes

- Most common pathotype: *Pm2,3d,4b,5,6,8,MId,MITa2,MITo,MIAx,MIRo,Wa,St,Cr*
- 11 other pathotypes, 9 novel
- No problems reported









Population generally stable

- Some changes seen, although not linked to any changes in the field
- Variety performance stable







A Look Ahead

RL rating of 8 or 9

 KWS Siskin, KWS Trinity, Costello, KWS Lili, Spyder, LG Motown



RL rating of 6 or 7

Savello, KWS Crispin, KWS Silverstone, Bennington, Grafton, KWS Zyatt, Zulu, KWS Kerrin, Moulton, Viscount, Graham, Elation, Dickens, KWS Jackal, LG Sundance, Cordiale, RGT Illustrious, Reflection, Crusoe, Freiston, Evolution, Gleam, Shabras, Elicit, JB Diego, KWS Barrel, KWS Santiago



RL Rating of 5 or below

 Hardwicke, KWS Basset, Revelation, Skyfall, Dunston, Myriad, RGT Gravity, Leeds







Barley Powdery Mildew







Background: Barley Powdery Mildew

- 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





2018 Barley Powdery Mildew Samples Received

- 27 samples
- 9 counties
- 14 varieties



- Low levels of mildew
- No problems reported to UKCPVS







Current Differential Set

	Differential	Resistance Gene	Differential	Resistance Gene
	Golden Promise	0	Triumph	Mla7,MIAb
	W.37/136	Mlh	Tyra	Mla1
	W.41/145	Mlra	Roland	Mla9
	Goldfoil	Mlg	Apex	mlo11
	Zephyr	MIg,MI(CP)	Riviera	mlo11?
	Midas	Mla6	Digger	Mla13
	Lofa	MILa	Ricardo	Mla3
	Hassan	Mla12	Vanessa	
	H.1063	Mlk1	Optic	
	Porter	Mla7	NFC Tipple	
	Lotta	MIAb	Propino	
K	Celebrating 50 Years of Research		KWS Meridian	







Results

lsolate number	Host Variety	Date sampled/received		RL Rating 2016/17			.ocat	ion															
17/002	Apache	25/01/2017					Cambridgeshire																
17/005	Armada	15/03/2017					Cambridgeshire																
17/015	Belgrade	05/06/2017		g			Cheshire																
17/010	LG Bletchlev	21/04/2017					Her	eford	shire														
17/032	Cer										01	2			0								
17/033	Cer										Ta 2	ITa			ISi								
17/034	Cer				q	q					,MI	, M	•	q	, M	0	×	7	"	0			
17/035	Cer Isolate			m2	m3	m4	m5	,m6	pII	m8	m2	m5	11Tc	m3	m5	II Sc	ίΑ	m1	IISI	IIR			
17/011	Couc Number	HOST Variety		٩	ď	ď	ď	еP	2	٩	ď	٩	2	٩	٩	2	2	٩	× >	2			
17/031	Duns			ad		la	ers	ton	int (F		Ē		ley	_	•	ő	sn	r		Θ
17/007	Elic		ပ္ပ	lah	n	nac	nde	sm	eme	ris ve	ock	rcia	nic	noc	S	dme	ona	nigo	am	big	Irric	00	osr
17/020	Freis		Cel	Ga	ch	Arr	Fla	Bri	Cle	Ma do	Bro	Me	Тоі	Bro	Sic	We	Axi	Am	Shi	Ro	Wa	Sti	с С
17/029	Freis 17-02-02	Apache	4.0	4.0	0.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	0.0	0.0	4.0	0.0	1.0	0.0	0.0	0.0	4.0
17/008	Glea 17-02-03	Apache	3.5	3.5	0.0	3.3	3.5	3.3	3.5	3.3	3.8	3.0	3.5	3.3	0.0	0.0	3.0	0.0	1.8	0.0	0.0	0.0	3.0
17/018	Glea 17-04-01	RW41525	4.0	4.0	0.0	4.0	3.5	4.0	0.0	4.0	4.0	4.0	4.0	4.0	3.0	3.3	4.0	0.0	2.0	0.0	0.0	0.0	4.0
17/026	Grah 17-04-02	RW41525	4.0	4.0	3.0	4.0	4.0	4.0	0.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	1.0	0.0	0.0	0.0	4.0
17/013	JB Di 17-05-01	Armada	3.0	3.0	0.0	3.0	0.8	3.0	3.0	3.3	3.8	3.3	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.5	0.0	0.0	3.5
17/009	KWS C 17-05-02	Armada	3.0	4.0	3.0	4 0	2.0	4.0	4.0	4.0	4 0	4 0	0.0	0.0	0.0	0.0	0.0	0.0	10	4.0	0.0	0.0	4.0
17/027	KWS C 17-08-01	Gleam	3.8	4.0	3.8	4.0	3.5	3.8	4.0	0.0	4.0	4.0	2.0	2.0	0.0	0.0	0.0	0.5	0.0	4.0	0.0	0.0	0.0
17/001	KWS K 17-08-02	Gleam	4.0	3.8	4.0	4.0	3.5	4.0	4.0	0.0	3.5	3.8	2.0	1.5	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0
17/036	KWS K 17-00-02	KWS Crispin	2.2	2.5	2.0	2.0	2.0	2.2	4.0	2.0	1.5	2.0	2.0	2.0	2.5	2.2	2.5	0.0	0.0	2.0	4.0	2.2	2.0
17/017	KWS Sa 17-09-01	KWS Crispin	3.3 2 E	2.5	2.0	0.0 0.5	2.0	0.0 0 E	0.0	2.5	1.0	3.0 2.5	0.0 0.0	2.0	2.0	0.0 0 0	3.5	0.0	0.0	2.0	4.0	2.0	2.0
17/028	KWS T 17-09-02		3.0	3.0	3.0	3.5	3.0 4 F	3.0	0.0	<u>3.5</u>	4.0	3.5	<u> </u>	<u> </u>	<u>3.0</u>	<u> </u>	4.0	0.0	0.5	3.3	<u> </u>	<u>3.0</u>	<u> </u>
17/016	Lee 17-10-01	Bletchley	4.0	4.0	1.0	4.0	1.5	4.0	4.0	0.0	4.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0
17/019	Revel: 17-10-03	Bletchley	4.0	4.0	2.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	2.8	4.0	0.0	1.0	4.0	0.0	0.0	4.0
17/021	RGT <u>G</u> 17-11-01	Cougar	4.0	4.0	0.0	4.0	4.0	4.0	3.0	0.0	3.5	3.0	0.0	0.0	3.5	3.3	0.0	0.0	0.0	3.5	0.0	0.0	0.0
17/030	RGT <u>G</u> 17-11-02	Cougar	3.3	3.8	0.0	4.0	2.3	3.3	4.0	0.0	3.8	3.8	0.0	0.3	0.5	0.8	0.3	0.0	0.0	4.0	0.0	0.0	0.0
17/014	RGT Knigł	KG1 Knightsbridge	4 0	4.0	18	4 0	4 0	4.0	4.0	4 0	4 0	4 0	4 0	4.0	10	10	4 0	15	10	40	0.0	0.0	4.0
17/004	RW41	RGT																			0.0	0.0	
17/025	KWS 5 17-14-02	Knightsbridge	4.0	4.0	0.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	3.0	4.0	3.0	1.0	4.0	0.0	0.0	4.0







Changes in Virulence Frequencies

- Generally stable
- Virulence found frequently for *Mlh*, *Mlra*, *Mlg*, *Ml(CP)*, *Mla6*, *Mla12*, *Mla1* • Virulence found frequently for *Mlh*, and Vanessa

 Virulence rarely found for Triumph (*MIa7*, *MIAb*) and Riviera (*mIo11*)



■2014 ■2015 ■2016 ■2017 ■2018

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Common Pathotypes

- No single dominant pathotype: 26 pathotypes from 29 isolates tested
- 25 novel in 2018
- No problems reported









Population generally stable

- Some changes seen, although not linked to any changes in the field
- Variety performance stable







A Look Ahead

RL rating of 8 or 9

 Chanson, Concerto, Fairing, Hacker, KWS Irina, KWS Sassy, Laureate, LG Diablo, LG Tomahawk, Olympus, Ovation, RGT Asteroid, RGT Planet, Scholar, Sienna



RL rating of 6 or 7

 Belmont, California, Craft, Electrum, KWS Astaire, Propino, Sunningdale, SY Venture, Talisman



RL Rating of 5 or below

 Bazooka, Belfry, Coref, Funky, KWS Cassia, KWS Creswell, KWS Glacier, KWS Infinity, KWS Orwell, Libra, Surge







Wheat Brown Rust







Background

• Surveillance started later than other cereal diseases

- 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







Recap 2017 Findings

Variety Performance

- High disease pressure later in the season
- No changes in varietal performance

Virulence Frequencies

- 26 new pathotypes identified
- Why so many?
 - New differential set
 - Mixed isolates

Adult Plant Trials









Adult Plant Trials Inoculation

- Inoculation technique used since 2017
- Pre spray
- Direct inoculation
- Applied onto leaf 1 and 2
- High humidity light winds
- Inoculated later in the season



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Adult Plant Trials 2018

Isolate	Host Variety	Pathotype
17/016	Shabras	1,2c,3a,3bg,3ka,10,14a,15,16,17,20,24,37
17/018	Crusoe	1,3a,3bg,10,13,14a,15,16,17,17b,20,26
17/019	Cougar	1,3a,3bg,3ka,10,13,14a,15,17,20,23,26,37
17/026	Evolution	1,2b,2c,3a,3bg,3ka,10,13,14a,15,16,17,17b,20,23,26,37
17/028	KWS Silverstone	1,2c,3a,3bg,3ka,10,13,14a,15,16,17,17b,20,23,26,37







Adult Plant Trial Results 2018

Moderate levels of disease seen

- Not always agreement between seedling and adult plant reactions e.g. Stigg
- Mixed inoculum?
- Cannot confirm variety x isolate interactions







Seedling Test Results 2018

Resistant

- Glasgow
- KWS Firefly
- Leeds
- LG Motown
- LG Rhythm
- Viscount

Susceptible

• All other varieties were susceptible






2018 Wheat Brown Rust Samples Received

- 55 samples
- 12 counties
- 32 varieties









Timescale of Samples Received



Virulence Frequencies: Five Year Summary



■ 2013 ■ 2014 ■ 2015 ■ 2017 **■** 2018







Virulence Frequencies: 2017-2018



2017 2018



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Wheat Brown Rust Samples Tested

LG Sundance KWS Barrel Skyfall

Fungicide applied 10 days later high levels of brown rust present



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Population Structure

- No one pathotype dominant
- 25 new pathotypes identified (out of the 31 isolates tested)
- Why so many new pathotypes?
 - New differential set more resistance genes being monitored
 - Mixed isolates?
 - Diverse but clonal population







Adult Plant Trials 2019

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







A Look Ahead

RL rating of 8 or 9

• Reflection, Revelation, Skyfall, Viscount



RL rating of 6 or 7

 Bennington, Dickens, Dunston, Elation, Elicit, Evolution, Freiston, Gleam, Grafton, Graham, Hardwicke, JB Diego, KWS Barrel, KWS Kerrin, KWS Silverstone, KWS Trinity, KWS Zyatt, LG Motown, LG Sundance, Moulton, RGT Gravity, RGT Illustrious, Spyder

RL F • Col KW

RL Rating of 5 or below

 Cordiale, Costello, Crusoe, KWS Basset, KWS Crispin, KWS Jackal, KWS Lili, KWS Santiago, KWS Siskin, Leeds, Myriad, Savello, Shabras, Zulu







Wheat Brown Rust Summary

- Moderate disease pressure throughout the season
- No major changes in varietal performance from seedling virulence frequencies and adult plant trial results

• If you see any varietal changes in response to brown rust at seedling or adult plant stage including any fungicide control difficulty please let us know







Wheat Yellow Rust







Background

- Incursion of Warrior group in 2011 led to displacement of old UK population
- Very diverse: new naming system introduced
- Since the incursion in 2011 17 varieties have dropped in resistance rating
- Most recent change in 2017: Red 30







Current Naming System: Colours and Numbers







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Genetic Groups: Quick Guide

Group Colour	Quick Guide
Pink	Original Warrior type = Yr 6,7,9,17,32, virulent on Warrior
Red	Warrior variation = Yr 6,7,9,17,32, +/- Warrior
Blue	Similar to old Solstice = Yr 6,9,17,32, avirulent on Warrior
Purple	Kranich race = Yr 6,7,8,9,17,32, Kranich





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Recap 2017 Findings

Variety Performance

- Moderate disease
 pressure
- No major shifts in varietal performance
- Majority of RL maintained their high resistance ratings

Virulence Frequencies

- 5 new pathotypes identified
- Red 30 (PstS14)
- Unassigned complex pathotype

Adult Plant Trials









Adult Plant Trials

Five representative races trialled on RL varieties and candidates









2018 Adult Plant Trials

Isolate	Host	Name	Pathotype
17/009	Shabras	Red 28	1,2,3,4,6,7,9,17,25,32,Re,Sp,Ro,So,Ca,St,Ap,Ev
17/024	KWS Lili	Red 30 (PstS14)	2,3,4,6,7,8,9,17,25,32,Sp,Ro,So,Ca,Ap
17/060	Spyder		1,2,3,4,6,7,9,17,25,32,Re,Sp,Ro,So,Wa,Ca,St,Kr,Ap,Cr,Ev
17/094	Bennington	Red 24	1,2,3,4,6,7,9,17,25,32,Re,Sp,Ro,So,Wa,Ca,St,Ap,Ev
17/112	Warrior	Red 26	1,2,3,4,6,7,9,17,25,32,Re,Sp,Ro,So,Wa,Ca,St,Ap





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Yellow Rust Adult Plant Trials

- Not enough disease to analyse
- Cold wet spring delayed fungicide application
- Hot, dry weather inhibited disease in spite of many inoculations
- > Omit T1 if late application, Irrigation in future
- No significant changes in RL ratings and no reports of further problems







Seedling Tests

- Seedling tests conducted on the five isolates used for 2018 adult plant trials and used all RL varieties and candidates
- All varieties were susceptible to one or more of the isolates except: Costello, KWS Crispin and KWS Siskin
- Full list: https://cereals.ahdb.org.uk/media/1446077/adult-and-seedling-stage-resistance-2018-with-candidates-.pdf







2018 Wheat Yellow Rust Samples Received

- 132 samples
- 18 counties
- 49 varieties







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Host Varieties



Samples received 'v' RL rating: Interesting samples

- New pathotypes seen from some of the isolates tested
- Graham and Shabras Red 27 (most common pathotype in 2018, first identified in 2017)
- Freiston Red 43 (new)
- Revelation Pink 10 (first identified in 2014)
- KWS Siskin sample failed during incubation





2018 Samples Received



Wheat Yellow Rust Virulence Frequencies



2017 Genetic Groups

2018 Data not available at the time of writing

Blue

Red

No isolates were detected from pink or purple groups







Common Isolates Found in 2018

Race Name	Pathotype	Frequency
Red 27	1,2,3,4,6,7,9,17,25,32,Re,Sp,Ro,So,Ca,Ap,Ev	33%
Red 3	1,2,3,4,6,7,9,17,25,32,Sp,Ro,So,Ca,Ap	19%

• Similar to those "races" found in 2017, but some variations may be due to environmental conditions in new growth rooms





New Isolates Found in 2018

Name	Pathotype
Red 43	1,2,3,4,6,7,9,17,25,32,Sp,Ro,So,Wa,Ca,Ap
Red 47	1,2,3,4,6,7,9,17,25,32,Sp,Ro,So,Wa,Ca
-	2,3,4,6,7,9,17,25,32,Sp,Ro,So,Ca,Ap
-	1,2,3,4,6,7,9,17,25,32,Re,Sp,Ro,So,Ev

• Red 43 and Red 47 isolates may be associated with slightly higher than expected levels of disease – to be confirmed

• Are they truly novel or is the diff test environment altering reaction types?





2019 Adult Plant Isolates

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	-	1,2,3,4,6,7,9,17,25,32,Re,Sp,Ro,So,Ev
18/009	Leeds	-	2,3,4,6,7,9,17,25,32,Sp,Ro,So,Ca,Ap
18/030	Revelation	Pink 10	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





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A Look Ahead

RL rating of 8 or 9



 Costello, Crusoe, Elation, Elicit, Evolution, Graham, KWS Barrel, KWS Basset, KWS Crispin, KWS Extase, KWS Firefly, KWS Jackal, KWS Siskin, KWS Trinity, KWS Zyatt, LG Detroit, LG Motown, LG Skyscraper, LG Spotlight, LG Sundance, Revelation, RGT Gravity, RGT Illustrious



RL rating of 6 or 7

Bennington, Dunston, Gleam, KWS Kerrin, KWS Lili, Leeds, Shabras, Viscount



RL Rating of 5 or below

• JB Diego, Myriad, Skyfall, Zulu







A Look Ahead

- Majority of RL varieties are highly rated
- All 2019/20 Candidates have ratings of 6 or above. KWS Kinetic and LG Graduate [6]
 KWS Parkin and Theodore [9]
- Have we seen any rust?- Reports, samples
- 19/001 KWS Kinetic infected in Cambridge demo field in mid January, first variety to show disease in that field
- 19/002 Dunston, North Cambs









Wheat Yellow Rust Summary

- Dominance of isolates from Red group
- Pathotypes similar to those found in 2017
- New isolates identified although impact yet to be assessed
- Unusual foci/epidemics could be first indication of something new







Rustwatch: A New Four Year Project



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Rustwatch: A new 4 year project

- 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"
- IPM trials
- Trialling of UK wheat varieties in Pakistan







Investigating 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 2018

Race identified autumn 2018

Test new race on adult plants in glasshouse spring 2019

Normally have to wait until Summer 2019







Microphenotyping



UKCPVS Celebrating 50 Years of Research Identify different types of resistance to aid breeders: durable?

Image from Moldenhauer et al 2008 Mol. Pl. Path.

SSV: Substomatal vesicle





Microphenotyping



Celebrating 50 Years of Research

Identify different types of resistance to aid breeders: durable? Image from Moldenhauer et al 2008 Mol. Pl. Path.

SSV: Substomatal vesicle




Linking of Virulence Surveys

- Workshop at GRRC February 2019
- Exchange results and methods
- New tools









wheatrust.org



Rustwatch: Investigate the Sexual Cycle



Zheng et al 2013 Nat. Comm.



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Rustwatch: We Need Your Help

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





Botanical Society of Britain and Ireland









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- 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







Rustwatch

- Stakeholders wanted
 - Participate in two meetings per year
 - Hear about the developments
 - Feedback on results so far



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Contact Sarah Holdgate or Bill Clark





Sampling

• Full details available on NIAB Website

http://www.niab.com/pages/id/316/UKCPVS



IDENTIFYING NEW DISEASE RACES CEREAL RUSTS AND MILDEWS

Disease sampling in 2018

Sending in samples

The UKCPVS is always checking for new races of cereal rusts and mildews across the UK.

Follow these simple guidelines to ensure the sample reaches UKCPVS in the best possible condition allowing the team can







Further Information

Annual report

https://ahdb.org.uk/ukcpvs

Global Rust Reference Centre

http://wheatrust.org/yellow-rust-tools-maps-and-charts/

• Field Pathogenomics

http://yellowrust.com

Rustwatch

http://agro.au.dk/forskning/projekter/rustwatch/





