Department for Environment Food & Rural Affairs

ADAS





Integrated Pest Management: Science and Practice
Disease control in cereals

Neil Paveley and Frank van den Bosch

A video series funded by Defra and produced by ADAS

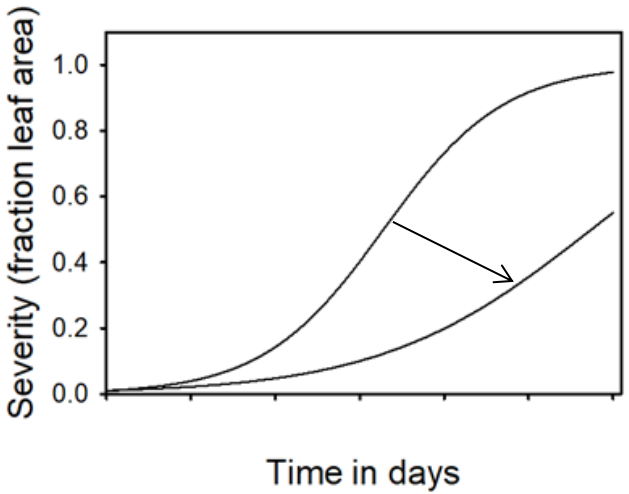
www.adas.co.uk

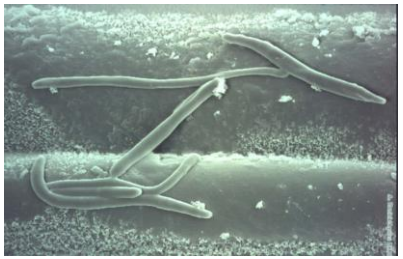
How can variety choice help?

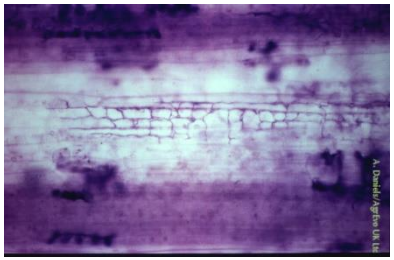
Cereal varieties can reduce disease by:

- **Escape:** reduces spores arriving on the upper canopy (Part A)
- **Resistance:** reduces disease severity per amount of spore arrival on upper canopy (Part B – this video)
- **Tolerance:** reduces yield loss per amount of disease severity (Part C)

How can variety choice help?



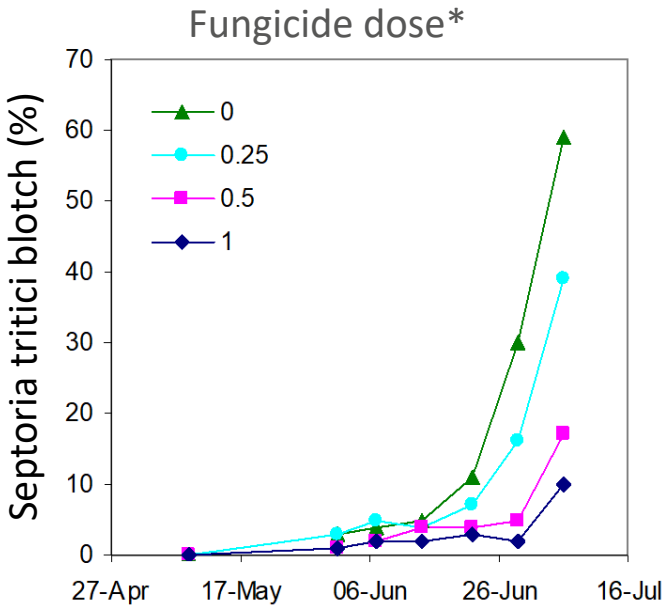




Reducing infections and slowing lesion formation reduces the growth rate of the epidemic

Images by Alison Daniels

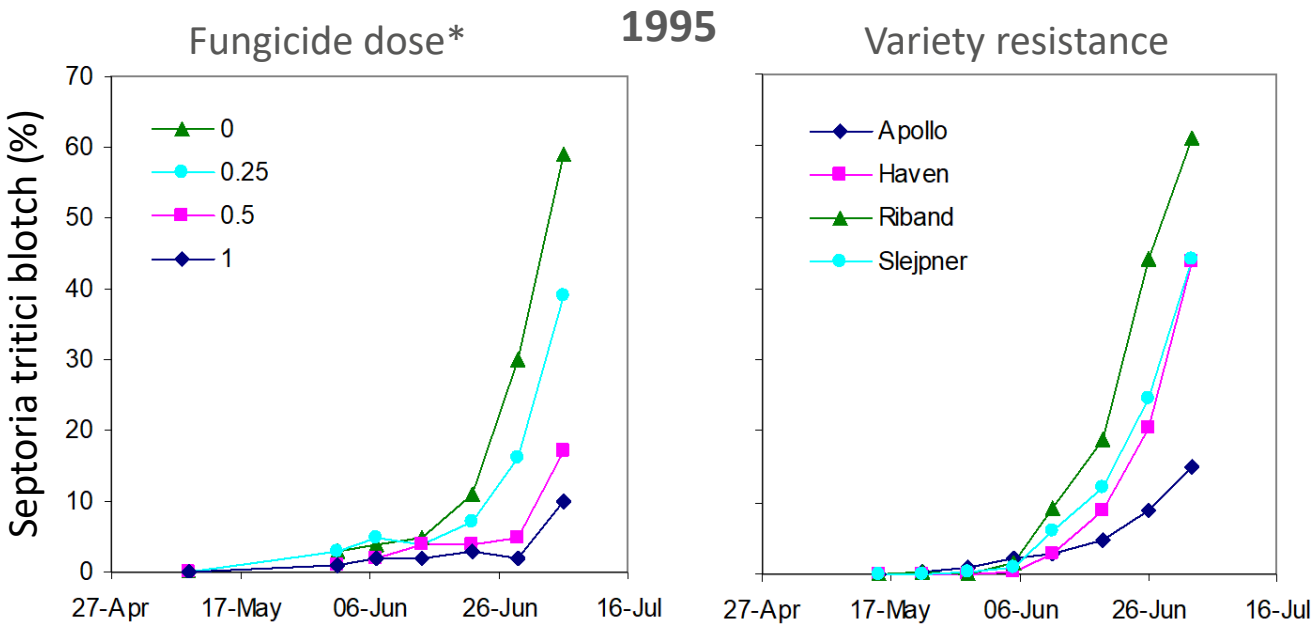
How can variety choice help?



*Dose = fraction of maximum permitted individual dose, tebuconazole

Source: AHDB research report no. 166

How can variety choice help?



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Source: AHDB research report no. 166

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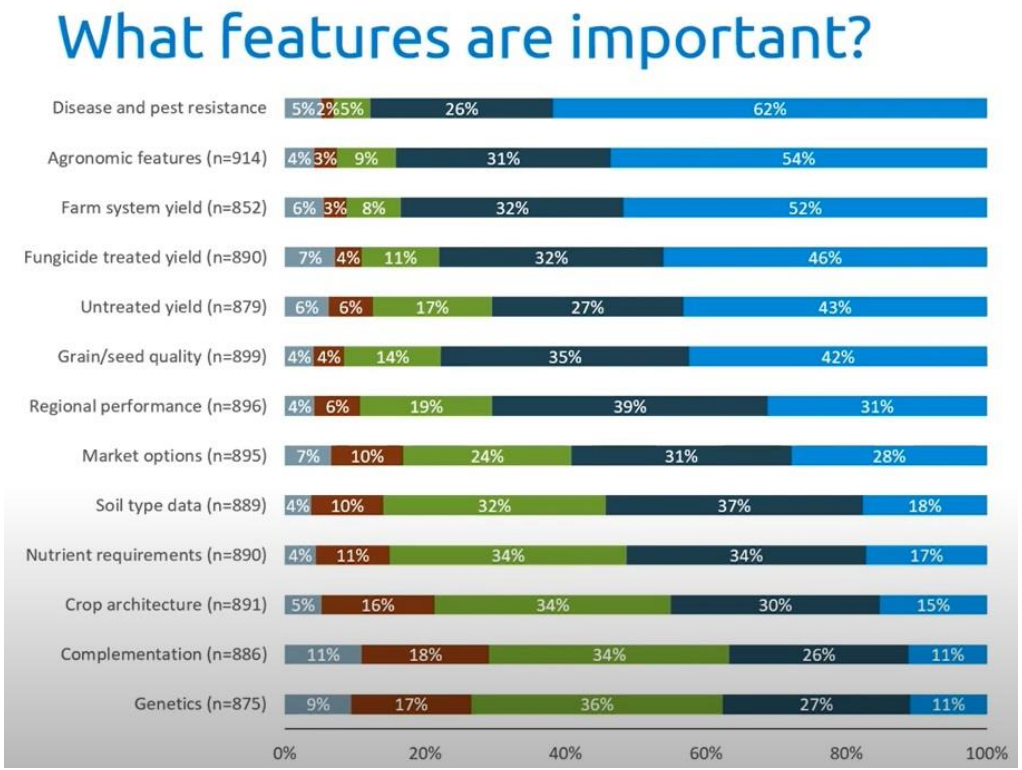


Source: AHDB survey 2023. https://www.youtube.com/watch?v=IeydkD_E5Og

Winter wheat 2024/25

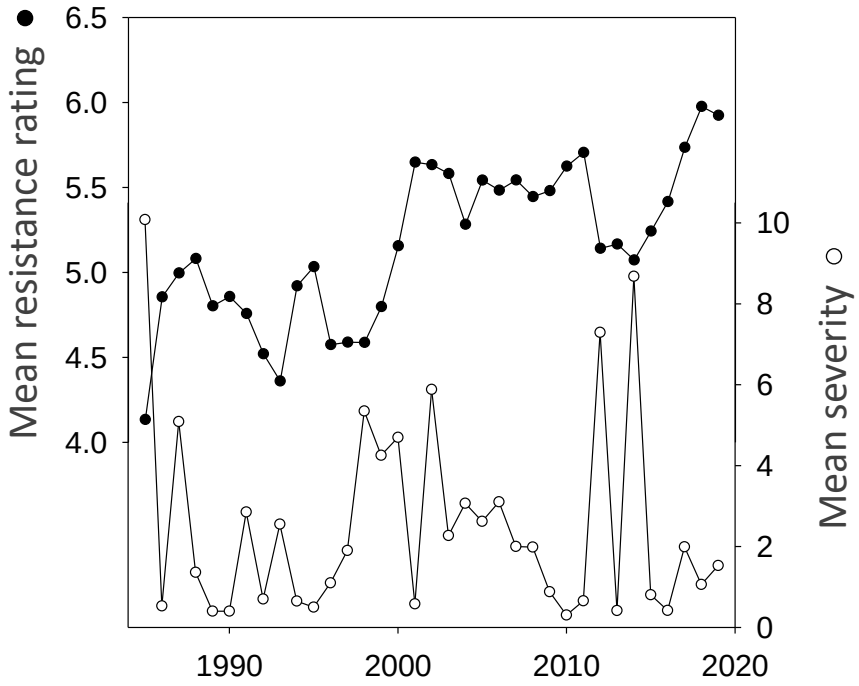
UKFM Group 1, 2 and 3

AHDB RECOMMENDED

	KWS Zyatt	SY Cheer	Skyfall	Crusoe	RGT Illustrious	KWS Extase	KWS Ultimatum	KWS Palladium	Mayflower	Bamford	RGT Wilkinson	KWS Brium	RGT Rashid	Almara	LG Illuminate	LG Astronomer	Average LSD (5%)
End-use group	UKFM Group 1					UKFM Group 2				UKFM Group 3							
Scope of recommendation	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	E	N	UK	UK	
Variety status		NEW	C			C				NEW		*		NEW	*		
Fungicide-treated grain yield (% treated control)																	
United Kingdom (11.0 t/ha)	99	97	96	95	95	101	101	100	97	106	100	100	99	99	98	98	2.3
East region (10.9 t/ha)	98	97	96	95	95	101	101	99	97	105	101	100	100	98	98	98	2.7
West region (11.2 t/ha)	99	98	96	96	96	102	101	101	97	107	99	99	98	99	99	98	3.0
North region (11.3 t/ha)	97	[98]	95	94	94	99	101	99	96	[105]	99	100	98	[102]	100	97	3.4
Untreated grain yield (% treated control)																	
United Kingdom (11.0 t/ha)	71	84	66	75	82	93	90	90	91	92	83	80	78	87	83	85	4.8
Disease resistance																	
Mildew (1–9)	7	[8]	6	7	6	7	7	8	7	[6]	7	7	3	[6]	5	4	1.5
Yellow rust (1–9)	3	7	3	8	7	7	9	9	9	7	7	9	8	8	7	8	0.6
Yellow rust (young plant)	s	-	s	s	s	s	r	r	r	-	s	s	r	-	r	r	
Brown rust (1–9)	7	6	9	3	5	6	6	5	6	6	5	5	5	6	6	7	0.6
Septoria tritici (1–9)	6.3	6.0	5.8	6.3	5.9	7.4	6.5	7.3	8.9	6.7	5.5	5.7	6.1	6.0	5.6	5.9	0.7
Eyespot (1–9)	6@	4	6@	5	6@	4	6	6	5@	6@	6@	5	5	4	5	5	1.5
Fusarium ear blight (1–9)	6	[7]	7	7	6	6	6	6	6	[5]	6	6	7	[6]	6	6	0.4
Orange wheat blossom midge	-	-	R	-	-	-	-	-	-	-	-	-	R	R	R	R	

Source: AHDB recommended list

Increasing resistance of varieties

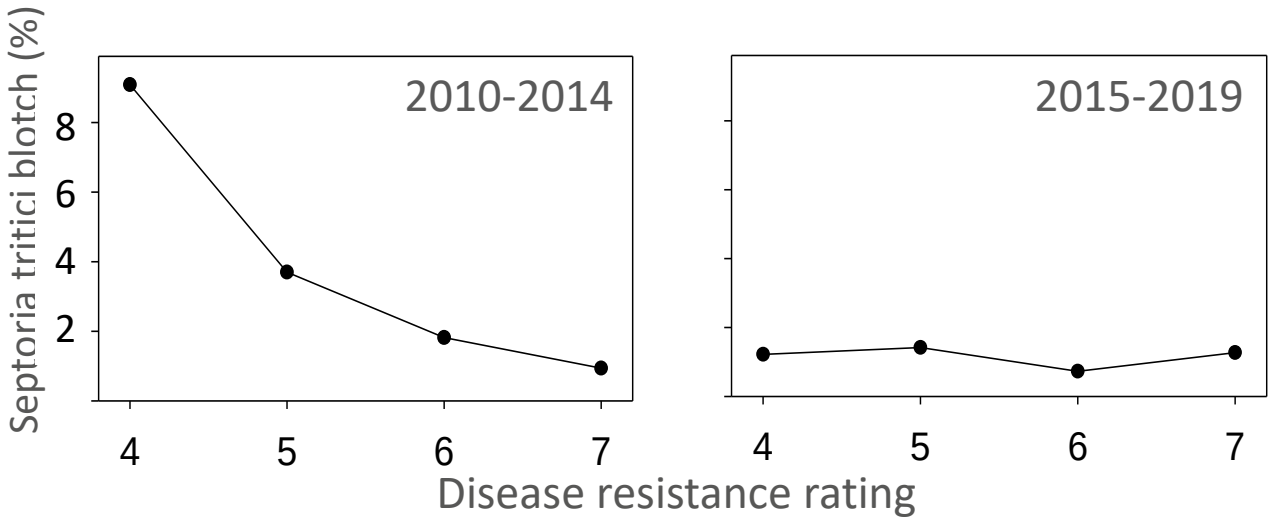


250+ commercial wheat fields sampled each year.

Disease assessed during grain filling

Source: DEFRA pest and disease survey (data by FERA, analysis by ADAS)

How can variety choice help?



Source: DEFRA pest and disease survey (data by FERA, analysis by ADAS)

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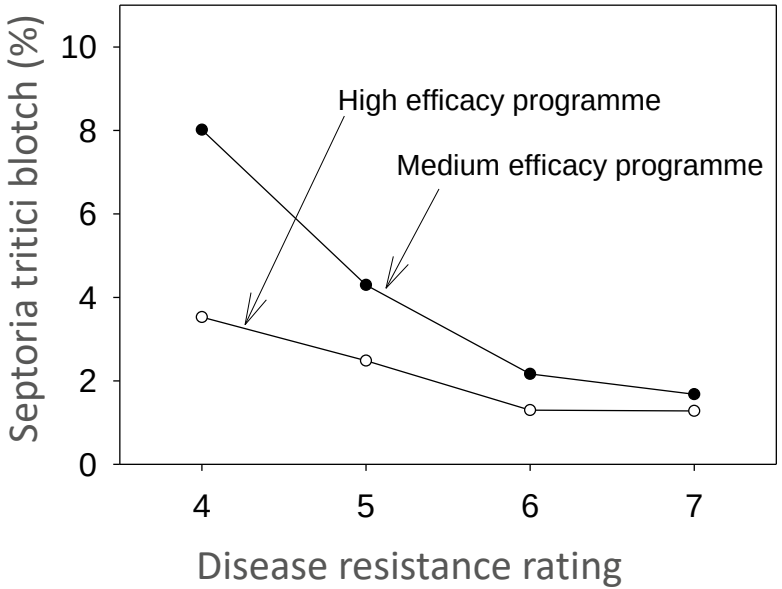


250+ commercial fields sampled each year 2005 to 2019

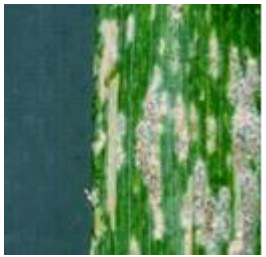
Source: DEFRA pest and disease survey (data by FERA, analysis by ADAS)

Types of disease resistance

Partial (quantitative) resistance

- Usually a combination of ‘minor genes’
- Main type of resistance against necrotrophs (e.g. septoria)
- AHDB resistance rating 5 to 7
- Loss of effectiveness usually gradual
- Provides valuable control of rusts (‘slow rusting’) and powdery mildew

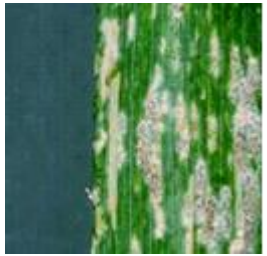


Types of disease resistance

‘Major gene’ (qualitative) resistance

- Usually a single resistance gene of large effect
- Mainly against biotrophic pathogens (rusts and mildews)
- Can provide a high level of resistance: AHDB resistance rating 8-9
- New virulent pathogen strains lead to loss of effectiveness



Source: AHDB

Types of disease resistance

‘Major gene’ resistance

mlo resistance against powdery mildew in spring barley

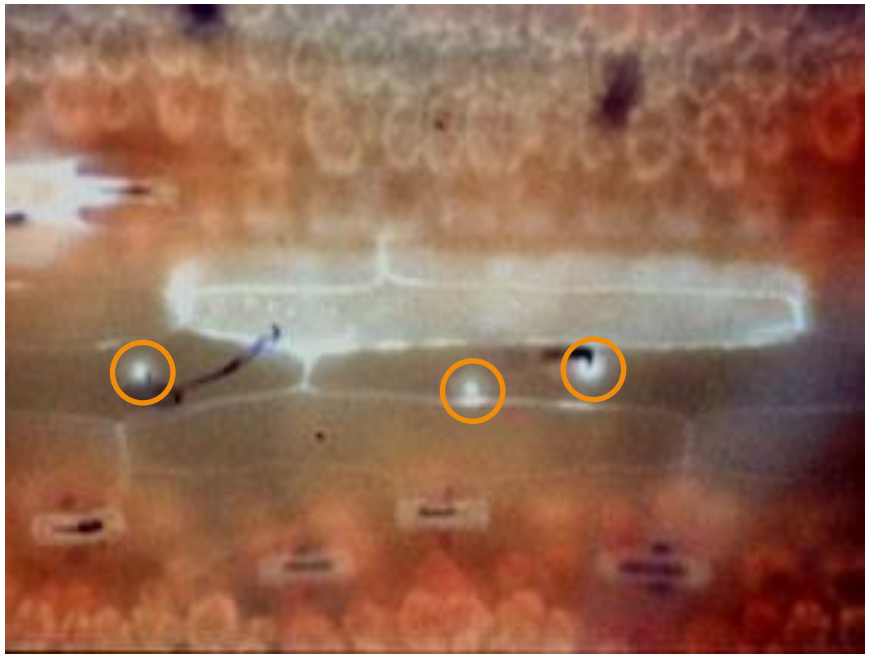
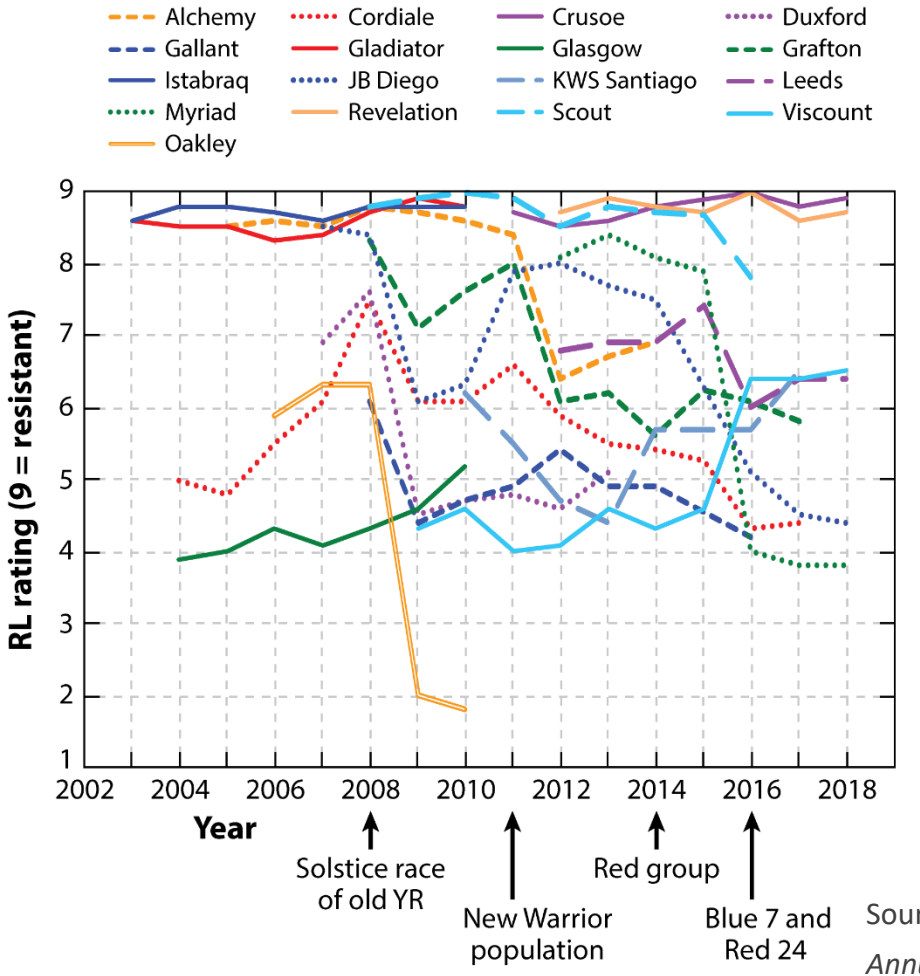


Image courtesy of Tim Carver, IBERS

Yellow rust of wheat



New virulent strains tracked and published by
UK Cereal Pathogen Virulence Survey (UKCPVS)

Source: Cowger & Brown (2019)
Annual Review of Phytopathology
Data from AHDB recommended list

Types of disease resistance – yellow rust

Variety	Seedling stage resistance	Adult plant resistance	RL rating
KWS Ultimatum	Resistant	Resistant	9
KWS Palladium	Resistant	Resistant	9
Mayflower	Resistant	Resistant	9
KWS Brium	Susceptible	Resistant	9
Blackstone	- (new variety)	Resistant	9
KWS Zealum	Susceptible	Resistant	9
LG Beowulf	- (new variety)	Resistant	9
KWS Dawsum	Resistant	Resistant	9
KWS Cranium	Resistant	Resistant	9
LG Typhoon	Resistant	Resistant	9
Costello	Resistant	Resistant	9

Source: AHDB recommended list 2024/25

How can variety choice help?

- Disease resistant varieties are available in all wheat quality groups, with high yields and good agronomic traits
- Fungicide inputs are not being adjusted sufficiently to account for the disease resistance of varieties
- Major gene resistance against rusts affected by new virulent strains
- UK Cereal Pathogen Virulence Survey provides warning of new strains
- Genetic markers assist stacking of minor resistance genes and combining minor genes with major gene resistance
- ‘Precision breeding’ act (2023) permits use of gene editing

Disease tolerance of varieties is covered in the next video

Further reading

Sources of information and data

AHDB Recommended Lists https://ahdb.org.uk/knowledge-library/recommended-lists-for-cereals-and-oilseeds-rl

Defra pest and disease survey (wheat and oilseed rape) https://www.pestanddiseasesurvey.co.uk/

UK Cereal Pathogen Virulence Survey https://ahdb.org.uk/knowledge-library/uk-cereal-pathogen-virulence-survey-ukcpvs

The genetic technology (precision breeding) act 2023 https://bills.parliament.uk/bills/3167/publications

Paveley ND, Hims MJ, Stevens DB, Clark WC (1998) Appropriate fungicide doses for winter wheat and matching crop management to growth and yield potential. AHDB (HGCA) final report no. 166.

Research papers

Keller B, Wicker T, and Krattinger SG (2018). Advances in Wheat and Pathogen Genomics: Implications for Disease Control. *Annual Review of Phytopathology* 56, 67-87.

Pixley KV, Falck-Zepeda JB, Giller KE, Glenna LL, Gould F, Mallory-Smith CA, Stelly DM, and Stewart CN (2019). Genome Editing, Gene Drives, and Synthetic Biology: Will They Contribute to Disease-Resistant Crops, and Who Will Benefit? *Annual Review of Phytopathology* 57, 165-188

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