AHDB
AGRICULTURE & HORTICULTURE DEVELOPMENT BOARD

UKCPVS Stakeholder meeting

Integrated management of cereal rusts and mildews

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CEREALS & OILSEEDS

Outline

- Disease risk
- Agronomic impacts
- Fungicide choice and timing
- Integrated disease management

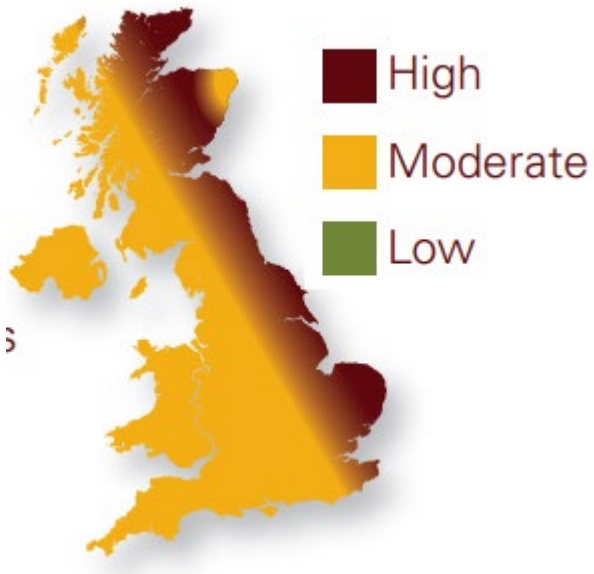
Factors affecting disease risk

- Risk of the crop being exposed to infection
  - Location
  - Climate
  - Previous crop
  - Cultivation method
  - Sowing date
  - Variety choice (surrounding fields)
- Ability of the crop to resist or tolerate infection
  - Weather
  - Variety choice (this field)
  - Sowing date
  - Nitrogen management / soil fertility
  - Crop health

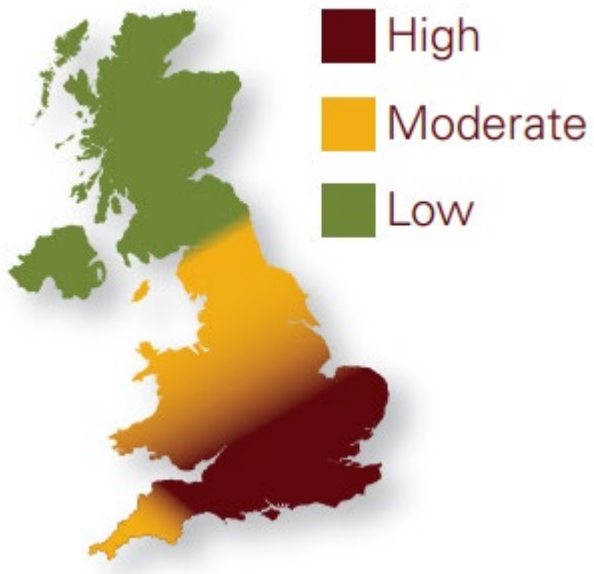
Geographic disease risk

Winter wheat

Yellow rust

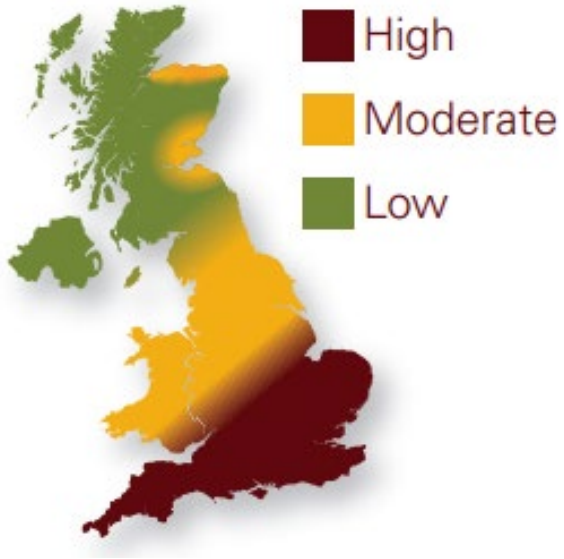


Brown rust

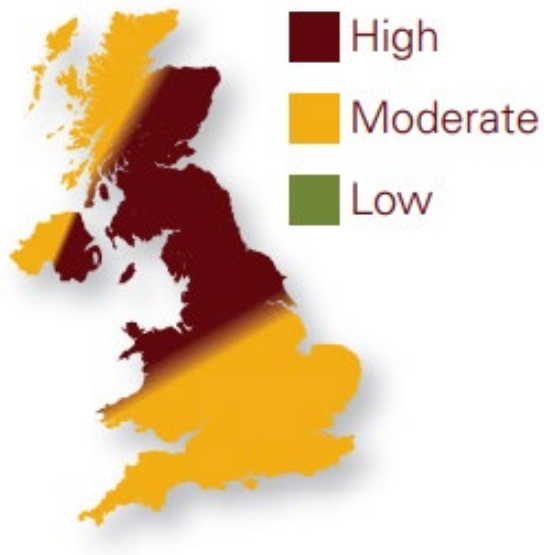


Winter barley

Brown rust



Mildew



Source: AHDB Winter wheat and winter barley disease management guides 2016

Weather effects

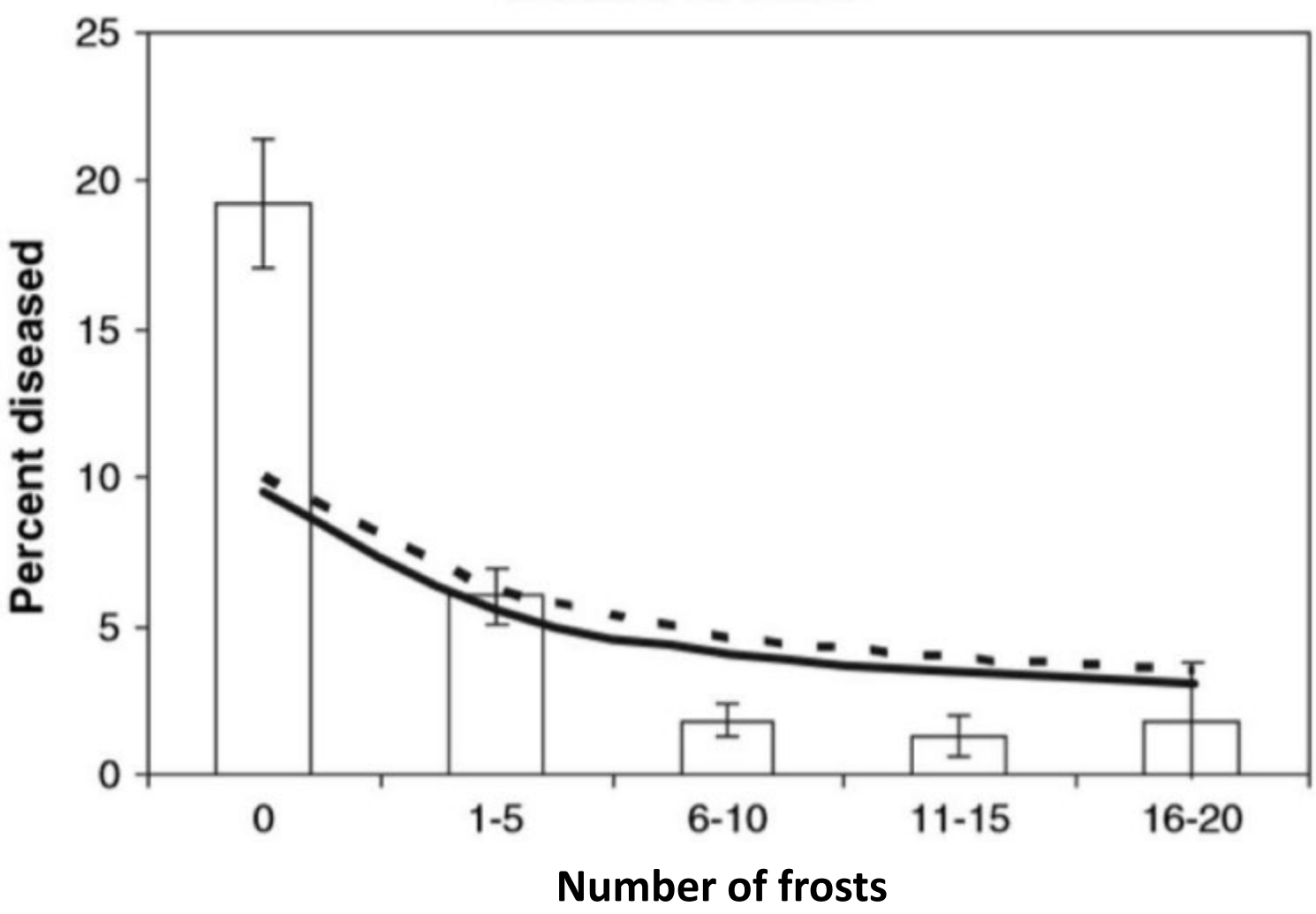
Wheat

- Yellow rust
  - Cold winters with several frosts below -5ºC reduce survival
  - Cool, damp spring weather
- Brown rust
  - High temperatures in early summer
  - Infection needs high humidity / leaf wetness
- Mildew
  - Warm, humid (but not wet) conditions

Barley

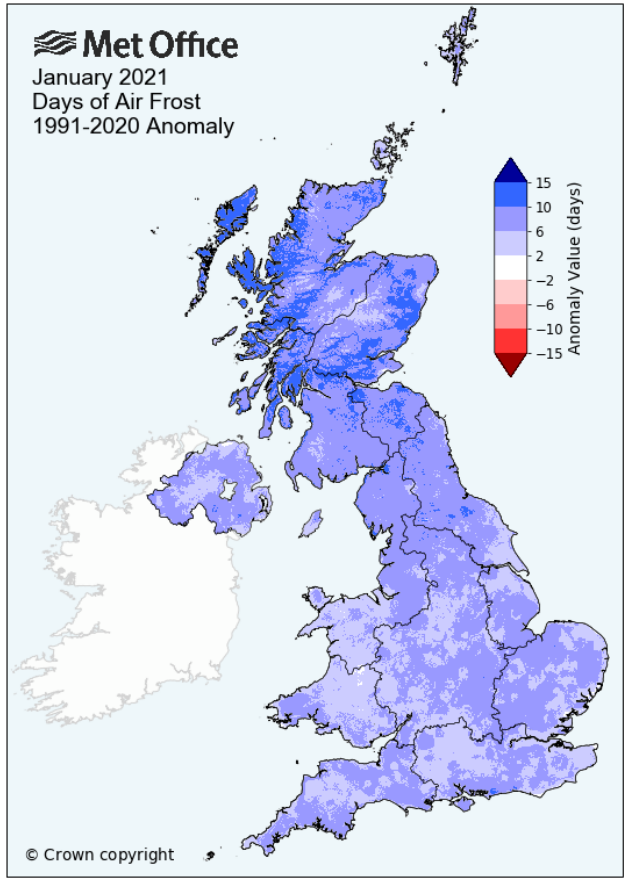
- Yellow rust
  - Cool, wet weather in spring before fungicides applied
- Brown rust
  - Warm, humid weather, especially from April to June
- Mildew
  - Warm, breezy conditions with short periods of high humidity
  - Temperatures >25ºC or rain inhibit disease

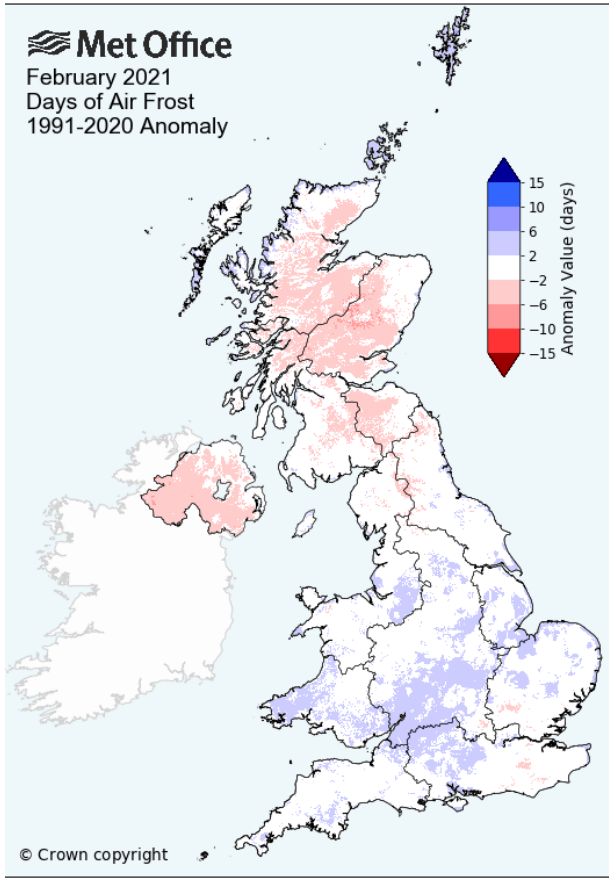
Effect of air frosts on yellow rust

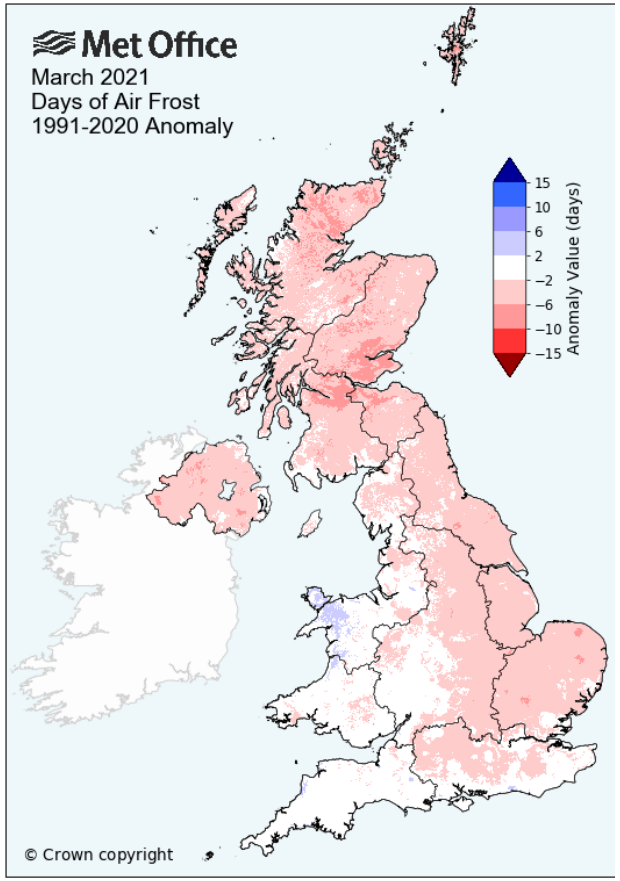


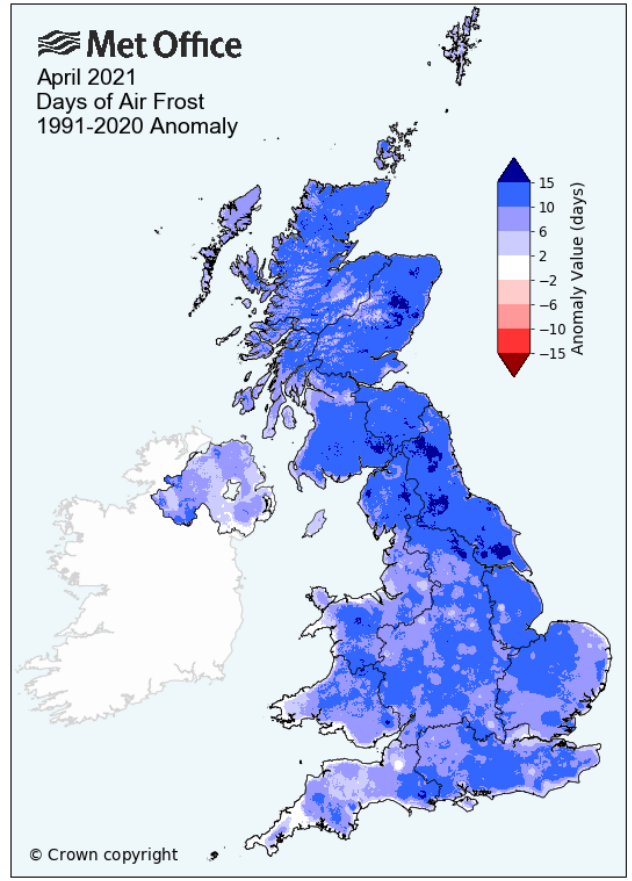
Source: Gladders *et al* (2007), Annals of Applied Biology 15

Days of air frost: 2021 vs 1991-2020 average



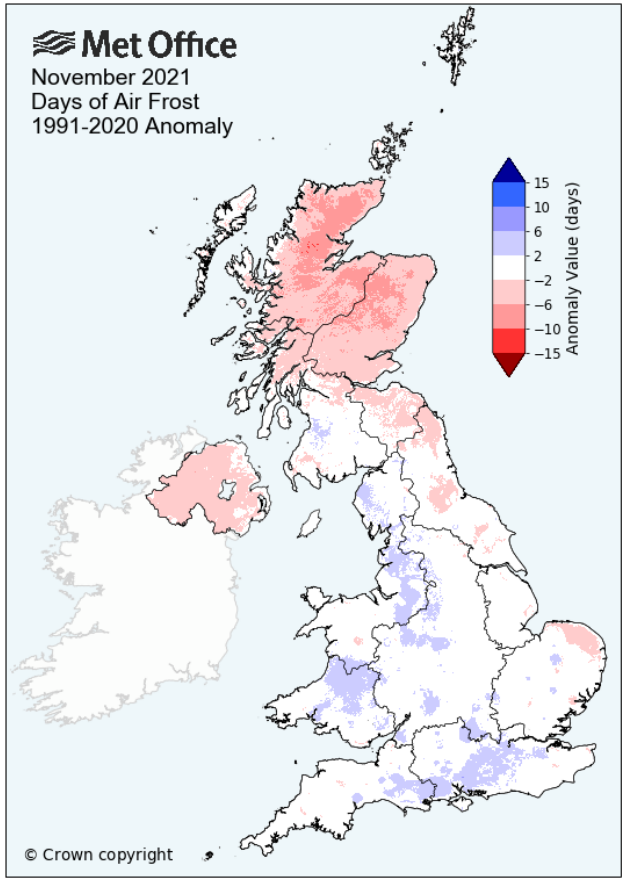


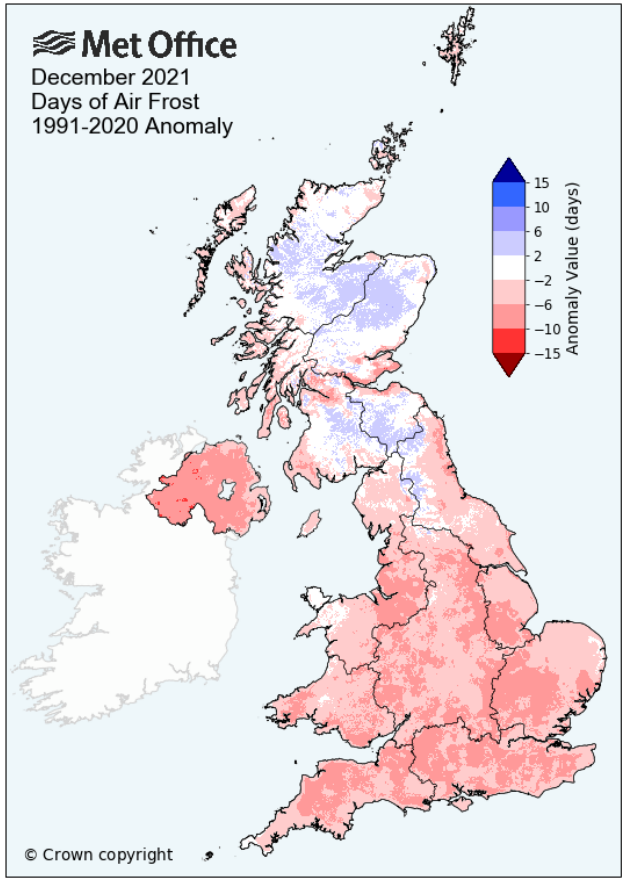


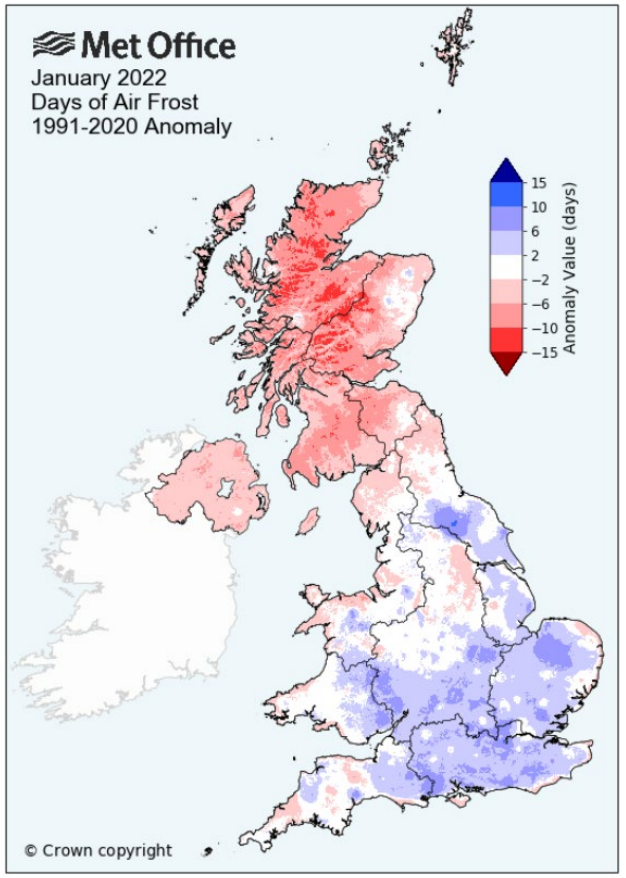


Source: Met Office https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-actual-and-anomaly-maps

Days of air frost: Winter 2021/22 vs 1991-2020 average







Source: Met Office https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-actual-and-anomaly-maps

Variety choice

Disease resistance ratings of varieties on AHDB 2022/23 Recommended Lists (number of varieties in each grouping)

	Winter Wheat			Winter Barley		Spring Barley	
RL Rating	Yellow Rust	Brown Rust	Mildew	Brown Rust	Mildew	Brown Rust	Mildew
8-9	22	4	6	3	2	0	17
6-7	9	18	22	18	14	0	0
5 or less	7	16	10	6	11	17	0

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

Agronomic impacts

- Cultivation system
  - For successive wheat or barley crops, reduced tillage can increase risk for rusts and mildew, if it increases volunteers. But this can be mitigated by other approaches
- Sowing date
  - Late sowing tends to exacerbate yellow rust in wheat
  - Brown rust (like septoria) is favoured by early sowing
  - Mildew commonly develops on very early sown crops, but is often more damaging on late sown crops

Agronomic impacts

- Dense crops
  - Dense crops favour rusts and in particular mildew (high seed rates)
- Nitrogen
  - Excessive nitrogen fertiliser / fertile sites favour mildew and to a lesser extent rusts
- Micronutrients
  - Several micronutrients (especially boron, copper and manganese) have a role within disease resistance in plants
  - If deficient, this can increase susceptibility *e.g.*, manganese and mildew

AHDB fungicide performance trials (wheat)

Wheat Yellow rust

Kings Lynn, single spray at T1 c. GS32

Wheat Brown rust

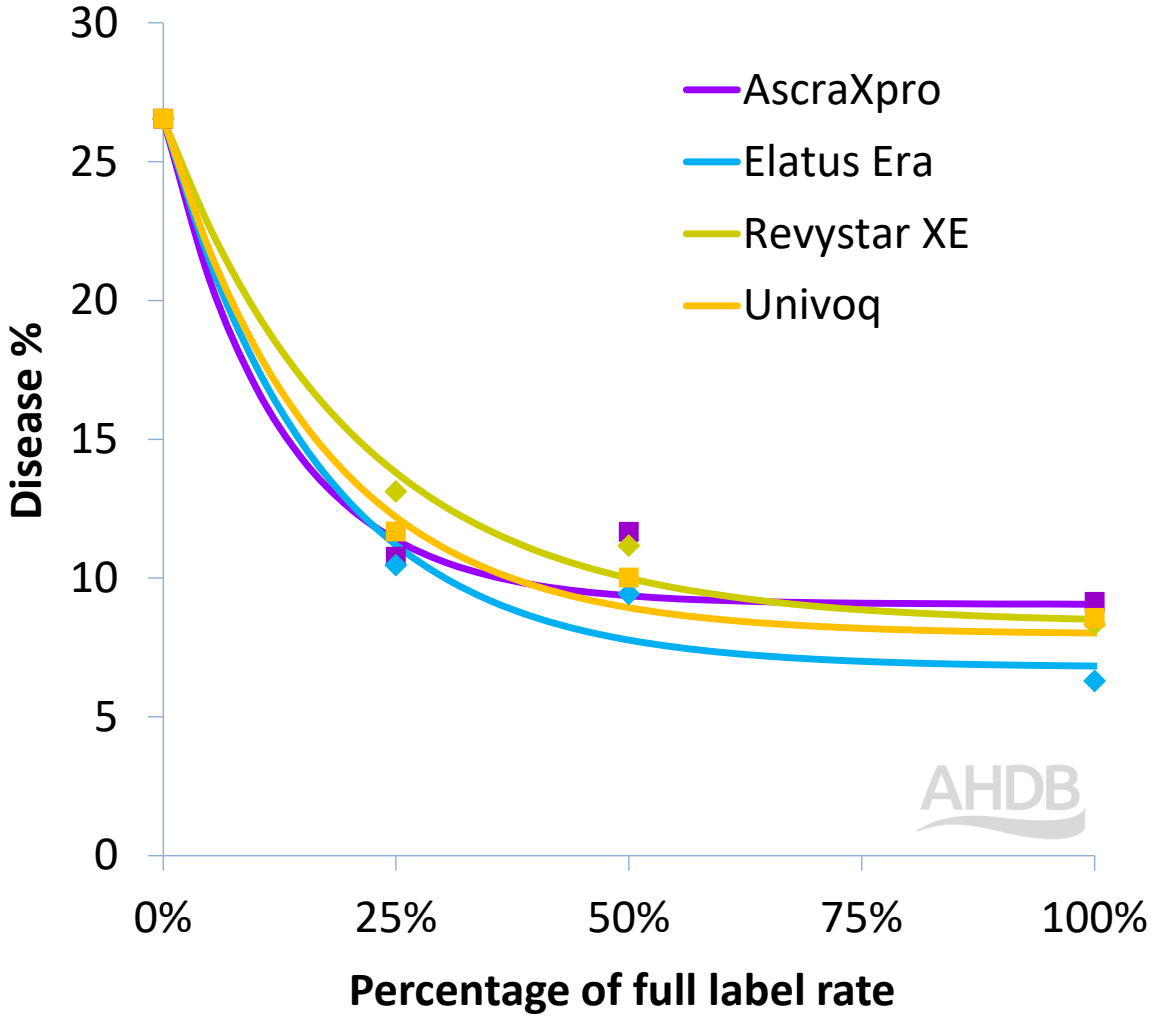
Cambridge, single spray at T2 c. GS39

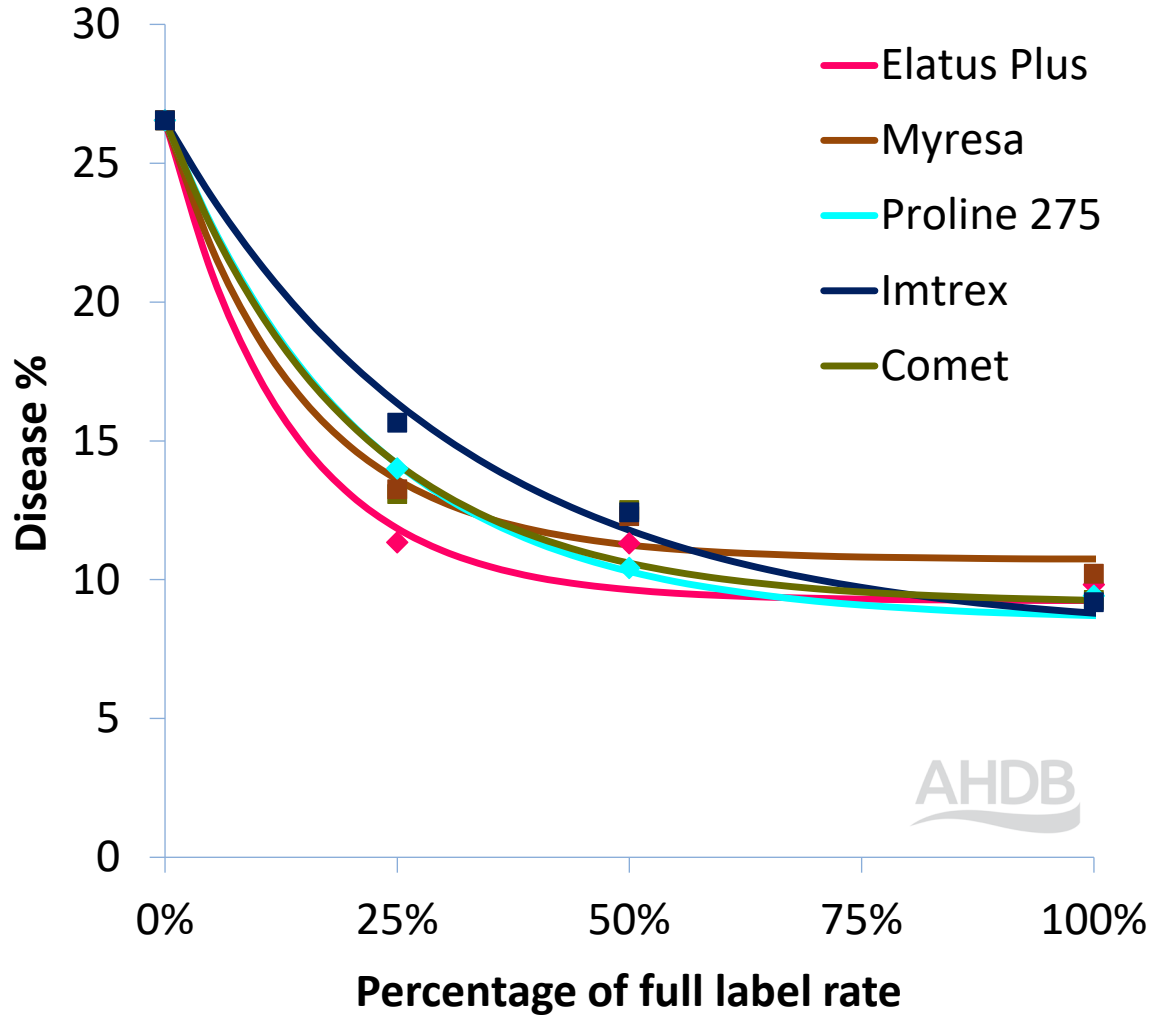
Registered products in fungicide performance rust trials

Product	Active(s)	Mode of Action
Proline	prothioconazole	DMI (azole)
Myresa	mefentrifluconazole (revysol)	DMI (azole)
Imtrex	fluxapyroxad	SDHI
Elatus Plus	benzovindiflupyr (solatenol)	SDHI
Comet	pyraclostrobin	QoI (strobilurin)
Ascra Xpro	bixafen + fluopyram + prothioconazole	SDHI + SDHI + DMI
Elatus Era	benzovindiflupyr + prothioconazole	SDHI + DMI
Revystar XE	mefentrifluconazole + fluxapyroxad	SDHI + DMI
Univoq	fenpicoxamid + prothioconazole	QII + DMI

Wheat Yellow Rust 2019-21 (3 trials)

Use Imtrex and Myresa only in mixtures with at least one fungicide with an alternative mode of action that has efficacy against the target disease





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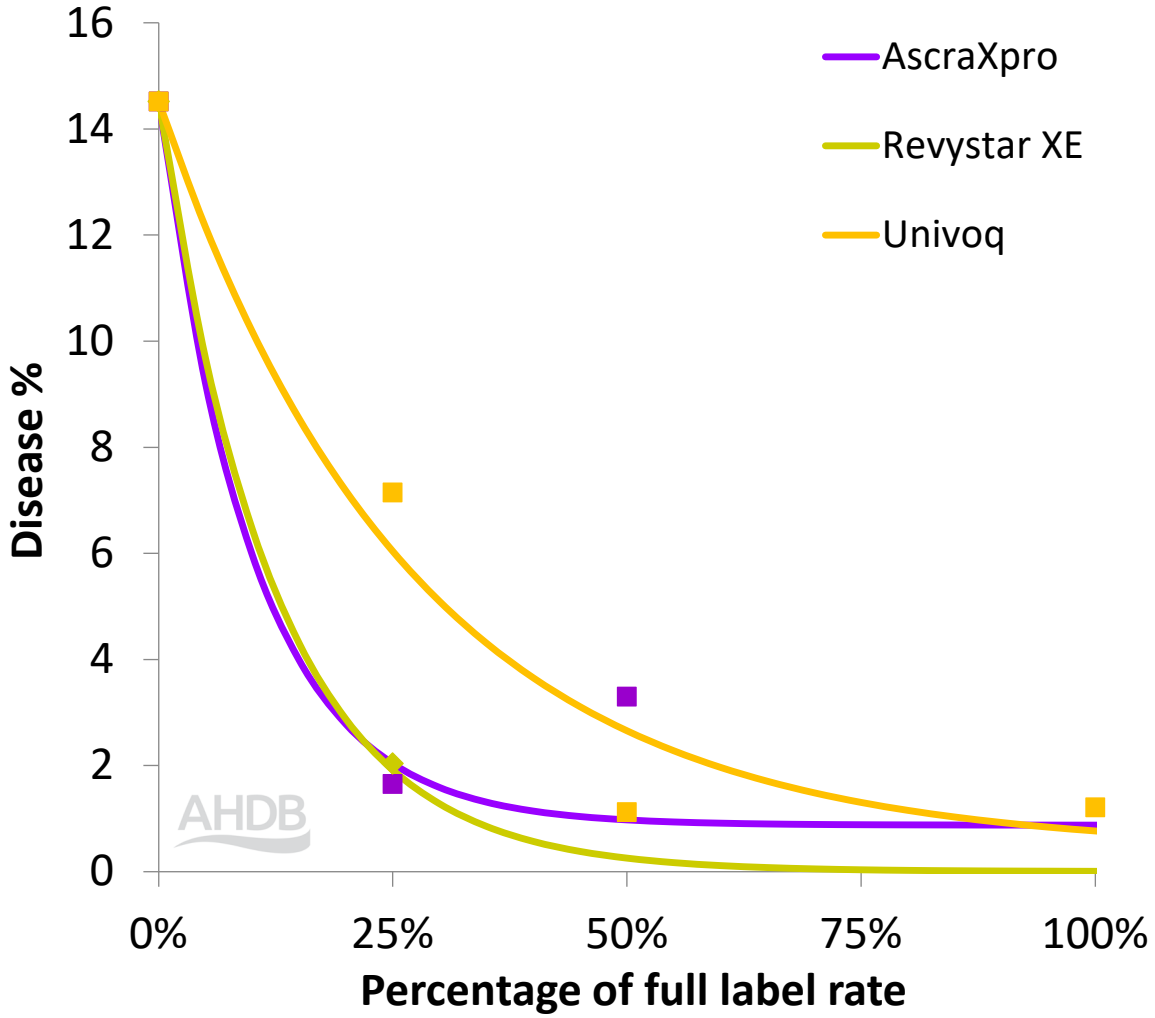

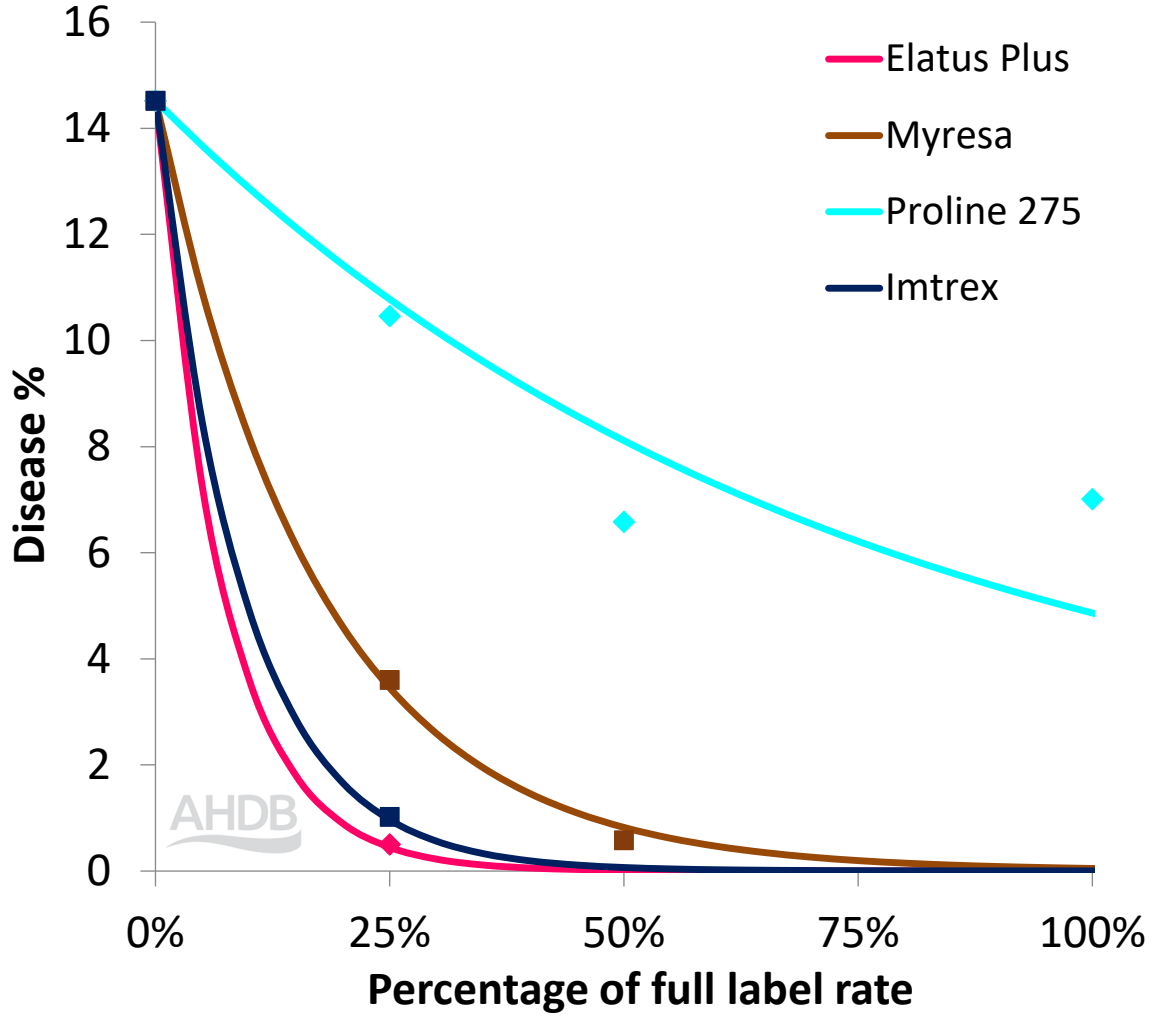

Fungicide timings / strategies (wheat)

- Latent periods differ between diseases; for example:
  - Septoria tritici 14-28 days
  - Yellow rust c. 10 days
  - Brown rust, mildew as little as 4-5 days
- For yellow rust, crops may be at risk before T1 fungicide sprays are applied, or between T1 and T2 if the interval between sprays is too long
- Compared to a conventional T1 (GS32), T2 (GS39), T3 (GS59-65) programme:
  - Additional sprays may be needed at ‘T0’ (GS30) for mildew or yellow rust
  - Holding spray may be needed at GS37 for yellow rust on susceptible varieties
  - Brown rust can develop rapidly after T2 but ‘T4’ sprays (GS71) are rarely justified

Yield response to spray timings (wheat yellow rust)

Spray Timing	Yield increase over untreated (t/ha)
T2 only	1.50
T1 + T2	1.98
T1 + T2 + T3	2.60
T0 + T1 + T2 + T3	3.07

JB Diego, Hampshire 2020

Untreated disease on flag leaf 58% yellow rust, 13% septoria (at GS73 on 22/06/20)

(Source: NIAB Trials Results 2019/20)

Fungicide timings / strategies (barley)

- Key timings for winter barley are T1 (GS31) and T2 (GS45-49)
  - T1 gives bigger yield response in north and west, or for rhynchosporium and mildew
  - T2 often gives bigger responses in east, or for net blotch, brown rust and ramularia
  - T0 (GS25-29) sprays may be needed if high levels of active disease after winter
- A T3 spray (GS55-59) can be appropriate, especially where T1 and T2 sprays are applied relatively early with PGRs (*e.g.*, at GS30 and GS39 respectively)
  - T3 sprays are not always economic, and should be minimal
- For spring barley, key timings remain T1 (GS25-30) and T2 (GS39-49)
  - For late sown crops, lower doses can be used, or a single spray applied at GS33-37

Further integrated disease management approaches

- Variety blends
  - Renewed interest in variety blends, especially in wheat
  - Small amount of published evidence that blends can reduce or delay development of mildew or rusts, especially in organic situations (further work is needed)
- Intercropping
  - Can reduce disease through dilution, acting as a physical barrier or inhibition
  - Intercropping cereals with legumes has shown potential to reduce yellow rust and mildew, particularly in wheat and during the early stages of the epidemic *(Zhang et al, 2019, European Journal of Plant Pathology 154)*
- Where considered practical, these could contribute to an integrated approach

Conclusions

- Assess the potential disease risk
- Make good use of all the tools in the toolbox
  - Varieties (diversity as well as resistance ratings)
  - General agronomy (no blueprint, instead match to situation/risk)
  - Fungicide programme (appropriate products at the appropriate timings)

Acknowledgements

AHDB Fungicide Performance

Paul Gosling and Catherine Harries, AHDB

Jonathan Blake, Philip Walker and Rebecca Joynt, ADAS

Fiona Burnett, SRUC

Simon Edwards, Harper Adams University

Stephen Kildea, Teagasc


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