October 2025

Arable Update

Cereals: Issue 234

Managing Septoria: Latest results on SDHI performance

Key points

- *Zymoseptoria tritici* (*Zt*), the cause of Septoria tritici blotch (STB), is showing a gradual reduction in sensitivity to SDHI fungicides in New Zealand.
- New genetic variants of *Zt* linked to reduced sensitivity have been detected, especially in Canterbury, but are not yet widespread.
- The diversity of *Zt* variants and combinations of variants is likely to increase, which will impact on field performance.
- Regional differences in sensitivity are emerging, but SDHIs are still performing in the field.
- Careful stewardship, i.e. mixing, rotating and limiting the number of SDHI sprays is essential to protect their ongoing usefulness.

Background

This Update outlines the latest results on how *Zymoseptoria tritici* (*Zt*), the fungus that causes Septoria tritici blotch (STB), is responding to succinate dehydrogenase inhibitor (SDHI - Group 3) fungicides in New Zealand wheat crops.

As SDHI fungicides are a key part of current spray programmes for STB, FAR monitors how sensitive *Zt* populations are to these fungicides. By tracking changes in sensitivity, FAR can provide the most up-to-date advice on fungicide programmes. This helps growers control STB effectively while slowing the build-up of resistance. Reduced sensitivity to SDHIs is already being seen in New Zealand and overseas. If not carefully managed, this could shorten the useful life of these important products.

How does the testing work?

Each year, Plant & Food Research screens *Zt* samples collected from wheat crops across New Zealand for sensitivity to key SDHI active ingredients, including isoflucpyram (found in Caley® Iblon® and Vimoy® Iblon®), benzovindiflupyr (found in Elatus™ Plus) and fluxapyroxad (found in Revystar®.

The programme includes:

Phenotyping: testing isolates in the lab against different doses of SDHIs to see if sensitivity is changing. Results are reported as *EC_{50} values or **resistance factors (RF). Lab tests use very small doses to measure how sensitive the fungus is. These are different to field rates, which are designed to deliver control.

* An EC_{50} is the fungicide dose that slows fungal growth by 50% in the lab. A low EC_{50} means the pathogen is very sensitive, while a high EC_{50} shows it is becoming less sensitive.

** A RF compares how sensitive a pathogen is to a fungicide against a sensitive reference strain. The lower the RF, the more sensitive the pathogen.

Genotyping: checking for DNA changes in a pathogen that are linked to reduced sensitivity.

Using both methods provides an early warning system. Phenotyping can tell us what is happening, and genotyping can tell us why it is happening. This helps us detect shifts before they become obvious in the field and gives time to adjust fungicide programmes.

What have we observed in recent tests?

Zt populations in New Zealand wheat continue to show a gradual reduction in their sensitivity to SDHI fungicides in lab testing.

Phenotyping results

In 2023-24, the mean EC_{50} values for isolates tested against SDHI active ingredients have increased compared with previous seasons (Figure 1). Of 149 isolates tested against benzovindiflupyr, 39% had an EC_{50} value >0.5 mg/L in 2023-24, compared with 13% in 2022-23. None of the isolates tested had an EC_{50} >0.5 mg/L when testing began in 2017-18.

Isoflucpyram is the newest SDHI on the market, so has had the least pathogen exposure. In 2023-24, 11% of isolates had an EC_{50} >0.5 mg/L up from 6% in 2022-23 and 5% when testing began in 2020-21.

For fluxapyroxad, the oldest of the three SDHI active ingredients tested 55% of the isolates tested had an EC_{50} >0.5 mg/L, up from 45% in 2022-23 and 1% when testing began in 2017-18.

There were regional EC_{50} and RF differences between the SDHI active ingredients (Table 1).

Genotyping results

This study identified a number of *sdh* variants (changes in the DNA of genes that encode the SDH enzyme) in the New Zealand *Zt* population.

In 2023-24, seven isolates carrying the C-H152R variant were identified in Canterbury (Table 2). This variant was first identified in New Zealand in 2020-21 and is associated with high resistance factors in all of the SDHIs tested. One isolate in Canterbury was found to carry a combination of variants (*C-N33T-N34T+C-H152R*). This variant had high resistance factors to isoflucpyram and fluxapyroxad.

The C-N86S variation, first identified in New Zealand in 2021-22 continues to be found in Canterbury and Otago/Southland *Zt* populations (Table 2). It is typically associated with low resistance factors, however when found at a high frequency in the population they are expected to impact field performance.

What do these results mean in the field?

Despite the identification of *sdh* variants that are associated with high resistance factors, the gradual reduction in sensitivity to SDHI fungicides, when compared with triazoles, indicates they may not yet have reached a frequency that will impact significantly on field performance. However, it is expected that the diversity and frequency of isolates carrying these variants will increase, which will ultimately impact on SDHI performance in the field.

Regional differences are also emerging. For example, the mean EC_{50} values and resistance factors in Manawatū/Whanganui were higher than South Otago/Southland and Canterbury, especially for fluxapyroxad. This does not mean SDHIs are failing in those regions at field rates, but it does highlight local differences in *Zt* populations. Regional resistance factors for isoflucpyram, benzovindiflupyr and fluxapyroxad largely indicate field rates will still provide effective disease control.

Overall, shifts in New Zealand *Zt* populations are still less severe than in many overseas cropping systems. This gives us a valuable opportunity to manage fungicide programmes carefully and maintain efficacy for longer.

What does this mean for fungicide programmes this season?

With a gradual reduction in sensitivity to SDHIs, stewardship is essential. Thoughtful use of these fungicides, such as limiting the number of applications and always using SDHIs in mixtures with other modes of action, will help extend their life.

A full list of SDHI active ingredients are provided in Table 3 and the latest stewardship guidelines are provided in Cereal Update 235.

Laboratory testing conducted by:

BIOECONOMY SCIENCE INSTITUTE | Plant & Food Research Rangahau Ahumāra Kai

Project supported by:

A LIGHTER TOUCH BASF We create chemistry CORTEVA agriscience ADAMA BAYER syngenta

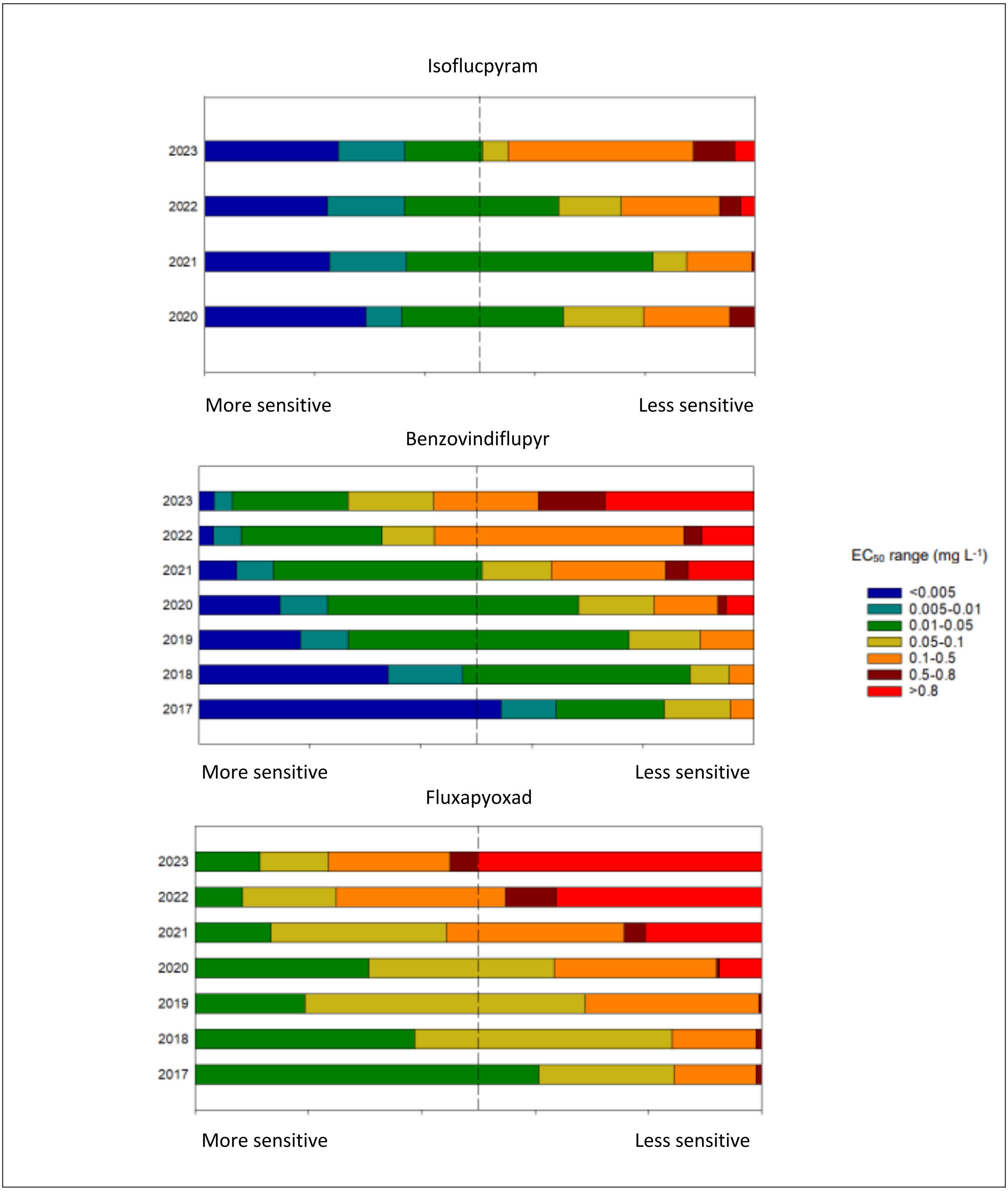

Figure 1. Comparison of mean EC_{50} (fungicide concentration that inhibits growth by 50% in mg/L) values of *Zt* field isolates tested against SDHI (Group 7) fungicides isoflucpyram (2020-2023), benzovindiflupyr (2017-2023) and fluxapyroxad (2017-2023). Dashed line indicates 50% of the isolates tested.

Table 1. Mean EC_{50} values (mg/L) and Resistance factors (RF)* of New Zealand *Zymoseptoria tritici* field isolates collected from Manawatū/Whanganui, Canterbury and South Otago/Southland in 2023-24, tested against three SDHI fungicides. The sensitive reference has an RF of 1.

	Sensitive reference	Manawatū/ Whanganui (n=9)		Canterbury		South Otago/ Southland (n=51)	
		EC_{50}	RF	EC_{50}	RF	EC_{50}	RF
Isoflucypram	0.003	0.465	155	0.123	41	0.264	88
Benzovindiflupyr	0.008	1.118	140	0.309	39	0.842	73
Fluxapyroxad	0.033	13.1	397	2.4	73	3.425	104

Table 2. A summary of the sensitivity of New Zealand *Zt sdh* variants to SDHIs isoflucpyram, benzovindiflupyr and fluxapyroxad. Resistance factors (RF)* were determined by comparing the mean sensitivity of each variant to the sensitive reference. The sensitive reference has an RF of 1. Darker shading indicates a higher RF.

Sdh variant	ARG Region	Year identified	No. isolates	Resistance Factor (RF)		
				Isoflucpyram	Benzovindiflupyr	Fluxapyroxad
C-H152R	Canterbury	2020-21	7	238	271	460
C-N33T-N34T+ C-H152R	Canterbury	2022-23	1	260	46	375
C-N86S	Canterbury/Otago/ Southland	2021-22	7	171	187	90
C-N33T-N34T+ C-N86S	Otago/Southland	2023-24	3	146	161	98
C-N33T-N34T +B-N225I	Canterbury/Otago/ Southland	2022-23	3	126	71	60
C-V166M	Otago/Southland	2018-19	5	54	170	144
C-N33T-N34T+ C-N79I	Manawatū-Whanganui/ Otago/ Southland	2021-22	3	29	83	60
C-N33T-N34T	Manawatū-Whanganui/ Canterbury/Otago/ Southland	2018-19	4	52	43	27
C-R151T	Canterbury	2023-24	1	2	27	20
C-N33T-N34T+ C-V166M	Otago/Southland	2023-24	1	2	32	18
Sensitive reference				0.003	0.006	0.03

*Resistance factors (RF) are the ratio between the mean EC_{50} value of the test isolates and the sensitive reference isolate. Sensitivity testing enabled the calculating of resistance factors for each triazole active ingredient.

Table 3. SDHI active ingredients, mode of action group, FRAC* Group number, chemical trade names, label rates and withholding periods for fungicides used to control Septoria tritici blotch in New Zealand wheat.

Active ingredient (g ai/L)	Mode of action group	FRAC* Group No.	Chemical trade names	Label rate (L/ha)	Withholding Period (days)	
					Silage	Grain
benvindiflupyr 100	SDHI	7	Elatus™ Plus (Syngenta Crop Protection Ltd)	0.75	28	42
fluxapyroxad 50 + mefentrifluconazole 100	SDHI + DMI	7 + 3	Revystar® (BASF Ltd)	1.5	28	35
isoflupyram 50	SDHI	7	Vimoy® Iblon® (Bayer Crop Science Ltd)	1.5	28	42
isoflucpyram 50 + prothioconazole 100	SDHI + DMI	7 + 3	Caley® Iblon® (Bayer Crop Science Ltd)	1.5	28	42
Bixafen 75 + prothioconazole 150	SDHI + DMI	7 + 3	Aviator Xpro® (Bayer Crop Science Ltd)	0.7 – 1.0	42	56

*FRAC – Fungicide Resistance Action Committee.

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