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Arable Update

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Managing Septoria: Latest results on triazole performance

Key points

- *Zymoseptoria tritici* (*Zt*), the cause of Septoria tritici blotch (STB), is showing reduced sensitivity to triazole fungicides in New Zealand.
- prothioconazole-desthio and epoxiconazole are less sensitive in lab tests, while mefenitrifluconazole remains more sensitive.
- New genetic types of *Zt* (haplotypes) linked to reduced sensitivity have been detected, especially in South Otago/ Southland.
- Regional differences in sensitivity are emerging, but triazoles are still performing in the field.
- Careful stewardship, i.e. mixing, rotating, and limiting triazole 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 triazole fungicides in New Zealand wheat crops.

As triazoles (DMI, Group 3) 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 triazoles 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 triazole active ingredients, including epoxiconazole, prothioconazole-desthio, and mefenitrifluconazole.

The programme includes:

Phenotyping: testing isolates in the lab against different doses of triazoles 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.

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

Genotyping: checking for pathogen DNA changes 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 declining sensitivity to triazole fungicides in lab testing.

Phenotyping results

In 2023–24, a clear shift in prothioconazole-desthio sensitivity was seen compared with previous seasons. Of 149 isolates tested, 36% had an EC_{50} >0.5 mg/L, compared with just 6.4% in 2022–23 (Figure 1). None of the tested isolates had an EC50 >0.5 mg/L when testing began in 2016-17.

For epoxiconazole, 83% of isolates had an EC50 >0.5 mg/L in 2023–24, up from 71% the year before and 30% when testing began in 2020-21.

Isolates remained highly sensitive to mefenitrifluconazole.

Tebuconazole and prochloraz were tested for the first time in 2023–24 (Table 1).

Genotyping results

A new *Zt* haplotype (F8), with reduced sensitivity to all triazoles tested, was detected in South Otago/Southland.

Other haplotypes (e.g. F4 and E4) continue to influence sensitivity to specific triazoles, with different impacts depending on the active ingredient (Table 2). For example, the F4 haplotype has more impact on the sensitivity of *Zt* isolates to epoxiconazole and mefenitrifluconazole than it does on prothioconazole-desthio, whereas the E4 haplotype has a greater impact on epoxiconazole and prothioconazole than mefenitrifluconazole (Table 2).

These genetic shifts align with the reduced sensitivity observed in phenotyping.

What do these results mean in the field?

There is no single threshold EC_{50} that defines "insensitivity" for triazoles—it varies by active ingredient. However, loss of field efficacy has already been observed for epoxiconazole, where RF values rose sharply in 2023–24.

Regional differences are also emerging. For example, mean EC_{50} values and RFs in South Otago/Southland were higher than in Manawatū/Whanganui or Canterbury. This does not mean triazoles are failing in those regions at field rates, but it does highlight local differences in *Zt* populations.

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?

As pathogen sensitivity to triazoles continues to fall, stewardship is essential. Thoughtful use of these fungicides, such as limiting the number of applications, using mixtures with other modes of action, and rotating active ingredients, will help extend their life.

A full list of triazole active ingredients is provided in Table 3 and the latest stewardship guidelines are provided in Cereal Update 233.

Laboratory testing conducted by:

BIOECONOMY SCIENCE INSTITUTE | Plant & Food Research
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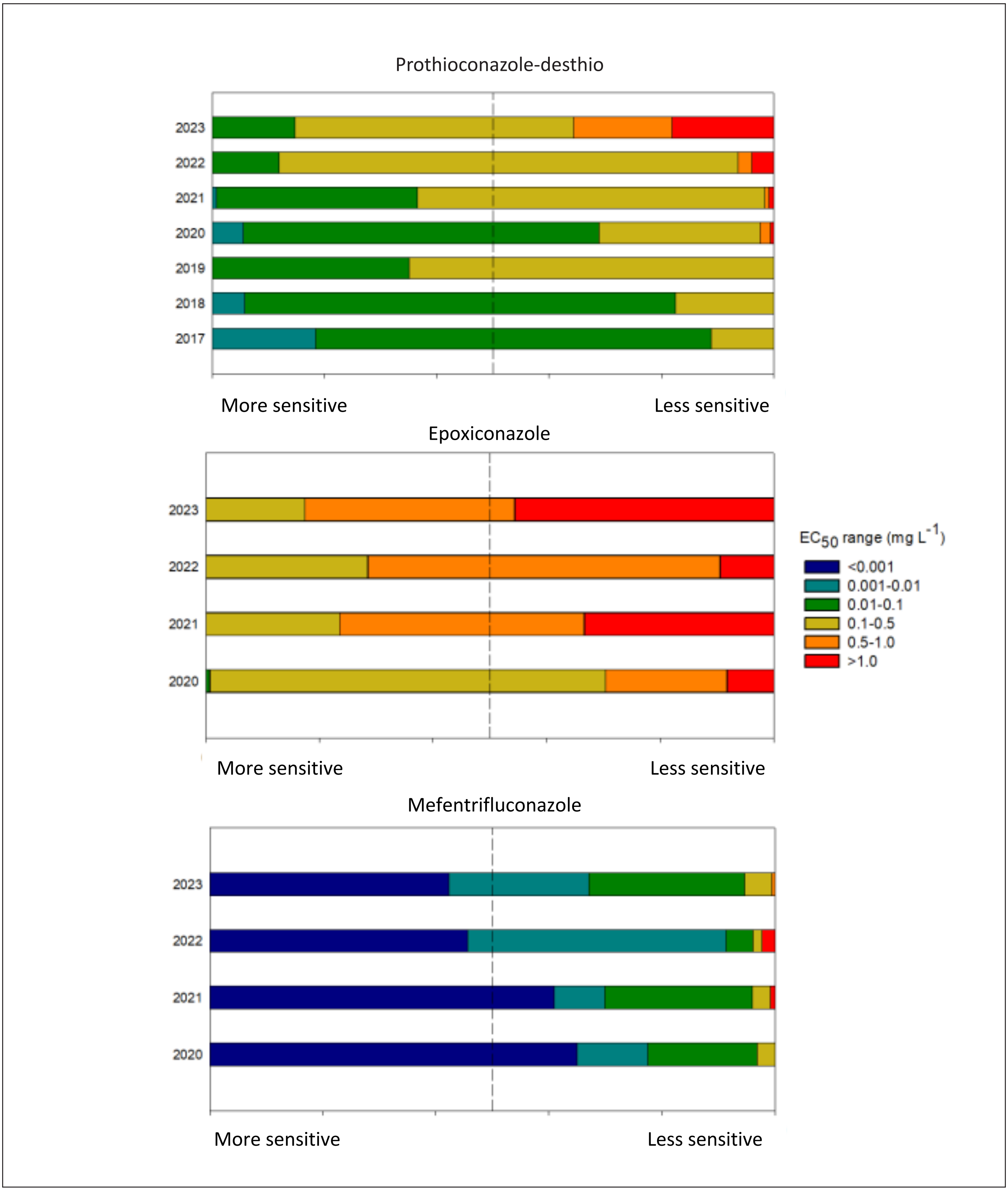

Figure 1. Comparison of mean EC_{50} (fungicide concentration that inhibits growth by 50% in mg/L) values of *Zt* field isolates tested against triazole (Group 3) fungicides prothioconazole-desthio (2017-2023), epoxiconazole (2020-2023) and mefenitrifluconazole (2020-2023) Dashed line indicates 50%.

Note: The point at which *Zt* becomes insensitive to a triazole will vary for each active ingredient within the Group 3 MOA.

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 five DMI – triazole fungicides. 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.

	Sensitive reference	Manawatū/ Whanganui (n=9)		Canterbury		South Otago/ Southland (n=51)	
		EC_{50}	RF	EC_{50}	RF	EC_{50}	RF
Epoxiconazole	0.008	0.958	120	1.259	157	3.687	460
prothioconazole-desthio	0.096	0.293	3	0.322	3	1.238	13
Mefentrifluconazole	0.0009	0.005	6	0.014	15	0.054	60
Tebuconazole	0.1	0.797	8	1.851	19	2.104	21
Prochloraz	0.011	0.137	12	0.121	11	0.402	37

Table 2. A summary of the sensitivity of New Zealand *Zt* Cyp51 haplotypes to triazoles epoxiconazole, prothioconazole and mefenitrifluconazole. 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.

Cyp51 haplotype	ARG Region	Year identified	No. isolates	Resistance Factor (RF)		
				Epoxiconazole	prothioconazole-desthio	Mefentrifluconazole
F8	SOS	2023-24	3	545	316	167
F4	NSI/MC/ SCNO/ SOS	2021-22	10	642	70	167
E4	SWNI/ NSI/MC/ SCNO/SOS	2018-19	29	233	100	7
G1	SWNI/NSI/ MC/ SCNO	2012	1	160	7	-
A3 (sensitive reference)	NSI/MC /SCNO	2003		-	-	-

*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. Triazole 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
Epoxiconazole 125	Triazole	3	Accuro™ (Adria Crop Protection Ltd)	1.0	28	42
Epoxiconazole 125	Triazole	3	Epozole™ (AGPRO Ltd)	1.0	28	42
Epoxiconazole 125	Triazole	3	Fortify™ (Ravensdown Ltd)	1.0	28	42
Epoxiconazole 125	Triazole	3	Opus® (BASF Ltd)	1.0	28	42
Epoxiconazole 125	Triazole	3	Stellar® (Adama NZ Ltd)	1.0	28	42
Epoxiconazole 50 + prochloraz 225	Triazole	3	Bolide® (Adama NZ Ltd)	2.0	42	42
Mefenitrifluconazole 100	Triazole	3	Revylution® (BASF Ltd)	1.5	28	35
Prothioconazole 250	Triazole	3	Joust® (Nufarm Ltd)	0.4 – 0.8	42	56
Prothioconazole 250	Triazole	3	Pilot™ 250 EC (Orion Agriscience Ltd)	0.4 – 0.8	42	56
Prothioconazole 250	Triazole	3	Procyon 250 ec (Kenzo NZ Ltd)	0.4 – 0.8	42	56
Prothioconazole 250	Triazole	3	Proline® (Bayer Crop Science Ltd)	0.4 – 0.8	42	56
Prothioconazole 250	Triazole	3	Thiazole (AGPRO NZ Ltd)	0.4 – 0.8	42	56
Prothioconazole 250	Triazole	3	Prothago® (Adama NZ Ltd)	0.4 – 0.8	42	56
Prothioconazole 250	Triazole	3	Vitalis® (Adria Crop Protection)	0.4 – 0.8	42	56
Prothioconazole 160 + tebuconazole 80	Triazole	3	Kestrel® (Bayer Crop Science Ltd)	1.0 – 1.25	42	56
Prothioconazole 125 + tebuconazole 125	Triazole	3	Prosaro® (Bayer Crop Science Ltd)	1.0	42	56
Mefentrifluconazole 100 + fluxapyroxad 50	Triazole + SDHI	3 + 7	Revystar® (BASF Ltd)	1.5	28	35
Prothioconazole 100 + isoflucpyram 50	Triazole + SDHI	3 + 7	Caley® Iblon® (Bayer Crop Science Ltd)	1.5	28	42
Prothioconazole 150 + bixafen 75	Triazole + SDHI	3 + 7	Aviator Xpro® (Bayer Crop Science Ltd)	0.7 – 1.0	42	56

*FRAC – Fungicide Resistance Action Committee.

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