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Arable Update

Cereals: Issue 233

Managing triazoles for prolonged performance in autumn sown wheat

Background

Rising costs and the growing threat of fungicide resistance make selecting the right fungicide programme more critical than ever. Triazoles (Group 3 fungicides) remain the backbone of these programmes, acting as key mixing partners with other fungicide mode-of-action (MoA) groups and playing an important role across all application timings. However, as noted in Cereal Update 232, *Zymoseptoria tritici* (*Zt*) sensitivity to several triazole active ingredients, particularly epoxiconazole and prothioconazole-desthio, is continuing to decline. *Zt* is the cause of Septoria tritici blotch (STB) in wheat.

Future decisions on fungicides must account for factors such as the number of applications, combining different MoA chemistries in spray mixtures, using appropriate dose rates, and alternating products within the same MoA across different timings (Table 1). This Arable Update illustrates how alternating and mixing MoAs and active ingredients can help sustain disease control, protect yield, and deliver financial returns.

How does alternating active ingredients and mixing MoAs work in the field?

Triazole actives should be positioned in wheat fungicide programmes based on the importance of the leaf being treated, the target disease and the probable return on investment. For STB, the most effective triazole is best used at T2 (GS 39) and the next best at T1 (GS 32) Products with stronger activity against diseases prevalent later in the season should be reserved for T3 (GS 59). In practice, this means the fungicide programme may look different depending on the crop, disease pressure, target disease and location (Tables 2-4).

As our understanding of fungicide resistance has improved, we now know the use of solo triazoles at any rate can drive resistance. To keep them effective, always apply triazoles at robust rates and with a mixing partner. This can be a multi-site (Group M4) folpet (e.g. Phoenix®, Valeo®) or another triazole with a different cross resistance pathway. For example, Opus® (epoxiconazole) has been replaced by Bolide® (epoxiconazole + prochloraz), and now Proline® is mixed with folpet or swapped for stacked triazoles like Kestrel® or Prosaro® (prothioconazole + tebuconazole). Using mixes that include fenpicoxamid (QuestarTM) are also an option. *Zt* remains highly sensitive to fenpicoxamid. Other MoAs, like strobilurins (Group 11), can be dialled in where the target is leaf rust.

FAR trials under irrigation in Mid Canterbury or in South Canterbury and Southland without irrigation have shown different triazoles provide largely comparable disease control, yields and economic returns (Tables 2-4). This means there are options that can be tailored to your crop, season and region. A list of active ingredients used in the trials below can be found in Table 5.

Key points

- *Zymoseptoria tritici* (*Zt*), the cause of Septoria tritici blotch (STB) in wheat, is showing reduced sensitivity to triazole fungicides in New Zealand.
- Careful stewardship, mixing, rotating, appropriate dose, and limiting triazole sprays is essential to protect their ongoing usefulness.
- Consider seasonal conditions, target disease and return on investment when alternating triazoles at T1 (GS 30), T2 (GS 39) and T3 (GS 59).
- FAR fungicide trials in Mid Canterbury, South Canterbury and Southland show how alternating triazoles provides largely comparable disease control, yields and economic returns.
- Use each triazole to its strength. Tailor how you alternate triazole active ingredient at each application timing based on your season, target disease and region.

Table 1. Fungicide Resistance Industry Initiative guidelines for use of triazole (Group 3) fungicides to control STB and leaf rust. Adapted from ADHB fungicide futures.

DON'T	• Use single triazole active ingredient products by themselves. • Use triazoles without a mixing partner for mildew control. • Overexpose triazoles – use alternative chemistry where possible.
AVOID	• Applying when disease risk does not merit it e.g. very early or very late fungicide applications. • Applying more than three triazoles in a season (including the seed treatment).
DO	• Alternate triazole active ingredients both within and between seasons. • Use at appropriate dose to ensure effective disease control. • Apply in mixtures that contain at least one other fungicide from an alternative MoA group that has comparable efficacy against the target pathogen. • "Stacked" triazole products, where two active ingredients from the same MoA group are applied together may need an additional mixing partner from an alternative MoA that has comparable efficacy against the pathogen.

Table 2. Percent leaf area affected by STB and leaf rust, yield and margin over fungicide cost (MOFC) for autumn sown wheat, cultivar Graham under irrigation at Methven, Canterbury in 2024-25, following application of different fungicide programmes. Disease assessed on the flag leaf – leaf 3 at GS 83 on 13 January 2025.Triazole (Group 3) active ingredients are alternated at each application timing.

Fungicide programme, timing and application rate (L/ha)										
GS 32 (T1) 9/10/24	**GS 39 (T2) 6/11/24**	**GS 59-65 (T3) 2/12/24**	**%LAA[1] by STB**	**Lower C.I.***	**Upper C.I.***	**%LAA[1] by Leaf Rust**	**Lower C.I.***	**Upper C.I.***	**Yield (t/ha)**	**MOFC ($/ha)**
Untreated	-	-	55.8	48.3	63.2	44.0	41.7	46.3	8.9	*
Kestrel® (1.0) + Phoenix® (1.5)	Vimoy® Iblon® (1.5) + Revylution® (1.5)	Opus® (1.0) + Comet® (0.4)	30.6	23.2	38.1	2.1	0	4.5	12.9	1410
Kestrel® (1.0)	Vimoy® Iblon® (1.5) + Revylution® (1.5)	Opus® (1.0) + Comet® (0.4)	27.2	19.7	34.6	1.7	0	4.1	14.1	1504
Bolide® (2.0) + Phoenix® (1.5)	Vimoy® Iblon® (1.5) + Revylution® (1.5)	Prosaro® (1.0) + Comet® (0.4)	32.7	25.2	40.1	3.8	1.4	6.1	13.2	1484
Revylution® (1.5) + Phoenix® (1.5)	Vimoy® Iblon® (1.5) + Kestrel® (1.0)	Opus® (1.0) + Comet® (0.4)	28.6	21.2	36.0	2.2	0	4.5	13.1	1501
Questar™ (1.5) + Kestrel® (1.0) + Phoenix® (1.5)	Vimoy® Iblon® (1.5) + Revylution® (1.5)	Opus® (1.0) + Comet® (0.4)	28.6	21.2	36.1	2.1	0	4.4	13.1	1326
Kestrel® (1.0) + Phoenix® (1.5)	Revystar® (1.5)	Opus® (1.0) + Comet® (0.4)	38.1	30.6	45.5	2.7	0.3	5.0	12.7	1352
Kestrel® (1.0) + Phoenix® (1.5)	Elatus™ Plus (0.75) + Revylution® (1.5)	Opus® (1.0) + Comet® (0.4)	32.0	24.6	39.4	3.3	0.9	5.6	13.0	1423
Kestrel® (1.0) + Phoenix® (1.5)	Questar™ (1.5) + Revylution® (1.5)	Opus® (1.0) + Comet® (0.4)	32.8	25.4	40.3	2.5	0.2	4.9	13.2	1515
Kestrel® (1.0) + Phoenix® (1.5)	Questar™ (1.5) + Vimoy® Iblon® (1.5)	Opus® (1.0) + Comet® (0.4)	30.0	22.6	37.5	1.5	0	3.8	13.4	1619
Proline® (0.64) + Phoenix® (1.5)	Vimoy® Iblon® (1.5) + Revylution® (1.5)	Opus® (1.0) + Comet® (0.4)	35.5	28.0	42.9	2.7	0.4	5.1	13.0	1413
		Mean	**33.8**	**-**	**-**	**6.2**	**-**	**-**	**12.8**	**1455**
		P value	**<0.001**	**-**	**-**	**<0.001**	**-**	**-**	**<0.001**	**0.09**
		LSD (P=0.05)	**-**	**-**	**-**	**-**	**-**	**-**	**0.6**	**264**
		CV (%)	**-**	**-**	**-**	**-**	**-**	**-**	**3.27**	**-**

Active ingredients: Bolide® (a.i. 50 g/L epoxiconazole and 225 g/L prochloraz, Group 3 fungicides); Comet® (a.i. 250 g/L pyraclostrobin, Group 11 fungicide); Elatus™ Plus (a.i. 100 g/L benzovindiflupyr – SOLATENOL™, Group 7 fungicide); Kestrel® (a.i. 160 g/L prothioconazole and 80 g/L tebuconazole, Group 3 fungicide); Opus® (a.i. 125 g/L epoxiconazole, Group 3 fungicide); Phoenix® (a.i. 500 g/kg folpet, Group M4 fungicide); Proline® (a.i. 250 g/L prothioconazole, Group 3 fungicide); Questar™ (a.i. 50 g/L fenpicoxamid – INATREQ™, Group 21 fungicide); Revylution® (a.i. 100 g/L mefenitrifluconazole, Group 3 fungicide); Revystar® (a.i. 100 g/L mefenitrifluconazole and 50 g/L fluxapyroxad, Group 3 and 7 fungicide); Vimoy® Iblon® (a.i. 50 g/L isoflucpyram, Group 7 fungicide). [1]LAA – leaf area affected by STB or leaf rust. *Differences are reported using 95% confidence intervals.

Table 3. Percent leaf area affected by STB and leaf rust, yield and margin over fungicide cost (MOFC) for autumn sown wheat, cultivar Graham, under dryland conditions at Makikihi, South Canterbury in 2024-25, following application of different fungicide programmes. Disease assessed on the flag leaf – leaf 3 at GS 85 on 6 January 2025. Triazole (Group 3) active ingredients are alternated at each application timing.

Fungicide programme, timing and application rate (L/ha)							
GS 32 (T1) 18/10/24	**GS 39 (T2) 7/11/24**	**GS 59-65 (T3) 6/12/24**	**%LAA[1] by STB**	**Lower C.I.***	**Upper C.I.***	**Yield (t/ha)**	**MOFC ($/ha)**
Untreated	-	-	91.6	82.2	100	11.3	*
Kestrel® (1.0) + Phoenix® (1.5)	Vimoy® Iblon® (1.5) + Revylution® (1.5)	Opus® (1.0) + Comet® (0.4)	27.3	17.9	36.6	13.9	713
Kestrel® (1.0)	Vimoy® Iblon® (1.5) + Revylution® (1.5)	Opus® (1.0) + Comet® (0.4)	26.6	17.2	35.9	13.8	722
Bolide® (2.0) + Phoenix® (1.5)	Vimoy® Iblon® (1.5) + Revylution® (1.5)	Prosaro® (1.0) + Comet® (0.4)	31.2	21.8	40.5	13.2	394
Revylution® (1.5) + Phoenix® (1.5)	Vimoy® Iblon® (1.5) + Kestrel® (1.0)	Opus® (1.0) + Comet® (0.4)	38.4	29.0	47.7	13.2	413
Questar™ (1.5) + Kestrel® (1.0) + Phoenix® (1.5)	Vimoy® Iblon® (1.5) + Revylution® (1.5)	Opus® (1.0) + Comet® (0.4)	26.0	16.7	35.4	13.6	528
Kestrel® (1.0) + Phoenix® (1.5)	Revystar® (1.5)	Opus® (1.0) + Comet® (0.4)	31.4	22.0	40.7	13.5	622
Kestrel® (1.0) + Phoenix® (1.5)	Elatus™ Plus (0.75) + Revylution® (1.5)	Opus® (1.0) + Comet® (0.4)	30.4	21.0	39.7	13.6	622
Kestrel® (1.0) + Phoenix® (1.5)	Questar™ (1.5) + Revylution® (1.5)	Opus® (1.0) + Comet® (0.4)	30.6	21.3	40.0	13.5	578
Kestrel® (1.0) + Phoenix® (1.5)	Questar™ (1.5) + Vimoy® Iblon® (1.5)	Opus® (1.0) + Comet® (0.4)	31.1	21.8	40.5	13.8	688
Proline® (0.64) + Phoenix® (1.5)	Vimoy® Iblon® (1.5) + Revylution® (1.5)	Opus® (1.0) + Comet® (0.4)	30.8	21.5	40.2	13.5	582
		Mean	**35.9**	**-**	**-**	**13.4**	**586**
		P value	**<0.001**	**-**	**-**	**<0.001**	**<0.001**
		LSD (P=0.05)	**-**	**-**	**-**	**0.5**	**226**
		CV (%)	**-**	**-**	**-**	**1.94**	

Active ingredients: Bolide® (a.i. 50 g/L epoxiconazole and 225 g/L prochloraz, Group 3 fungicides); Comet® (a.i. 250 g/L pyraclostrobin, Group 11 fungicide); Elatus™ Plus (a.i. 100 g/L benzovindiflupyr – SOLATENOL™, Group 7 fungicide); Kestrel® (a.i. 160 g/L prothioconazole and 80 g/L tebuconazole, Group 3 fungicide); Opus® (a.i. 125 g/L epoxiconazole, Group 3 fungicide); Phoenix® (a.i. 500 g/kg folpet, Group M4 fungicide); Proline® (a.i. 250 g/L prothioconazole, Group 3 fungicide); Questar™ (a.i. 50 g/L fenpicoxamid – INATREQ™, Group 21 fungicide); Revylution® (a.i. 100 g/L mefenitrifluconazole, Group 3 fungicide); Revystar® (a.i. 100 g/L mefenitrifluconazole and 50 g/L fluxapyroxad, Group 3 and 7 fungicide); Vimoy® Iblon® (a.i. 50 g/L isoflucpyram, Group 7 fungicide). [1]LAA – leaf area affected by STB or leaf rust. *Differences are reported using 95% confidence intervals.

Table 4. Percent leaf area affected by STB and leaf rust, yield and margin over fungicide cost (MOFC) for autumn sown wheat, cultivar Graham, under dryland conditions at Drummond, Southland in 2024-25, following applications of different fungicide programmes. Disease assessed on the flag leaf – leaf 3 at GS 75-80 on 10 January 2025.

Fungicide programme, timing and application rate (L/ha)							
GS 32 (T1) 18/10/24	**GS 39 (T2) 7/11/24**	**GS 59-65 (T3) 6/12/24**	**%LAA[1] by STB**	**Lower C.I.***	**Upper C.I.***	**Yield (t/ha)**	**MOFC ($/ha)**
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Bolide® (2.0) + Phoenix® (1.5)	Vimoy® Iblon® (1.5) + Revylution® (1.5)	Prosaro® (1.0) + Comet® (0.4)	31.2	21.8	40.5	13.2	394
Revylution® (1.5) + Phoenix® (1.5)	Vimoy® Iblon® (1.5) + Kestrel® (1.0)	Opus® (1.0) + Comet® (0.4)	38.4	29.0	47.7	13.2	413
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Proline® (0.4) + Phoenix® (1.5)	Vimoy® Iblon® (1.5) + Revylution® (1.5) + Phoenix® (1.5)	Opus® (1.0) + Comet® (0.4)					
Questar™ (1.5) + Proline® (0.64) + Phoenix® (1.5)	Vimoy® Iblon® (1.5) + Revylution® (1.5)	Opus® (1.0) + Comet® (0.4)	30.8	21.5	40.2	13.5	582
		Mean	**35.9**	**-**	**-**	**13.4**	**586**
		P value	**<0.001**	**-**	**-**	**<0.001**	**<0.001**
		LSD (P=0.05)	**-**	**-**	**-**	**0.5**	**226**
		CV (%)	**-**	**-**	**-**	**1.94**	

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Table 5. 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	Prothago® (Adama NZ 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	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
benvindiflupyr 100	SDHI	7	Elatus™ Plus (Syngenta Crop Protection Ltd)	0.75	28	42
isoflupyram 50	SDHI	7	Vimoy® Iblon® (Bayer Crop Science Ltd)	1.5	28	42
pyraclostrobin 250	Strobilurin	11	Comet® (BASF NZ Ltd)	0.8	28	56
pyraclostrobin 250	Strobilurin	11	Convoy™ (Orion AgriScience Ltd)	0.8	28	56
pyraclostrobin 250	Strobilurin	11	Pyrax® (Adria Crop Protection Ltd)	0.8	28	56
fenpicoxamid 50	Qil	21	Questar™ (Corteva Agriscience)	1.5 – 2.0	28	None if used as directed
folpet 500 (g/kg)	Multi-site	M4	Phoenix® (Adama NZ Ltd)		28	Latest appl. GS 39
folpet 500 (g/kg)	Multi-site	M4	Valeo 500 SC® (Adria Crop Protection Ltd)		28	Latest appl. GS 39

*FRAC – Fungicide Resistance Action Committee.

Acknowledgements

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